ELECTRODE

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ELECTRONIC DESIGN is the fastest growing of all business publications.
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Vol. 3, No. 11
November 1955

Contents

BPA NBP

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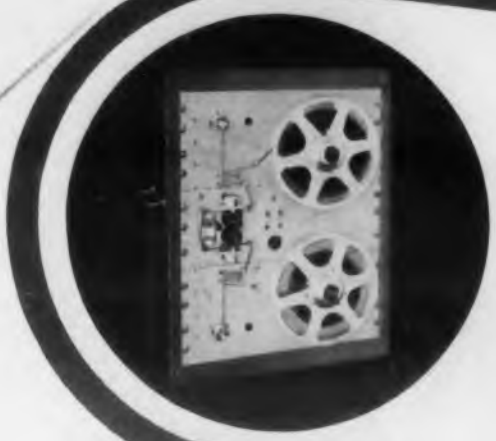
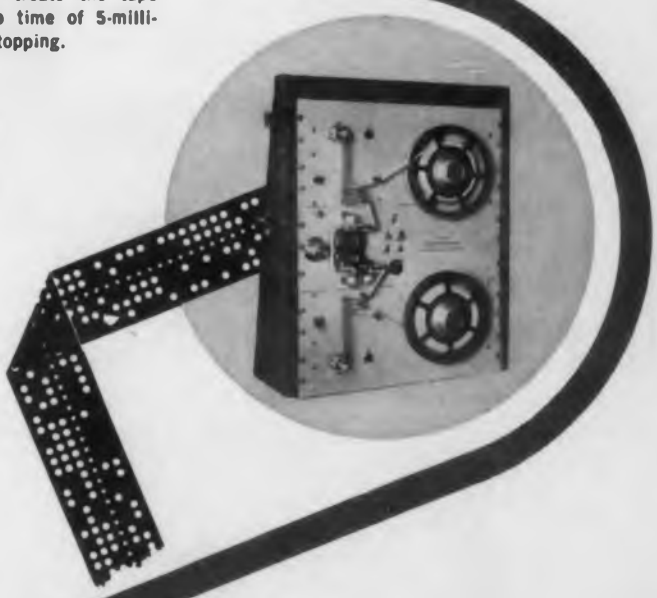


headquarters for digital magnetic and perforated tape handlers

Model 902 Magnetic Tape Handler treats the tape gently while providing a start/stop time of 5-milliseconds. Fully reversible without stopping.

Model 903 Perforated Tape Reader provides a 5 millisecond start time and stops on the character at 300 characters per second and on the character following a stop code at 600 characters per second.



The Potter Digital Magnetic Head eliminates "digit drop-outs" due to oxide collection. Phosphor bronze head mount provides close tolerances insuring complete interchangeability of tape from one machine to another.

Whether your data processing requirements call for perforated or magnetic tape handling, Potter offers a complete line of high-speed equipment to meet your needs . . . for either intermittent or continuous playback with speeds of up to 60 inches per second and start/stop times of less than 5-milliseconds!

Servo-controlled tape drives permit fast starts and stops without tearing or spilling tapes. At 30 inches/second speed, less than ⅛" of tape is consumed in a start/stop cycle!

For complete specifications on Perforated Tape Readers, Magnetic Tape Handlers and Digital Magnetic Recording and Playback Heads, write TODAY:

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CIRCLE 2 ON READER-SERVICE CARD FOR MORE INFORMATION

Editorial

Maturity

Sooner or later, every industry reaches the point where statesmanlike actions and decisions must be taken to insure future growth. The quantity and quality of such decisions and actions is a measure of the maturity of the industry. In this light, just how mature are the electronic industries? Well, let's see . . .

Take the matter of tubes. Both tube manufacturers and users decry the bewildering and excessive variety of tube types on the market. The circuit designer has to live with wide tolerances and cases where tubes with the same RETMA type number from different sources vary all over the lot.

Take the matter of standardizing components for automatic assembly methods—printed circuits and the like. Work has been going on in this field for some time—but we are far from reaching effective compromises.

These are only two of the many matters that require mature deliberation and action by the electronic industries. It can be argued that the industry is young and inexperienced. The problems are being considered and will be resolved "in due time".

The trouble is that "due time" is not soon enough. The sheer size and rapid growth of the electronic industries makes mature decisions mandatory and they must be reached now.

We must exert more effort in this direction. If committees studying some of these problems meet once every two months—let's have them meet once a month. If we need more people to serve on these committees, let's make the need known, explain the problem, and get the needed people. If it takes money to tackle these problems, let's make an appeal to industry through RETMA, IRE, AIEE, or independent groups and get the money. The dollars are there and the need is urgent.

Without concerted, intelligent, and immediate efforts the present rapid expansion will not produce healthy electronic industries, but chaos.

Engineering Review

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

We May Fall Behind in Nuclear Power . . . The United States may fall behind England and West Germany in nuclear power development because those nations are so much closer to the point at which atomic power becomes economic. W. Kenneth Davis, Director, Div. of Reactor Development, Atomic Energy Commission, raised this possibility in a recent speech. England has started importing coal for the first time. Under greater pressure to develop atomic power, power-hungry nations may progress technically faster than the United States.

Russian Scientist Visits U. S. . . . The first Russian physical scientist to visit the United States since World War II attended the recent World Symposium on Applied Solar Energy in Phoenix, Ariz. He is Professor V. A. Baum, head of the Heliotechnical Laboratory, G. M. Krhizhanovsky Power Institute, Moscow, U. S. S. R. It is hoped that the current lowering of the Iron Curtain will permit American engineers to visit Russia and learn what Russian scientists are doing in the applied sciences.

Increasing Tube Reliability . . . By giving up a little in performance, electronic design engineers can grealty increase tube reliability. This point was made by M. A. Acheson, Sylvania Electric Products Co., New York, N. Y., in a paper presented at the Fall Radio Show. Mr. Acheson also stated that the gain in tube reliability through the use of series-string heater arrangement more than offsets other factors tending towards lower reliability introduced by this system of tube arrangement.

The series-string tubes are more reliable because their heaters are heavier, Mr. Acheson stated. He also urged designers to give more attention to conservatively rated tubes rather than the latest "hot" tubes to achieve greater reliability.

Automation Evolution Not "Revolution" . . . A leading industrialist has objected to the frequent labeling of the trend towards automatic manufacturing as "The Second Industrial Revolution". "Evolution", is the proper term according to Henry F. Dever, President, Brown Instruments Div., Minneapolis-Honeywell Regulator Co., Philadelphia, Pa. In the same speech, given recently in Los Angeles, Mr. Dever objected to some of the science-fiction type of discussion of automatic developments. He considered this type of publicity a disservice to an important technical trend, which is giving the public a false and misleading picture.

Committee to Study Frequency Allocation . . . The Radio-Electronics-Television Manufacturers Association has announced the appointment of a special committee to make an immediate examination of the TV frequency allocation problems before the Federal Communications Commission and to submit its recommendations to the FCC. The committee will be called the Frequency Allocation Study Committee and will be primarily concerned with the place of u-h-f in the TV system. Dr. W. R. G. Baker will be chairman of the committee.

Electronics Aids Carrier Operations

The world's largest ship, the U. S. S. Forrestal has been equipped with the latest electronic devices to insure instant communications with and safe return of its air fleet. A TACAN antenna is mounted at the highest point on the carrier (upper circle) and a newly developed u-h-f radio operates through an antenna on the bow (forward circle). This radio has one and one-half times the range of the gear it replaces. The equipment was developed by Federal Telecommunications Laboratories, Nutley, N. J.

Electronic Pilot Holds 'Copters Still . . . Of particular value in rescue operations, an electronic control has been developed that can hold helicopters in hovering position or fly them forwards or backwards like an autopilot. The device can be used to fly the plane by remote control without a pilot.

A product of Aeronautical Equipment Div., Sperry Gyroscope Co., Great Neck, N. Y., the device should be available in 1956. The transistorized equipment weighs 60 lb and occupies less than two cubic feet Should the helicopter engine fail, the system remains operative during the glide down on a small fraction of the reserve electrical power from the craft's battery.

TV Protects Giant Press . . . A closed-circuit TV camera helps protect a giant 35,000-ton forging press from the effects of off-center loads. The camera is fixed on a hydraulic mechanism that indicates eccentric loading. This mechanism is located at the foundation of the press. The monitor is located at the operator's station. The equipment is used at the Cleveland, Ohio, plant of the Aluminum Co. of America.

Transistor Transponder . . . A miniature transponder has been developed to be worn on a pilot's uniform. If his plane crashes or he is forced to parachute, the transponder will guide radar-equipped rescue parties to him. The device was developed in Great Britain for use by NATO naval forces.

Cars Soundproofed Electronically? . . . Automobiles and planes that have been soundproofed electronically are predicted for the near future. Such use of electronic sound absorbers, which consist of a microphone, an amplifier, and a loudspeaker, was predicted by Mones E. Hawley, Radio Corp. of America, at the National Noise Abatement Symposium. Mr. Hawley also revealed that RCA has undertaken two contracts to apply such equipment to military problems.

CIRCLE 6 ON READER-SERVICE CARD

Electronics Brings Men Back into Office . . . Complicated and expensive electronic office machinery is forcing employers to hire more men for office work. According to a survey made by the Drexel Institute, Philadelphia, Pa., the increase in office machine operators since 1950 has mainly been made up of men. The number of women operators has remained the same. The survey also revealed that employment of machine operators will double every ten years for the next few decades.

Any further economic upswing will produce a shortage of office machine operators. The survey was made for the National Office Management Association.

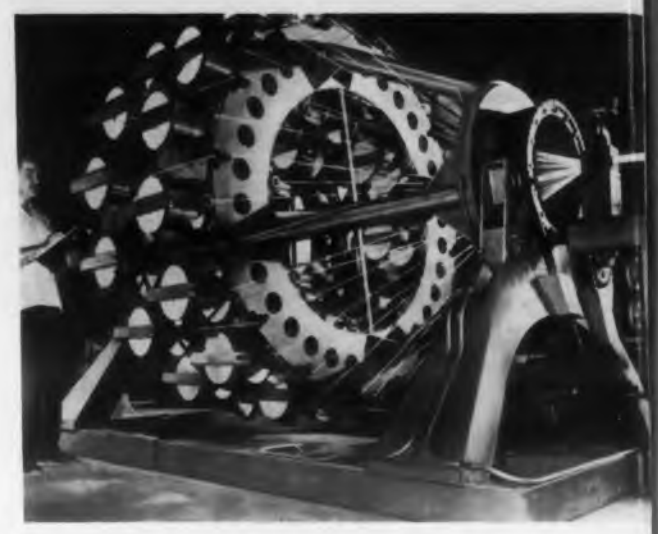
30-Hour Week . . . "The intelligent development of automation in industry will result in giving the average worker a 30-hour week within the next five to ten years, with no reduction in pay or standard of living." This prediction was made by Dr. Arnold O. Beckman, president, Beckman Instruments, Inc., in a recent speech.

Lead Room for Tube Study . . . A room with solid lead walls for X-ray study of tubes has been constructed at the Newton plant of Raytheon Manufacturing Co. Twenty tubes will be inspected at a time by a 300,000v X-ray machine. The X-ray photos will be studied for welding flaws in the elements. This type of inspection goes beyond the microscope inspection of tubes that is now standard in the industry.

Sheen President of ISA . . . Robert T. Sheen, president, Milton Roy Co., Philadelphia, Pa., has been elected president of the Instrument Society of America. Dr Lee de Forest was presented with the society's first Achievement Award at its last annual convention.

Another recent recipient of an honor is Dr. Harold S. Osborne, president, International Electrotechnical Commission. Dr. Osborne was awarded the 75th anniversary medal of the ASME for his work in promoting international standards.

CIRCLE 7 ON READER-SERVICE CARD ➤



Cable Winder

Custom cable winding costs can be cut as a result of the development of this "Planetary Cabler". Made by Douglas Roesch, Inc., Los Angeles, Calif., it handles thin wire, co-ax cable, and heavy power conductors at the same time.

Human Brains Better Than Computers . . . To build a computer with the overall capabilities of the human brain would involve a machine of such tremendous complexity that it hardly seems practical today, Dr. D. E. Wooldridge, president of Ramo-Wooldridge Corp., Los Angeles, Calif., declared. "After all", he admitted, "in electronic terms, the human brain is the equivalent of a billion trillion electron tubes. Compared with that, as someone has observed, our best computer is still a low-grade moron."

Coast-to-Coast Electronic Train Reservations . . . By contracting to rent its electronic reservation-making system to the Santa Fe Railroad, the Teleregister Corp. announces that a coast-to-coast reservations network can now be set up. The new system can be linked to similar systems to be rented to the New York Central and New Haven Railroads, respectively. A customer in San Francisco, for example, could make a reservation within seconds on trains running between Boston and New York. The Central and the Santa Fe meet in Chicago.

If this all-electronic system is rented to all the major railroads, it would be possible to make reservations on any American train from any sizable town in the United States, or even Canada. However, the equipment will not be able to choose between competing lines; the customer must do that.

The Stamford, Connecticut, firm has also rented its reservation equipment to many air lines. The possibility of linking overseas ticket offices with the American reservation memorizing devices is of interest. Renting a transoceanic cable to link the system is prohibitively expensive. We suggest as a possible solution the installation of compact relay transmitters in transoceanic aircraft. If enough air lines

cooperate in the venture, then there would always be a plane every few hundred miles over the Atlantic relaying the pulse signals. Such flying relay stations have already been used to relay a TV program from Florida to Cuba. At present, it is not likely that "over-the-horizon" microwave transmission will soon be developed to the point where it can bridge the Atlantic at its narrowest point—1900 miles.

Electronically Controlled Camera Compiles Books . . . The laborious task of compiling directories has been put on a semi-automatic basis by means of electronic controls. A camera rapidly photographs punched cards bearing the desired information on a long spool of film. The listings are therefore in the columnar form common in most business directories and telephone books.

The device is known as the Listomatic Camera Model 1, and it was developed by Eastman Kodak Co., Rochester, N. Y. The information on the cards should be typed with a justifying typewriter for even lines in the space where holes are not punched. By typing on punched cards, the information can be arranged in alphabetical or other groupings by machine. The next operation that could be done automatically is to develop a typewriter that prepares the punched cards according to spoken or hand-written instructions.

The device photographs 230 cards per minute. The unit is loaded with 400′ reels of film. After all the cards for a particular directory have been photographed, and the reels developed, the reels are cut by hand to the correct column length and mounted on forms for photolithography. This device represents an advance for the printing industry through electronic means. A number of other electronic aids to the printing industry, or even electronic printing itself, are now under investigation.

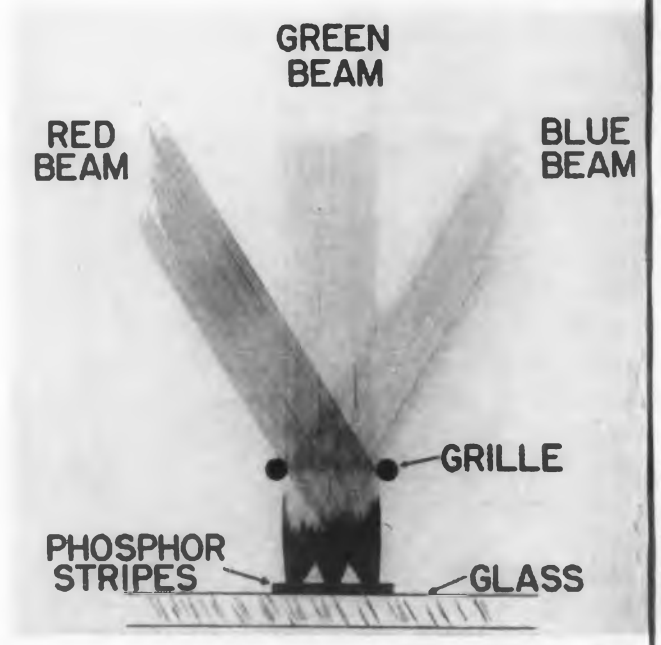
The working parts of an electronically controlled camera that helps prepare directories.

Brighter Color-TV Picture Tube . . . Known as the "Post acceleration" tube, an experimental color-TV tube has been developed that features greatly increased brightness. The tube receives its name from the fact that the electron beams are accelerated after passing a grill located close to the phosphoros screen. As a result of this feature, much lower deflection voltages and simpler convergence controls are required. The 22" tube, which is naturally rectangular, will not be available for use in the 1956 lines of receivers. Further development on this "Lawrence-type" tube is in progress.

The tube gives a brighter image because an electronic shadow mask is employed instead of a perforated metal disc. A new type of shadow mask permits 90% of the electrons to reach the phosphor screen compared to about 15% for metal shadow masks. It is under development by Tube Dept., General Electric Co., Schenectady 5, N. Y.

The shadow mask consists of an array of parallel wires. Three electron guns are employed, but they are mounted in the same plane, as illustrated, instead of in a triangualr arrangement as in present color TV tubes. In normal operation the final gun electrode potential and cone potential are held at about 6500v, the grill is at a potential approximately 200v lower than the gun, and the phosphor screen is maintained at approximately 25000v.

The three electron beams corresponding to the three colors enter the grill with a slight angualr separation of less than 1°. Two effects occur. First, the central ray of a particular beam no longer travels in a straight line but assumes a parabolic path. Secondly, a focusing action occurs in which the diameter of the beams reduced from about 35 mils down to 5 mils



The electron beams are reduced in diameter by the grill in the "post-acceleration" tube.

The three electron guns are mounted in the horizontal plane.

because the beam width is so small in comparison with the vertical phosphor stripe width a guard band is formed on either side of the beams landing area. This allows the beam to move about on a particular stripe without striking an adjacent stripe, and therefore, affecting color purity. This wide guard band allows considerably larger mechanical tolerances in manufacture and electrical tolerances in operation.

The tube has one disadvantage. Because secondary electrons hit the screen in a random manner, there is a loss of contrast compared to present tubes. This loss is most apparent in a completely dark room, but is negligible in the more common partly illuminated room because of the greater brightness of the tube and the high attenuation (50%) in the safety glass face. This glass is also spectrally sensitive.

The earth's magnetic field changes the electron trajectories, and hence, the angle of entry of the beam into the grill region. This effect will cause the beam to strike a different portion of the filed in the absence of an external magnetic field. In the vertical direction color purity can easily be maintained due to the use of vertical continuous stripes of the same color. Therefore, any field which would cause a shift in this direction can be neglected. An axial field would cause rotation in the center of the picture coinciding with the center of rotation. The major cause of color impurity is then due to the vertical component of any stray fields because this will give a horizontal shift. This component includes the earth's magnetic field. This tube has been shielded without the use of expensive shields.

The present tube is a "sandwich" type containing the grill mounted on a frame and an internal flat phosphor plate. The next development will be a tube with the phosphor on the inside and on the envelope face. The designers of this tube believe that it could replace the present color-TV tube without requiring extensive changes in a receiver's circuitry.

Hidden Recorder

Up to eight hours of conversation can be secretly recorded on this tape recorder. It has been built into a conventional briefcase by Amplifier Corp. of America, 398 Broadway, New York 13, N. Y. The complete unit weighs about 12 lb. The on-off switch is cleverly concealed in the clasp.

Charge Accounts for Toll Roads . . . By means of new electronic devices, motorists on the nation's toll roads can charge toll fees instead of paying on the spot. In addition, new electronic equipment has been developed to feed information on toll-booth traffic to the control point from which the toll highway is controlled.

All of this equipment has been developed by Taller & Cooper Co., Brooklyn, N. Y. The charge-account gear has already been installed on the N. Y. State Thruway, the nation's longest toll road. This toll booth equipment is tied into a giant computer for rapid processing of all this information.

The same firm has also developed an automatic toll collector that enables a motorist to direct questions to a supervisor located some distance away. If someone attempts to drive past this device without paying his toll, an alarm bell rings and red lights flash on. If the motorist then continues on his way and does not back up and pay his toll, an automatic camera photographs his license plate and simultaneously records on the film, time, date, and place. All of this automatic toll equipment includes features to safeguard the funds they collect.

The development of the above equipment is part of the nation-wide trend toward replacing all repetitive jobs with electronic devices and releasing workers for jobs that require judgment, such as repairing these devices.

Color TV Moves Slowly in UK . . . After observing the failure of color TV to develop in this country as quickly as prophesized, the British are moving very slowly towards color TV according to the September *Wireless World* (*p. 464*), the official bodies governing broadcasting in Great Britain are not likely to approve any color TV system in the near future. Experimental compatible color transmissions are now in progress in the United Kingdom.

Audio Engineering Officers . . . Col. Richard H. Ranger, president of Rangertone, Newark, N. J., has been elected president of the Audio Engineering Society. W. O. Stanton, Pickering & Co., Oceanside, N. Y., was elected executive vice-president and the vice-presidents are E. D. Nunn, Audiophile Records, Saukville, Wis., and R. A. Long, Stanford Research Institute, Stanford, Calif.

International Technical Cooperation . . . International Business Machines Corp. will establish a research and development laboratory in Zurich, Switzerland. The purpose of the new laboratory is to establish closer contact between the American organization and development activities being conducted by European scientists and engineers in the accounting and processing field. IBM is located at 590 Madison Ave., New York 22, N. Y.

New Electronic Magazine . . . A new periodical dealing with experimental and theoretical developments in electronics has commenced publication in Great Britain. Known as the *Journal of Electronics*, it is affiliated with *The Philosophical Magazine*.

The initial number includes articles by scientists from the United States, Great Britain, Germany, Holland, and Switzerland. It is available at $2.80 (one pound) per issue from Academic Press, 125 E. 23rd St., New York 10, N. Y.

CIRCLE 13 ON READER-SERVICE CARD ➤

Million Color TV Sets in '57 . . . In 1957, when color TV prices will probably be around $500, the industry should sell as many as 1,000,000 color receivers, R. W. Galvin, executive vice-president, Motorola, Inc., has predicted. In the same year, black-and-white set sales should reach 6,000,000, he said. This increase in color set sales for the future may be attributed to a reduction in price and the fact that present black-and-white set owners will be looking for replacements for their old sets.

Award Winners . . . Dr. Claude E. Shannon, Bell Telephone Laboratories, Murray Hill, N. J., has been named recipient of the Stuart Ballantine Medal of The Franklin Institute, Philadelphia, Pa. The medal was awarded to Dr. Shannon for his achievements in the field of communications.

Dr. E. W. Engstrom, executive vice-president, Radio Corp. of America, received the Society of Motion Picture and Television Engineers Progress Medal Award "for his outstanding leadership and vision in sound motion picture and television development".

Mobile TV Projection Gear . . . A mobile projection unit for projecting closed circuit TV images in theaters has now been placed on the market. The unit is of value for equipping theaters quickly for special closed circuit events such as championship fights, theatrical performances and operatic performances. The equipment was developed by General Precision Laboratory, Inc., Pleasantville, N. Y., and produces a sharp image on a 50′ x 65′ screen.

A-M Tuner for Areas Without F-M . . . A high-quality a-m tuner has been developed for sale in areas without f-m stations. Most good tuners available at present are a-m—f-m types. The new tuner is being marketed by Altec-Lansing Corp., 161 Sixth Ave., N. Y. 13, N. Y., at $99.

◀ CIRCLE 18 ON READER-SERVICE CARD

-H-F Transistor to be Mass-Produced . . . A "diffused-base" transistor that can be mass-produced has been developed. The new germanium type should be available in volume from the Phoenix, Ariz., plant of Motorola, Inc., Chicago, Ill., in one or two years. The device can be operated at 1000Mc. This firm has been manufacturing transistors for its own use for some time.

Talking with Satellites . . . Rocket enthusiasts attending the Sixth International Astronautical Congress in Copenhagen recently partitioned the International Telecommunications Union to allocate frequencies for use with satellites, according to the September, 55 issue of the *DuMont Dispatch*. We are having enough problems for allocating frequencies for use on earth without considering the new problem of communicating with satellites that don't exist yet.

Science Talent Search . . . The fifteenth annual Science Talent Search will provide $11,000 in science scholarships for 40 high school seniors. The scholarships are offered by Westinghouse Electric Corp., Pittsburgh, Pa., with the search conducted by Science Clubs in America.

Entrants in the search must report on an original science project and take an aptitude examination. It is expected that about 16,000 students will participate in the project.

Soviet TV System . . . 700,000 sets are in use in the Russian TV system. The system is comprised of stations in Tallinn, Baku, Minsk, Sverlovsk, Kuibyshev, Tiflis, as well as those operating in Moscow, Leningrad, Riga, Kalinin, Kharkov, Omsk, and Kiev, it was reported in *RETMA International News*. The stations broadcast 45 hours of programming each week in addition to community TV and cinema relays. TV documentary films are reportedly prepared in 45 centers throughout the U. S. S. R.

CIRCLE 19 ON READER-SERVICE CARD ➤

Meetings

Nov. 14-17: *Second International Automation Exposition*, Navy Pier, Chicago, Ill. The exhibition will feature automatic controls, materials handling devices, etc. The electronic computer clinic will be repeated. For information, write to Second International Automation Exposition, 845 Ridge Ave., Pittsburgh 12, Pa.

Nov. 21-22: *Symposium on Aeronautical Communications*, Hotel Utica, Utica, N. Y. Sponsored by the IRE Professional Group on Communications Systems. The symposium will stress the communications systems both ground-to-ground and ground-to-air used in aeronautical activities. Both military and civilian aspects of these systems will be discussed and an exhibit will be held. For information, write to R. C. Benoit, Jr., 138 Riverview Parkway North, Rome, N. Y.

Dec. 12-17: *Nuclear Engineering and Science Congress and Atomic Exposition*, Cleveland Municipal Auditorium, Cleveland, Ohio. Fifty technical sessions will cover every phase of peace-time uses of atomic energy and its by-products. Nuclear developments for applications in industry, science, and agriculture will be exhibited. For information, write to Atomic Exposition, 931 Book Bldg., Detroit 26, Mich.

Dec. 14: *Operations Research Symposium*, University Museum, University of Pennsylvania, Philadelphia, Pa. Sponsored by the IRE Philadelphia Section and Professional Group on Engineering Management and the Delaware Section, Society for Industrial and Applied Mathematics. Subjects of talks will be the scope of operations research, operations research experience in various fields, statistical and forecasting, scheduling and queuing problems, linear programming, inventory and production control with emphasis on the use of computing machinery. For information, write to R. V. D. Campbell, O. R. Symposium Registration, Burroughs Research Center, Paoli, Pa.

Jan 16-18, 1956: *Conference on The Practical Utilization of Recorded Knowledge—Present and Future*, Western Reserve University, Cleveland, Ohio. The conference will discuss problems in the processing, dissemination, and utilization of the increasing volume of recorded information in such fields as chemistry, physics, patents, etc. A series of papers is being prepared to summarize the "state of the art". For information, write to Dean Jesse H. Shera, School of Library Science, Western Reserve University, Cleveland 6, Ohio.

Dec. 15-17: *Acoustical Society of America,* Sheraton-Biltmore Hotel, Providence, R. I. Sessions have been arranged on low temperature acoustics, ultrasonics of liquids, liquids and gases, noise, marcosonics and shock waves, speech and music, and architectural acoustics. For information, write to Acoustical Society of America, 57 E. 55th St., New York 23, N. Y.

Dec. 28-30: *Conference on Low Temperature Physics and Chemistry,* Louisiana State University, Baton Rouge, La. Sponsored by the National Science Foundation and Louisiana State University. Topics for discussion will include liquid and solid helium, superconductivity, ionic and nuclear paramagnetism and magnetic cooling, electronic and thermal properties of metals at low temperatures. Those wishing to attend should write to Dr. J. M. Reynolds, Dept. of Physics, Louisiana State University, Baton Rouge, La.

Jan. 9-10, 1956: *Second National Symposium on Reliability and Quality Control in Electronics,* Hotel Statler, Washington, D. C. Sponsored by the Professional Group on Reliability and Quality Control of the IRE, American Society for Quality Control, and RETMA. Of particular interest to electronic designers are sessions on "Quality Control and Automation"; "Advances in Tube Reliability"; "Controlling Relay Characteristics"; and "Reliable Capacitors". For information, write to IRE, 1 E. 79th St., New York, N. Y.

Feb. 2-3, 1956: *Symposium on Microwave Techniques,* University of Pennsylvania, Philadelphia, Pa. Sponsored by the IRE Professional Groups on Microwave Theory and Techniques and Antennas and Propagation and the Philadelphia Section of the IRE. Sessions are planned on radiating systems, guided microwave transmission, components, propagation, and measurements. For information, write to IRE, 1 E. 79th St., New York, N. Y.

April 5-6: *Conference on Magnetic Amplifiers,* Hotel Syracuse, Syracuse, N. Y. Co-sponsored by the AIEE Committee on Magnetic Amplifiers, the IRE Professional Group on Industrial Electronics, and the Central New York Section of the Instrument Society of America. Special technical papers on the theory and application of magnetic amplifiers. Fifty companies will have exhibits. Those interested in presenting a paper should submit a 200-word summary to Paul Schmidt, Chairman, Technical Program Committee, 3A-104 Bell Telephone Laboratories, Whippany, N. J., by December 31, 1955. For information, write to C. F. Spitzer, General Electric Co., Building 3, Syracuse, N. Y.

ays better...

One look tells you 3 ways this new Sylvania socket can help you produce a better printed circuit chassis

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new collar design supports the metal tube shield isolating it from the printed circuit board and contact tails. Short circuits are eliminated.

2. "It stacks"

designed for foolproof nesting to accommodate automatic assembly techniques. Ground-strap slot keys sockets for proper orientation.

3. "It sits up"

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← Available in 7- and 9-pin types

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Before you package your printed circuit design be sure you take a close look at these sockets. Write for data or samples. Address Dept. L22S.

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V. Lawrence Parsegian

Radiation Applications Inc., New York, N. Y.

Editor's Note: The recent "Atoms-for-Peace" conference at Geneva focussed the World's attention on the growing industry based on nuclear developments. In the spirit of that historic conference, ELECTRONIC DESIGN *is publishing this article in hopes of aiding this new industry. Dr. Parsegian is also Chairman of the Engineering Group, Rensselaer Polytechnic Institute, Troy, N. Y.*

ELECTRONIC devices can contribute practical answers to many of the problems facing the growing atomic industry. This article discusses instrumentation needs of this industry in the hope that electronic design engineers will be stimulated to solve them. Possible solutions to some of the problems and avenues of research are also offered.

Laboratory Needs

The analytic and research laboratories that make use of radioactive isotopes number many hundreds. In all of these laboratories the handling of radioactive solutions and powders is time consuming, and hazardous because the available instrument techniques and equipment were never designed for use with radioactive materials.

For example, the determination of weight, probably the most common measurement of the laboratory, is accomplished by placing expensive balances inside a hood, where it is subject to contamination. The tiny weights and specimens are handled with awkward tongs, reading through window systems that also introduce blasts of ventilating air. The danger of dropping the specimen, of having it blown around, of getting too close to it, and of being in the direct path of the radiation in the case of more active specimens, is always present.

Volume measurement, another most common operation, is accomplished with awkward tong systems and glassware that were never designed for use with radioactive materials. There is also considerable risk to this operation because they have to be observed closely. The tables give the results of a survey of the analytic techniques and of how they fall short. This field is wide open for ideas and invention. In fact, it offers a much more fruitful area for small companies that want to get into the atomic program than does the field of radiation measuring devices on which so many new firms have concentrated.

Reactor and Processing Plant Needs

The measurements called for in the nuclear reactor and in the associated processing plants are not unlike those required in more conventional plants, the principal ones being flow rate, pressure, temperature, liquid level, and one new variable, namely nuclear radiation.

The conditions under which these measurements have to be taken are so different, however, because of the presence of intense nuclear radiation, that in effect a wholly new set of specifications and performance characteristics and new instruments are needed.

In the reactor proper and in the reprocessing plant the sensing element or detector must do its work behind very thick shielding walls, and must be considered untouchable to human hands when replacement is necessary. Telemetering and operation or replacement by remote manipulating is needed.

The future atomic reactor systems will have to be much more automatically controlled than the early installations, and the majority of the instrument and equipment systems required for this job will have to be electrical and electronic.

In the reprocessing plants there is an intense mixture of gamma radiation, X-rays, and beta radiation emitted by the fission products, and secondarily from the process liquids, process equipment and from the surrounding shields. Alpha particles are also emitted by the product plutonium and from uranium. These same activities are present in the reactor also, with the important addition that the neutron flux is also present to a predominant degree.

These emissions actually constitute important process variables, just as temperature and pressure are process variables for process monitoring. The art of radiation measurement has not yet progressed to the required degree to use them as such.

To meet the needs of reactors and plants, a whole new series of detector elements are required. These must include detectors that withstand the high temperatures of the reactor, and do so with instrument parts that are small and that do not absorb neutrons excessively. Conversion devices that transform neutrons into heat energy for the measurement of neutron flux may not easily fall into this desired category.

The industry needs detectors that can differentiate neutron flux and gamma radiation. The methods whereby one measures total radiation and subtracts from it a measure of gamma flux to determine neutron flux density are far from satisfactory. The measurement of rate of change of radiation flux is important for proper control of reactors. The time-constant must be made short for certain applications. Also the range must be made large so that a few instruments will properly cover the range from say 10^4 neutrons/cm^2 per sec. to flux densities exceeding 10^{12} neutrons/cm^2 per sec, a factor from low-to-high of over 10^8 times when the instruments are used for control of reactors. Gamma-ray flux intensities exceed several hundred roentgens/hr in reactors. Similarly there are needed detectors that can be immersed in corrosive process fluids for the measurement of non-penetrating alpha particles. It would be very

This table shows the result of a survey of how present analytical laboratory techniques using radioactive isotopes fall short. Measurement techniques are given at the top, and manipulative ones at the bottom. The undesirable characteristics are listed from left to right in decreasing order of severity. The diamond symbol indicates that the limitation is not too serious or exists only at high levels of radioactivity. The round symbol in color means that there are severe limitations at all levels of radioactivity.

Measurement

- Radioactivity:
  - alpha, weak beta
  - gamma, strong beta:
    - absolute counting
    - monitoring
- Temperature
- Volume
- Weight
- Density
- Pressure
- Electro-conductivity
- Surface tension
- Viscosity
  - mechanical
  - flow rate
- Refractive index
- pH, electropotentials
- Flourescence, colorimetry, and spectrophotometry
- Infrared
- Emission spectroscopy
- Mass spectroscopy
- X-ray diffraction

Manipulation

- Analysis:
  - gravimetric
  - volumetric
  - washing & liquid transfer
- Agitation:
  - mechanical
  - air agitation
  - vibration
- Centrifugation and precipitation
- Titration
- Extraction:
  - batch
  - column
- Distillation
- Ion exchange
- Heating
- Sampling

helpful if alpha particles or if beta particles could be measured specifically in the presence of gamma radiation. Detection of alphas at a rate of 10/sec in a gamma-beta flux of say 50 roentgens/hr could be useful in certain applications.

What directions are likely to achieve these goals? Perhaps we can develop detectors that make use of effects of radiation on solids and liquids, in addition to gaseous discharge. "Radiation damage" in such materials perhaps could be pursued to provide sensitive detectors of the integrating type, while perhaps self-healing detectors will provide the more usual measurement of flux and change of flux.

Another class of radiation-measuring instruments, safety monitoring instruments of the total ionization type are also needed. Such detectors could be used in substantial numbers throughout the plant to guard against the influx of radiation-carrying air and vapors into "safe" areas.

It is important to know the energy spectrum as well as the intensity of neutron fluxes and gamma ray beams. There are no simple instrument techniques available to make these measurements. It would be helpful, for example, to be able to selectively determine the energy spectrum from thermal energies up to several million electron volts in say eight or more energy bands, for both neutron and gamma types of radiation.

In the case of instruments to be used in reactors, the choice of materials is limited both because neutrons are destructive and because absorption of neutrons is expensive. In separation plants, and for most health and safety monitoring instruments, the problem is simpler because gamma-resisting materials are easier to find. The gamma ray intensities involved in health and safety monitoring range from background (0.3 mr/day) to something beyond tolerance level (100 mr8 hr day). The gamma ray activities in separation

Undesirable Characteristics

Contact with radive material	Open system	Hand prepared samples	Eye observation	Does not permit remote manipulation	Detector part of large unit	Difficult to decontaminate or replace	Transfer of large volume	Chemical or other preparation	No automatic record	Damaged by radioactivity	Comments
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	◆	◆		◆				◆	◆		
											Conditions satisfactory
											Conditions satisfactory
●	●	●	●						◆		Severe problem
●	●	●	◆	◆	◆	●	◆		◆		Very severe problem
●	●	●	●	◆	◆	●	◆		◆		Severe problem
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◆	◆	◆			◆	◆		◆			
◆	◆	◆			◆			◆			
◆	◆	◆			◆			◆			Limited to 0.2 millicurie samples
●	●	●	◆	◆		●	◆	◆			
●	●	●	◆	◆			◆	◆			
	◆		◆								
◆	◆										Hood mandatory
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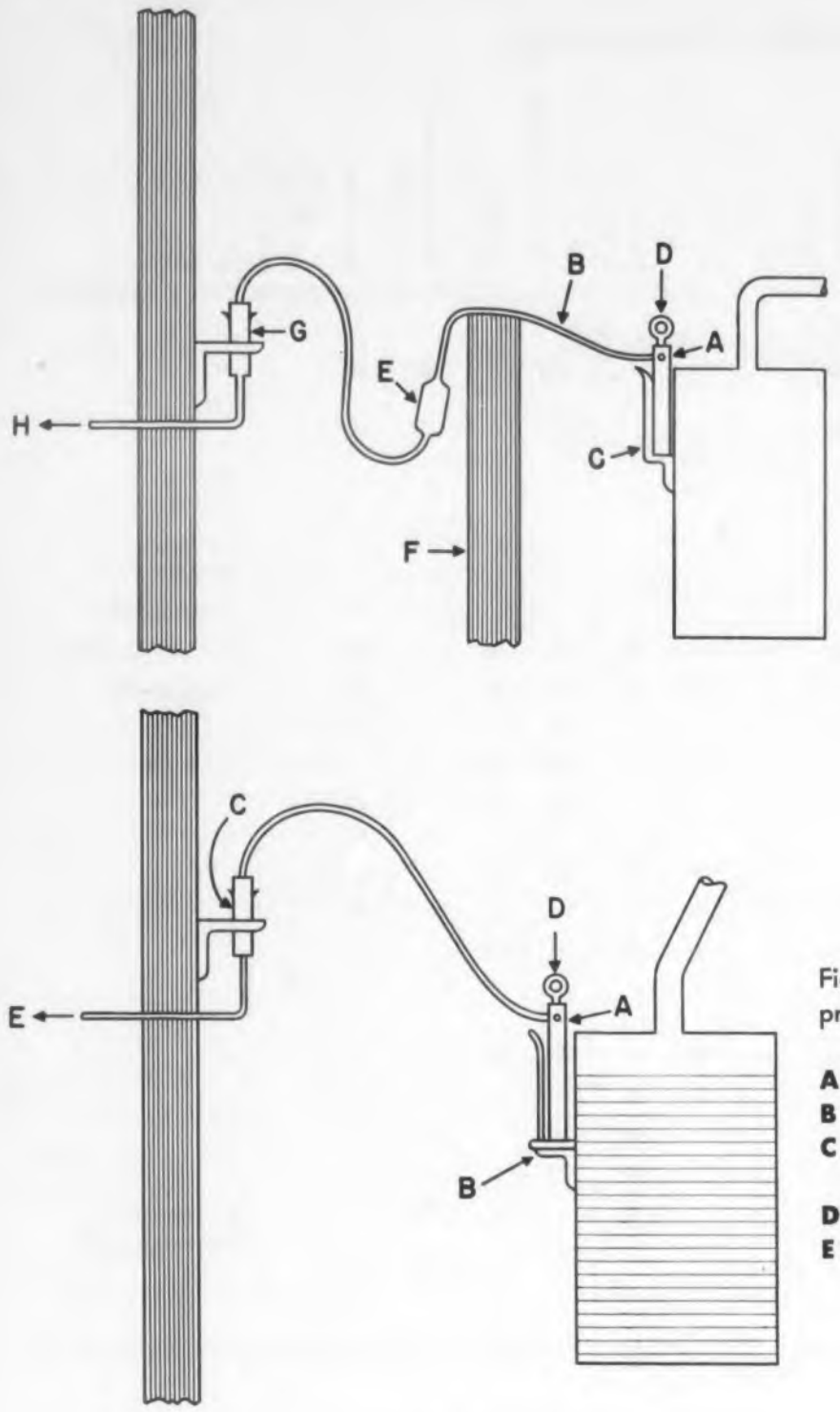


Fig. 1. A simple radiation detector and preamplifier for use in a processing plant.

- **A** Sealed ionization chamber
- **B** Sealed cable to preamplifier
- **C** Guide frame
- **D** Lifting eye
- **E** Preamplifier
- **F** Local shield
- **G** Quick-disconnecting electrical connector
- **H** To amplifier and indicator system

Fig. 2. A liquid-level detector for processing plants.

- **A** Liquid level detector
- **B** Guide frame
- **C** Quick-disconnect electrical connector
- **D** Lifting eye
- **E** To instrument panel

plants range from background up to hundreds of roentgens per hr. Fig. 1 illustrates a simple radiation detector and preamplifier. The detector can be simply suspended alongside the vessel containing the radioactive material while the preamplifier is somewhat removed to permit it to be shielded from the most active radiation. A simple quick-disconnect device beyond the preamplifier allows rapid replacement of the entire unit.

Process Instruments

Satisfactory measurement of flow rates is easily achieved in the petroleum industry by the use of orifice-type meters, despite the fact that such meters may require periodic servicing. When such an instrument is used in a nuclear reprocessing plant, its failure becomes extremely troublesome. Replacement of the unit must be accomplished by remote-manipulating devices, including the manipulation of bolts and nuts that connect the unit to the process pipe lines. Reassembly of the process equipment by remote mechanisms, and refilling, and recalibration of the system, can prove quite time consuming and expensive.

Certain generalizations can be made as to the characteristics one may require of instruments applied to this service. These are:

1. The most important characteristics to be sought for in instruments for these applications are long life and easy replaceability of the elements located in the radioactive areas. This is tantamount to requiring that the detector element be made simple and dependable even at the expense of transferring complexity to the instrument panel. It also places a premium on instrument systems that do not require contact with radioactive process streams, but can measure from outside pipe and tank systems.

2. The detector element of the measuring system presents the most serious challenge because it is the part that is subjected to radiation and to the fluids.

3. Telemetering of intelligence to and from the radioactive process areas to distant (100 to 300′ away) instrument panels is necessary.

4. Adaptability to calibration check by remote means, overall simplicity, stability under variable plant conditions, sensitivity, adaptability to automatic control, absence of moving parts, "packaged" units, resistance to corrosive fumes, ruggedness against plant handling, and sufficient overall accuracy, are perhaps the other characteristics that are desirable in such instruments in roughly decreasing order of importance.

Process Measurements

The measurements of greatest interest in processing are the measurement of liquid flow rate, temperature, liquid level, pressure, radioactivity, and process fluid composition. Of these, only temperature measurement by means of thermocouples can be considered to be in a fairly satisfactory state of development for use in nuclear plants, since thermocouples can be readily protected from process fluids by means of conventional protection wells.

Fig. 2 illustrates a system where the liquid level is determined by a detector placed outside the vessel. and electrical wires and quick-disconnect electrical devices complete the telemetering to the panel.

Metering of fluid flow rates presents a very difficult problem. The conventional orifice of pressure-differential type meters are unsatisfactory, because they usually include moving parts and cannot be depended on to give the required life performance. The problems are often accentuated when one must cope with corrosive liquids that have a wide range of viscosities, densities, and which may even include abrasives or precipitation products.

One attempt to improve this flow problem has been the use of electromagnetic induction methods, as illustrated in Fig. 3. The principle has been demonstrated in certain applications, but the instruments need to become less expensive, simpler, more rugged in the sense of conventional industrial instruments, and adapted to more applications.

Industry has also made some use of instrument techniques for the continuous analysis of stream composition, such as by fluorometers, infra-red analysers, and even with mass spectrometers.

Aside from the mass-spectrometer type of instru-

ment that identify specific atomic and molecular masses, much can be attempted by the use of electromagnetic phenomena, including effects related to molecular dynamics, dielectric properties, inductive coupling, absorption, and transmission phenomena. A number of instruments have been developed that will indicate a meter change with loading of search coils. Less progress has been made in development of electromagnetic detector systems that indicate concurently both changes in a resistive component and in an inductive component of the field coil loading, along the lines developed by Foerster of the Kaiser Wilhelm Institute in Germany. Being able to read simultaneous changes in two components instead of the conventional single meter reading adds greatly to the information that can be derived from the instrument readings. While Foerster has applied this principle largely to metallurgical problems, there does not seem to be any obvious reason why the principle cannot be extended somewhat into liquid processing fields as well.

Suggested Solutions

There are many physical effects due to radiation that might be utilized in new radiation detecting devices. For example, the change in optical density of certain silver-activated phosphate glasses turns out to be fairly useful for measuring radiation dosages. This method requires the use of optical transmission measurements, but other changes might lend themselves to more easy application in simple, all-electronic instruments for measuring either total dosage, dose rate, or to distinguish types of radiation. A brief review of some of these observed changes might lead to much-needed new ideas.

Color Changes: A wide variety of materials change color when subjected to X-rays or nuclear radiation. Halite (NaCl) turns yellow-brown on irradiation to X-rays and sylvite (KCl) turns purple. The change of color disappears when the crystals are annealed at 150°C. Compression changes the behavior somewhat. Dosages of from 10^4 to 10^7 roentgen are needed to show these effects clearly.

Glasses show color changes when exposed to nuclear radiation. Soda-lime glass will color in the visible spectrum, going smoothly from the red to the violet end. "Pyrex" is slower to color. Small additions will change the behavior, some reports indicating that the most active additions are iron, titanium, arsenic, antimony, manganese and cerium, decreasing in that order. The phosphorus family of glasses change when there are contaminants such as arsenic or bismuth present. Fine borate glasses discolor when manganese is present. Some organics show changes that appear to be due to irreversible color changes. Among these are many dyes of the triphenyl methyl, alizarin, thiazine and indige types. Changes in diazo dyes have been suggested for measuring intensity of radiant energy.

Dyed polymethyl methacrylate changes color under X-rays particularly in the case of Sudan III dye. Polythene shows similar effects, becoming fluorescent to ultra-violet excitation after irradiation.

A wide variety of other gems, salts, fluorites, nonprecious gems, and minerals show color changes due as a result of radiation.

Luminescence: The luminescence under radiation of a wide variety of sulfides (particularly zinc sulfide), of halides such as barium halide, chloride, and fluoride, of sodium chloride phosphors, calcium tungstates, zinc silicates, calcium silicates, and germanates, has been studied in great detail because of their importance to X-ray and television screens.

Electrical Conductivity Changes: X-rays will increase the electrical conductivity of polystyrene by a factor of 10^8; the effect reverses on standing. Other solid dielectrics such as paraffin and sulphur show increases in conductivity when under radiation.

Liquids such as petroleum ether, carbon tetrachloride, carbon disulfide, and benzene all show changes in conductivity. Carbon disulfide has been found useful for radiation measurement. However, in contrast with the solids, Ohm's law is not obeyed by X-irradiated liquids; the current increases in the liquid with increasing voltage to a saturation value that is not exceeded until dielectric breakdown.

Further research may reveal some material that has sufficiently large and reproducible changes in conductivity to allow development of good, simple instruments to make use of this principle for the measurement of radiation.

Other Electrical Effects: Numerous metals show a photoelectric effect when exposed to X-rays. Copper-oxide barrier cells show good proportionality between soft X-ray intensity and the photoelectric current, but the proportionality constant fails for the region below 1 A°; their usefulness for dose-rate measurement is limited to between 1 A° and 100 A°. Results on selenium cells are inconclusive and contradictory.

Semiconductors are sensitive to nuclear radiation. The conduction of n-type germanium is decreased by alpha particles at a rate of 78 electrons removed per alpha particle. When all the electrons are used up, positive holes are created at the rate of 8.6 per alpha particle, making the germanium a p-type semiconductor. Both n-type and p-type silicon become nonconducting under such bombardment.

Viewing Devices

Viewing devices offer unusual problems, ranging from the simple mirror devices used in laboratories to the complex optical systems used in large production plants. Binocular vision is very important in this connection, particularly in maintenance work in large plants. Television is useful for many of these applications; it would be even more useful if binocular vision were available with it.

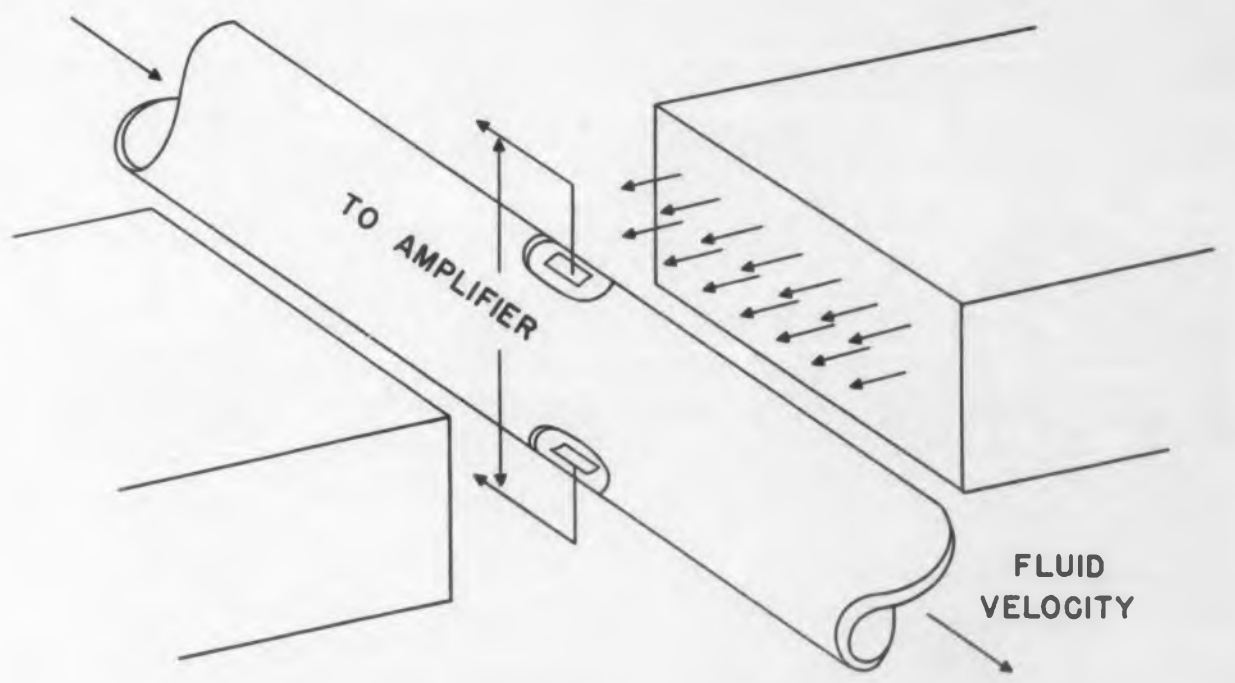
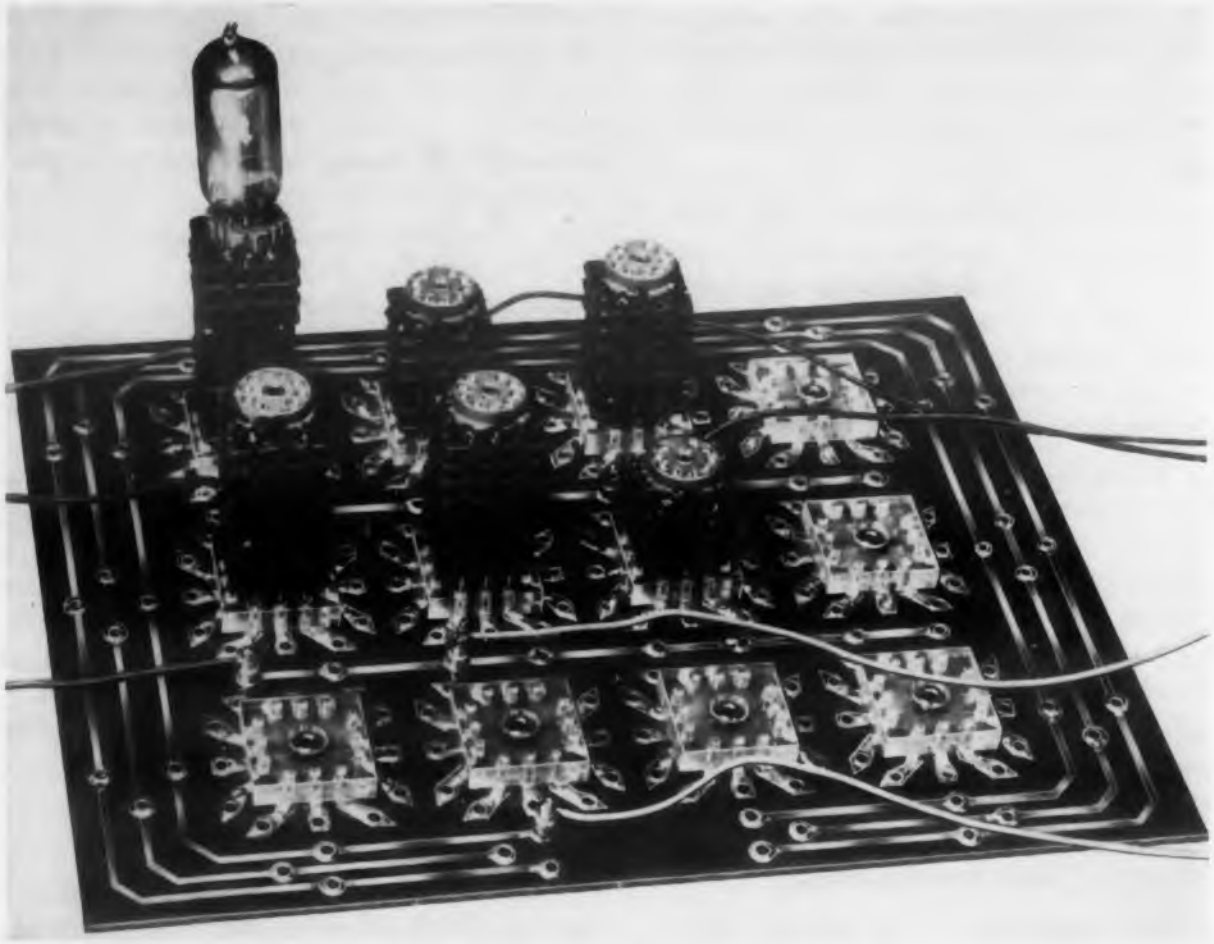
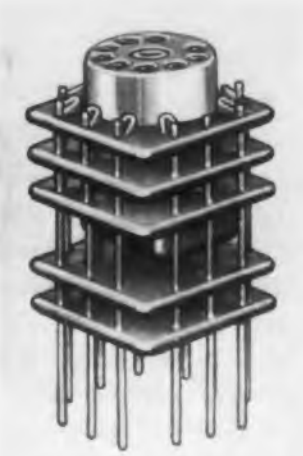


Fig. 3. This diagram illustrates the principle of the magnetic induction flowmeter.



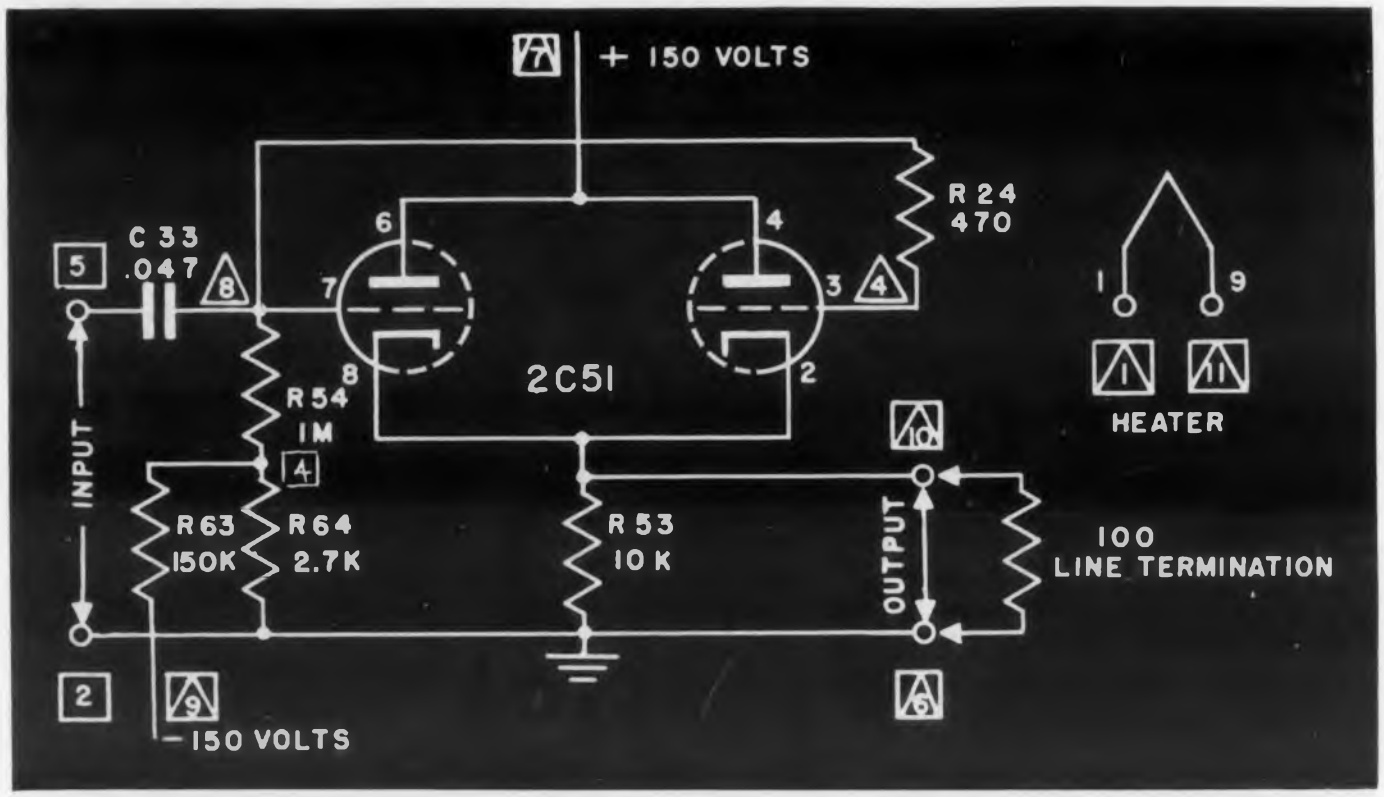
Breadboards such as the one above help the engineer interconnect standard circuit modules into complete electronic subassemblies.



Standard Modular Wafer Circuits

MODULIZED standard circuits are now available in sample lots for circuit-characteristic and production-process evaluation. Prototype circuits and preproduction runs of specific circuits can also be ordered. This program is being undertaken in cooperation with the Department of Commerce to further the development of modular techniques for production equipment. See production sample on cover.

Under contract to the Department of Commerce, the Aerovox Module Div., of Aerovox Corp., 1200 Jefferson Davis Highway, Arlington, Virginia, will also bid on production quantities, contingent on government approval, to supply customer's production requirements. The company will offer the services of their engineering staff to help convert electronic circuits and systems to modular design; these services are available on a consulting or contract basis. The original facilities developed in "Project Tinkertoy" are beng used (ED June, 1955, page 11), and the company is currently expanding their own production plant to mass produce modules (deliveries are scheduled for January, 1956).



This low-level cathode follower circuit, module illustrated top center, is one of many that are available.

Individual module mounting sockets for solder/wire or banana plug connection.

Many National Bureau of Standards preferred circuits are currently being made by this modular process of machine-making ceramic materials with adhesive carbon resistors, including printed conductors and mounted miniature components. Individual wafers are stacked into building blocks to perform functions such as video limiting, d-c regulation, intermediate video amplificaton, low-level cathode follower acton, video driving, and multivibrator action. These circuits represent designs that are well stabilized. As mentioned earlier, modules to customer's specifications can be made. It is expected that the line of modulized standard circuits will include some 40 or more circuits to cover the majority of applications.

To aid the engineer in inter-connecting standard circuit modules to form complete electronic subassemblies, breadboard accessories, illustrated, are available. These breadboards for solder or wire interconnection includes scokets for mounting modules. For more information on these currently available wafer modules, turn to the Reader's Service Card and circle **18.**

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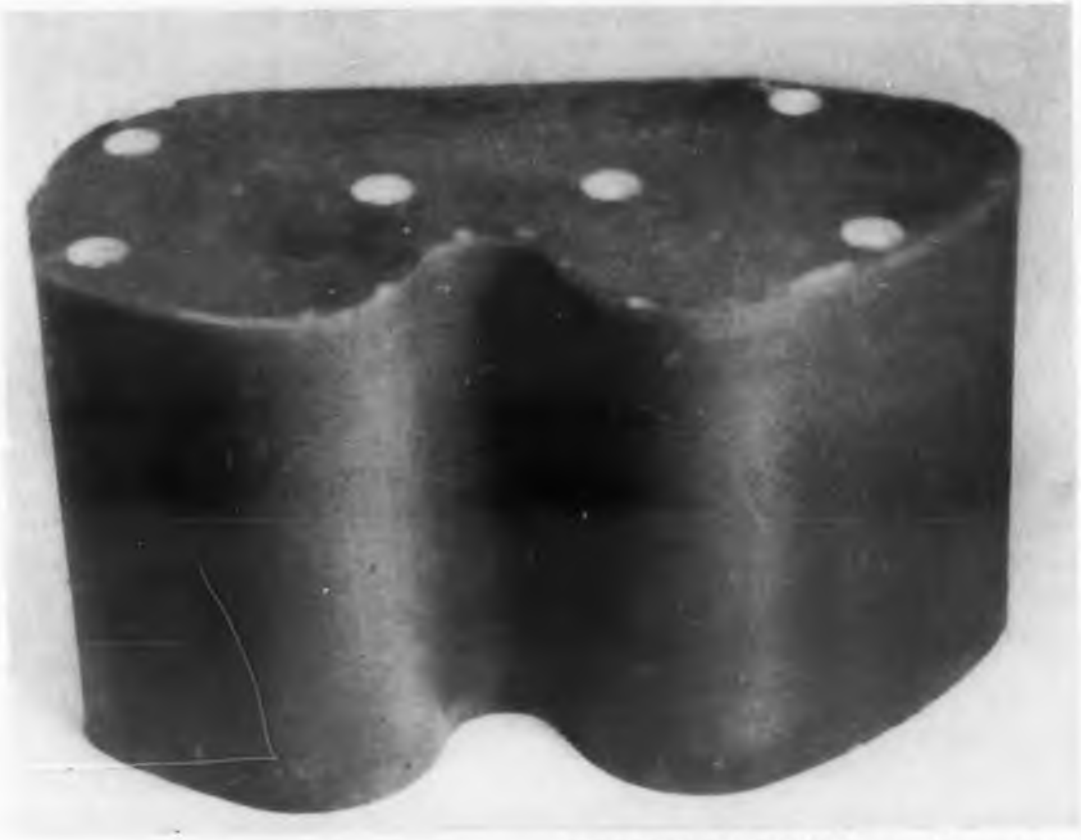
Foaming Potting

High voltage capacitor network before and after potting. Curing takes place in mold at room temperatures. No machining or shaping is necessary.



Compound

Each foamed cube has same weight but varies in density. Samples are 3, 8, 13, and 20 lb/cu. in., left to right.

FOAMING around intricate component shapes when poured into a mold, this potting compound obviates need for fabricating preformed insulation. Known as Sta-Fome, its curing temperature and liberated heat can be kept below 80°C so that components such as diodes, transistors, capacitors and so on will not be "cooked" and damaged during potting. Throughout the reaction Sta-Fome releases less than half the heat encountered with some earlier commercial isocyanates. A casting can be completed in 30 min. No toxic acids are released during curing.

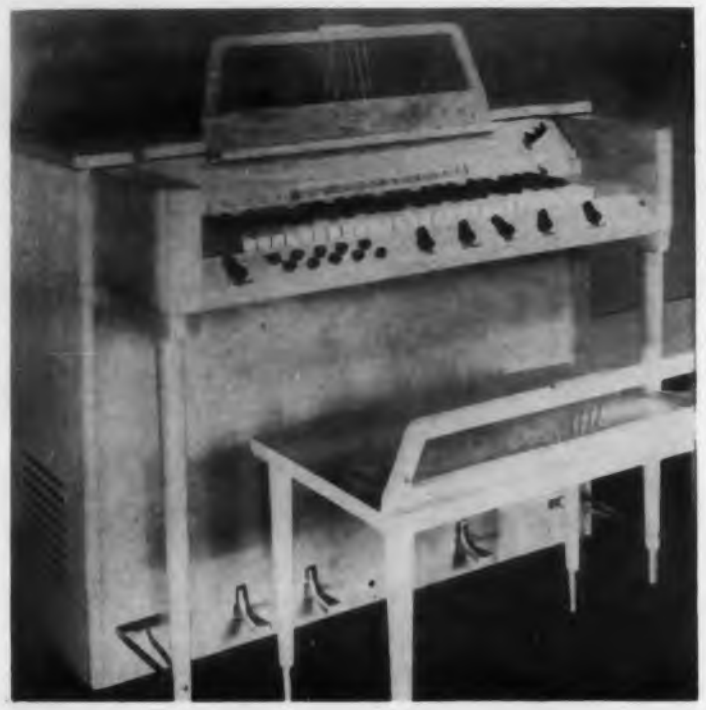
This light weight, rigid and elastomeric material with special properties for thermal insulation and chemical agents for foaming during polymerization is made by Eastern Precision Resistor Corp., Richmond Hill 18, N. Y. It can be formulated with varying densities from 2 to 30 lbs per cubic ft. It has a thermal conductivity comparable to standard insulating materials (0.25-0.30 btu/sq.ft./hr./°F/in. at 70°F). It has good adhesion to all types of surfaces without special treatment.

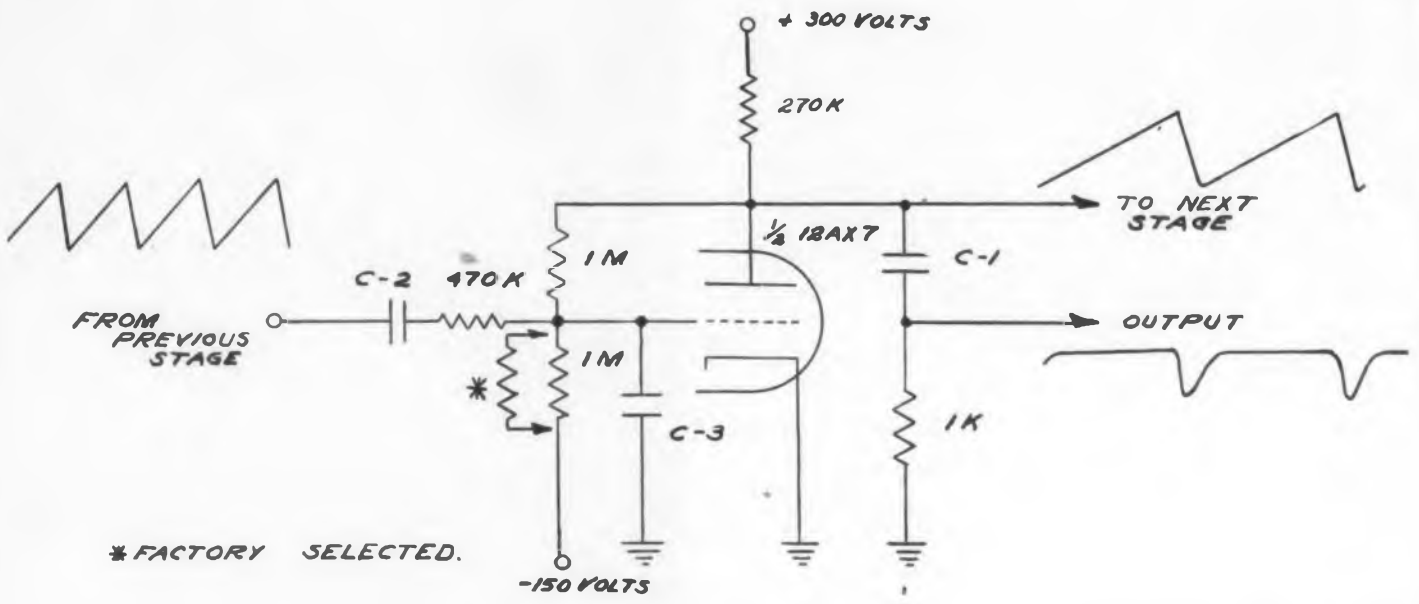
Tensile strength varies with density ranging approximately from 25 lbs psi to 400 psi. Sections regain original shape after compression. Stress to produce a 10% deflection for the 3 lb per cubic ft density material is 4.6psi—475psi as required for density of 20 lbs per cubic ft. water absorption is very low. The compound withstands continuous service up to 212°F and will not crack on repeated heating and cooling cycles which go as low as —80°F. The material can be readily sawed, drilled or sanded with ordinary tools, For more data, turn to the Reader's Service Card and circle number **21.**

Design Forum

Electronic Organ

George H. Hadden, Chief Engineer
Minshall Organ Inc., Brattleboro, Vt.





Each tone generator is made up of four of these direct-coupled divider stages.

DESIGNING an electronic device that produces music is a far more challenging task than designing a device that *reproduces* music. In this article the design of a small electronic chord organ selling for less than $1000 is discussed with particular reference to evaluating design changes later incorporated in the firm's larger organs. The Minshall Chord Organ was designed to be sold at a minimum price, give pleasure to competent musicians, while remaining simple to operate for the novice.

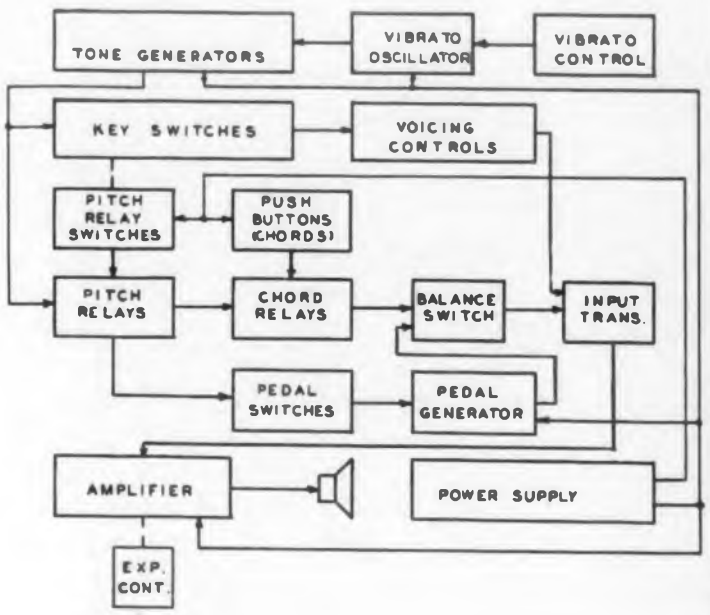
A major consideration in organ design is the public's standards for reliability. The electronic organ is competing with trouble-free instruments like the piano and conventional organ. Therefore, the designer of electronic organs has a considerable component problem. Present top-quality commercial capacitors, for example, still exhibit initial and long-term instability of an order that can be tolerated in radios and TV receivers, but which represents a challenge when used in quality electronic musical instruments. Since the cost of hermetically sealed military type capacitors is prohibitive due to the quantity involved and the price structure of the organ market, the design objective has been suitable circuitry and operating impedances that would offset the influence of effect of initial tolerance and subsequent drift of commercial components.

The first step in designing the chord organ was to evolve a block diagram of functions and the sequence of these functions. The chord organ can be broken down into three divisions: the organ section, the chord section, and the pedal division. The method of generating musical notes by these three divisions and the switching problems involved are too complex to be discussed in this article. It is sufficient to say that the latter problem was solved by a buss-bar arrangement. The front panel controls were kept to a minimum at the same time.

The tone generators are the most important electronic element in the organ. We utilized the basic principles of the tone generators from our larger organs and developed a circuit that we have been considering for some time as a future refinement for the more expensive models. This circuit, which is illustrated, is direct coupled.

In order to change from an r-c coupled circuit, a negative power supply closely related to the positive supply was required. Since some regulation was required, we decided to obtain absolute regulation at little added cost by utilizing a *VR-150* regulator diode.

One of the first concessions to cost and complexity in the design of the organ was to limit it to four octaves. Since the new direct-coupled generator does not require a buffer stage to utilize th output of the master oscillator, an additional triode stage was saved. Therefore, two dual-purpose *12AX7* tubes can produce four octaves compared to six triode sections producing five octaves in the older models. The master oscillator is an l-c Hartley type exhibiting ample stability while affording a rich vibrato when



Block diagram of the chord organ.

desired by applying a low-frequency sine wave to the control grid in conjunction with the use of a relatively short r-c time constant in the grid-to-tank coupling circuit.

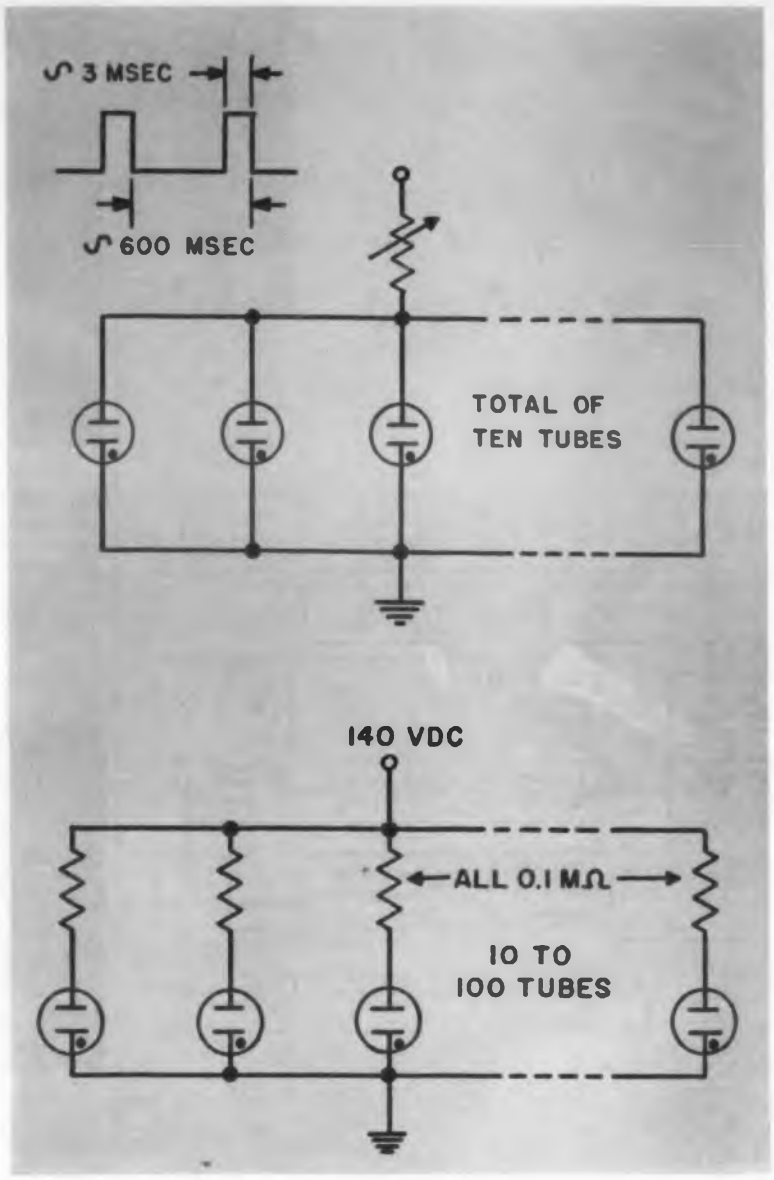
Printed circuits are utilized in this organ in an unusual manner to gain their benefits for a product that is manufactured in thousands rather than hundreds of thousands. The system in which only a part of the components on the printed circuit board are dip-soldered and the remaining components that determine the exact function of the circuit are added by hand-soldering has been discussed elsewhere[1].

Since few technicians can be expected to be familiar with electronic organs, ease of servicing was a major design objective. This objective has been achieved by unitized construction and plug-in harnessing. Servicing can be easily accomplished by dealers who maintain a small stock of replacement subchassis.

[1] G. Maisch, "Printed Circuit Design: V-Applications", *Electronic Design* January, 1955, pp 40, 41.

Background
for
Designers

Pulse-Aging Gas-Diodes



Gas diodes are processed for improved characteristics in the upper circuit and their stability is checked in the lower circuit.

EQUALIZING and stabilizing of the voltage characteristics of cold-cathode gas diodes by an inexpensive method is explained on these pages. The tube characteristics are improved by a process of aging in which pulsed voltages are applied simultaneously to a large number of tubes. Trials of the processed tubes in actual operating circuits show that these aged values are reasonably stable. The method promises to provide an inexpensive, easily available component for many computer circuits. It was developed by D. C. Friedman and W. D. Urban of the data processing systems laboratories, National Bureau of Standards, Washington 25, D. C. The work was sponsored by the Wright Air Development Center, Dayton, Ohio, and the Air Force Cambridge Research Center, Cambridge, Mass.

The cold-cathode gas diode has many qualities that would make it an excellent computer component. It requires little power, but it can handle large currents momentarily. It is small, light, rugged, cool in operation, and inexpensive. Life for normal indicator operation is over 10,000 hr. Its operation may be stated binary-wise in several ways, so that it provides the "yes-no" statement of a digital computer element.

However, four major defects in the operation of this component have thus far limited its use. Because it is manufactured as an indicator, only one characteristic—the maximum firing voltage—is controlled, and this characteristic may have a large tolerance. This variation leads to the first defect: in a batch of tubes, a wide range in firing and holding voltages is commonly found. Selection might be used to overcome this difficulty, except for the second defect: the characteristics of any one tube vary unpredictably with use. The other two major defects are associated with use and circuitry: the normally long deionization time limits speed of operation, and the need for a continuous path to maintain ionization makes selection circuits difficult to engineer. A means of overcoming the first two defects is discussed here.

It is, of course, possible to obtain special tubes that are stable and generally equal in characteristics. However, these tend to be costly. The aim of this investigation has been to devise a method to obtain high-quality gas diodes by inexpensive processing of low-cost indicator lamps. Therefore, the bulk of the work was done with *NE-2* and *NE-51* lamps taken from general stock.

The circuit for the equalizing process consists of a large number of tubes in parallel connected to a pulse power source through a common resistor as illustrated. Pulses are continually applied until the firing potentials and holding potentials of all the tubes rise to common terminal values. Further processing produces no additional change. In the stability check, all the tubes are subjected to identical conditions. Providing a separate resistor for each tube minimizes mutual interaction, while the power supply and environmental changes are common to all tubes.

The first characteristic potential to be considered is the firing voltage—the minimum voltage necessary to start conduction in a tube that has been off a long time compared to its deionization time. The second is the holding or maintaining voltage—the voltage drop across the tube when it is carrying its rated current.

For the *NE-2*, these are about 90v and 75v, respectively. For the *NE-51*, these values are approximately 5v lower. Both tubes are rated at 1/25w.

Since equalizing the tubes consists mainly of operating the tubes beyond their normal operating range, some means of obtaining pulsed operations was required. Two methods were used here. For very large overloads, a relay pulser was employed. The length of the pulse was determined by the break time of a set of relay contacts. When desired, this time could be lengthened by use of an RC circuit, but usually it was held to a minimum. The "off" time was set by a timing relay also operated with a variable RC circuit. Two relays were used to obtain "fail-safe" operation insofar as the tubes were concerned. For tests at higher duty cycles, full or half-wave 60cy voltage was used. To keep the over-all duty cycle low, a clock-driven switch was used to obtain 25- or 75% duty cycles over approximately 100sec periods. In all tests, bulb temperature was checked to make sure it did not rise significantly above ambient temperature.

A set-up was finally devised for equalizing the characteristics of 10 tubes at a time. This arrangement was based on the assumption that at some time during the life of the tubes, when used as indicators, the characteristic voltages must rise, since end of life is indicated by the voltages rising to the point where the tubes will not operate in the circuit. It was also assumed that stability could not be attained until the tube characteristics had started on this rise. The 10 tubes were connected in parallel as illustrated.

At first only one or two tubes would fire because they had much lower firing voltages than the others. However, since these drew a heavy current, they soon aged to the point where other tubes took up a portion of the burden. If the characteristic voltage of any tube should drop when processing started, that tube would carry an excess load and quickly raise its firing voltage back to the level of the others. In this way all 10 tubes were soon made to fire simultaneously. Since the current divided according to the conductances at the holding potential, the characteristic holding potentials tended to become equal because of unequal aging. Thus, equalization of both characteristic potentials was obtained automatically.

Many tubes can be equalized at the same time in this manner, as long as not too much current is drawn by a single or a few tubes. To prevent such an overload, a power supply with poor regulation was used to operate both tubes and relays. A high current load automatically lowered the duty cycle and the pulse voltage. Such protection was especially convenient when the sputtered cathode material formed a conducting path between the electrodes of a tube. In this case the poor regulation of the power supply permitted the path to be evaporated open again without damage to tubes or equipment.

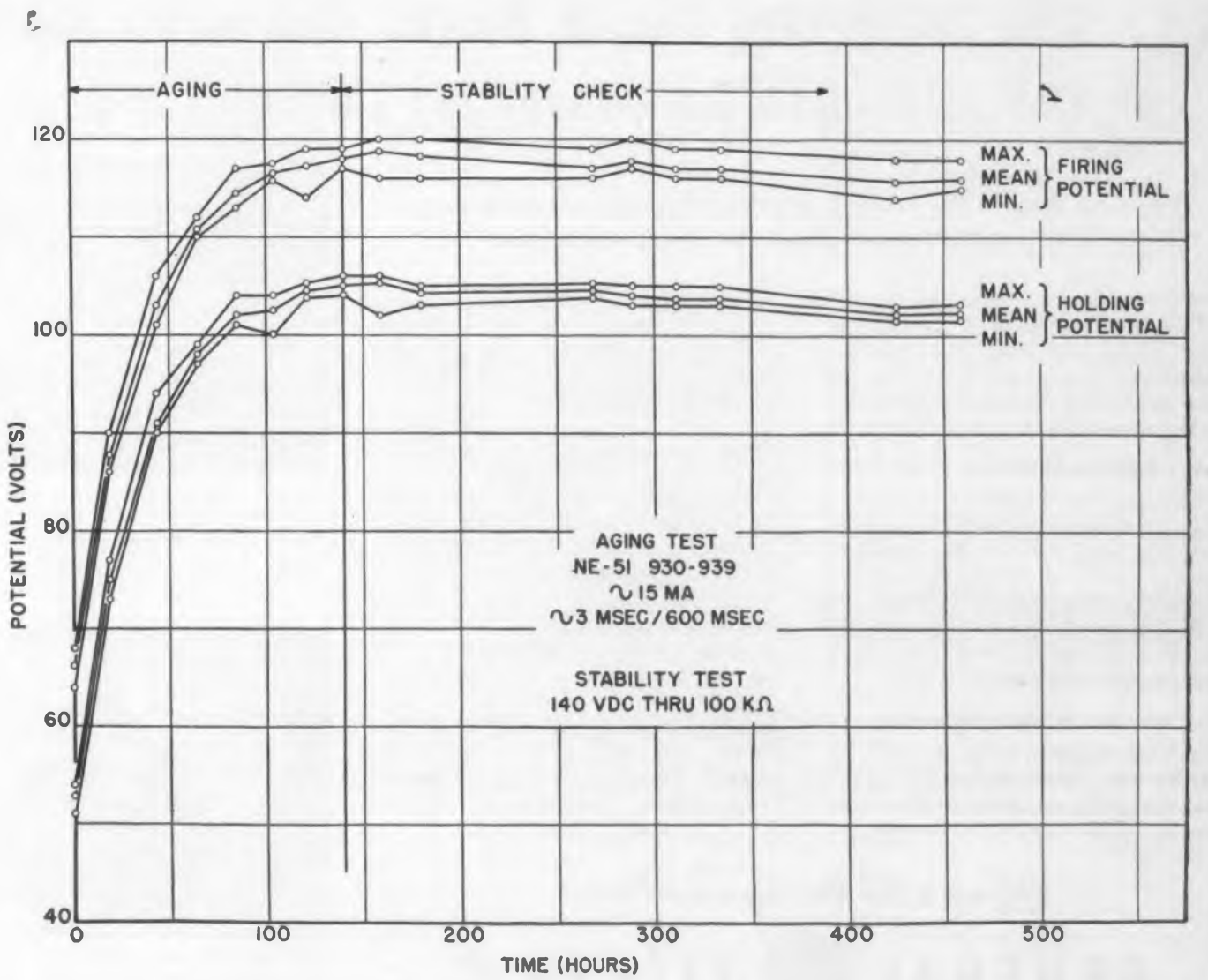
Another method of processing is an automatic "drop-out" technique. Here the source supplying the tubes is a low-voltage pulse whose amplitude is set at the desired final voltage. As the tubes change characteristics, the firing voltage approaches the pulse amplitude, until finally the tube stops firing. In many cases no limiting resistor is needed since the voltage is so low. Variations in current affects the time to drop out, but the final voltage is unchanged.

The use of 60cy current as a supply was also investigated. A half-wave rectifier provided the unidirectional pulses. Because of the high duty cycle compared to the pulse method, the current had to be kept to an undesirably low value to prevent overheating, especially at the start of a run, and this increased processing time. Tubes processed in this way behaved much like those processed by relay pulses. The main advantage is the simplicity of the power source.

When a full sine wave was applied to the tubes, however, the results were different. It was found that during the processing the characteristic voltages measured in both directions of conduction changed in a similar manner. However, during a check for stability with unidirectional operation, it was found that the characteristic voltages in the backward direction dropped quickly and became erratic, although those measured in the forward direction seemed to remain fairly stable. This effect is probably due to deposition of material on the anode. When checked for stability with bidirectional operation, the characteristics seemed to be reasonably stable.

Indications are that the improvement over the usual characteristics of the *NE-2* or *NE-51* is probably due to coating the glass with material sputtered from the cathode. This coating acts as a selective getter, purifying the gas in the tube, and as a bulb coating that prevents the release of oxygen from the glass itself. It is to be hoped that sufficient stability for the circuits in which visual indication is required may be obtained with a partial coating. Little sputtering occurs toward the tip of the tube, and no tube has been so blackened that its glowing electrode could not be seen in normal room lighting.

Because of the gas clean-up that occurs, the change in characteristic voltages is tied to the processing. By balancing such parameters as time and current, it may be possible to control the final voltage to some extent. This control depends upon the amount of selective gettering that occurs, the normal gas pressure, and the partial pressure of the undesirable gases inside the glass tube envelope.



Results of aging tests of type *NE-51* cold-cathode gas diodes. Processing was continued until the rate of change of characteristic voltage dropped appreciable.

G-E THRU-CON BOARDS. Copper plated top and bottom wiring patterns, with positive connections through holes, offer a continuous wiring system. Separate eyelet connections through holes are eliminated.

G.E.'s Thru-Con Printed Circuit Boards have wiring patterns on two sides, positive connection through the board

Thru-Con Boards for printed circuitry lead to cost reductions, and product improvement in many industries

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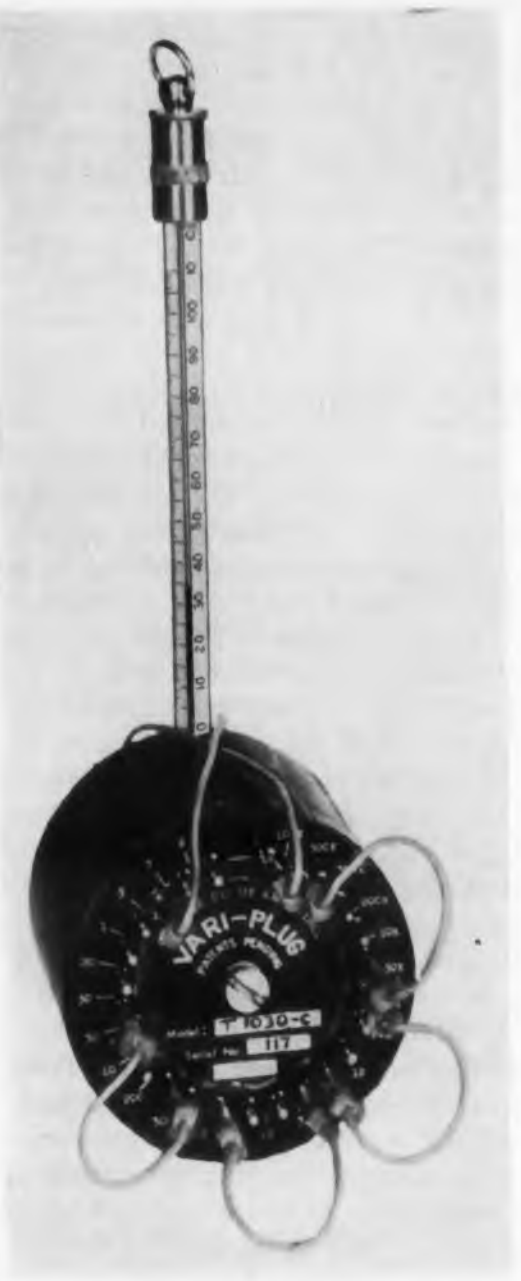

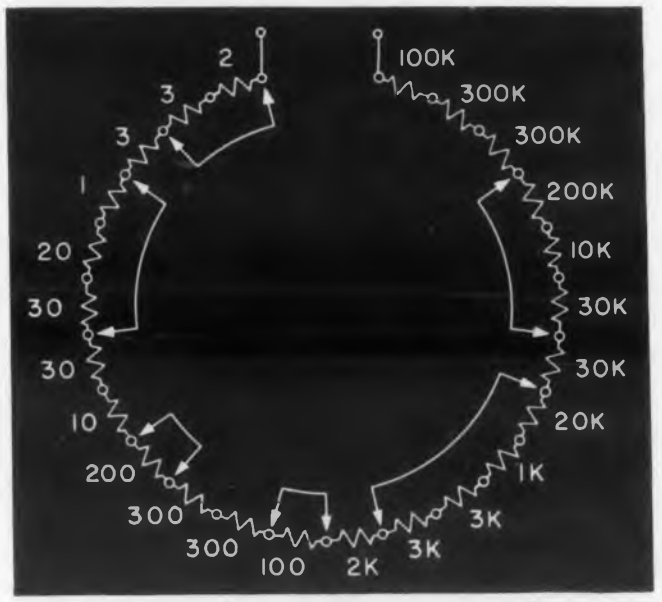

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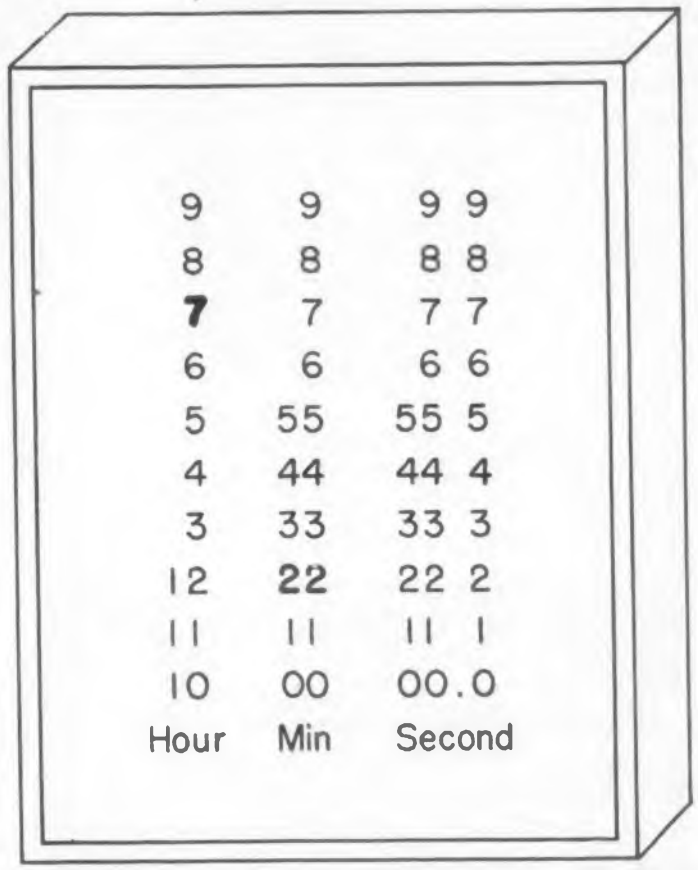
Accurate Pocket Sized Resistance Decade

ADJUSTABILITY of this resistance-decade permits a resistance of 1 megohm to be approximated with an accuracy of 1 part in a million. Unique design permits the provision of a thermometer well for measurement of temperature rise of the 24 individual resistors. Knowing the temperature coefficient value of each resistance and the temperature rise (from a thermometer), minutest resistance change due to current flow through the decade can be determined without having to disconnect the unit from its voltage supply circuit. The pocket-size unit has a range from a fraction of an ohm into the megohms but measures only 2-3/4" in diameter by 2-1/2" deep. It can be panel mounted.

The unit is adjusted by interlocking, shock and vibration proof, plug-in connectors instead of switches. Small size and flexibility of the decade, manufactured by Consolidated Resistance Company of America, Inc., 44 Prospect St., Yonkers, N. Y., is gained in part by the internal connections of the 24 resistors. The connection pattern is 1-3-3-2. This combination requires the least number of resistances and shorting connectors (jumpers) without becoming too difficult to adjust by unskilled operators. Binary codes and other connection schemes extend the range but complicate connections and computations. The model pictured is known as the "1000" Vari-Plug Resistance Decade and uses 1% to 0.01% resistors encapsulated in epoxy resin. Resistance adjustment can be made in 0.1 or 1 ohm steps in a few seconds.

By knowing resistance change due to temperature rise, as indicated by the thermometer, optimum wattage ratings providing maximum sensitivity for a specified accuracy can be determined. The unit can be used to help set fixed resistance values into analog computer circuits. The standard accuracies for voltage divider connections is 0.005% and 0.002%. For more data, turn to the Reader's Service Card and circle **25.**

Transistor Clock



Transistor ring-counter actuates lamps to show time.

TRANSISTORS actuate neon lamps in this clock to illuminate numerals which show time to a fraction of a second. The display can be read from considerable distance in daylight or darkness. The indication is in an unambiguous digital form. Timing is based on 60cy line frequency (or a precision oscillator can be used for millisecond display).

First two columns of the clock built by Saunders & Co., 66 Westland Rd., Weston 93, Mass., show hours. The next two columns show minutes and the next two seconds; the last column shows fractions of seconds. Since the indication is by lamps, the time can be recorded on film (even in darkness) with extremely short exposures. Leads added to lamps will actuate external devices at preset times.

Only one lamp in each column is lit at a time. Each lamp is connected to an individual binary cell which is of a new type using single junction transistors. The binary cells are connected in sequence to form registers. Each register actuates one column of lamps. A single positive bit circulates in each register lighting each lamp in turn. The bit steps one place with each input pulse. As the bit returns from nine (or five in some registers) to zero, it pulses the next column. This forms ring counters of six and ten. The ring counter controlling the seconds column is pulsed by 60cy. Seven such registers form the clock illustrated.

Binary cells tolerate large variations in all components. 60 low-voltage binary cells are used. Two transistors forming the pulse for each shift register make the total transistor compliment 74. The total power consumption is about 6w. For more details on this transistor clock, turn to the Reader's Service Card and circle **28.**

This function generator is separately available in kit form for use with the analog computer.

DESIGNERS of control systems will find this inexpensive analog computer of great value in the rapid development of new systems. By offering the Model ES-400 in kit form, its price is greatly reduced. The computer can also be employed as an auxiliary to existing computer installations to speed analyses.

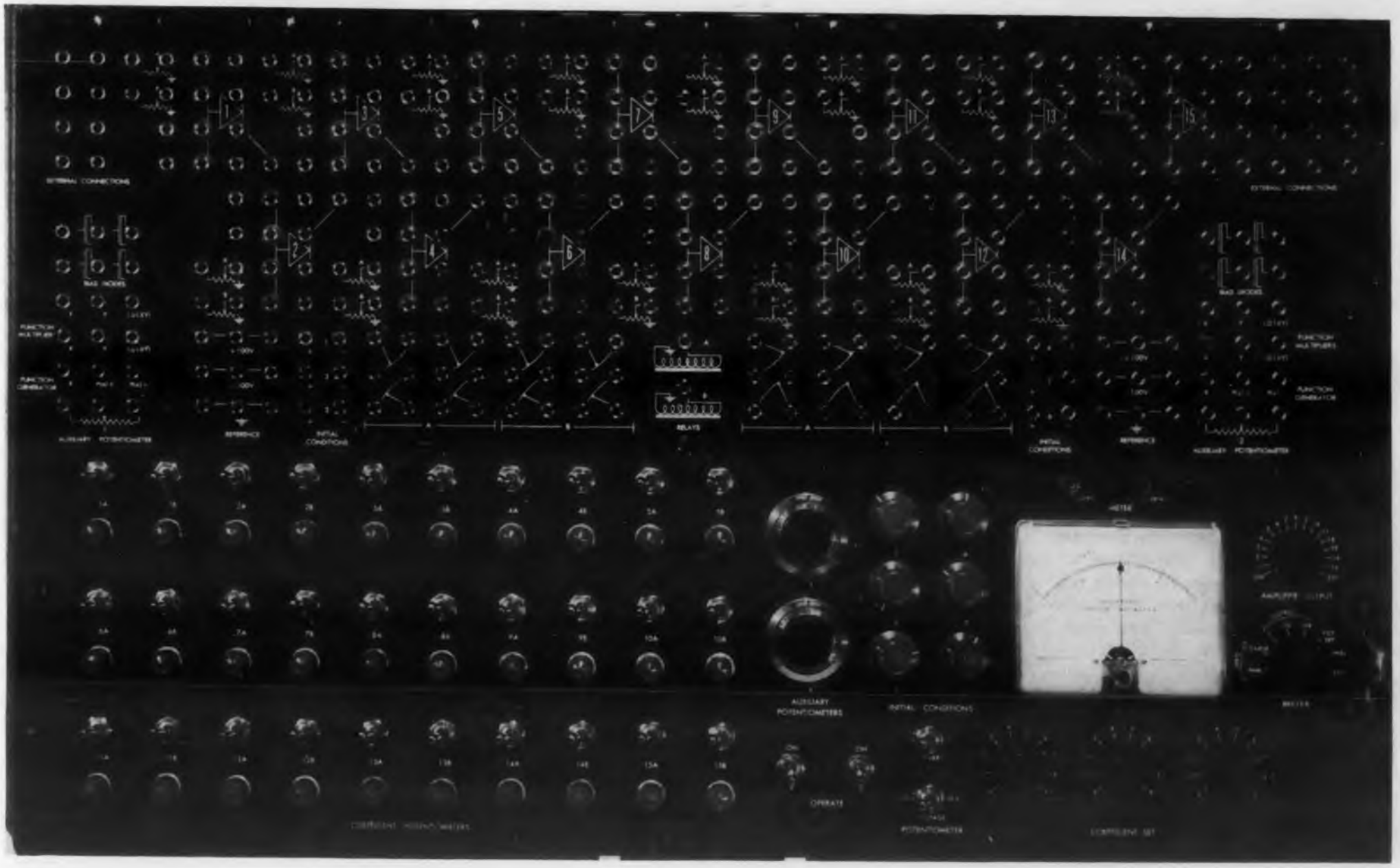
The large patchboard makes for ease of use and checking. Among the components brought out to the board are 30 coefficient potentiometers, 15 d-c amplifiers, two 10-turn potentiometers, four dual bias diodes, and two relays. Each of the 30 potentiometers can be set to an accuracy of better than 0.1% by means of a dividing network and a null meter mounted in the panel. The purpose of the diodes is to simulate nonlinear functions such as backlash, dead-zone, limits, and stops. One use of the relays is to hold a problem in the midst of solutions, to enter new information, or for recording purposes. This instrument is available from Heath Co., Benton Harbor 15, Mich.

The amplifiers are three-tube units utilizing printed circuits. They may be mounted in the upper portion of the assembled computer, as illustrated, or on a standard relay rack. These low-drift circuits are linear from +120v to −120v. They will deliver 10 mills with a minimum open-loop gain of 50,000. Phase shift when connected as a unity inverter is one degree for 1200 cycles. The single power supply may be mounted in the computer cabinet or on a relay rack. The three dual initial-condition power supplies are mounted inside the cabinet.

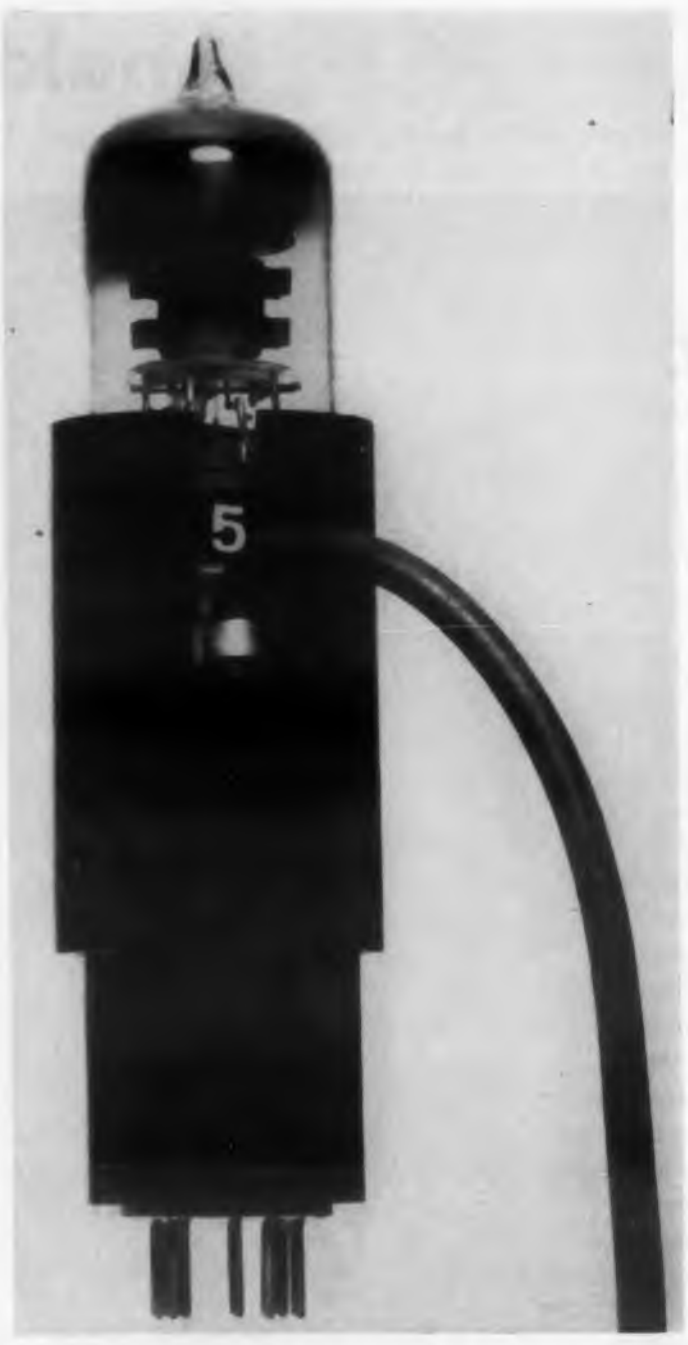
A separate function generator, also in kit form, is available for use with the computer. Its break voltages may be varied from 0 to 100v. Frequency response varies with the function generated, but is generally flat to better than 1200cy. Generators built by other firms can be used with the computer as well. For more data, turn to the Reader's Service Card and circle **31.**

The 15 amplifiers are mounted in a thermally and electrically shielded portion at the top of the cabinet.

Analog Computer Kit



The standard-base type is 1.37" diam x 1.62".



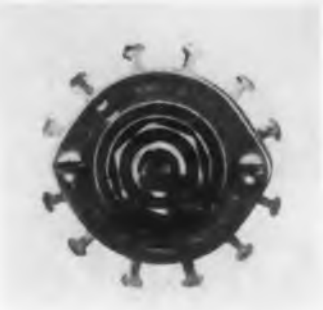
The base diameter of this Rotoprobe for 7-pin miniatures is 0.75". It is 1.87" high measured from the socket.

Socket Adapter with Permanent Probe

CIRCUIT checking of compact equipment is aided by the "Rotoprobe". By removing a tube, plugging this adapter into its socket, and then inserting the tube in the device, the voltage values on all the tube elements can be obtained by simply rotating the device. A permanent cable carries the checking voltages back to the vacuum-tube voltmeter.

In critical tube locations on prototype gear under field test, the device could be installed permanently to speed evaluation. When used with one of the new automatic range-finding VTVM's now coming on the market, circuit checking is practically on an assembly line basis. As illustrated, the number of the connection under test is indicated. Three sizes of Rotoprobes are available: for 7- and 9-pin miniatures, and for octal-base tubes. The device is made by Vector Electronic Co., 3352 San Fernando Rd., Los Angeles 65, Calif.

As the unit is rotated, the spring contact moves off one connector before making contact with the next one, so there is no danger of shorting elements. All voltages are measured to ground. The body of the adapter is made of phenolic, and its socket connections are silver-plated beryllium copper. The cable is 3-1/2" long. Tests with the unit can be made blind—without even seeing the tube under test—as long as you can reach it with your hand. For more information on this lab aid, turn to the Reader's Service Card and circle number **33.**



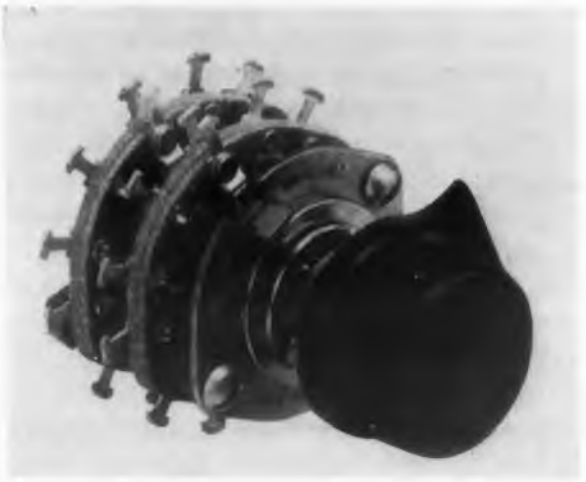
Switches look this way straight down their shafts. Shown actual size.

MINIATURIZATION of portable test equipment and mobile control and communications gear is aided by the utilization of the small multi-deck rotary switches shown on these pages. These Series 7000 switches have a depth behind the panel of only 1.16" for the three-deck version. The units are also available in one- and two-deck models.

Outside diameter for all types including contacts is 1.16". The wafers are made of impregnated glass melamine, which is humidity resistant and tough, without being brittle. Standard contact arrangements from one pole, 12 positions, to four poles, three positions are offered. All have positive indexing with a 1-1/2 in-lb torque. There is continuous rotation for single pole, and stops for multi-pole operation. The silver-alloy wafer contacts are double wiping for low contact resistance. Contact resistance is 0.005 ohms. They are self-cleaning. There are solder lugs on the connection ends of the wafer for ease in wiring. The current-carrying capacity of the contacts is 1amp at 50v, d-c. Current-breaking capacity is 250ma at 50v, d-c. These units are made by International Instruments Inc., P. O. Box 2954, New Haven 15, Conn.

Each switch is furnished with a standard, pointer-type block plastic knob, mounting washers, and a hex nut. Overall depth behind the panel of the single-deck type is 0.6". The rotor contacts are also silver-alloy. Maximum panel thickness is 1/8". Dielectric strength of the insulation is 1000v rms, minimum. For more data, turn to the Reader's Service Card and circle **36.**

Small Multi-Deck Switch



From top to bottom, the switch is made in three-, two-, and single-deck versions

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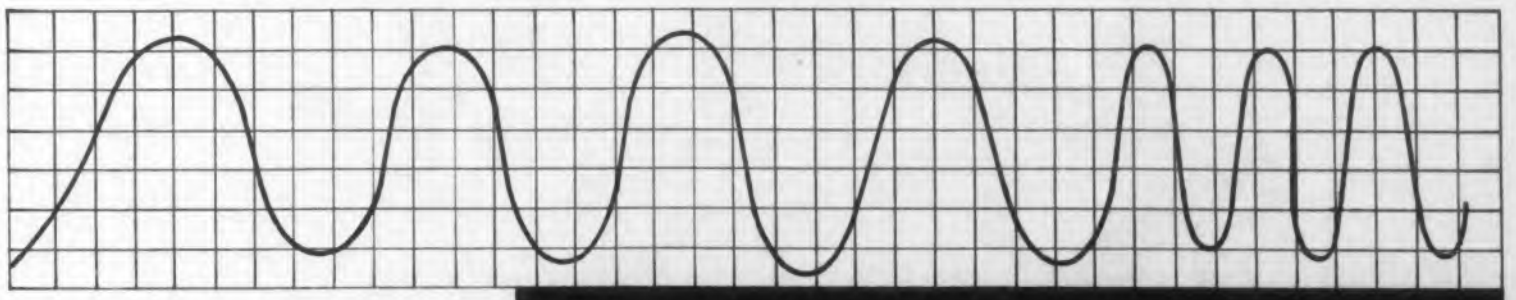

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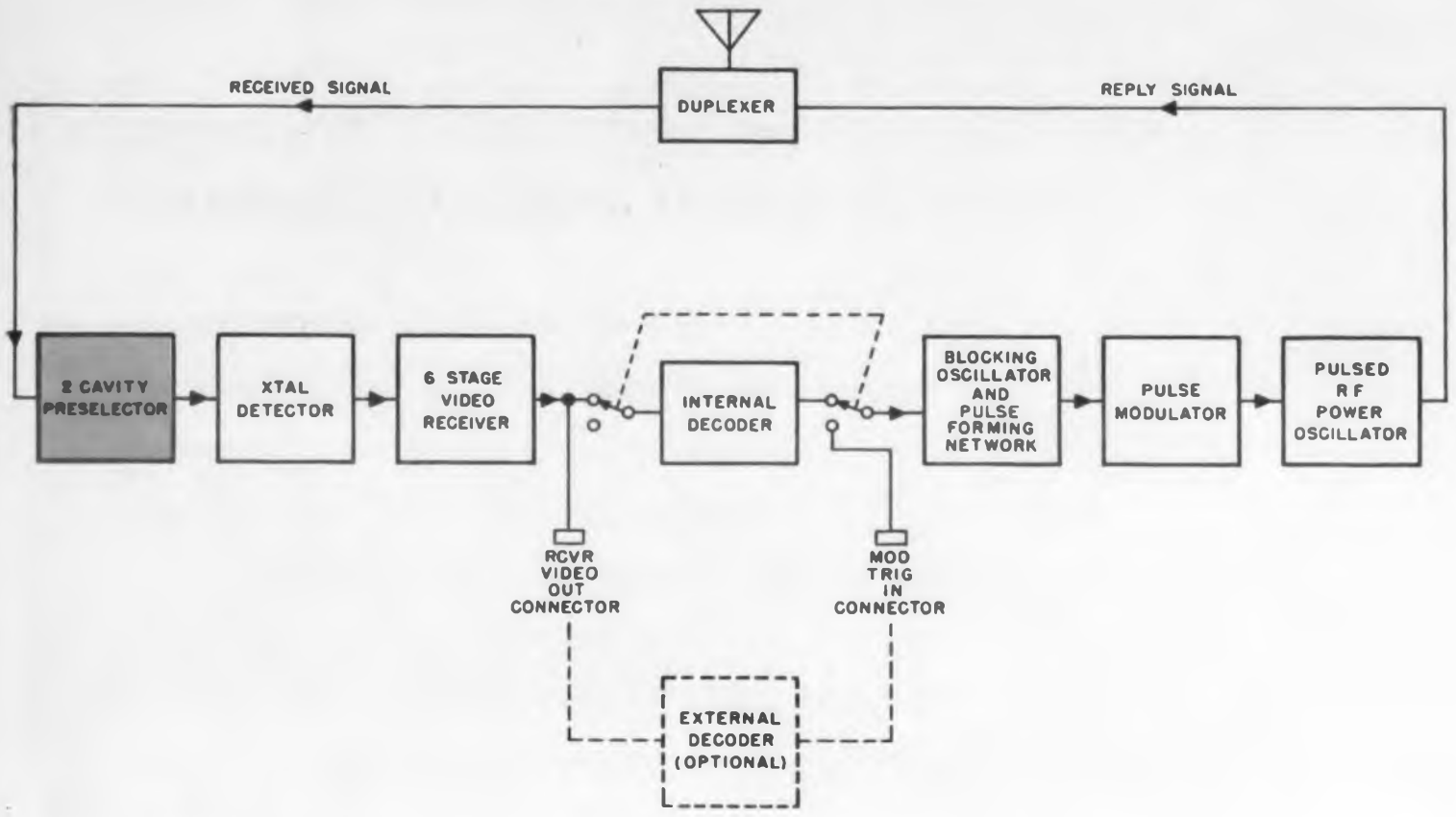
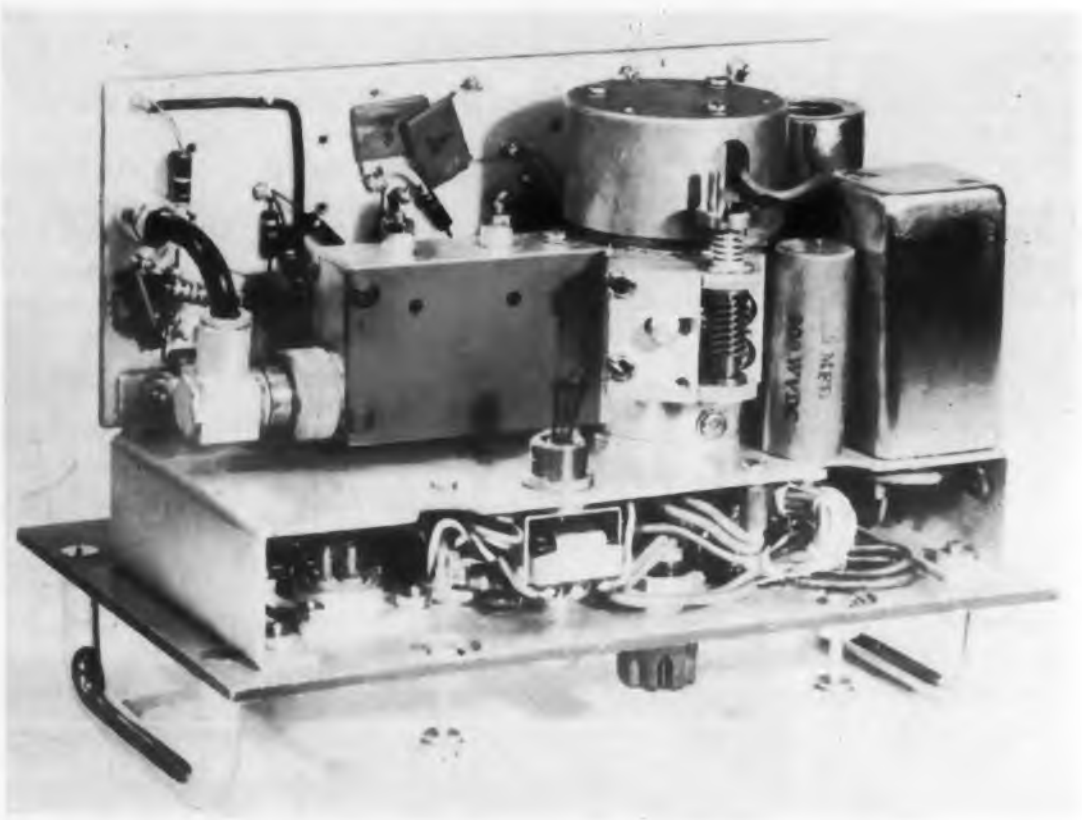


Miniature Transponder



The miniaturized two-stage pre-selector is indicated by the color block. The plastic board is a terminal board and not a printed circuit board.

BY NOT ATTEMPTING to design a transponder that can duplicate all the functions and characteristics of existing transponders, the designers of the unit shown on these pages have produced a much more compact and inexpensive device. As a result the transponder can be installed in aircraft, vehicles, or boats that could not carry the heavier models.

A transponder is a device that sends out a pulse signal when triggered by a signal from a ground radar. Its principle use is in airport operations where it prevents the ground radar crew from ever losing sight of approaching planes. This particular transponder could have great value in the near future when more and more private and executive planes are in operation, greatly complicating airport operations. A transponder can also be employed to identify the plane in which it is installed. The unit discussed here was developed by Radio Receptor Co., Inc., 240 Wythe Ave., Brooklyn 11, N. Y.

The first step in the miniaturization process was the decision to use subminiature tubes—of the reliable type—for the bulk of the transmitter and receiver design. One miniature tube, a *5763*, produces over 20w of transmitted power as a pulse modulator. To gain further miniaturization, a power oscillator is employed instead of a crystal oscillator. Instead of the more sensitive superheterodyne-type receiver, a much cheaper crystal video receiver was designed. This receiver has 90db gain with a 2.5Mc bandwidth. Special receiver characteristics have been achieved by using cascaded linear feedback pairs incorporating negative capacity loops in combination with several non-linear feedback loops.

A thermistor is incorporated in the receiver circuit

The separate power supply chassis is mounted on top of the transponder. The device can also be made with an integral power supply.

varying the receiver gain with temperature to automatically compensate for the increase in noise of the crystal with decreasing temperature. If the noise level rose too high, the transmitter would fire randomly although the transponder is not being interrogated. The receiver can handle a wide variation in input signal without requiring a gain control and without loss of pulse reproduction fidelity. As the input signal level rises, pulse-stretching in the crystal-video receiver is kept to a minimum.

The vibrator power supply has an overall efficiency of 70%. Three supply voltages are required: —24v bias, 150B+, and +1250. The +1250v supply drain varies with duty cycle (the number of interrogations). By utilizing different half cycles of the vibrator, the B+ supplies do not interact and some regulation is gained.

The circuit contains provision to prevent overloading of the transmitter due to excessive interrogation by automatically counting down the number of replies to each interrogation. This transponder contains its own decoder, and provision has been made for external decoding when desired.

The developers of this device are to be commended not only for their skill, but for their daring in developing an instrument based on a concept that has not yet been approved by the cognizant government agency — the Air Navigation Development Board. This concept and the device itself must be approved before it can be sold and installed in civilian aircraft. It also has obvious military applications. This transponder represents another example of how electronic design and development engineers are changing the ways of the world.

Useful Plots of Transmission Line Relations

Essad Tahan
Air Associates, Inc.
Orange, N. J.

THIS article presents a number of the more frequently used transmission line equations in a graphical form for easy reference. The use of these graphs saves time and allows a clearer treatment of transmission lines.

VSWR—One of the most important measurable quantities in this type of work is the voltage standing wave ratio. In practice, a directional coupler or reflectometer may be used to measure the mismatch on a line. These devices are designed to couple into a line to measure the magnitude of the incident and reflected voltage waves. *VSWR* can be calculated from equation 1.

$$VSWR = \frac{V_i + V_r}{V_i - V_r} \tag{1}$$

where V_i = magnitude of the incident voltage

V_r = magnitude of the reflected voltage

and rearranging:

$$VSWR = \frac{\frac{V_i}{V_r} + 1}{\frac{V_i}{V_r} - 1} \tag{2}$$

Now the reflection coefficient at the load end of the transmission line is equal to k_r where:

$$|k_r| = V_r/V_i \tag{2a}$$

thus:

$$VSWR = \frac{\frac{1}{|k_r|} + 1}{\frac{1}{|k_r|} - 1} \tag{3}$$

or

$$\frac{1}{|k_r|} = \frac{VSWR + 1}{VSWR - 1} \tag{3a}$$

Equations 3 and 3a are of the same form and can be represented as:

$$\rho = \frac{a + 1}{a - 1} \tag{4}$$

Fig. 1 is a plot of this equation. Two curves are plotted here. Upper curve *A* is used with the abscissa at the bottom of the graph, and the lower curve B used with the abscissa at the top of the graph. This plot has an interesting property in that either a or ρ can be made the ordinate and the other the abscissa to represent the following: (1) if $\rho = 1/|k_r|$ a will be the *VSWR* on the line; (2) if $\rho = VSWR$, then conversely a is $1/|k_r|$ or the ratio of incident to reflected voltages; (3) if $\rho = 1/|k_r|$ a will be the value of impedance on the line at a V_{min} or V_{max} which is resistive.

These curves are useful for a *VSWR*, $1/|k_r|$ or V_i/V_r, and z from 1.0 or 0 db to 100 db. To obtain accuracy the following ranges are set up for use with these curves.

Case a for *VSWR*'s or z's on line having values from 1 to 9, let $1/|k_r|$ be the ordinate of the curves and the *VSWR* or z the abscissa.

Case b for *VSWR*'s or z's on the line having values from 19db to 100db, let $1/|k_r| = V_i/V_r$ be the abscissa and *VSWR* or z the ordinate.

Actually for any *VSWR* in excess of 1.25 or 1.9db, one can use the ordinate as *VSWR* and the abscissa will give the magnitude of the reciprocal of reflection coefficient directly such as in case *b*. After a few trials, one can automatically choose the ordinate and abscissa for the best accuracy and speed.

An example of each case discussed above will be presented:

Example 1—Consider a lossless transmission line having a *VSWR* equal to 10db. Find the reflection coefficient at the load.

Now since the *VSWR* is less than 10db, use curves as specified in case *a*. Locate the intersection of the vertical line from *VSWR* = 3.16 = 10db on the ordinate to curve *B* or point *1*. Find $1/|k_r|$ from horizontal projection to the left ordinate, i.e., $1/|k_r|$ = 5.7db which is equal to 1.92. Thus $|k_r| = 0.521$.

If one desires to use the curves as specified in case *b*, locate the intersection of the horizontal line from *VSWR* = 10db on the ordinate to curve *A* or point *2*. Find $1/|k_r|$ from the vertical projection to the lower abscissa, i.e. $1/|k_r| = V_i/V_r = 1.92$, and $|k_r| = 0.521$ which checks above value.

Example 2—What is the amount of power reflected on a line having a *VSWR* of 1.20?

By necessity, one must use the chart with the *VSWR* as the abscissa and $1/|k_r|$ as the ordinate. Proceeding as in example 1, the magnitude equals 21db or $|k_r| = 0.09$. Thus the power reflected equals $(k_r)^2$ or 0.0081 which equals 0.81%.

Example 3—What is the ratio of the magnitude of the incident to reflected voltage on a line having a 1.06 *VSWR*?

Using the *VSWR* as the abscissa and from curve *A*, V_i/V_r equals 30db.

VSWR Attenuation—Another useful relation is the *VSWR* at any Point *d* on the transmission line having a mismatch at the receiving end and an attenuation, αd, between the point in question and the load. The equation is as follows:

$$S_d = \frac{\frac{1}{k_r} + \epsilon^{-2\alpha d}}{\frac{1}{k_r} - \epsilon^{-2\alpha d}} \tag{5}$$

where

S_d = $VSWR$ at any point d on the transmission line

k_r = magnitude of reflection coefficient at the receiving end

αd = total attenuation between the receiving end and point d in nepers

This equation is plotted in Figs. 2, 3 and 4 and its derivation is shown in the appendix. Examples illustrating the use of the charts are:

A few examples will be given to illustrate the use of the charts.

Example 4—If the load terminating a line or cable has a $VSWR$ equal to *2*, what attenuation is necessary to reduce the mismatch to 1.1? From the curves in Fig. 2 for S_r equal to 6db, locate the intersection of the vertical line from 1.1 on the abscissa and then project horizontally over to 8.4db. This is the necessary attenuation to reduce the mismatch at the load to 1.1.

Example 5—If the $VSWR$ on a slotted line is 2.2, and if a cable is used to connect the line to the load, what is the actual $VSWR$ of the load if the cable has 1.5db of attenuation? The $VSWR$ from the curve in Fig. 2 is 10db or 3.16.

Example 6—What is the $VSWR$ looking into a piece of RG 21/U cable having a total attenuation of 10db if it is terminated in a load having a 10db $VSWR$? Assume cable connectors have a unity $VSWR$. The input $VSWR$ from Fig. 2 is 1.11.

The curves plotted in Figs. 2, 3 and 4 cover a range of $VSWR$ at the load from 1.0 to infinity and cable or line attenuation from 0.1db to 30db which for all practical purposes covers all of the cases encountered in use.

The curves shown in Fig. 2 have the following ranges:

$$1 \leqq S_d \leqq 2.45$$
$$0 \text{ db} \leqq S_r \leqq \infty$$
$$0.1\text{db} \leqq \alpha d \leqq 100\text{db}$$

and for Fig. 3:

$$1 \leqq S_d \leqq 100$$
$$10 \leqq S_r \leqq \infty$$
$$0.1\text{db} \leqq \alpha d \leqq 10\text{db}$$

Fig. 4 is a plot of the relation $\epsilon^{-2\alpha d}$ versus αd and is useful for calculations when it is desired to evaluate S_d by equation 5. This applies for cases where the actual $VSWR$ at the receiving end, S_r, is not plotted in Fig. 2. One example of each illustrates the use of Figs. 2 and 3.

Example 7—Find the $VSWR$ looking into a length of

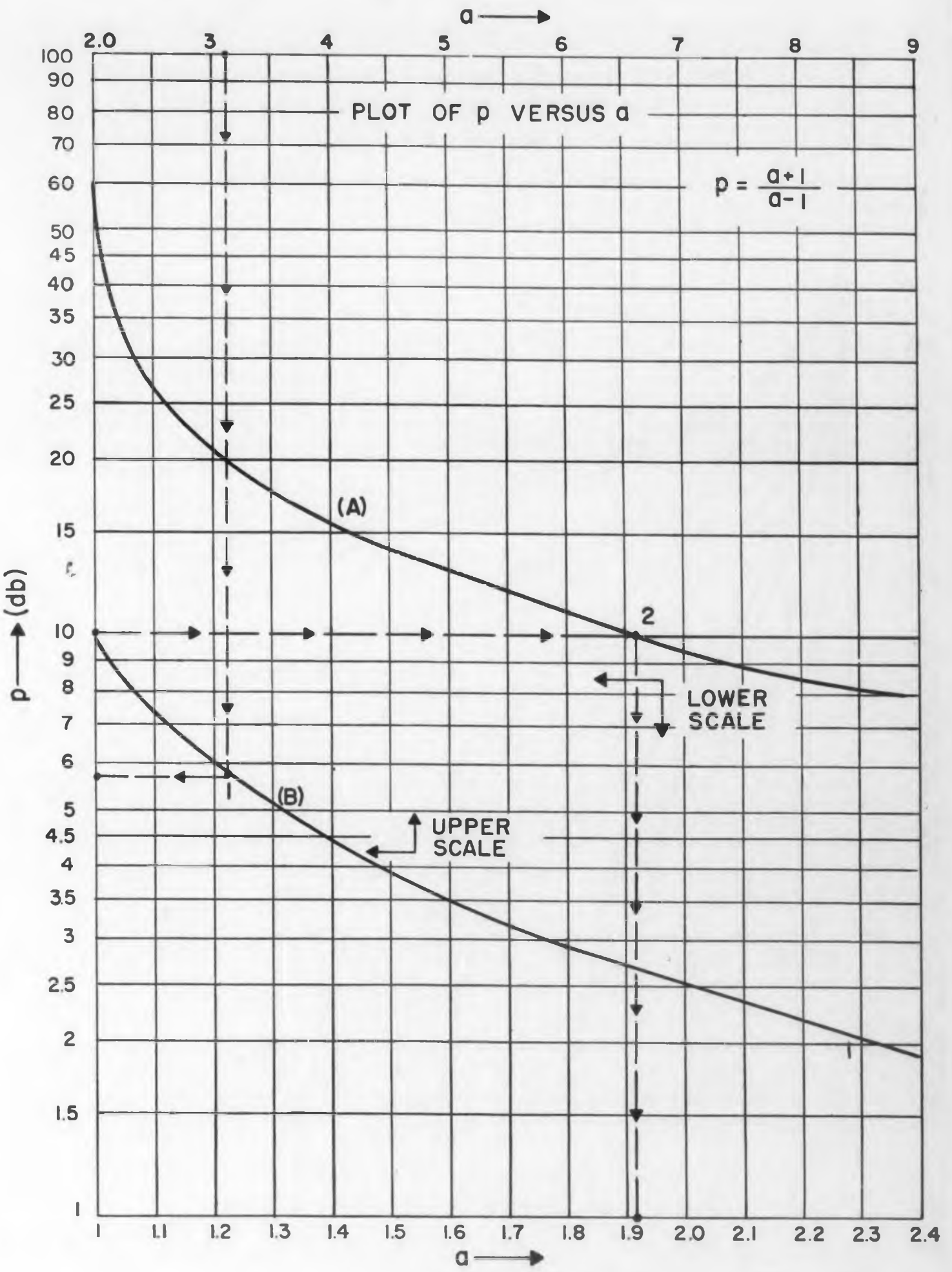


Fig. 1. Plot of equation $p = a + 1 / a - 1$ for various scales.

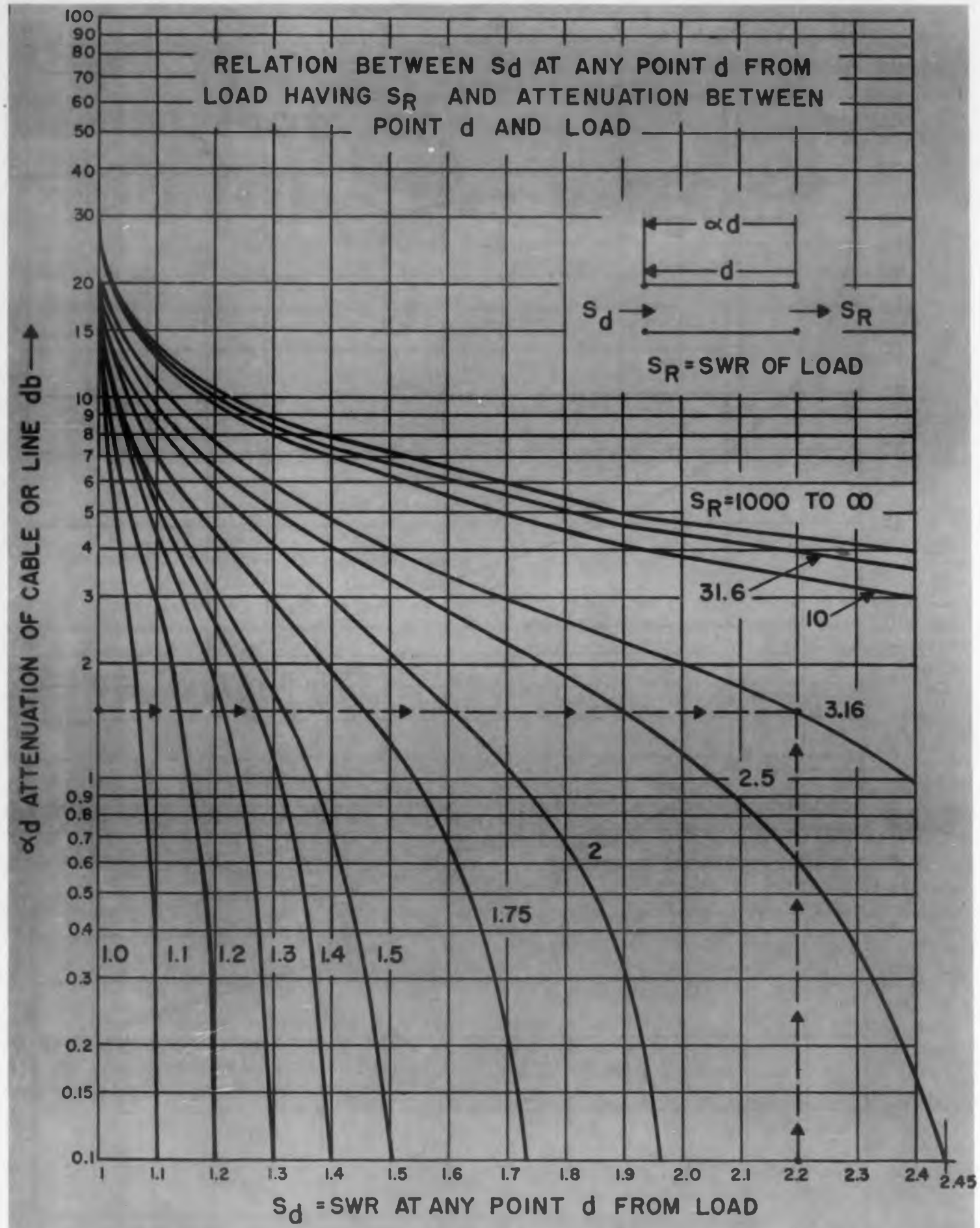


Fig. 2. Relation of standing wave ratio at any point *d* from a load for various values of SWR of load or attenuation of cable or line.

RG 8/U cable having an attenuation of 1db when the cable is terminated in a short having an S_r equal to 40db. From Fig. 3 project across on the line corresponding to αd equals 1db until it intersects the curve for S_r equal to 40db. The *VSWR* at a point d or S_d equals 8.

Example 8—Find the actual *VSWR* load if the S_d on a slotted line is 2 and if a cable having a total attenuation of 0.5db is inserted between the slotted line and the load. Since the intersection of the horizontal projection from the ordinate αd equals 0.5db and the vertical projection from S_d equal to 2 does not occur at a plotted curve, one must calculate S_r using equation 5, Figs. 1 and 4.

By rearranging equation 5:

$$\frac{1}{k_r} = \epsilon^{-2\alpha d}\left[\frac{S_d + 1}{S_d - 1}\right] \qquad (6)$$

The value of $\epsilon^{-2\alpha d}$ is obtained from Fig. 4 and when this plus the value of S_d are substituted in equation 6, the result is $1/k_r = 2.67$. The *VSWR* of the load S_r is quickly obtained from Fig. 1 as 6.9db or 2.22.

Also the efficiency of any specified length of a transmission line (TLE) can be calculated from Fig. 4 if αd in db is known.

$$P_r/P_s = I_r^2/I_s^2 = \epsilon^{-2\alpha d} = TLE \qquad (7)$$

where P_s and P_r is the power and I_r and I_s is the current at the sending and receiving end, respectively when the line is terminated in its characteristic impedance.

$$P.L. = 1 - TLE = \text{power loss.} \qquad (8)$$

See the appendix for the derivation.

Example 9—Find the efficiency of a 200′ run of 50-ohm transmission line having a 3⅛″ outer conductor for TV channel 13. For channel 13, $\alpha' = 0.155\text{db}/100'$; total attenuation $(\alpha d) = 2\alpha' d = 2 \times 0.155 = 0.310\text{db}$. From Fig. 4, for αd equal to 0.310db, $\epsilon^{-2\alpha d}$ is found to be 0.93 or the transmission line efficiency is 93% and the power loss in the line is 7%.

Example 10—What is the efficiency of a 500′ length of 1⅝″ 50-ohm transmission line for channel 4? For channel 4, $\alpha' = 0.173\text{db}/100'$, and $\alpha d = 5 \times 0.173 = 0.865\text{db}$. From Fig. 4 the efficiency is 82 5% and the power loss is 17.5%.

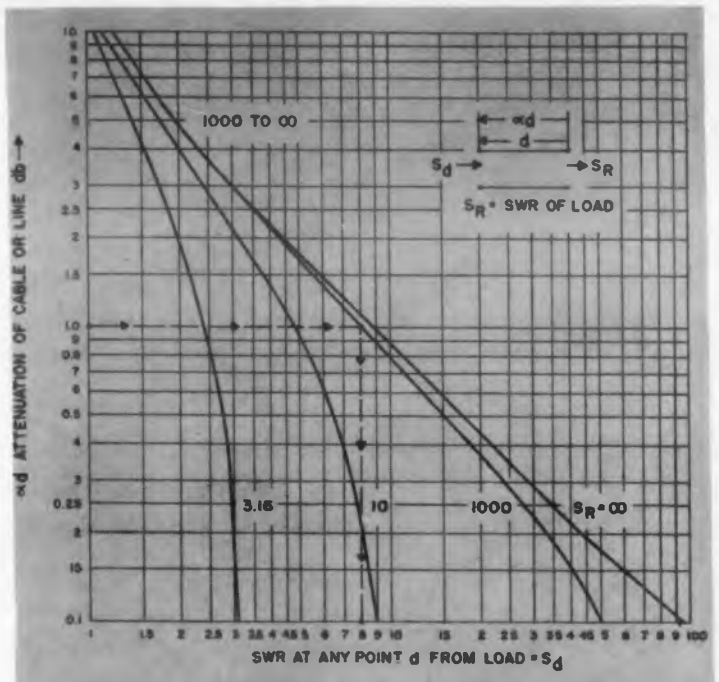


Fig. 3. Relation between S_d at any point d from load for various values of S_r. See also Fig. 2.

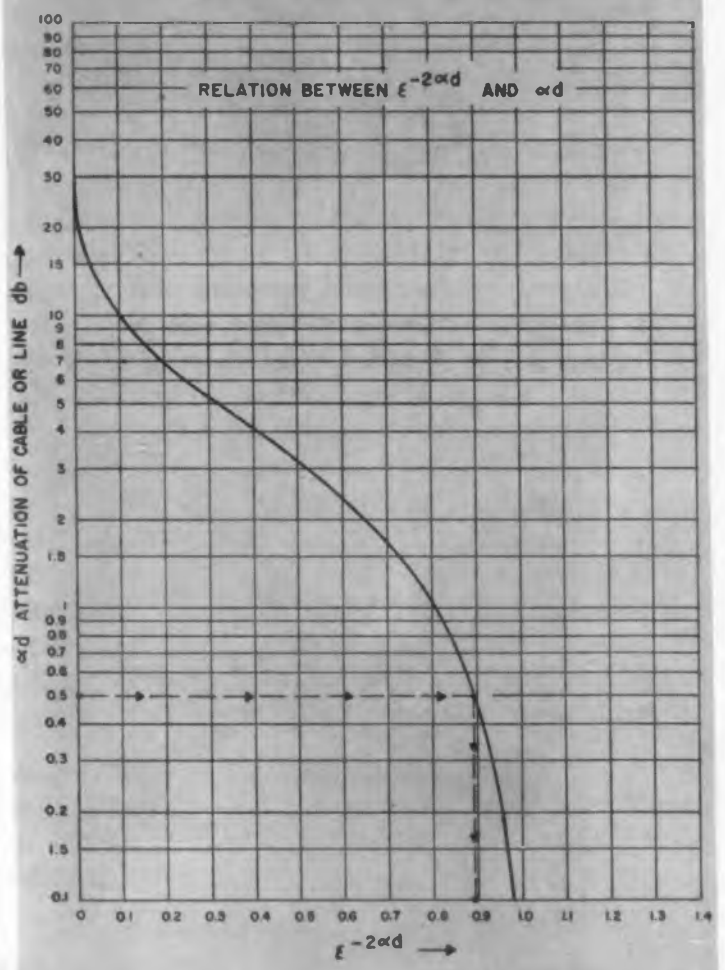
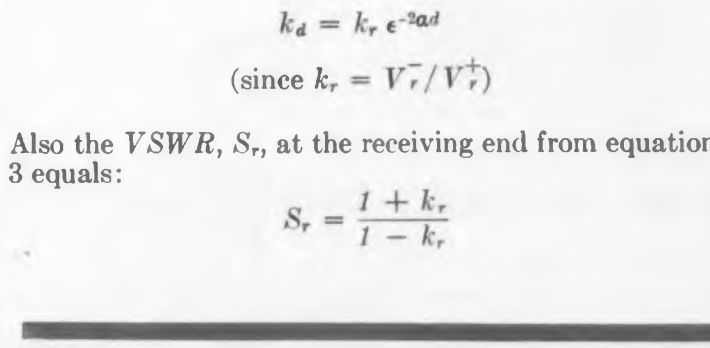


Fig. 4. Relation between $\epsilon^{-2\alpha d}$ and αd, attenuation of cable or line.

Appendix

The derivation of equation 5 is as follows: Consider a length of transmission line having an attenuation per unit length equal to α.



where K_r = reflection coefficient at the load or $z = 0$.

$$K_r = k_r \underline{|\Psi_r} = \frac{V_r^-}{V_r^+} = \frac{Reflected\ Voltage}{Incident\ Voltage}$$

K_d = reflection coefficient at $z = d$

$$K_d = k_d \underline{|\Psi_d}$$

now
$$K_d = \frac{V_d^-}{V_d^+} = \frac{V_r^- \epsilon^{-\alpha d} \epsilon^{-j\beta d}}{V_d^+ \epsilon^{\alpha d} \epsilon^{j\beta d}}$$

Setting $\gamma = \alpha + j\beta d$ where d is a positive number

$$V_d^- = V_r^- \epsilon^{\gamma d}$$
$$V_d^+ = V_r^+ \epsilon^{\gamma d}$$

therefore,

$$K_d = (V_r^-/V_r^+) \epsilon^{-2\alpha d} \epsilon^{-j^2\beta d}$$
$$k_d = V_r^-/V_r^+ \epsilon^{-2\alpha d}$$

thus

$$k_d = k_r \epsilon^{-2\alpha d}$$

(since $k_r = V_r^-/V_r^+$)

Also the $VSWR$, S_r, at the receiving end from equation 3 equals:

$$S_r = \frac{1 + k_r}{1 - k_r}$$

Thus the $VSWR$ at any point d on the line equals:

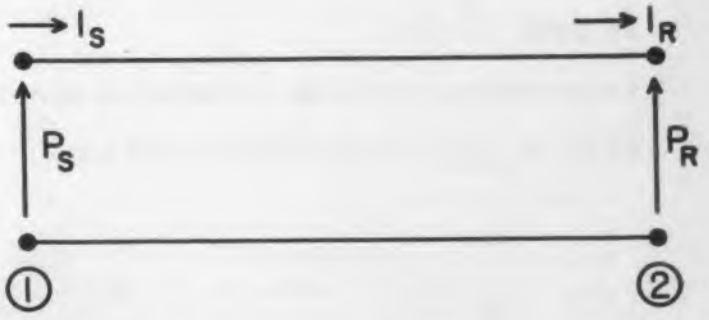
$$S_d = \frac{1 + k_d}{1 - k_d} = \frac{1 + k_r \epsilon^{-2\alpha d}}{1 - k_r \epsilon^{-2\alpha d}} = \frac{\frac{1}{k_r} + \epsilon^{-2\alpha}}{\frac{1}{k_r} - \epsilon^{-2\alpha d}}$$

where α equals the attenuation per unit length in nepers.

For a lossless line, $\alpha = 0$, the above equation reduces to:

$$S_d = \frac{\frac{1}{k_r} + 1}{\frac{1}{k_r} - 1} = S_r$$

Derivation of equations 7 and 8:



$$I_r = I_s \epsilon^{-\alpha d}$$

and

$$P_s = I_s^2 Z_o$$

$$P_r = I_r^2 Z'_o$$

The transmission line efficiency (TLE) is:

$$P_r/P_s = I_r^2/I_s^2 = \epsilon^{-\alpha d}$$

and the power loss, PL, equals:

$$PL = 1 - TLE$$

Tiny Trimmer Potentiometer

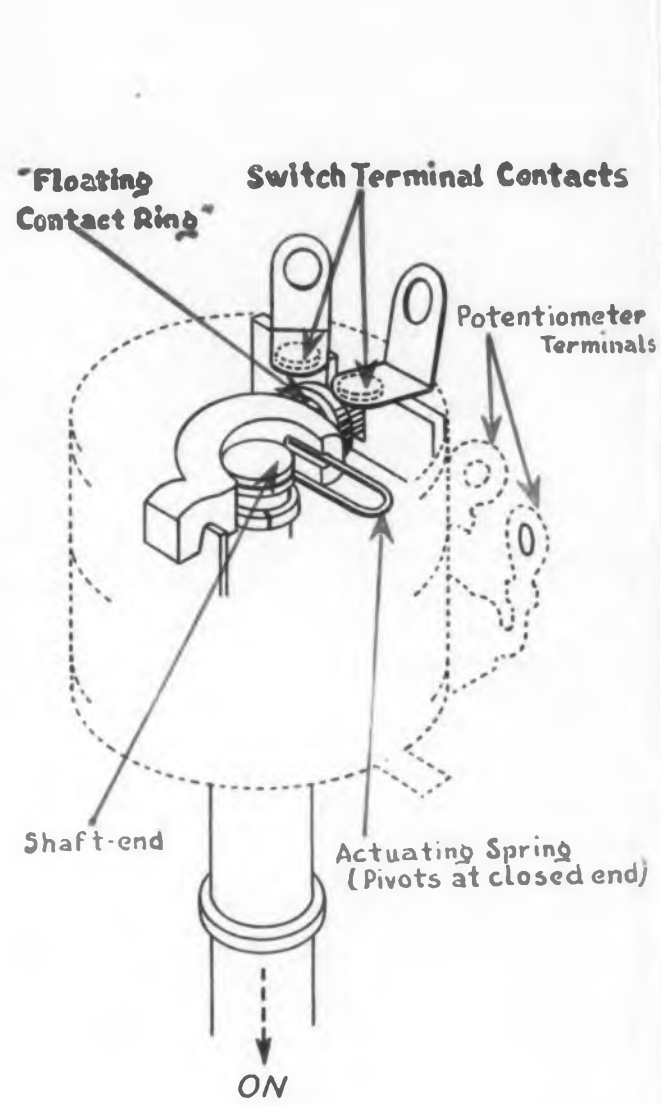
TRIMMER potentiometers are getting smaller and smaller. The wire-wound unit described here can be cemented into a hole only 0.27" diam or mounted in a diode clip. It only weighs 1.1 gr (0.039 oz).

This high-resolution trimmer is also available in a version with a threaded body for panel mounting that weighs 2.2 gr. The lighter version (Type 101A) can also be supported by its own leads like a resistor. These units have an adjustment knob at one end that can be turned with the fingers or by screwdriver. The knob can be turned 320°. The resistance of the standard unit is 4700 ohm, but special models with resistance from 330 to 3300 ohm can be ordered. This trimmer is made by Carter Manufacturing Co., 23 Washington St., Hudson, Mass.

These trimmers are particularly useful in aircraft and missile applications or in transistor circuits. They are housed in a tough thermosetting plastic. They dissipate 1/4w at 20°C. The leads are 1-1/2" long tinned single-conductor. The temperature coefficient of resistance of the winding is 0.002% per degree C, for resistance values over 100 ohm. For more data, turn to the Reader's Service Card and circle **40.**

This unit is being cemented into the hole.

Push-Pull Volume Control Switch



Floating contact ring is engaged with terminal contacts as shaft is pushed in. U-shaped spring is pivot. Because ring floats, contact life is long.

VOLUME controls with push-pull on-off action are a sales feature which radio and TV set manufacturers can now offer to their customers. Once volume is adjusted for the desirable loudness, the listener can turn his set on anytime at the same volume simply by pulling the shaft. There is no need to wait for warm up, no readjusting. In addition to greater convenience to the set owner, the push-pull switch reduces mechanical wear and extends the life of the volume control.

Long switch life is achieved by the P. R. Mallory & Co., Inc., Indianapolis, Ind., by using a small floating contact ring made of a special alloy. The ring floats on its retaining pin, and every time the switch is used, the contact ring rotates. Thus, a new surface area makes the actual contact. Arc erosion and wear is spread around the whole circumference of the ring and contact life is substantially increased. The floating ring-contact is moved radially to engage the terminal contacts by the pivoting actuating spring. This U-shaped spring serves as the coupling between the shaft and the contact. Of course, the volume control has longer life because it need not be rotated except for minor volume adjustments.

Controls with resistance values from 200 ohms to 10 megohms are available with the push-pull switch. For more information, turn to the Reader's Service Card and circle number **43.**

New Products

Extremely Small Transistors

Volume is 0.0087 cu. in.

These p-n-p fused junction germanium transistors which are one-quarter to one-third the size of former units have a volume of only 0.0087 cu. in. They are designated types *2N130*, *2N131*, *2N132* and *2N133*. The first three are intended for use in audio or low radio frequency applications; the fourth is a low noise transistor for use in low level audio circuits. The average noise factor of the *2N133* is 6.5db and will not exceed a maximum limit of 10db. This is an improvement over older types having a maximum noise factor of 12db. Maximum ambient temperature is 85°C. These new transistors are electrically similar to and are designed to replace the CK 721 series. Raytheon Manufacturing Co., Dept. ED, 55 Chapel St., Newton 58, Mass.

CIRCLE 45 ON READER-SERVICE CARD FOR MORE INFORMATION

Deposited Carbon Resistors

Double Molded Insulation

This new 1/2w molded deposited carbon resistor is designed for applications that require a combination of precision, stability and small physical size along with the added benefits of double insulation.

The double insulation offers complete mechanical protection, longer load life, better electrical insulation, greater moisture resistance and performance that exceeds all electrical requirements of MIL-R-10509A. Electra Mfg. Co., Dept. ED, 4051 Broadway, Kansas City, Missouri.

CIRCLE 46 ON READER-SERVICE CARD FOR MORE INFORMATION

AN Connectors

Make Hermetic Seals

HS 2 (AN 3102) receptacles and HS 6 (AN 3106) plugs feature hermetic "Vac-Tite" glass-to-metal construction to insure leakproof performance under conditions of extreme heat and pressure. They are for use in severe instrumentation problems where the vacuum tightness and arc-resistance of glass are necessary during high-temperature operation. Shock and vibration proof, they are corrosion resistant, 100% moisture and pressure repellant, and equivalent to MIL-C-5015. Hermetic Seal Products Co., Dept. ED, 33 S. 6th St., Newark 7, N. J.

CIRCLE 47 ON READER-SERVICE CARD FOR MORE INFORMATION

Cathode-Ray Indicators

For Large-Size Displays

These two new units, 17″ and 21″ indicators, employ television-type cathode-ray tubes and are designed primarily for use in conjunction with low-frequency, laboratory-type oscillographs as well as other electronic amplifying equipment. The 17″ instrument, the Type 343, mounts in the standard 19″ rack-and-panel or rack cabinet. The larger screen unit, Type 345, is housed in a metal cabinet.

The coupling of the indicator to a master oscillograph is performed through the illustrated cathode-follower adapter (supplied with Types 343 and 345) which alters the impedance of the master oscillograph deflection-plate signals to a value suitable for transmission over lines up to 100′ in length. Allen B. DuMont Laboratories, Inc., Dept ED, 760 Bloomfield Ave., Clifton, N. J.

CIRCLE 48 ON READER-SERVICE CARD FOR MORE INFORMATION

Electronic Counter

Measures Frequency, Speed, Etc.

The Model 512A is a portable, high-accuracy electronic counter that can measure frequency, speed, rpm, random events, weight, temperature pressure, acceleration, and many other phenomena. It provides direct numerical readings in cy, rpm, or rps, from 1cy to 120kc. The period of count is either 1/10sec or 1sec and the count display time can be varied at will. The instrument uses conventional power line frequency for counting time base; or is available with a plug-in crystal time base for measurements of more precise accuracy. It includes three accessory power supplies of −150v d-c, +300v d-c, and a 6.3v a-c filament supply. Connections are also supplied for photocells and an external standard. Weight is 25 lb. Hewlett-Packard Co., Dept. ED, 275 Page Mill Rd., Palo Alto, Calif.

CIRCLE 49 ON READER-SERVICE CARD FOR MORE INFORMATION

Subfractional Motor

In 3″ Diam Frame

This subfractional motor, in a 3″ diam frame, is for instrument, recording unit, and office appliance applications. Most units will be of the single-value capacitor type, for single-phase operation. Efficiencies of the various ratings run over 30%, which is high for motors of this size; as a result, there is a lower temperature rise.

Units have nominal ratings for continuous duty of: 1800rpm and 3600rpm (synchronous) and 1700rpm and 3400rpm (induction). They are available in a variety of power ratings from 1/50hp to 1/200hp. Holtzer-Cabot Motor Div., National Pneumatic Co., Inc., Dept. ED, 125 Armory St., Boston, Mass.

CIRCLE 50 ON READER-SERVICE CARD FOR MORE INFORMATION

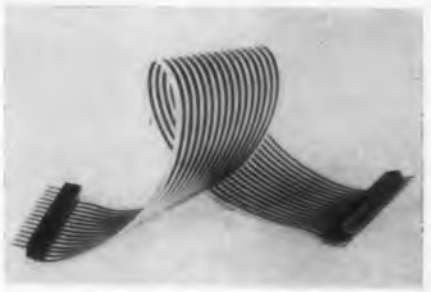
Uses Solid Thermosetting Compound

The "Royal Cub" paper-dielectric capacitor combines high temperature and high stability operation with mechanical toughness and long-life characteristics, achieved by the use of "Polykane", a solid thermosetting compound. The capacitor operates over a −55° to +100°C range at full-rated voltage. Average capacitance-temperature variation is 5% from the 25°C value, insulation resistance at 25°C exceeds 4000 megohms-mfd, with power factor less than 1%. The capacitor is available in 100, 200, 400, 600, and 1000v d-c working, and capacitances from 0.001mfd to 1.0mfd, depending on voltage. Cornell-Dubilier Electric Corp., Dept. ED, Plainfield, N. J.

CIRCLE 51 ON READER-SERVICE CARD FOR MORE INFORMATION

Printed Circuit Cables

New Plastic-Copper Laminate



Unique, flexible printed circuit cables, made by an exclusive process of laminating the versatile plastic Kel-F with copper in thin sheets, are a new concept in multi-conductor cabling.

The new cables have excellent electrical and mechanical properties for operation over a wide range of environmental conditions. Complete encapsulation of the conductors in Kel-F ensures maximum protection against moisture. Glass cloth can also be included in the laminations for increased strength and high temperature stability.

These new cables are lighter and thinner than many conventional cables. They are adaptable to many types of connectors or terminations and are easily secured by clamps, rivets or cement. The design eliminates wiring errors.

Additional conducting and insulating layers can be added to the basic cable to provide a greater number of separate conductors. As many as three conducting layers are possible, depending on the flexibility required. Each layer is made slightly shorter than the layer below to expose all the conductor ends for solder connection. Stacked circuits have been built up to five layers and may go higher depending on the application. Sanders Associates, Inc., Dept. ED, Nashua, N. H.

CIRCLE 52 ON READER-SERVICE CARD FOR MORE INFORMATION

Subminiature Capacitors

Complete Line, Down to 3v

The tiniest capacitor most suitable for any given application can be supplied by this company. Paper, metallized-paper, electrolytic, mica, ceramic, and all the film dielectrics such as: mylar, teflon, polystyrene, etc., as well as types of impregnants are used as required to obtain the tiniest capacitor compatible with the overall specification characteristics required.

Miniatures and subminiatures are available in all capacities from 0.1-mmf to 500mfd, and in capacity tolerances from 0.1 to 20%. Units are furnished in voltages from 3 to 1000v. Operating temperature ranges are available as specified from —65 to 200°C, without derating. Units have high insulation resistance, low power factor, high Q, moisture resistance, shock resistance, etc.

Capacitors can be supplied cased or uncased, flat or round, in ceramic, metal, or plastic types. Leads can be positioned radially, axially, for plug-in or any other required position. Leads in all types are plastic anchored and cannot be pulled out. Capcon, Inc., Dept. ED, 25 Willett St., New York 2, N. Y.

CIRCLE 54 ON READER-SERVICE CARD

Power Connectors

Meet Amended MIL-C-3767

These miniature armored connectors meet the requirements of the recently amended military specification MIL-C-3767 (Amendment No. 1). The 2-bladed Version, UP120M, and the 3-bladed UP121M conform to the new military standard drawings set forth in MS 91184 and MS 91185 respectively. Equipment manufacturers can therefore specify these components for electronic and electrical equipment referencing the foregoing specs. Plugs are rated for 125-15amp up to 250-10amp, and will accommodate cables from 0.125 to 0.450" diam. The grounding blade on the UP121M is removable. Automatic and Precision Manufacturing Co., Dept. ED. 252 Hawthorne Ave., Yonkers, N. Y.

CIRCLE 55 ON READER-SERVICE CARD

◀ CIRCLE 56 ON READER-SERVICE CARD

Plastic Foam Cores

High Dielectric Constant

Eccofoam Hi Ki combines high dielectric constant and low weight for microwave lens systems, antennas, and the cores in sandwich type radomes. The material has an extremely low dissipation factor and is usable from —65 to 275°F. It is presently available as sheet stock which can be machined readily, or as custom molded shapes of exact dimensions. Dielectric constant for density of 5 lbs/cu ft is 1.1 to 4.0. For 10 lbs/cu ft, it is 1.2 to 7.0. Emerson & Cumming, Inc., Dept. ED, 869 Washington St., Canton, Mass.

CIRCLE 58 ON READER-SERVICE CARD

Behind Panel Meter

Features Large Scale

A new plexi-covered indicating instrument with a 6″ x 2-1/2″ dial face is especially useful where rapid, accurate readings must be made from a distance or where several scales must be combined in one instrument. It is designed for mounting behind the equipment panel. The SS56 meter with its 6″ dial arc length is available as a moving coil premanent magnet type in all d-c ranges; nominal 2% accuracy. Although the plexiglass cover allows for exterior or edge lighting, the SS56 is also supplied with provision for internal scale illumination. Marion Electrical Instrument Co., Dept. ED, Manchester, N. H.

CIRCLE 59 ON READER-SERVICE CARD

Synchronous Motor

Has High Torque

This low-priced 430 series reversible synchronous motor measures only 2″ x 2″ x 2″ in overall dimensions. It develops an exceptionally high starting and synchronous torque. Torque is 5in-pounds at 1rpm at rated voltage of 115v. Speed range is from 1800-rpm to 10rph. Bristol Motor Div., Vocaline Co. of America, Inc., Dept. ED, Old Saybrook, Conn.

CIRCLE 60 ON READER-SERVICE CARD

CIRCLE 61 ON READER-SERVICE CARD ➤

Wafer Cell

Gives High Power in Small Space

This "wafer cell" is designed to make possible a 30% increase in battery power and life, while eliminating traditional hand operations from cell manufacturing. It consists of a sandwich of artificial manganese dioxide mix between tiny disks of flat zinc and carbon electrodes. The carbon rod of round cell batteries has been replaced by a small piece of conductive carbon, and the whole sandwich is wrapped in an airtight pliofilm envelope and heat healed. Welded or soldered wire connections between cells are eliminated by the use of silver wax; a dab of wax on the positive and negative sides of the cell permits the cells to be connected in series merely by being stacked in a column.

A 2" battery made from 13 cells in a single column develops 22-1/2v. Multiple cell stacks enable this firm to produce miniature high-voltage batteries for heavy-duty electronic applications. The U200 battery for example, provides over 300v in less than 20 cu in. Burgess Battery Co., Dept. ED, Freeport, Ill.

CIRCLE 63 ON READER-SERVICE CARD FOR MORE INFORMATION

Timing Receiver

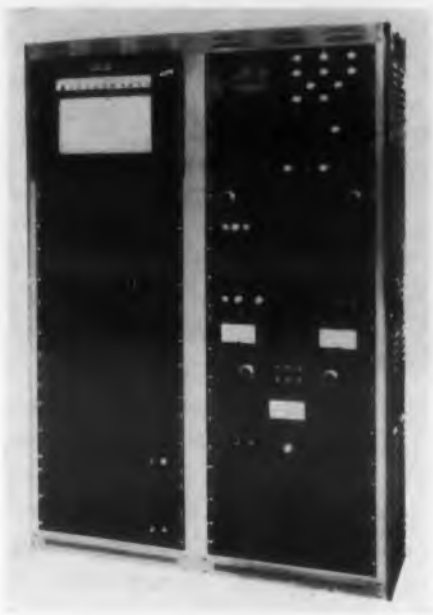
For Missile Test Instrumentation

Designed especially for missile and aircraft test range instrumentation, the Model 2 "PCM" Timing Receiver is a highly sensitive, low-noise figure superheterodyne designed for reception of pulsed signals in the 152-174Mc range. It accepts and reproduces pulses from 1-20μsec long. The receiver noise figure is 6db to 7db, and band width is 1Mc. This receiver is designed to operate completely unattended. Its fully automatic gain control, which maintains essentially constant output with input signals whose levels vary from 5μv to 10,000μv, and its frequency stability of ±0.005 percent, make manual adjustments unnecessary. It mounts in a standard 19" relay rack, and is 10-1/2" high. It requires a power supply delivering 100ma, 200v regulated d-c, and 6.3v a-c. West Coast Electronics Co., Dept. ED, 5873 Jefferson Blvd., Los Angeles, Calif.

CIRCLE 64 ON READER-SERVICE CARD FOR MORE INFORMATION

Pulse Height Analyzers

With 0.2% Linearity



Two pulse height analyzers, Models 3300 and 3301, are of 100 and 256 channels counting capacity and use magnetic core memory circuits. They are based on the Argonne National Laboratory Model 101 design. Rates of accumulation of data may exceed 1,000,000-cpm, and input pulse rates of as much as 10 times this rate of actual accumulation can be tolerated without distortion of the spectrum.

Data accumulation is in the decimal mode, and permanent readout is by decimal printer and/or precision linear graphical form by means of a Brown recording potentiometer. Even during the accumulation of data, the content of the memory is displayed in the form of an accurate linear plot of counts versus pulse amplitude on a cathode ray tube. This curve "grows" during the measurement interval.

Several different modes of operation of the analyzer are available, such as: in coincidence with the output of a separate single channel analyzer, or with a "window" effect to permit placement of all the channels into any region of the complete spectrum. Overall linearity is 0.2%. Radiation Instrument Development Laboratory, Dept. ED, 2337 W. 67th St., Chicago 36, Ill.

CIRCLE 65 ON READER-SERVICE CARD FOR MORE INFORMATION

Selenium Rectifiers

With Vacuum-Processed Plates

Two series of high-current low-voltage power rectifiers have been added to this firm's line. Designated as "XX" and "Z", they are available in 26v a-c ratings. The "XX" cells measure 6" x 10" and are rated at 10amp d-c in single-phase half-wave and double half-wave circuits, or at 20amp d-c, single-phase bridge or single-phase center-tap circuits. Type "Z" cell's rating (and length) is about +30% greater. Bradley Laboratories, Inc., Dept. ED, New Haven, Conn.

CIRCLE 66 ON READER-SERVICE CARD FOR MORE INFORMATION

Vibrators

Withstands to 120g

Series 1600 and 1600g subminiature vibrators are 8-contact, 400cy units designed for either interrupter or self-rectifying (synchronous) operation. They are housed in cylindrical cases measuring 5/8" diam x 1-1/2" long, exclusive of prongs. The plug-in base fits a standard seven-pin miniature socket.

The Series 1600g vibrator has been specifically designed for operation under severe vibration, shock, and sustained acceleration such as encountered in missiles and other airborne devices. The total weight of its moving system is 8 milligrams. On the other hand, the force on the contacts when fully engaged is 250 grams. It shows no appreciable unbalance at a sustained acceleration at 50g, even along its most sensitive plane. It is expected that the amount of unbalance along this sensitive plane at an acceleration of 120g sustained will be low enough to permit normal operation. It can be driven at full amplitude with 450mw.

The Series 1600 vibrator is for use in the commercial field. Its high frequency and low driving power make possible the design of miniature power supplies for compact portable devices, such as electronic flash units, Geiger counters, walkie-talkies, etc. Vibration Research Laboratories, Inc., Dept. ED, 97 Lake Ave., Tuckahoe, N. Y.

CIRCLE 69 ON READER-SERVICE CARD FOR MORE INFORMATION

Alligator Clip

Only 1-1/16" Long

"Mini-gator" clips are only 1-1/16" long, with a nose of 11/64"OD and a weight of 1/20 oz. They are manufactured in both steel (cadmium plated) and solid copper. One piece insulators are available in both red and black. The vinyl plastisol insulators fit skin-tight, do not materially increase the clip's size, and cover it down to the nose to completely prevent shorts and shocks. Mueller Electric Co., Dept. ED, 1580H E. 31st St., Cleveland 14, Ohio.

CIRCLE 70 ON READER-SERVICE CARD FOR MORE INFORMATION

Moving Coil Forms

With Tolerances to ±0.001"

This line of moving coil forms for the instrument and electronics industries is produced by a new method which virtually eliminates cracked corners, incorrect temper, and failure to hold tolerances. The forms are available in aluminum alloy (25, 35, and 525) and in copper, with tolerances to ±0.001" and walls down to 0.003". Size range is from 5/8" OD down to smallest practicable (dimension refers to OD of tubing from which forms are made). Uniform Tubes, Inc., Dept. ED, Level Rd., Collegeville 2, Pa.

CIRCLE 71 ON READER-SERVICE CARD FOR MORE INFORMATION

Voltage-to-Digits Converter

5 Readings per sec

This compact analog-to-digital converter called the Type P Digi-Coder—converts any process variable that can be represented by an electrical signal into a form suitable for directly operating electric typewriters, digital printers, tape or card punches, lamp banks, or for initiating process control.

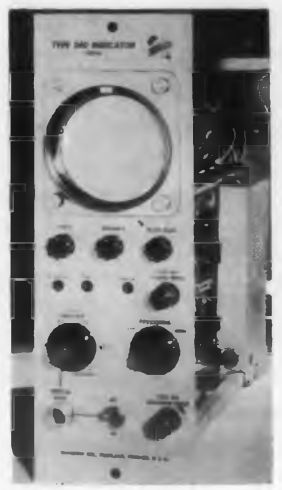
High speed, as many as five readings a second, plus high accuracy, ±0.15% full scale on all readings, makes the unit a versatile building block for data reduction and automatic control. It couples a self-balancing potentiometer to this company's Digi-Coder.

D-c input signals are amplified by a d-c chopper-type amplifier and then fed to a null-balance potentiometer. The potentiometer servo mechanism supplies discrete shaft positions to the Digi-Coder section of the device. The output can be in decimal, binary, binary-decimal, teletype or any special digital code. In addition to coded output, visual readout is provided by dial pointer on a calibrated circular scale. The electrical analog input voltage span may be any d-c signal varying between 0-1mv up to 0-1v d-c. A 1sec full scale potentiometer is normally employed depending on the length of scale travel between readings, readouts at rates up to 5 per sec are possible. Fisher & Porter, Dept. ED, Hatboro 35, Pa.

CIRCLE 72 ON READER-SERVICE CARD FOR MORE INFORMATION

Monitoring Indicator

Can Replace Bulky Oscilloscopes



The Type 360 Indicator contains a 3" flat-faced cathode-ray tube, accelerating-voltage supply, vertical amplifier with a sensitivity of 0.05v/div, and a calibrated vertical attenuator.

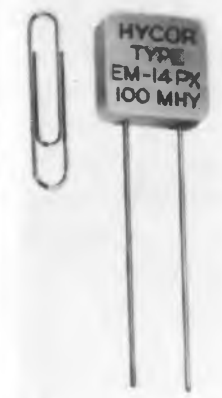
It can be operated from any source of the proper voltages and waveforms, although it was designed to work with the company's power supply and waveform generator.

A type 360 can take the place of a bulkier oscilloscope in single monitoring applications, or several can be used along with other instruments as building block in complex sequence-control and monitoring systems. Features include: d-c to 500kc vertical-amplifier passband; four calibrated sensitivities from 50mv/div to 50v/div, with a 10:1 attenuator for continuously variable sensitivities from 50mv/div to 500mv/div. A horizontal gain control permits sweep calibration. Adapted to rack mounting, the unit has a weight of only 9 lb. Tektronix, Inc., Dept. ED, P. O. Box 831, Portland 7, Ore.

CIRCLE 151 ON READER-SERVICE CARD FOR MORE INFORMATION

Toroid Coil

For Printed Circuits



This "Postage Stamp" Toroid Coil configuration was designed specifically for use in printed circuitry. Its tinned No. 20 AWG wire leads are spaced in accordance with the standards recently proposed the RETMA Automation Committee.

The unit consists of a subminiature molybdenum permalloy toroid core with a winding having a residual hole as small as 1/16" diam. Windings are impregnated with a special compound, and the finished coil is encased in a tough epoxy plastic. Overall dimensions are: 13/16" x 13/16" x 3/8" thick. It is available in any inductance up to 1hy. The useful frequency range covers 1500cy to 150kc, dependent upon inductance value. The unit is capable of withstanding temperatures from −55° to +125°C, plus extreme environmental conditions. Hycor Co., Inc., Dept. ED, 11423 Vanowen St., North Hollywood, Calif.

CIRCLE 152 ON READER-SERVICE CARD FOR MORE INFORMATION

Portable Power Supply

Regulated, Lightweight Unit

The 302C is a regulated, portable, low-cost power supply. With a weight of only 12 lb, it features excellent regulation over a wide voltage range with less than 3mv ripple. A dual-scale meter, stand-by switch, pilot light, and fuse protection are standard accessories. Extra power, over 400v at 90ma, can be obtained for intermittent periods. To double voltage output, two units may be operated in series, or any number may be paralleled to increase current capacity. A separate bias output is also provided. Recovery time is better than 15-millisec.

Three outputs may be obtained: 0-350v d-c at 80ma, continuously variable, with regulation less than ±0.05%; 0-150v d-c at 5ma, continuously variable, regulation less than ±1%; or 6.3v a-c at 5amp, unregulated, center-tapped. Input is 105-125v 50-60cy 150w max. Allied Engineering Div., Allied International, Inc., Dept. ED, South Norwalk, Conn.

CIRCLE 139 ON READER-SERVICE CARD FOR MORE INFORMATION

Tubular Capacitors

For Printed Circuits

Type 89P "Autocon" one-ended case solid dielectric paper tubular capacitors are designed for printed wiring board assemblies. They are enclosed in a pre molded cylindrical shell of non-flammable thermosetting plastic with the capacitor section securely sealed against the entrance of moisture by a plastic resin end seal bonded to the phenolic housing. The two short, straight leads which issue from the end seal are held at a closely controlled distance from each other.

An index key molded in the phenolic housing adjacent to the outside foil lead facilitates identification of the lead for automatic insertion by machinery or hand operators. In addition, three stand-off feet raise the end seal and shell proper above the printed wiring board, avoiding moisture and dust traps. The feet also permit the use of double-sided wiring boards without causing low resistance shorts between top-side conductors through accumulated dust around the circumference of the capacitor. Sprague Electric Co., Dept. ED, 347 Marshall St., North Adams, Mass.

CIRCLE 140 ON READER-SERVICE CARD FOR MORE INFORMATION

Transducer

Pressure-to-Frequency Type

Series P400 Pressure-to-Frequency Transducers are manufactured in absolute (illustrated), differential, or gage types for measuring pressure in non-corrosive liquids and gasses. The P400 incorporates a temperature controlled variable inductance pressure pickup and an FM oscillator mounted together in the same case.

Mechanical displacement of a diaphragm by the applied pressure produces a proportional inductance in a closely spaced coil-core structure. This inductance change is then converted to proportional frequency by the FM oscillator contained in the transducer and is supplied at constant amplitude across the output terminals. The variable inductance pickup is housed in a small oven which is thermostatically controlled. The Series P400 were specifically designed to be used with standard FM/FM telemetering equipment. They can be supplied on any standard subcarrier frequency between 1.7kc to 70kc, and with deviations at ±7-1/2% or ±15%. Datran Engineering Corp., Dept. ED, 3613 Aviation Blvd., Manhattan Beach, Calif.

CIRCLE 81 ON READER-SERVICE CARD FOR MORE INFORMATION

Frequency Meters

Accurate to ± 1/4cy

The "Arga" Expanded-Scale Frequency Meter is for fast, accurate monitoring of frequency. Offered in two models, it was designed originally for making production inspection measurements on the frequency regulation of motor and engine-driven generating units, but has found many other applications, particularly where a permanent record of frequency is required.

Input voltage harmonics of 5%, or changes in input voltage of ±10%, will not cause errors in frequency indication greater than ±1/2cy for the Model 401, or 1/4cy for the Model 601. The Model 401 has a base frequency of 400cy, and a span of ±25cy. The Model 601 has a base frequency of 60cy, and a span of ±5cy. Shasta Div., Beckman Instruments, Inc., Dept. ED, P. O. Box 296, Station A, Richmond, Calif.

CIRCLE 82 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature Axial Blowers

In A-C and D-C Models

This firm offers miniature axial blowers for 60cy, 400cy, or d-c. They consist of a motor and a die-cast aluminum fan mounted in a die-cast aluminum housing. Special provisions can be made so that the a-c blower will meet the radio noise requirement of MIL-I-6181. The housing on all blowers provides environmental protection to MIL specs.

These blowers are available with air flow in either direction and also for operation on other frequencies. A high-speed version (up to 50cfm) is available where long life requirements are not of essence. Globe Industries, Inc., Dept. ED, 1784 Stanley Ave., Dayton 4, Ohio.

CIRCLE 83 ON READER-SERVICE CARD FOR MORE INFORMATION

TW Tube Amplifier

With 2-8kMc Ranges

The Model 25 Traveling Wave Tube Amplifier permits 2-4kMc or 4-8kMc operation with two readily interchangeable TW tubes. The gain over both bands is at least 30db, and the maximum power output is at least 10mw. Noise figure is typically 25db.

Provision is made for both amplitude and phase modulation of the unit from external sources. R-f outputs ranging from square waves to fractional microsecond pulses may be achieved with appropriate modulating waveforms of modest amplitude. Similarly, phase modulation over bandwidths of several tens of megacycles is readily accomplished. If desired, both types of modulation may be applied simultaneously.

Input requirements are 105-125v, 50-1000cy. Dimensions are 4-7/8" x 7-5/8" x 19-9/16" deep, and weight is 35 lb. Provision is made for mounting in an A1-D shock tray for mobile or airborne use. Westlabs, Inc., Dept. ED, P. O. Box 1111, Palo Alto, Calif.

CIRCLE 84 ON READER-SERVICE CARD FOR MORE INFORMATION

Cold Punching Laminate

For Printed Circuit Boards

An electrical grade phenolic laminated plastic, Grade XXXP-471 Phenolite, which can be punched at room temperature is particularly suited for copper clad printed circuits where automatic processes require close registration of punched mounting holes. Permitting punching at temperatures as low as 68°F, the new grade assures precise dimensions of holes and hole spacings as no distortion from heating arises.

The cold punching laminate is available in the same thickness range, tolerance, and sheet sizes as the company's other XXXP grades. Its properties of high insulation resistance and low electrical losses, match or exceed values of these properties for the company's hot punching grades. Also, copper clad bond strength and hot solder dip properties of the new product are comparable to other copper clad grades in the line. National Vulcanized Fibre Co., Dept. ED, 1055 Beech St., Wilmington 99, Del.

CIRCLE 112 ON READER-SERVICE CARD

Deposited-Carbon Resistors

Used in Matched Pairs

Pure crystalline carbon is deposited on a ceramic insulator by a patented method of thermal decomposition of a hydro-carbon. Higher resistance values are attained by spiral-cutting through the coating. The resistance element is protected either by multiple layers of insulating, moisture-resistant varnishes separately baked on, or by hermetic sealing in an impervious steatite shell. On special order, a plated brass shell with glass end-seals can be provided.

"Fixtohm" resistors meet standard tolerances of ±5% and down to 1%. They are extremely stable, small, and reproducible, with excellent high-frequency characteristics and negative temperature coefficient. Campbell Industries, Inc., Dept. ED, 3806 St. Elmo Sta., Chattanooga 9, Tenn.

CIRCLE 113 ON READER-SERVICE CARD

◀ CIRCLE 114 ON READER-SERVICE CARD

Magnetic Storage Matrix

In Kit Form for Mock-Ups

These components for magnetic storage system mock-ups include a complete set of all of the magnetic elements including driver transformers, matrix switches, and the actual matrices to mock up several different circuit arrangements for evaluation.

Also introduced in this set of storage elements is the M16X16X4-1 storage array which in conjunction with the MS16X16-Si matrix switch is an entirely new arrangement of a digital magnetic storage system. In this system only the selected cores of the particular word being interrogated are disturbed by the readout current pulse. This gives essentially noise-free operation. Valor Electronic Components Co., Dept. ED, 5808 Marilyn Ave., Culver City, Calif.

CIRCLE 115 ON READER-SERVICE CARD

Parabolic Antennas

Made From Spun Aluminum

An economy line of spun aluminum type parabolic antennas for the 890-960 and 1700-2110Mc ranges in 2, 4, and 6′ sizes is available from this company. They feature highly efficient dipole feed, mounted and adjustable to either horizontal or vertical polarization from the rear of the parabola. Gain, beamwidth, and patterns are identical to those data previously published for spun dishes of the same diameter. Prodelin Inc., Dept. ED, 307 Bergen Ave., Kearny, N. J.

CIRCLE 116 ON READER-SERVICE CARD

High-Q Ferrite

For Rod Antennas

This high-Q ferrite, designated as "M" material, is the answer to most antenna rod problems. The magnetic properties of this material are initial permeability at 1Mc of 125; maximum permeability of 450; saturated flux density of 3300, and a residual magnetism of 1050. National Moldite Co., Dept. ED, Hillside, N. J.

CIRCLE 117 ON READER-SERVICE CARD

CIRCLE 118 ON READER-SERVICE CARD ➤

Battery-operated VTVM

Covers 20cy to 1 Mc

The Model D-21 is a portable voltmeter covering frequencies from 20cy to 1Mc. Battery powered, it is contained in a 5″ high plastic case and weighs only 30 oz complete. It offers stability at all operating temperatures from 0° to 120°F. Accuracy is ±5%. It is designed specifically for measurements where a-c is not available, or where use of battery-powered equipment is more convenient.

The D-21 is transistorized, and has printed circuits for maximum reggedness, dependability, and uniformity. Peak sensitivity is 0 to 1mv and any of 12 decade (10db) ranges may be switched on the front panel. A 10 megohm input impedance on all ranges prevents disturbances to circuits under test. The front panel meter reads direct in db from −20bd to +2db, or volts from 0 to 1v or 0 to 3v (voltage calibration is linear). Output terminals are provided for use with monitoring devices having input impedances of 10,000 ohms and higher. Alto Scientific Co., Dept. ED, 855 Commercial St., Palo Alto, Calif.

CIRCLE 94 ON READER-SERVICE CARD FOR MORE INFORMATION

Delay Line

For Color TV

An inexpensive, distributed-constant delay line, the Type T30036 is designed for use as a compensating delay in the luminance channel of color TV receivers. It has a high impedance of 4300 ohms and uniform response to 4Mc. Phase characteristics also are linear within 5%. Total delay is 0.8μsec, and rise time is only 0.1μsec.

The unit is enclosed in an aluminum can 1-3/8″ square x 3-1/8″ high, exclusive of terminals. Modifications can be made for quantity users. Shalleross Manufacturing Co., Dept. ED, Collingdale, Pa.

CIRCLE 95 ON READER-SERVICE CARD FOR MORE INFORMATION

Band-Pass Filters

With Wide Adjustability

These variable electronic band-pass filters have a gain of unity in the pass band; gain drops outside the pass band at a rate of 24db/octave. The use of peaking reduces the attenuation at the corner frequencies by 8db and permits a band width as narrow as one octave without attenuation in the center of the pass band.

Both the high and low cut-off frequencies are independently adjustable from 0.02-2000cy in the 330-A and from 0.2-20,000cy in the 330-M. This provides maximum flexibility of adjustment of both the band center frequency and the band width. By using two electronically regulated supplies, the internal hum and noise is reduced to less than 100μw in both units. Calibration accuracy is $\pm 5\%$. Size is 17" x 8" x 12" overall. Krohn-Hite Instrument Co., Dept. ED, 580 Massachusetts Ave., Cambridge 39, Mass.

CIRCLE 96 ON READER-SERVICE CARD FOR MORE INFORMATION

Preamplifier

Trims Pickup Outputs

The Model 2614 is a probe-type preamplifier for use with piezoelectric pickups which permits the user to "trim" the self-generating pickup output sensitivity to an even or "standard" value so that direct reading of physical parameters such as acceleration, force, and pressure is possible with standard vacuum tube voltmeters. An input selector switch gives a choice of three input conditions: 1000 megohms for use with this company's vibration pickups, extending the low frequency range of piezoelectric pickups to 2cy; 1000 megohms with d-c isolation for general uses; and 22 megohms for special shock pickups, and fast recovery from overloads. Amplifier gains of 1, 3, and 10, with stability of 1% or better, a frequency response from 2cy to 15,000cy, and an output of 5v into 2500 ohms (source impedance 50 ohms), make this unit valuable for all measuring installations and convert standard vacuum tube voltmeters into direct-reading meters. Size is only 2-1/2" x 5-1/8" x 1-5/8". Endevco Corp., Dept. ED, 180 E. California St., Pasadena, Calif.

CIRCLE 97 ON READER-SERVICE CARD FOR MORE INFORMATION

TRU-OHM NEWS

TRU-OHM PRODUCTS, *division of Model Engineering & Mfg. Co., Inc., General Sales Office: 2800 N. Milwaukee Ave., Chicago 18, Ill.*

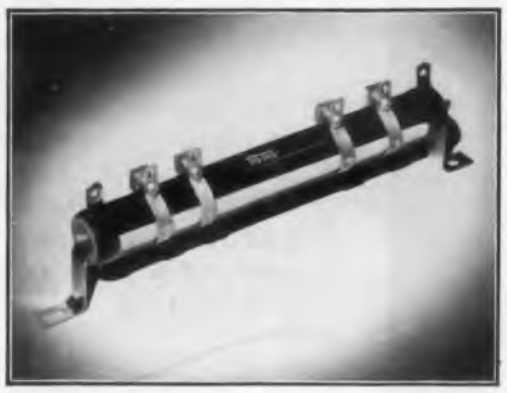
Vol. 80,000,000 1955-56 No. 80,000,000

80 MILLION SOLD!

TRU-OHM is Now the World's Largest Producer of Wire-Wound Resistors!

Special size resistors: Tru-Ohm's highly skilled factory trained technicians turn out large varieties of special resistors. Complete data of these special size resistors is available.

Chicago . . . From Tru-Ohm's general sales office. Since starting just a few short years ago, TRU-OHM PRODUCTS has grown phenomenally to ten times its original capacity. Having just produced its 80,000,000th wire-wound resistor, Tru-Ohm is now the world's largest growing and largest producers of wire-wound resistors.



Resistor No. 80,000,000. One of many wire-wound resistors which are turned out by the thousands daily.

Complete line of power rheostats . . . of finest quality with UL approval; variety from 25 watts up.

High Quality, Speedy Delivery Sets Record

Over 50,000 square feet of the most modern manufacturing facilities, including a brand new furnace, enable volume production . . . assure faster delivery, finer quality, better prices. And TRU-OHM EXPEDITES FOR YOU . . . ships on time.

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For Original Equipment or Replacement Needs

A complete line of resistors as well as a complete line of power rheostats are now produced for the finest industrial manufacturers in the world . . . for replacement applications . . . sold through parts jobbers.

CIRCLE 99 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Supply

For Transistor Work

This compact d-c power supply is especially engineered to power resistors, and is also used in designing transistor circuits and in development work on transistors. It is a closely regulated, dual-voltage supply, with both outputs contained in a single chassis suitable for rack mounting or bench use. Cabinet size is 5-1/4" x 19" x 14" deep.

Each output supplies 0-100v d-c continuously variable (without switching), and 0-100ma maximum. No derating of output current is necessary. Voltage is adjustable to 1/10v variations by means of "Helipots" equipped with "Duodials". Ripple is below 1.5mv rms for any voltage or load within the ratings. Recovery time, 0 to full load, is 0.5millisec; full load to removal, 0.25millisec. Drift, after 1-hour stabilization time, is less than 0.1% in an 8-hour period. Dressen-Barnes Corp., Dept. ED, 250 N. Vinedo Ave., Pasadena 8, Calif.

CIRCLE 100 ON READER-SERVICE CARD FOR MORE INFORMATION

Electrolytic Capacitors

For Transistor Circuitry

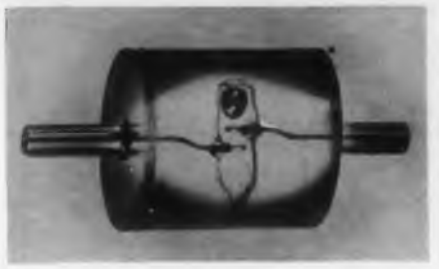
These tiny hermetically-sealed aluminum electrolytic capacitors, known as "Lyttl-Lytics", are designed as moderately priced highly reliable units. They are valuable for use in transistorized pocket radio receivers, wireless microphones, personal style wire recorders, and similar equipment. Ultra-low leakage current assures minimum drain and long battery life when the capacitors are used in filtering applications across a battery.

The units are available in a wide range of ratings from 1mfd to 110mfd and in standard working d-c voltages of 1, 3, 6, 10, 12, and 15v. Sizes range from 3/16" diam x 1/2", to 3/8" diam x 3/4". Their construction lends itself to mechanized assembly on printed wiring boards. Maximum operating temperature is 65°C. Sprague Electric Co., Dept. ED, 347 Marshall St., North Adams, Mass.

CIRCLE 101 ON READER-SERVICE CARD FOR MORE INFORMATION

Mercury Switch

Produces Pulse Action



In this pulse switch, establishment of a temporary contact as the mercury flows past the electrodes is simplified by mounting the glass part within a sturdy cartridge. An instantaneous pulse of many amperes is provided. Metallic contact rods protrude concentrically on both sides of the cartridge, and serve both as conductors of electricity as well as the means by which the switch is supported between uprights. They also make possible simple mechanical rotation of the cartridge.

The pulse switch can be turned, tilted or driven by a motor or other means of rotation, whereby electrical contact is established for one pulse every 180°. The rate of fall of the mercury droplet can be influenced to some extent by tilting the axis of rotation.

The unit has many uses in electro-magnetic counters and other relay-operated devices, flashing aircraft beacons, and as a negative speed-governor. Tensitron, Inc., Dept. ED, Harvard, Mass.

CIRCLE 102 ON READER-SERVICE CARD FOR MORE INFORMATION

Log Count Rate Meter

Covers Four Cycles

The Model 500 Log Count Rate Meter offers the wide range and reading accuracy of a logarithmic device with the stability and precision of a linear rate meter. Its principal applications counting, reactor control, continuous sampling, area monitoring, and in other situations where wide range pulse counting is required.

The log function is generated only by R-C elements eliminating the need for tube selection. Accuracy of the unit is ±3% over the entire meter deflection range, with stability ranging from 1% for 1 hour to 8% for 24 hours. For maximum reading accuracy a 1% long scale meter is employed and provision is made for the use of an external recorder. Input sensitivity is 0.25 volts, negative. The standard instrument has a range of 1 to 10,000 counts per minute in four cycles, but the unit can also be supplied with any full range from one to five decades. Operation is from a 117 volt, 60 cycle supply and consumes 100 watts. Devtron Engineering Associates, Dept. ED, 1 Winslow St., Redwood City, Calif.

CIRCLE 103 ON READER-SERVICE CARD FOR MORE INFORMATION

Bridge Balance

Connects Pickups and Recorders

This four-channel bridge balance, the Type 8-110, is designed to provide a control link between resistive-bridge transducers and recording or indicating devices such as direct-writing or photographic oscillographs, chart recorders, analog-to-digital conversion systems, and ordinary meters. It is for use in direct recording of the output of a wide variety of pickups without the use of amplifiers.

The unit can be "stacked" with this firm's 5-117 Recording Oscillograph, or with other 8-110 units. Up to four 120 ohm to 350 ohm strain-gage bridges or strain-gage-type pickups may be connected to the instrument. Voltage across each bridge can be adjusted individually and continuously from the level of the supply voltage, 20.0v d-c max, down to 0v. Consolidated Engineering Corp., Dept. ED, 300 N. Sierra Medre Villa, Pasadena, Calif.

CIRCLE 106 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Supply

Miniature Tubeless Unit

A miniature, encapsulated power supply that contains no vacuum tubes and is capable of withstanding the most stringent military environmental specifications, the Model CP is only 2-5/8" x 3-1/16" x 4-1/4" long. Originally designed for this firm's line of miniature vacuum tube voltmeters, it is finding use with packages of one to three-stage tube circuits.

The supply operates from a 115v, 60cy or 400cy line, and provides two unregulated outputs: 150v d-c at 6ma as a plate supply, and 6.3v a-c (center-tapped) at 0.6amp as a filament supply. Ripple is kept below 1mv at 400cy, and 5mv at 60cy. The case is completely isolated from all the circuit terminals. Trio Laboratories, Inc., Dept. ED, 3293 Seaford Ave., Wantagh, L. I., N. Y.

CIRCLE 107 ON READER-SERVICE CARD FOR MORE INFORMATION

When the gun failed, they used a tablespoon

HE LEARNED acting the hard way, barnstorming frontier towns by barge and stagecoach.

Once a Texan even suggested the troupe tour through Indian country, carrying their stage weapons for protection. Joe Jefferson declined. He said he shivered when he imagined himself facing a hostile Indian and armed only with a stage pistol whose tendency to misfire had several times "compelled our heavy villain to commit suicide with a tablespoon."

By the 1860's, Jefferson was America's favorite actor. They loved him everywhere for his genius at making people happy. And his sunny outlook still sparkles in the spirit of America. Like Jefferson, Americans still know how to travel a hard road and smile when the going's roughest.

These confident Americans are the real wealth of our nation—the real reason why our country's Savings Bonds rank among the world's finest investments.

That's why, to save for *your* goals in life, you cannot find a surer, safer way than United States Savings Bonds. Invest in them regularly and hold onto them!

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It's actually easy to save money—when you buy United States Series E Savings Bonds through the automatic Payroll Savings Plan where you work! You just sign an application at your pay office; after that your saving is done *for* you. And the Bonds you receive will pay you interest at the rate of 3% per year, compounded semiannually, for as long as 19 years and 8 months! Sign up today!

Safe as America—U.S. Savings Bonds

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D-C Servo Motor

For Aircraft Applications

The miniature d-c servo motor 5BBY13DJ7 is capable of withstanding a high potential of 1500v and of responding to field currents of 0.0075amp. Suited for aircraft applications on blowers, actuators, tuners, and similar devices, the motor will operate equally well at sea level or at 50,000′ and within temperature limits of −65° to 165°F. It is also used as a prime mover in gun direction computer systems, electronic devices, and can be modified for other aircraft and missile applications.

Weighing less than 8 oz, the motor may be wound as a straight shunt machine when required. It is reversed by a small, dpdt relay. The motor draws maximum armature current of 0.8amp from a 28v line. It is rated 0.002hp at 6500rpm, and can be geared to speeds as low as 130rpm. General Electric Co., Specialty Component Motor Dept. ED, Schenectady 5, N. Y.

CIRCLE 109 ON READER-SERVICE CARD FOR MORE INFORMATION

Limit Switch

Can Control Two Circuits

The 1LS1 is a small-size, heavy-duty limit switch designed for control of two independent circuits. It features sealed construction and high electrical capacity, plus adjustability.

The switch has a roller-arm actuator which can be field-adjusted through 360° with positive locking in any position. Actuation can be clockwise, counter-clockwise, or in both directions. The actuator head may be removed in the field and faced at any of four positions at 90° angles. Contact arrangement is two-circuit, double break.

Electrical rating of the unit is 10amp at 120v, 240v, or 480v a-c; pilot duty rating is 0.2amp at 115v d-c, 0.1amp at 230v d-c, and 0.04amp at 550v d-c. Operating force is 3 lb max, full overtravel force is 6 lb max, and release force is 1/2 lb min. Pretravel is 20° max, differential travel is 12° max, overtravel is 30° min. Micro Switch, Dept. ED, Freeport, Ill.

CIRCLE 110 ON READER-SERVICE CARD FOR MORE INFORMATION

Eccosorb CH

Microwave Absorber for Darkrooms

Microwave Darkroom with Emerson & Cuming Luneberg Lens under test

Eccosorb CH is a series of broadband absorbers reflecting less than 2% of the energy incident upon its surface. It is composed of enmeshed, rubberized fibers and made in sheets 2 feet by 2 feet in various thicknesses. Eccosorb CH is light weight and flexible. It is easily mounted and its natural, white surface color gives good light reflection.

Free Space Rooms are easily and economically built for indoor antenna measurements. Reflections are eliminated for all practical purposes. You can build your own microwave dark room or **we offer you a complete Free Space Room ready to use.** Emerson & Cuming engineers design and build special types for unusual conditions. Send us your specifications.

Another absorber, ECCOSORB HF comes in rods, sheets or molded shapes in several volume resistivities for waveguide terminations and similar uses. If you have a problem write for information on . . .

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- ELECTRONIC EMBEDMENTS
- CASTING RESINS
- LOW LOSS ROD AND SHEET STOCK
- MICROWAVE ABSORBERS

CIRCLE 111 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Supply Test Set

Has Load Modulator and Recorder

This Power Supply Test Set includes the Model 901 Power Supply Regulation Analyzer, the Model 910 Power Supply Variable Load, the Model 920 Line Voltage Adjuster, and a recording potentiometer. These units are available separately.

The regulation analyzer measures applied d-c voltage, percentage change, and rms ripple on the applied d-c voltage of regulated and unregulated power sources. The voltage test range is 1.018v to 1112v. Three ranges are provided for measuring percent regulation from 0.002% to 10%. Eleven ranges for measuring rms ripple are provided.

The variable load consists of an electronic load and a resistor load, covering 0-600v, 0-600ma. Provision is made for automatically modulating either the resistor load or the electronic load 10sec on and 10sec off. The line voltage adjuster provides for adjusting the line voltage for any fixed input voltage in the range 95v to 135v. The recording potentiometer is included for measuring regulation and stability characteristics. Kepco Laboratories, Dept. ED, 131-38 Sanford Ave., Flushing 55, N. Y.

CIRCLE 86 ON READER-SERVICE CARD FOR MORE INFORMATION

Transformer Unit

A Portable Lab Supply

With three-phase 230-250v 60cy input, this portable laboratory power supply transformer unit has two output ranges: 211-640v 31-amp, in 10v steps, and 100-295v 66amp, in 4v steps. Adjustment is by eight fine steps and eight coarse steps with overlap. Taps are changed on three phases simultaneously. It is designed for continuous duty at the rated output, and includes a heavy-duty 115v cooling fan. Parallel 100amp capacity output jacks are provided. The case measures 13-3/4" x 29" x 42" high. The Strong Electric Corp., Dept. ED, 140 City Park Ave., Toledo 2, Ohio.

CIRCLE 87 ON READER-SERVICE CARD FOR MORE INFORMATION

Trigger Generator

An All-Magnetic Unit

The 414-A, an all-magnetic trigger generator, is engineered to trigger hydrogen thyratrons by using saturable reactors instead of electronic tubes. It is a capacitor-type pulser in which electrical energy is stored through a-c resonant charging, although it operates at a much lower power level. Rapid discharge of the capacitor through the reactors releases pulse powers. Acting as static magnetic switches, the reactors are similar in construction and appearance to transformers. The unit, which replaces approximately four electron tubes, has various applications in commercial radar and laboratory testing, as well as in digital and other computers.

Because it is a line-type pulser using a-c rather than d-c power, its pulse repetition rate is that of the line frequency. Input is 12.5v ±10% 400cy. Output is 200v peak min, 275v peak max, into 500 ohms resistive load. Pulse rise time is 1μsec, 20% to 80% amplitude. Pulse width is 4μsec at 50% amplitude. The simple circuitry is hermetically sealed in a can 1-7/8" x 1-13/16" x 3". Weight is 14 oz. Magnetic Research Corp., Dept. ED, 200-202 Center St., El Segundo, Calif.

CIRCLE 89 ON READER-SERVICE CARD FOR MORE INFORMATION

Deflection Yoke

Controls Spot in CR Tube

This deflection yoke is designed for accurate control of the spot position in a cathode ray tube intended for radar application. It has a linearity accuracy in the azimuth direction of better than 1/4%. Linearity in the range direction is better than 1/2".

In the yoke, orthogonality, or the angle between azimuth and range directions, is held to an accuracy of 1/10°. A cylindrical iron core surrounds the windings for shielding purposes. The entire assembly is pressed into a phenolic cylinder, then completely impregnated and sealed to prevent entrance of moisture. Dimensions are 1-1/2"ID, 3-1/8"OD, and 3-3/4" long. Windings can be made to suit practically any specified requirement. Standard Coil Products Co., Inc., Dept. ED, 2085 N. Hawthorne Ave., Melrose Park, Ill.

CIRCLE 90 ON READER-SERVICE CARD FOR MORE INFORMATION

SERVO MOTOR-GENERATORS FOR EVERY PURPOSE

Kearfott Servo Motor-Generators are characterized by low rotor inertia, low time constants and high stall torque. Motor-Generator combinations provide ½ to 3.1 volts per 1000 R.P.M. with an extremely linear output over a speed range of 0—3600 R.P.M. and useful output up to 10,000 R.P.M.

CHARACTERISTICS				
TYPE	MOTOR		GENERATOR	
	STALL TORQUE	NO LOAD SPEED	OUTPUT FUND. NULL	LINEARITY
DAMPING				
SIZE 10	.35 OZ. IN.	6000	21/1	.5%
SIZE 10	.30 OZ. IN.	8500	23/1	.5%
SIZE 11	.63 OZ. IN.	5900	25/1	.5%
SIZE 15	1.5 OZ. IN.	5000	25/1	.5%
SIZE 18	2.4 OZ. IN.	5000	25/1	.5%
SIZE 18	3.0 OZ. IN.	9600	23/1	.5%
RATE				
SIZE 15	.45 OZ. IN.	10,500	170/1	.5%
SIZE 15	1.5 OZ. IN.	4700	350/1	.2%
SIZE 18	2.4 OZ. IN.	4700	350/1	.2%
SIZE 18	3.0 OZ. IN.	8400	350/1	.2%
*INTEGRATOR				
SIZE 15	.70 OZ. IN.	6300	400/1	.1%
SIZE 15	1.25 OZ. IN.	4500	400/1	.1%
SIZE 18	1.35 OZ. IN.	7200	400/1	.1%
SIZE 18	2.4 OZ. IN.	5200	333/1	.05%
SIZE 18	3.0 OZ. IN.	8000	333/1	.05%

Integrator Tachometers are temperature stabilized

Send for Bulletin describing Servo Motor-Generators of interest to you.

ENGINEERS

Many opportunities in the field of Precision components are open. Write for details today.

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 119 ON READER-SERVICE CARD FOR MORE INFORMATION

Capacitive Probe

Rated 60kv Peak

Model JP-325 High Voltage Probe utilizes a vacuum capacitor voltage divider rated at 60-kv peak. The output of the divider is padded with a ceramic capacitor and is fed into three feet of RG-58 A/U cable so that the overall division ratio is 325:1. The input resistance is above 1012 ohms, and the input capacitance is 4mmfd.

Internal resonances are above 200Mc so that the high frequency response is limited by that of the meter or oscilloscope with which this probe is used. The low frequency response is determined by the input shunt resistance of the measuring instrument. With 10 megohms shunt resistance, the probe will be linear at frequencies down to 60cy. If it is possible to operate directly into the vertical deflection plates of an oscilloscope so that the shunt resistance is above 100 megohms, then the probe frequency response is flat down to 5cy. With this probe it is therefore possible to calibrate an oscilloscope at low frequencies and subsequently use it at frequencies up to 50Mc or with pulses as short as 1μsec without the necessity of recalibration. Jennings Radio Mfg. Corp., Dept. ED, P. O. Box 1278, San Jose, Calif.

CIRCLE 120 ON READER-SERVICE CARD FOR MORE INFORMATION

Wide-Band Amplifier

With Gains of 10 and 100

The Model 854A Amplifier provides a choice of two fixed voltage gains, 10 and 100, over the frequency range of 10cy to 1Mc. It is useable to higher frequencies with some slight sacrifice in uniformity of response ($\pm$1db, 5cy to 2Mc at a gain of 100).

The circuit used introduces distortion of less than 1% when operating into recommended loads. Equivalent input noise is 20μv with gains of 100, and 80μv with gain of 10. Output voltage is a maximum of 10v into a minimum load of 3000 ohms. The input impedance is 1 megohm shunted by approximately 15mmfd. The unit is also available in standard relay rack mounting (3-1/2" x 19"). Shasta Div., Beckman Instruments, Inc., Dept. ED, P. O. Box 296, Station A, Richmond, Calif.

CIRCLE 121 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 122 ON READER-SERVICE CARD

Fluid Epoxy Resin

Has 8 Day Pot Life

Epocast 13 is a new fluid epoxy resin mixed with an appropriate amount of hardener and will have a pot life of eight days, making it particularly useful to assembly operations where numerous pours are to be made. No amine hardeners are employed and the material is relatively toxic-free. Curing temperatures are 200 to 250°F. This economical casting resin is useful for potting and encapsulation of electrical components. It is available in kit quantities, allowing for an easy volumetric resin-hardener mix. Furane Plastics Inc., Dept. ED, 4516 Brazil St., Los Angeles 39, Calif.

CIRCLE 123 ON READER-SERVICE CARD

Mylar-Dielectric Capacitors

Extra-Rugged Types

In the form of metal-cased, glass-sealed, hermetically sealed tubulars, these capacitors utilize Mylar dielectric. Over a million capacitor hours of life test have been analyzed before release of this line. Sizes chosen are the minimum consistent for high dependability and long service life at maximum rated conditions. High insulation resistance, low dielectric absorption, and satisfactory operation at temperatures up to 150°C are included with small size. Aerovox Corp., Dept. ED, New Bedford, Mass.

CIRCLE 124 ON READER-SERVICE CARD

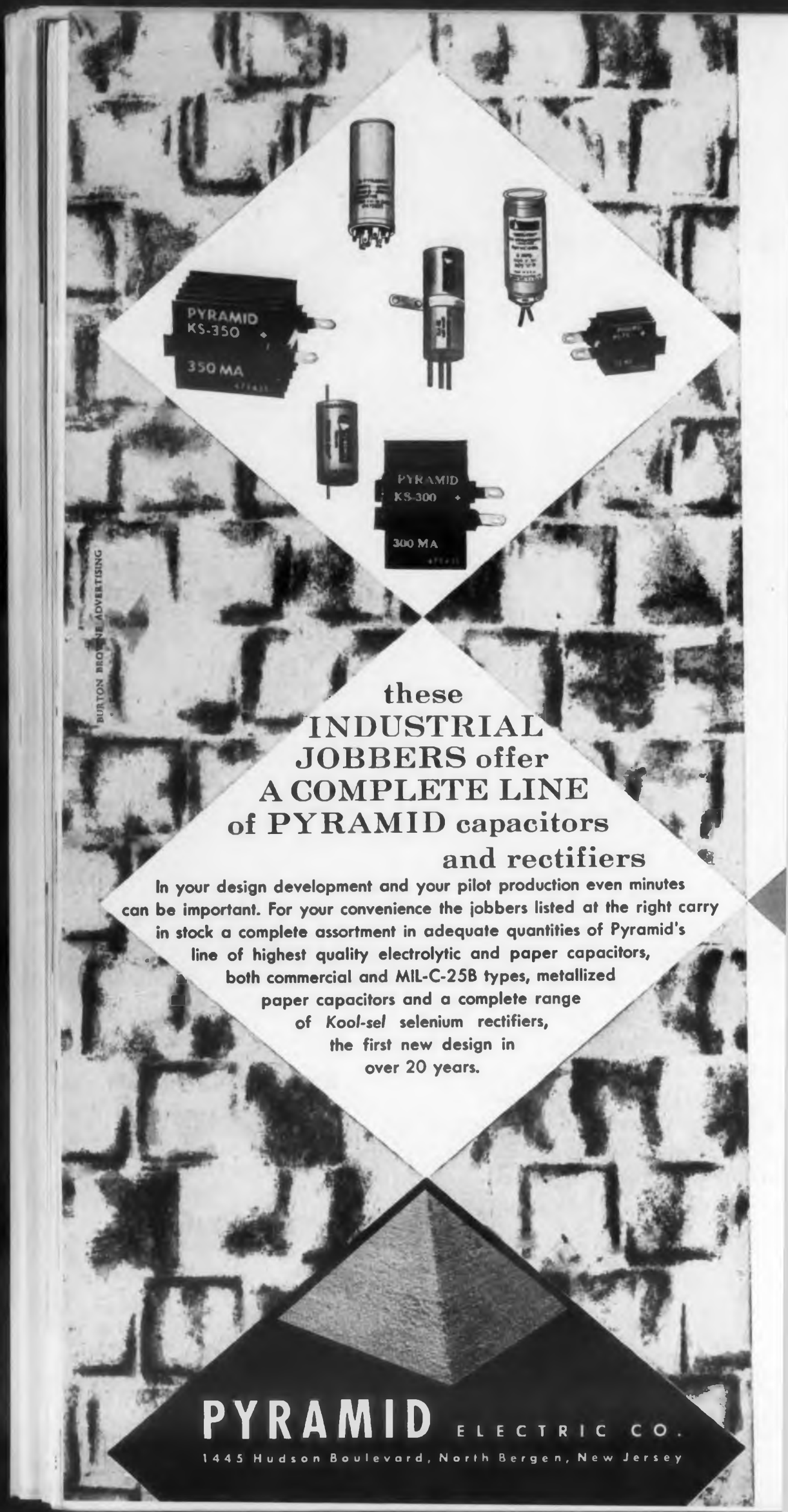
Environmental Test Unit

Has Temperature-Humidity Control

This environmental test equipment has control from —80 to 200°F and 20-90% relative humidity. Accuracy of control was held to ±1-1/2%. The control system followed a predetermined cycling time. The cabinet has 6 openings or ports for easy insertion of cable, etc.; electrical terminals are provided inside a specially designed rack for pressure and tensile testing. Webber Mfg. Co., Inc., Dept. ED, 2740 Madison Ave., Indianapolis, Ind.

CIRCLE 125 ON READER-SERVICE CARD

CIRCLE 126 ON READER-SERVICE CARD ➤



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In your design development and your pilot production even minutes can be important. For your convenience the jobbers listed at the right carry in stock a complete assortment in adequate quantities of Pyramid's line of highest quality electrolytic and paper capacitors, both commercial and MIL-C-25B types, metallized paper capacitors and a complete range of *Kool-sel* selenium rectifiers, the first new design in over 20 years.

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Art Electronic Supply Co.
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Burstein-Applebee
1012-14 McGee Street, Kansas City 6, Missouri

California Electronic Supply, Inc.
11801 W. Pico Boulevard, West Los Angeles 64, Calif.

Capitol Radio Wholesalers, Inc.
2120 Fourteenth Street, N.W., Washington, D. C.

Cramer Electronics, Inc.
811 Boylston Street, Boston 16, Massachusetts

Dalton-Hege Radio Supply Co.
924 W. Fourth Street, Winston-Salem, North Carolina

Dean's Electronics
969 American Avenue, Long Beach, California

Durrell Distributors
222 Mystic Avenue, Medford, Massachusetts

East Coast Radio & Television
1900 N. W. Miami Court, Miami 36, Florida

Electronics Center, Inc.
211 West 19th Street, New York, New York

Electronic Equipment Distributors
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Federated Purchaser, Inc.
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Herbach & Rademan, Inc.
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Hughes-Peters, Inc.
111 East Long Street, Columbus, Ohio

Interstate Electronics Co.
227 Fulton Street, New York, New York

Kann-Ellert Electronics, Inc.
9 South Howard Street, Baltimore, Maryland

Kierulff Electronics, Inc.
820 West Olympic Boulevard, Los Angeles, California

Lukko Sales Corp.
5024 West Irving Park Road, Chicago, Illinois

Milgray Electronics, Inc.
120 Liberty Street, New York, New York

Milo Radio & Electronics
200 Greenwich Street, New York, New York

Newark Electric Co.
235 West Madison Street, Chicago, Illinois

Niles Radio & Phonograph Co.
1254 Arapahoe Street, Denver, Colorado

Olive Electronics Supply Corp.
6711 Olive Boulevard, University City 5, Missouri

Peerless Radio Distributors
92-32 Merrick Road, Jamaica 33, New York

Fred P. Purcell Company
1221-27 N. Washington Ave., Scranton, Pennsylvania

Radio & Electronic Parts Corp.
3235 Prospect Avenue, Cleveland, Ohio

Radio Specialties Company
1946-56 South Figueroa Street, Los Angeles, California

Srepco, Inc.
314 Leo Street, Dayton, Ohio

Standard Electronic Sales Corp.
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Albert Steinberg & Co.
2520 North Broad Street, Philadelphia, Pennsylvania

Sterling Radio Products Co.
1616 McKinney Avenue, Houston 1, Texas

Waldor Radio & Appliance Co.
1809 North Second Avenue, Miami 32, Florida

Varnish for Printed Circuits

Resilient Coating Is Good Seal

A new varnish designed especially as a protective insulating coating for modular assemblies, printed circuits, and printed circuit components is far more flexible than conventional coatings. The No. 642 Printed Circuits Varnish can be baked or air-dried to a tough, resilient coating that completely seals the laminate and component leads against arc-producing moisture. A 2-1/2 mil coating of this water-white varnish withstands 1250v after 72hrs exposure at 100% relative humidity. This highly arc-resistant varnish will not support tracking, nor will it char. It is completely free from aging characteristics or discoloring and may be readily thinned with Xylol or its equivalent. The Insl-X Sales Co., Dept. ED, 26 Rittenhouse Place, Ardmore, Pa.

CIRCLE 127 ON READER-SERVICE CARD

Airborne Inverter

Light Weight, High Output

The 41 lb aircraft inverter, Model SE-24-1, is rated at 2250v at 35,000' (44°C). The inverter has electronically controlled carbon piles which regulate power for shunt and exciter fields and both voltage and frequency modulation are low. The output power is ideal for sensitive servo systems. The unit measures 13-1/4" long by 9-1/4" high by 7-1/8" wide. Leland Electric Co., Dept. ED, 1501 Webster St., Dayton 1, Ohio.

CIRCLE 128 ON READER-SERVICE CARD

Battery Megohmmeter

Has 500v Test Voltage

Model 2030 Portable Megohmmeter measures leakage resistance from 5 megohms to 10,000,000 megohms in 5 ranges with an accuracy of ±3%. A regulated 500v supply is incorporated in the instrument for supplying test potential. The instrument is entirely self-contained, safe, and rapid to use. Freed Transformer Co., Dept. ED, 1715 Weirfield St., Brooklyn 27, N. Y.

CIRCLE 129 ON READER-SERVICE CARD

◀ CIRCLE 130 ON READER-SERVICE CARD

Cast Plastic Sheets

Have Low Dielectric Constant

The unique casting process employed by this company differs from the more common processes (extrusion, injection, compression) in that it starts out with a liquid monomer instead of with solid plastic molding powders. The basic raw material is actually poured into the mold as a liquid. This technique results in a finished product of superior mechanical, optical, and fabricating properties.

At the present time, cast plastic sheet material is available in thicknesses from 0.040 to 1" and in the following materials: CR-39, a thermosetting cast resin; acrylic; polystyrene; and Polycast 1, 2, 3, and 4. These latter types have various crazing and abrasive qualities and Polycast 4 is an ultra high frequency material for use in electronics. It has low dielectric constant and power factor. Polycast Corp., Dept. ED, 69 Southfield Ave., Stamford, Conn.

CIRCLE 131 ON READER-SERVICE CARD

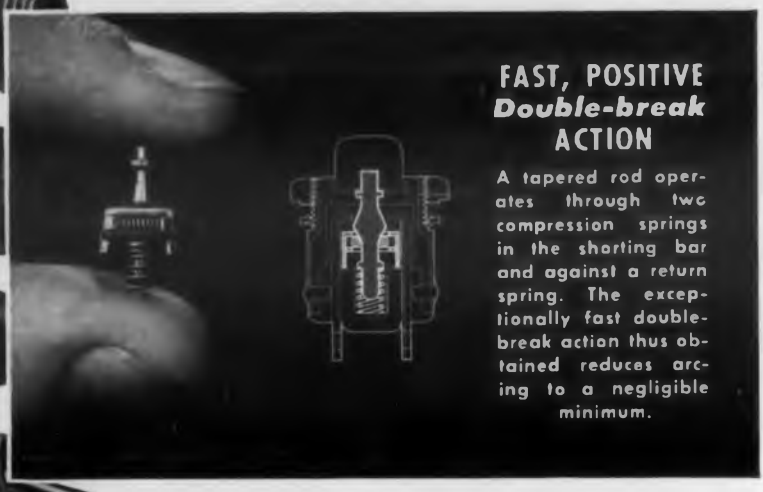
Telemetering Transmitter

For High-Power Data Transmission

This XT-1 telemeter transmitter is basically a crystal controlled, phase modulated transmitter that accepts low level modulating signals between 900cy and 100,000cy and provides wide-band, frequency modulated output with less than 1% distortion. Particularly economical for use where large channel capacity is required, the XT-1 telemetering transmitter makes available a channel capacity greater than most non-crystal controlled telemetering transmitters. It has a power output of more than 8-1/2w over the band from 215 to 235Mc. The unit weighs only 60 oz and occupies only 144 cu in, and withstands the vibration and temperature encountered in aircraft and missile applications. West Coast Electronics Co., Dept. ED, 5873 W. Jefferson Blvd., Los Angeles 16, Calif.

CIRCLE 132 ON READER-SERVICE CARD

CIRCLE 133 ON READER-SERVICE CARD >



FAST, POSITIVE *Double-break* ACTION

A tapered rod operates through two compression springs in the shorting bar and against a return spring. The exceptionally fast double-break action thus obtained reduces arcing to a negligible minimum.

SWITCH SUCCESS "SECRET" No. 1

This little beryllium device is the heart of Hetherington push-button and snap-action aircraft-type switches. Its unique, patented design and sturdy construction assure faster, more positive switching action in less space with less weight—*and with a life cycle exceeding military requirements.* It is a No. 1 "secret" of Hetherington's success in matching or surpassing exacting specifications—military or civilian—for switch dependability in the 15 to 50 ampere field.

Hetherington Aviation and Industrial Products

- **High quality push-button and snap-action switches in the 15-50 ampere range**
- **Special switch box assemblies**
- **Aircraft control stick grip assemblies**
- **Indicator lights**
- **Switch-indicator light combinations**
- **Trim tab control switches**
- **Auto pilot, tank jettison, canopy release, seat ejector or seat positioning switches**
- **Bomb or rocket firing mechanisms**
- **Microphone circuit switches**
- **Audible signal silencers**
- **Limit switches . . . and many others**

HETHERINGTON, INC., Sharon Hill, Pa.
(West Coast Division: El Segundo, California)

HETHERINGTON Switches

CIRCLE 135 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Supplies

Have Zero Recovery Time

A group of high-current regulated supplies announced by this firm exhibits the unusual characteristic of zero recovery time from a line or load transient. Designed around a fast-response thyratron rectifier, a "stiff" filter, and a large output storage capacitance, these units have been successfully used in computers, telemetering systems, and aircraft-control applications in which the power supply must be extremely steady.

In the "Zero-Lag" system, the voltage never leaves the regulated region. Standard regulation is 0.5% against static line changes of 20%, static load changes of 100%, dynamic line changes of 10%, and dynamic load changes of 25%. Standard ripple is less than 0.1%. There is no practical limit to size, although the system is most economical in the region from 4-160v, and 4-100amp.

There are 30 stock models, illustrated is Model Z-33, 16-40v, 0-30amp, 0.5% regulation, 0.1% ripple. NJE Corp., Dept. ED, 345 Carnegie Ave., Kenilworth, N. J.

CIRCLE 136 ON READER-SERVICE CARD FOR MORE INFORMATION

Crystal Accelerometer

For 10-30,000cy Range

The M-191 accelerometer is a low-cost, lightweight, stable, linear accelerometer which employs an ADP crystal in its construction and is designed for use over the frequency range of 10cy to 30,000cy. The dynamic range is 0.001g to 1000g. This unit is 5/8" diam x 1-5/16" high, weighs 1 oz, and mounts through a tapped hole in the base. An 18" length of special low-noise, coaxial, flexible cable equipped with "Microdot" connectors is supplied.

The accelerometer is sensitive only to the vector component of the vibration lying along its axis. Its sensitivity per unit acceleration (g) is independent of frequency over the entire operating frequency range. It is effectively equivalent to a primary standard, uniformity being such that all units may be interchanged without individual calibration. Massa Laboratories, Inc., Dept. ED, 5 Fottler Rd., Hingham, Mass.

CIRCLE 137 ON READER-SERVICE CARD FOR MORE INFORMATION

Pulse Amplifier

Variety of Output Impedances

Pulses at high power levels, with many different characteristics of duration, duty ratio, and impedance level, can be produced by the Type 1219-A Unit Pulse Amplifier. Although designed primarily as a companion instrument for the Type 1217-A Unit Pulser, the amplifier can be driven by any available source of either positive or negative pulses to produce pulses of current with magnitudes ranging from 600ma to 200ma, depending upon duty-ratio. This pulse of current can drive internal loads to give either positive or negative voltage pulses, or can be used to drive a load external to the instrument.

The internal load resistors, extending from 50 ohms to 570 ohms, are chosen to terminate a wide variety of transmission lines in their characteristic impedances. The open-circuit output pulse voltage is between 10v and 250v, depending upon the impedance and the available current. The maximum pulse duration is dependent only on the tolerable ramp-off. For a 10% drop the pulse duration is 10,000μsec for positive pulses and 4000μsec for negative pulses. The amplifier is only 10-1/2" wide and weighs 8-1/2 lb. General Radio Co., Dept. ED, 275 Massachusetts Ave., Cambridge 39, Mass.

CIRCLE 77 ON READER-SERVICE CARD FOR MORE INFORMATION

DPDT Relay

Weighs Only 1 oz

This sensitive subminiature dpdt relay is for jet aircraft, guided missiles, and other airborne applications. It is hermetically sealed and dry nitrogen filled, is only 0.656" diam x 1.500" long, and weighs only 1 oz.

The relay is available in contact ratings to 5amp resistive (10amp special) at 28v d-c or 115v a-c. It is manufactured in accordance with MIL-R-5757B and satisfies test requirements of MIL-R-6106A. It functions over an ambient of −65° to +125°C.

The unit will withstand vibration of 10g minimum at 10-500cy and withstand 50g minimum shock. Life at rated load is 100,000 operations (minimum). Electro-Mechanical Specialties, Inc., Dept. ED, 6819 Melrose Ave., Los Angeles 38, Calif.

CIRCLE 78 ON READER-SERVICE CARD FOR MORE INFORMATION

new star of the magnetic firmament !

STACKPOLE

Ceramagnet

CERAMIC MAGNETS

Ceramagnet, the unique new Stackpole ceramic magnet, material excels in high resistance, repelling, aging and other essential characteristics. Its cost—well below that of conventional magnetic materials—opens important new engineering horizons wherever positive, highly permanent attracting, repelling or even "cushioning" might be utilized.

Ceramagnet units can be supplied in almost any desired shapes or sizes. Send details of your application for recommendation and samples.

Electronics Components Division

STACKPOLE CARBON COMPANY

St. Marys, Pa.

One or a Million . . .

How expensive are your design ideas?
How accurate are your prototypes?
How quickly can you swing from pilot to production?

Do your design changes run up cost because of prototype "unreliability"? In orders of one or one million, I-S BeCu^{mp} springs measure up to one single standard of performance. This allows you to check your design against production tolerances and tests — without the expense of ordering production quantities. Our "Short-Run" department was set up expressly to handle pilot runs and small production requirements as regular output — instead of treating them as costly "special orders".

I-S Short-Run = Same High Performance – Lower Cost

Two Other Important Advantages

(1) Our ability to produce a better spring faster and usually at a lower cost.

(2) The specialized ability of our engineers to cooperate with your designers in developing your "problem" springs.

Like many other leading manufacturers, you will find that these I-S facilities can make significant improvements in your manufacturing processes and in your product. And they most likely will save you money! One thing is certain . . . it costs nothing to compare — it may cost considerable, *not to!*

The design stage normally poses the basic problems of time and unit costs—plus the uncertainties of performance. By utilizing I-S engineering research and advanced spring-making techniques, you save in testing time and development—as well as in elimination of regular production waste. In addition, you are ready to go into million-plus production, without time-consuming engineering usually involved in the transition from bench-made prototypes to full line production.

For more information on BeCu^{mp} Springs, write today to reserve your copy of our newest catalog—No. 8; for Electronic Components, ask for No. 8-A.

Instrument Specialties Co. Inc.

270 BERGEN BOULEVARD, LITTLE FALLS, NEW JERSEY
Telephone Little Falls 4-0280

BeCu^{mp} = Beryllium Copper, Micro-Processed

CIRCLE 142 ON READER-SERVICE CARD FOR MORE INFORMATION

JAN Tube Shield Replacement

Cooling and Vibration Protection

This new heat dissipating TR series tube shield, designed for direct replacement of JAN-type shields, enables existing equipment to be converted without extensive modification. When this shield is used, up to 50% reduction of the bulb temperature reached when tube is enclosed in a standard JAN shield is attained. Tube life, and therefore, reliability is improved.

They are directly interchangeable with the JAN shield and fit standard JAN 7 and 9 pin miniature sockets similar to the TS102P01, TS103P01, etc. Other benefits offered by the new TR shield, in addition to lowering of bulb temperature, vibration dampening and longer tube life, are its light weight, greater amount of shield-to-bulb contact with patented liner design, excellent electrostatic shielding properties, positive-attaching design and moderate price. International Electronic Research Corp., Dept. ED, 177 W. Magnolia Blvd., Burbank, Calif.

CIRCLE 143 ON READER-SERVICE CARD FOR MORE INFORMATION

Corona Detector

Can Provide Visual Readings

This detector determines the presence of corona in high-voltage rotating apparatus. It consists of a probe mounted on the end of an insulating pole, a control unit, and cables. It is connected to a standard oscilloscope for a visual corona reading. The equipment is inexpensive, portable, safe, and easy to use, and it is designed to help prevent damage, shutdown, and material spoilage.

The probe is essentially a small capacitor. When placed near a corona source, the variations in charge result in corresponding variations in the voltage on the electrodes of the probe. These variations are applied to a resonant circuit and cause it to oscillate momentarily. These pulse-type oscillations are then amplified and appear on the oscilloscope as a corona indication. Sunshine Scientific Instrument. Dept. ED, 1810 Grant Ave., Philadelphia 15, Pa.

CIRCLE 144 ON READER-SERVICE CARD FOR MORE INFORMATION

Genisco Rate-of-Turn Tables facilitate fast, precise calibration and evaluation of rate gyros

Ball-disc integrator drive provides infinitely variable rates from 0.01° to 1200°/sec.

EXTREMELY ACCURATE... constancy of angular velocity of the turntable is within 0.1%, including wow and drift errors, at any rate.

SMOOTH, CONSTANT ROTATION... unique synchronous motor, designed specially for this application, has large diameter rotor; high polar inertia.

EASY TO OPERATE... single handwheel controls turntable speed. Inexperienced personnel can operate machine after few minutes instruction.

IDEAL FOR LARGE VOLUME TEST PROGRAMS... ruggedness, simple operation, repeatability, and versatile mounting facilities make it the ideal machine for production-line testing.

PRECISE REPEAT POSITIONING... within 0.2% in same rotational direction; 0.5% in opposite direction, under 500° per second.

LOW ELECTRICAL NOISE LEVEL... better than —55 dbm per slip ring circuit (zero dbm = 1 mw in 600 Ω).

UNUSUALLY RUGGED... built to take years of continuous use; requires only minimum amount of maintenance.

TABLE CAPACITY... 100 pounds.

ACCESSORIES INCREASE ITS USEFULNESS!

SUB-RANGE ADAPTER... extends low range of Genisco Rate-of-Turn Table to 0.0001° per second.

PRECISION STROBE UNIT... for use in areas where accuracy of line frequency is questionable, or for calibration of gyros with accuracies better than line frequency.

MOUNTING STANDS... available in portable and fixed models.

Send today for complete specifications. Please direct your inquiry to Contracts Manager, Genisco, Incorporated, 2233 Federal Avenue, Los Angeles 64, California.

RELIABILITY FIRST

Genisco INCORPORATED

CIRCLE 146 ON READER-SERVICE CARD

Illumination Device

For Shadow-Free Photos

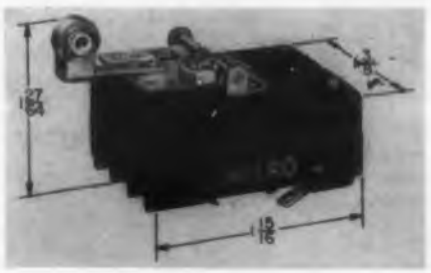
The "Type B Hinelight", through use of a graded circumferential tube light arrangement which places the camera lens inside the light source, reduces shadow in complex electronic and mechanical assemblies to the vanishing point. The feature is particularly important when such things as wired devices and other subjects of irregular or complex construction are to be photographed.

It is especially valuable in the preparation of engineering reports, government manuals, instruction books, visual training and assembly guides, and patent applications. Any high-quality, back-focusing view camera, Land Polaroid camera, or 35mm equipment may be used with the lighting system. The unit illustrated, with appropriate camera and stand, can be supplied as a complete, ready-to-operate assembly if required. Hinelight Corp., Dept. ED, 2500 John St., Fort Wayne, Ind.

CIRCLE 147 ON READER-SERVICE CARD FOR MORE INFORMATION

Dual Switch

Operated by Single Lever



The 6AS13 is a single-actuated dual switch designed for a wide range of control and electronic applications. A low-force, double-pole switch with the ability to switch two isolated circuits at the same time, it consists of two basic switching units operated by a single roller-lever actuator. Operating point of one switching unit is field adjustable to provide either simultaneous actuation or a definite sequence of operation.

The 6AS13 is available with a variety of lever lengths, either straight or formed levers, with or without a roller. Positions of levers can be varied to left or right. A second spdt switching unit can be added.

Basic switching units are listed by UL at 15amp 125v, 250v, or 460v a-c; 1/2amp 125v d-c; and 1/4amp 250v d-c. Other basic switching units can be used to provide higher electrical capacity for d-c circuitry, or for special circuit applications. Micro Switch, Dept. ED, Freeport, Ill.

CIRCLE 148 ON READER-SERVICE CARD FOR MORE INFORMATION

Prototype Lab Reports assure - -

DEPENDABLE, CUSTOM-BUILT ESC DELAY LINES

Every ESC prototype is accompanied by a Laboratory Report which includes your submitted electrical requirements, photo-oscillograms, which indicate input and output pulse shape and output rise-time; the test equipment used and our conclusions which evaluate the electrical characteristics of the prototype. There's no margin for error!

CONSULT ESC for the most economical solution to your delay line problem.

Typical of ESC custom-built units is #11-12. Design features and specifications include: *Impedance:* 100 ohms; *Delay:* .5 μsec.; *Rise Time:* .035 μsec.; *Attenuation:* 0.1 db; *Thermal Stability:* 0.00005 μsec. per μsec. per degree Centigrade delay change; *Spurious:* low cross talk in minimum space; *Temperature:* efficient operation from —55°C to +125°C; *Phase Shift:* linear; *Meets all applicable mil-specs.*

WRITE ESC for an informative catalog and complete information.

ESC CORPORATION

536 Bergen Boulevard, Palisades Park, New Jersey

CIRCLE 149 ON READER-SERVICE CARD FOR MORE INFORMATION

Digital Voltmeter

Will Operate Auto-Typewriter

The Type 33-110 "Sadie" Digital Voltmeter has a sensitivity such that 100mv provides full-scale digital output (999). Controls permit selection of any voltage in either of two ranges (10-25mv and 20-50mv) for full-scale readout. Digital output appears on an illuminated panel for visual readings, and is also available through contact closures representing three decimal digits. Outputs may be used for operation of automatic typewriters, card punches, and tape punches.

Input signals must be quasi-static in nature—that is, they must remain constant long enough for the unit to attain balance. Strain gages, pressure pickups, load cells, position-measuring potentiometers, thermocouples, analog computers, and mass spectrometers are a few of the devices which may provide this type of signal. The converter measures approximately 9-1/2″ x 10″ x 18-1/2″. It can be used on the bench. Two units will fit side by side in a standard rack. It is also available with a drawer-slide mounting for use in data-processing systems. Consolidated Engineering Corp., Dept. ED, 300 N. Sierra Madre Villa, Pasadena 15, Calif.

CIRCLE 75 ON READER-SERVICE CARD FOR MORE INFORMATION

Distributed Amplifier

Highly Applicable to Nuclear Work

This distributed amplifier, Model 500, is designed for use as an oscilloscope drive, or for general laboratory uses. It has particular application in the field of amplification of narrow pulses, such as are found in the nuclear instrumentation field. Size is 13½″ x 2⅜″ x 5¼″ over-all (approx). The power supply is a separate unit.

Bandpass is 200 kc to 250Mc. Input and output impedances are 90 ohms and 160 ohms, respectively. Power output is 3w, and gain is 12db. Output voltage is 22v rms, 62v peak-to-peak. Instruments for Industry, Inc., Dept. ED, Mineola, N. Y.

CIRCLE 76 ON READER-SERVICE CARD FOR MORE INFORMATION

Panel Meters

Have External Magnet Movements

Rectangular 5-1/2″ panel instruments are available in three types: d-c, r-f, and a-c rectifiers. Each of the three types can be supplied with external magnet meter movements, or shallow or deep core magnet meter movements.

The 4-1/2″ instruments are available in the same three meter types and can be supplied with either the shallow or deep core magnet meter movement. Instruments can be supplied with sensitivities as low as 10μamp. All practical ranges can be supplied. Simpson Electric Co., Dept. ED, 5200 W. Kinzie St., Chicago 44, Ill.

CIRCLE 153 ON READER-SERVICE CARD

Copper for Printed Circuits

Is Rolled and Hard Tempered

Hard tempered rolled copper specially designed for use with printed circuit wiring boards is available in both 0.0015 and 0.0027 gauges. The Rolled Printed Circuit Copper weighs 1 oz or 2 oz per square foot, depending upon the gauge and is supplied in widths up to 38″ in standard 350 lb coils. It is of uniform gauge and density throughout because of the rolling process used in its fabrication. Revere Copper and Brass Inc., Dept. ED, 230 Park Ave., New York 17, N. Y.

CIRCLE 154 ON READER-SERVICE CARD

Pulse Transformer Kit

Inductances of 0.5 to 50mh

The kit, No. 100Z1, contains five laboratory-type pulse transformers especially chosen to cover a wide range of practical applications, with primary inductance values from 0.5 to 50mh, and turns ratios as high as 8:1. Each miniature transformer has multiple windings, permitting the engineer to select the characteristics best suited to his application—whether in push-pull driving, blocking oscillator, pulse gating, pulse amplifier, or impedance matching circuits. Sprague Electric Co., Dept. ED, 347 Marshall St., North Adams, Mass.

CIRCLE 155 ON READER-SERVICE CARD

precision

Fluorocarbon Parts

- **meet exacting specifications . . .**
- **cut assembly costs**

Profit from precision parts, fabricated from duPont TEFLON, Kellogg KEL-F, BAKELITE fluorothene resins and other plastics — by United States Gasket Company.

Quality controlled "from powder to part," they assure uniform electrical, chemical and physical characteristics of the highest quality. Uniform density and dimensional stability permit superior accuracy and dependability in the finished part.

Come to USG for all your requirements— Fluorocarbon sheets, tape, tubing, cylinders, rods, bars, beading, electrical spaghetti—as well as molded and machined parts to your own specifications.

Write for catalog No. 300.

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FABRICATORS OF FLUOROCARBONS & OTHER PLASTICS
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CIRCLE 156 ON READER-SERVICE CARD FOR MORE INFORMATION

Wire Grid Resistor

Dissipates Heat Rapidly

In this high current, electrical resistor, the resistance units are formed of sturdy, self - supporting wire screen. The wires are of Nichrome wire, and the wire screen is brazed to large copper terminals.

Because the resistance wire is virtually suspended in free air, with no other obstruction to impede the flow of cooling air, the heat dissipating capacity is very high. The construction provides a compact, lightweight unit.

The basic mechanical design, with the wire screen in a V shape, permits expansion and contraction with only minor forces exerted on the insulators. The insulators are ceramic, maintained under slight compression so they cannot vibrate. The resistor is produced in complete grid bank assemblies, either open or enclosed, in 31 standard current capacities from 32amp to 126amp. Schaefer Bros. Co., Dept. ED. 1059 W. 11th St., Chicago 7, Ill.

CIRCLE 157 ON READER-SERVICE CARD FOR MORE INFORMATION

Backward Wave Oscillators

Voltage-Tuned Units

A series of four backward-wave oscillators features electronic tuning across the units' respective frequency ranges. Tuning is accomplished by varying or sweeping a single voltage without any complementary mechanical adjustments. The frequency band may be traversed at microsecond rates. This type of oscillator should find its greatest use as a swept signal source for microwave instrumentation and testing, as a swept local oscillator in superhetrodyne receivers, and as a master oscillator in variable frequency transmitters.

The characteristics of these four tubes span the frequency ranges of 2.0-4.0kMc, 3.75-7.0kMc, 7.0-140-kMc, and 12.4-18.0kMc, with power outputs of approximately 1000mw, 100mw, 50mw, and 10mw respectively. The tuning voltage in all cases is within the range of 300-3300v. Huggins Laboratories, Inc., Dept. ED, 711 Hamilton Ave., Menlo Park, Calif.

CIRCLE 158 ON READER-SERVICE CARD FOR MORE INFORMATION

Aircraft Relay

For Overvoltage Protection

This relay can be supplied for incorporation into any aircraft a-c electric system or panel. It is patterned after the ordinary fluorescent tube starter, but can handle a-c and d-c power simultaneously. It is normally used in conjunction with a slave relay, a transformer, and two resistors for obtaining the desired voltage level and time delay characteristics.

The overvoltage relay is sensitive to the peak voltage and can be used at any a-c supply frequency where the ratio of peak to rms is greater than 1.3:1. Contacts are rated 0.5amp and 28v. The time voltage characteristic is repeatable within 10% of the original time after an elapsed time of 10sec following operation. It will hold time-voltage limits over a temperature range of −55° to +120°C (sea level). There are no resonant frequencies up to 500cy. Size is only 0.383″ diam x 2.38″ long, and weight is 0.177 oz. Jack & Heintz, Inc., Dept. ED, 17600 Broadway, Cleveland 1, Ohio.

CIRCLE 161 ON READER-SERVICE CARD FOR MORE INFORMATION

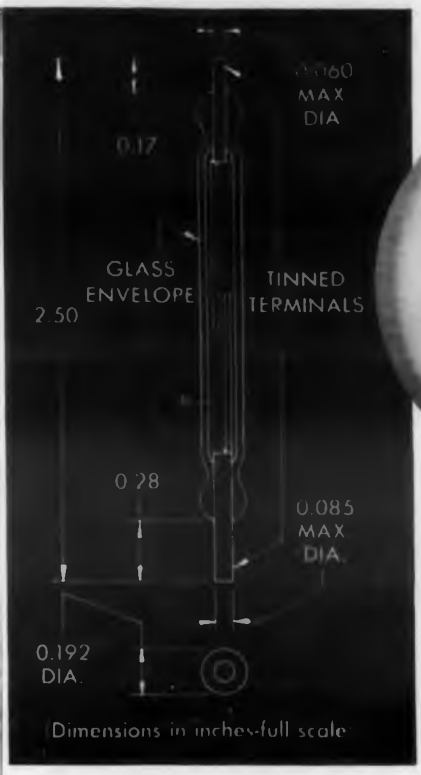
Miniature Clutch

Delivers High Torque

The Model C-130, a small but powerful electromagnetic clutch, is for instrumentation, servomechanism, control, and automation applications where there is need for a simple disconnect. It measures only 1-5/16″ diam x 2-5/8″ long, weighs 5-1/2 oz, has a torque output of 7 in-lb, and has a power consumption of only 3w. Price is low.

The clutch has a high speed of response: in the neighborhood of 10millisec to 15millisec. In addition to on-off clutch service, it may be used as a high-speed non-chattering brake, and for slip applications for restricted periods of time. The construction allows for considerable misalignment between the driving and driven members. Dial Products Co., Dept. ED, 7 Bergen Court, Bayonne, N. J.

CIRCLE 162 ON READER-SERVICE CARD FOR MORE INFORMATION



the mighty little glaswitch*

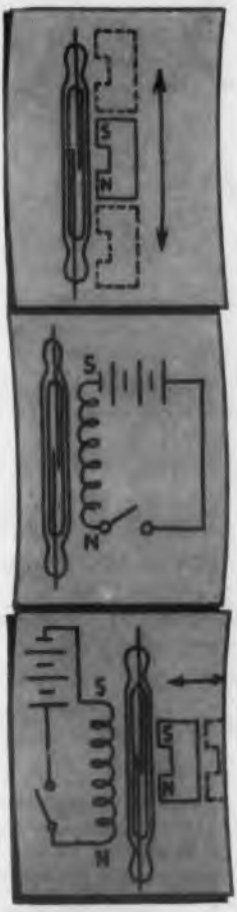
LIGHTNING RESPONSE . . . SEALED IN GLASS

The magnetically actuated reeds in this tiny Revere GLASWITCH make contact in just 1 millisecond . . . at rates up to 400 cycles per second. Hermetically sealed in an inert, dry atmosphere, with lightning fast snap action, both shelf and contact life are extremely long. Smaller than a cigarette, the GLASWITCH can be located anywhere . . . in any position . . . even in explosive atmospheres . . . individually or in multiples for multi-contact use.

Whenever you need faster, more positive response . . . where extreme sensitivity is a must . . . where light weight is important . . . investigate the Revere GLASWITCH. Write today for complete specifications and suggested uses.

CHARACTERISTICS:

Type—Single pole single throw—normally open—snap action
Enclosure—Hermetically sealed glass tube containing inert dry atmosphere
Operating Time—1 millisecond
Operating Rate—Up to 400 cycles per second
Contact Surfaces—Electroplated Rhodium
Contact Resistance (measured terminal-to-terminal)
Closed Circuit—0.050 ohms maximum
Open Circuit—500,000 megohms minimum
Contact Ratings
D.C. Loads at 28 volts
0.5 amps resistive
0.5 amps inductive (L/R—0.026)
A.C. Loads at 115 volts, 60 cycles
10 watt lamp load
Ambient Temperature Range— —85°F to +500°F



METHODS OF ACTUATION:

A moving permanent magnet or controlled external electromagnetic field are all you need . . . and the sky's the limit on imagination!

* Trademark

Revere CORPORATION OF AMERICA

WALLINGFORD, CONNECTICUT A subsidiary of Neptune Meter Company

CIRCLE 163 ON READER-SERVICE CARD FOR MORE INFORMATION

Microwave Rotary Joint

Provides Increased Safety

Although nominally rated at 250-kw, the Model H-250R X-Band Rotary Joint does not break down until approximately 700kw. A maximum vswr of 1.10 is maintained over the 8.5-9.6kMc band, and variations of vswr and phase with rotation are negligible.

The rotating element consists of a small package readily modified to fit the mechanical requirements for a particular antenna application. Construction permits attachment of special waveguide configurations directly to the joint, thus avoiding the extra flanges or blind solder joints. Shown are two variations of the basic rotary joint designed to solve a particular user's problem.

The joint can be supplied with either a pressure or weather seal or both. Preloaded ball bearings are used, and full 360° rotation is provided. Litton Industries, Components Div., Dept. ED, 336 N. Foothill Rd., Beverly Hills, Calif.

CIRCLE 165 ON READER-SERVICE CARD FOR MORE INFORMATION

Quartz Spring Kit

For Experimental Work

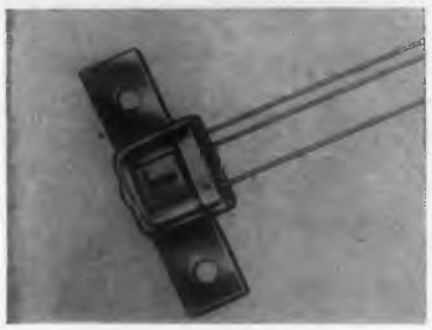
This engineering kit contains five precision quartz springs for experimental use. Fabricated of fused quartz to thicknesses finer than a human hair, these helical springs are especially suitable for use in complex mechanical systems and exacting instrument applications. Load maximums range from 5gm to 50mg, with maximum extension of 5cm throughout. All springs are supplied with hook and attachments. They are regular stock items available in production quantities.

High resistance to temperature variations, an extremely low coefficient of expansion, and excellent chemical stability make fused quartz particularly suitable in applications where dimensions must be accurately maintained. The material also offers elasticity far exceeding that of conventional spring materials, plus high strength and sensitivity. Houston Technical Laboratories, Dept. ED, P. O. Box 6027, 2424 Branard, Houston 6, Tex.

CIRCLE 166 ON READER-SERVICE CARD FOR MORE INFORMATION

Medium Power Transistors

Up to 750mw at 25°C



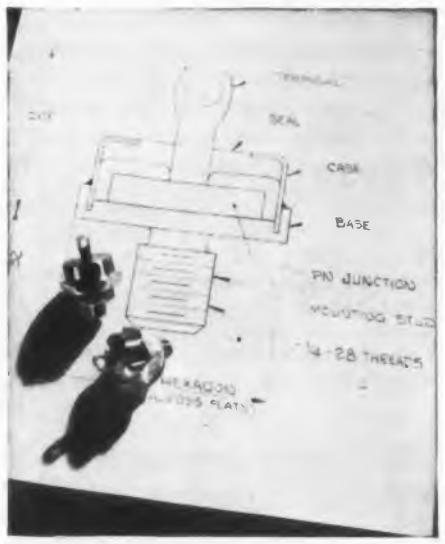
These new transistors are designed for high power dissipation with linear operation over a wide collector current range. They are hermetically sealed with vacuum to insure reliability under the most severe operating conditions. Efficient thermal connections provide greater power dissipating at elevated temperatures (up to 75mw dissipation at 25°C). Maximum dissipation ability of *2N85, 2N86, and 2N87* medium power transistors is obtained by chassis mounting.

These transistors are intended for Class A or B output or driving stages, and will provide high output with a minimum of distortion. Approximately 1.5w output can be obtained from a pair of 2N86 medium power transistors operated in push-pull Class B, even at temperatures up to 70°C when mounted on an aluminum chassis for heat dissipation. Transitron Electronic Corp., Dept. ED, Melrose 76, Mass.

CIRCLE 167 ON READER-SERVICE CARD FOR MORE INFORMATION

Silicon Rectifiers

40amp with Cooling



Silicon rectifiers capable of handling up to several kilowatts of power have been announced by this firm. These diodes have a typical forward voltage drop of only 0.7v at a current of 8amp and a cell temperature of 190°C.

At present, four voltage classifications are available: 50v, 100v, 150v, and 200v. They have a forward current rating of 8amp with natural convection cooling at 25°C. Higher current ratings up to 40amp can be achieved with forced cooling. Applications include such diverse fields as magnetic amplifiers, rotating rectifiers on the shafts of brushless generators, welders, plating lines, and power packs. Westinghouse Semiconductor Dept. ED, 356 Collins Ave., Pittsburgh 6, Pa.

CIRCLE 168 ON READER-SERVICE CARD FOR MORE INFORMATION

COSTLY DESTRUCTION TESTS DEMAND THE RELIABILITY OF A

FAIRCHILD OSCILLO-RECORD CAMERA

Of course, you can always get another piece of equipment to test, set up your instruments, repair your personnel, relandscape the grounds and start all over . . . but it's really easier and less expensive to get the data the first time. Barring a cataclysm like the one above, the Fairchild Oscillo-Record Camera is your best bet for getting accurate records of the test data you want . . . the first time.

Since Fairchild built the first camera specifically designed for oscilloscope recording, more *Oscillo-Record* cameras have been used than all other continuous motion oscilloscope recording cameras combined. The *Oscillo-Record* camera has several design features which contribute to its outstanding reliability and trouble-free operation in obtaining accurate test data. It is ruggedly constructed; its sprocket film drive eliminates slippage, even at high speeds. Rigid, top-of-scope mounting safeguards it against accidental upsetting, maintains the camera in focus at all times and leaves oscilloscope controls unobstructed. Other features include the electronically-controlled continuously variable film speed which permits the selection of the exact rate of film transport for optimum performance.

For any wave pattern . . . continuously varying, stationary or single transient, at all speeds from 1 to 3600 inches per minute, (7200 in/min on special order) the Fairchild Oscillo-Record camera is the reliable means of photographing scope patterns. Industrial Camera Division, Fairchild Camera & Instrument Corp., 88-06 Van Wyck Expressway, Jamaica, L. I., N. Y., Dept. 120-25N.

FAIRCHILD

OSCILLOSCOPE RECORDING CAMERAS

CIRCLE 170 ON READER-SERVICE CARD FOR MORE INFORMATION

Contact Meter-Relay

Has Front Adjust Contacts

The Model 255-C ruggedized meter - relay, with shock - mounted movement and sealed metal case, is available with high limit, low limit, or both high and low limit contact arrangements. Sensitivity ranges are from 0-20μamp to 0-50amp, or 0-5mv to 0-500v. External shunts or multipliers are required for higher ranges, and rectifiers or thermocouples are used for a-c or r-f.

Single contacts can be set for operation from full scale to within 1% of the zero point, double contacts to within 2% minimum spacing. The platinum alloy contacts can be adjusted from the front and have a life exceeding 10,000,000 operations; they are provided with a locking feature to assure a positive "make." Standard contact rating is 5-25ma, 75-125v d-c, but other ratings can be supplied. Meter accuracy is 2%, and contact repeatability is 1%. The unit is interchangeable with the regular 2-1/2" round case meter. Assembly Products, Inc., Dept. ED, Chesterland, Ohio.

CIRCLE 171 ON READER-SERVICE CARD FOR MORE INFORMATION

10-440Mc Signal Generator

With Multi-Purpose Modulation

This multi - purpose, self - contained signal generator, USM-16, is designed for use where extreme accuracy is required. It provides multi-purpose modulation including CW, AM, FM, PM, and sweep. Over its range of 10-440Mc, it can be tuned to within less than 1000cy of the desired frequency, with reference to a two-stage temperature-controlled crystal calibrator, without charts or auxiliary equipment.

Automatic frequency and level control assure stability at any desired frequency with drift, after warm-up, held to less than $\pm 0.002\%$ in 8 hours at room temperature. The unit has an output of 0.1μv to 0.224v (-127 to 0dbm) into a 50 ohm load with the selected output remaining constant over the full frequency range. The output level and modulation percentage or deviation are shown on direct-reading meter. Byron Jackson Electronics, Dept. ED, 492 E. Union St., Pasadena, Calif.

CIRCLE 172 ON READER-SERVICE CARD FOR MORE INFORMATION

Control

For Motor-Alternator Sets

The "VF" line of controls is made up of compact, inexpensive, integrated single packages for the precise regulation of both voltage and frequency of motor-alternator sets and inverters. Presently available in two models, VF-60 for 60cy outputs, and VF-400 for 400cy, the control permits conversion from any d-c source voltage to any a-c output voltage, within the ratings of the controlled machine. Units can be built for any power frequency.

Standard units regulate both output voltage and frequency to within ±2%. Special models, which control voltage and frequency to within ±1/4%, are available for military and other exacting applications. The control permits operation of a-c equipment on vehicles, airplanes, ships, and in remote locations, with high reliability. Electric Regulator Corp., Dept. ED, 314 Pearl St., Norwalk, Conn.

CIRCLE 175 ON READER-SERVICE CARD FOR MORE INFORMATION

Geared Motor

For Radial Thrust Loads

An open-type geared motor designed for overhanging or radial thrust loads, this unit offers ruggedness, quietness, and dependability. It uses double-supported gear shafts running in sintered-bronze bearings, heavy-duty gears and output shaft, and helical pinion and gear in the first step. Bearings are assured long life lubrication through extra-large oil wicks.

A wide selection of base motors is available: synchronous or non-synchronous unidirectional, or non-synchronous reversible. These units offer starting torques up to 75 lb-in and gear ratios from 4:1 to 30,000:1, and they should be of value to manufacturers of recording instruments, timers, office machines, and appliances. Barber-Colman Co., Small Motors Div., Dept. ED, Rockford, Ill.

CIRCLE 176 ON READER-SERVICE CARD FOR MORE INFORMATION

If you need a special component, send a brief statement of your specifications addressed to Bulletin Board, Electronic Design, 19 E. 62nd St., New York 21, N. Y. Include your complete address.

digital data recording systems

TEMPERATURE

POSITION

PRESSURE

FORCE

WEIGHT

VOLTAGE

DESIGNED . . . DELIVERED . . . IN OPERATION*

- WIND TUNNEL INSTRUMENTATION
- RADAR AND SONAR TRACKING DEVICES
- AUTOMATIC COMPUTER INPUT
- WEIGHT DISPLAY AND RECORDING
- GAS DYNAMICS RESEARCH
- ENVIRONMENTAL TESTING
- ENGINE TEST FACILITIES

*NAMES ON REQUEST

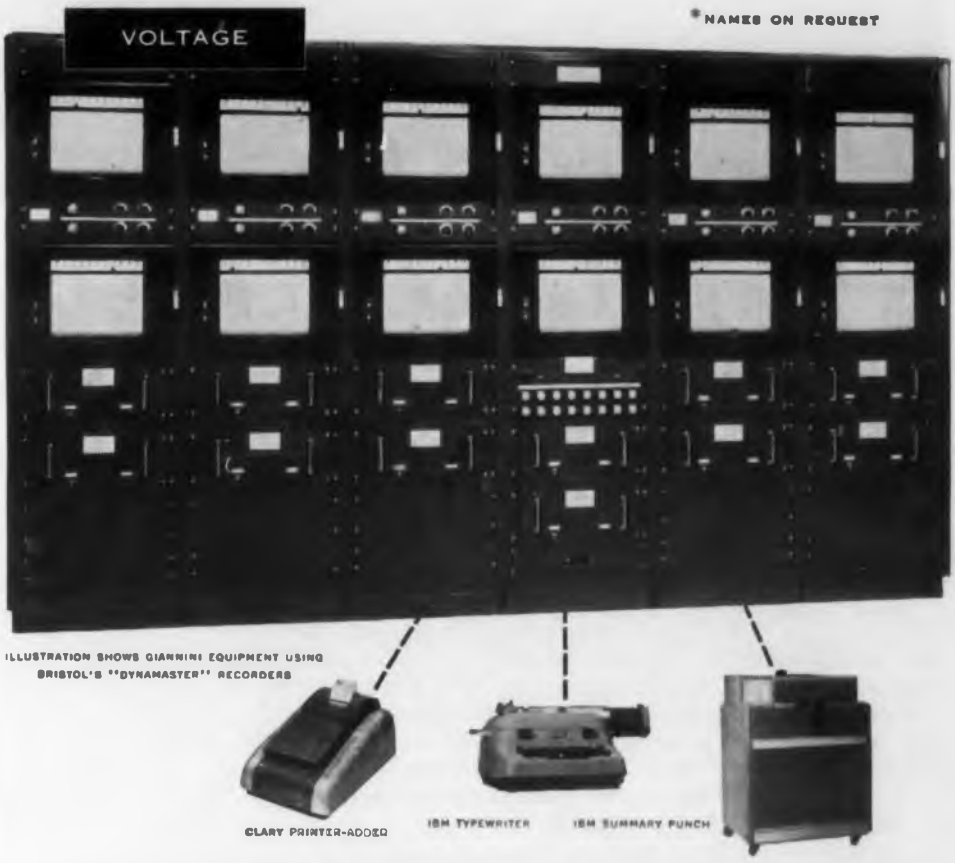


ILLUSTRATION SHOWS GIANNINI EQUIPMENT USING BRISTOL'S "DYNAMASTER" RECORDERS

CLARY PRINTER-ADDER

IBM TYPEWRITER

IBM SUMMARY PUNCH

FOR PRINTED TAPE, TYPEWRITER TABULATION OR PUNCHED CARD RECORDS

Giannini digital data handling and recording systems can be adapted to many additional processes that require rapid and/or continuous recording of precise information. Utilizing simple, reliable electromechanical instruments, Giannini systems have been chosen for applications requiring extreme reliability and accuracy. *Write us concerning your data handling problems—Literature available upon request.*

Giannini **DATEX** DIVISION

REGIONAL SALES OFFICES: EMPIRE STATE BLDG., NEW YORK 1, N.Y. • CHICKERING 4-4700
8 SO. MICHIGAN AVE., CHICAGO, ILL. • ANDOVER 3-5272
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G. M. GIANNINI & CO., INC. • PASADENA 1, CALIFORNIA

CIRCLE 177 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature Relay

Withstands Rough Shocks

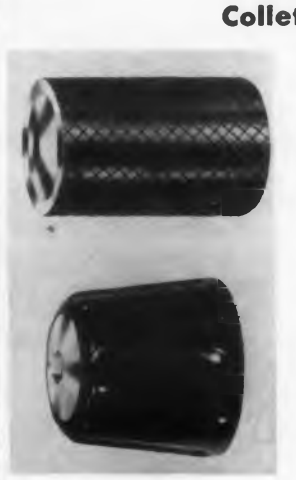
The Model No. 10 is a miniature sensitive relay suited for both commercial and military applications where either spdt or dpdt relays meeting high shock, temperature, vibration, and minimum space requirements are needed. It has a 10g standard vibration immunity and a 100g non-operating shock resistance. Units are hermetically sealed and conform to MIL R-5757 B.

Contacts are silver, rated 2amp 28v d-c, and 115v a-c; 100,000 operations is the life expectancy at rated resistive loads. Operating power is 40mw for dpdt, and 20mw for spdt. The unit contains a high-efficiency double-coil magnetic circuit with a resistance up to 12,000 ohms, with a maximum dissipation of 1w. Size is (approx) 1" x 1" x 2" long. Magnadyne Co., Dept. MS, 84 S. Water St., Port Chester, N. Y.

CIRCLE 179 ON READER-SERVICE CARD FOR MORE INFORMATION

Instrument Knobs

Collet-Fitting Types



The "Dalohm" Type K-1 and K-2 precision collet-fitting instrument knobs are interchangeable among the different knob sizes and accommodate all shaft sizes from 1/8" through 3/8". The knobs fit concentrically on the shaft and can be positioned accurately and easily. They are made of cast aluminum or thermosetting plastic. Dale Products, Inc., Dept. ED, Columbus, Nebr.

CIRCLE 180 ON READER-SERVICE CARD FOR MORE INFORMATION

Total Hour Indicators

For 60cy or 400cy Equipment

The Model 7008 Running Time Meter indicates up to 10,000 hr on a dial-type face. It weighs less than 6 oz and has a power drain of approximately 2w. It is hermetically sealed in accordance with MIL-I-7793 (AER) and meets military shock (25g) and vibration requirements. Haydon Manufacturing Co., Inc., Dept. ED, Torrington, Conn.

CIRCLE 181 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Supplies

In Six High-Voltage Models

The HV and HVA Series of power supplies, each in 60kv, 100kv, and 200kv models, are announced by this firm. Input is 115v a-c; max continuous current output is 1ma, positive or negative polarity.

The HV Series permits, through use of a suitable variable transformer, a-c primary voltage to be varied independently of the filament voltage. A powerstat and an associated meter are available, mounted on the unit if desired. The HVA Series consist of a basic HV Supply and a separate a-c control, each housed in a completely enclosed cabinet.

Reversible polarity, 0-230v a-c, and additional current output are available on special units. Microtime Laboratories, Dept. ED, 7247 Atoll Ave., N. Hollywood, Calif.

CIRCLE 182 ON READER-SERVICE CARD FOR MORE INFORMATION

Nylon Fastenings

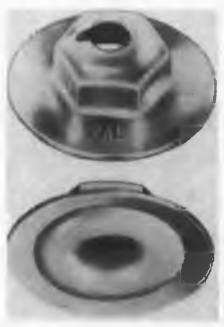
In Strengths to 15,000psi

The "Nylogrip" line of nylon fastenings currently includes screws, nuts, and bolts in a wide range of types and sizes. These fasteners are self-locking, non-corrosive, and insulating, and although they weigh less than one-half a much as aluminum fasteners, they have tensile strengths up to 15,700-psi and can withstand continuous heat up to 300°F. Nylogrip Products, Dept. ED, 449 Watertown St., Newton 58, Mass.

CIRCLE 183 ON READER-SERVICE CARD FOR MORE INFORMATION

Lock Nut

Seals Against Water, Dust



The addition of a sealing compound to "Palnut" Washer Type Lock Nuts provides a complete seal around threads and nut seat when tightened, to prevent entrance of water, dirt, and dust. A single one of these units does the job of an ordinary nut, lock washer, flat washer, and sealing washer. High speed assembly is achieved with standard power tools. The nuts are available in Nos. 8-32, 10-24, 12-24, and 1/4"-20. The Palnut Co., Dept. ED, 61 Cordier St., Irvington 11, N. J.

CIRCLE 184 ON READER-SERVICE CARD FOR MORE INFORMATION

Ionization Gage Controls

Are Highly Stable and Linear

Nos. RG-2 and RG-3 Ionization gage controls measure pressures from 1micron to 2×10^{-10}mm Hg. High stability and linearity are provided by a new type of circuit using an ion current amplifier employing 100% negative feedback, similar to those used in "electrometer" amplifiers. The high stability of the circuit makes it suitable for attachment to a recorder. Auxiliary recording equipment is available, or a packaged unit can be supplied.

Type RG circuits are designed to be used with the Type RG-75 "Non-burnout" gage; the circuit also may be used with other gage tubes. The controls are available either with or without a circuit for controlling two thermocouple gages. Units are supplied either in a cabinet or on a panel for rack mounting. Operation is from 110v 60cy. Vacuum Electronic Engineering Co., Dept. ED, 86P Denton Ave., New Hyde Park, N. Y.

CIRCLE 187 ON READER-SERVICE CARD FOR MORE INFORMATION

Woven Heat Elements

In Rubber and Plastic

Woven heat elements are available from this firm for a wide variety of applications in aircraft as well as in industry generally. Various materials are used for insulating these tailor-made units. Neoprene rubber is employed where medium heat (200°F) is required, such as for deicing propeller blades and aircraft wings, or as battery, antenna, and rocket tube heaters. Silicone rubber has excellent stability and flexibility for long periods through a temperature range of —80° to 500°F; some of its present uses include gyroscopes, servomechanisms, temperature sensing elements, and heaters for missiles.

This firm is also incorporating heating units within Fiberglas-reinforced plastic; this permits a heater to furnish its own structural support which will withstand the most severe environmental conditions. Safeway Heat Elements, Dept. ED, Middletown, Conn.

CIRCLE 188 ON READER-SERVICE CARD FOR MORE INFORMATION

Time Delay Relay

Permits Electrical Interlock

An electrical interlock in a circuit which allows push-button control can now be obtained by use of an instant action auxiliary switch in the Model NEI "Agastat" time delay relay.

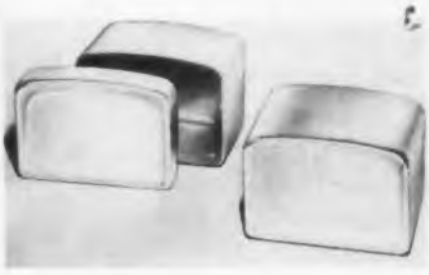
Time delay is pneumatically-controlled and provides a readily adjusted and accurate timing interval from 0.1sec to 10 or more minutes. Measuring 2-1/2" x 3-3/8" x 4-1/2", the relay is easily mounted. Affixed to the front is a normally closed double-throw micro-switch.

The relay is available for all a-c and d-c voltages, in spdt double-break, and dpdt single-break models. It is rated 15amp at 115v 60cy a-c. A'G'A Div., Elastic Stop Nut Corp. of America, Dept. ED, Elizabeth, N. J.

CIRCLE 190 ON READER-SERVICE CARD FOR MORE INFORMATION

Instrument Cases

Of Drawn Aluminum



This firm is tooled for a standard line of drawn aluminum instrument cases. The first one available, the ZIC-2, is 11" wide x 7-3/4" high, with depth varying as ordered, from 4" to 8-1/4". The cover of the ZIC-2 is recessed to protect knobs and dials to be installed, and all cases have four dimples on the bottom. Zero Manufacturing Co., Dept. ED, 1121 Chestnut St., Burbank, Calif.

CIRCLE 191 ON READER-SERVICE CARD FOR MORE INFORMATION

Diode Clip

Holds Pigtail Leads

This spring-loaded clip securely holds fragile diode pigtail leads from 0.005" to 0.035" diam. It is made of brass and is finished in 0.0002" bright alloy plate. When mounted, it is 11/32" in overall height. The mounting stud is 7/32" long, hexagonal with a 2-56 thread. Cambridge Thermionic Corp., Dept. ED, 445 Concord Ave., Cambridge 38, Mass.

CIRCLE 192 ON READER-SERVICE CARD FOR MORE INFOMATION

CIRCLE 193 ON READER-SERVICE CARD ➤

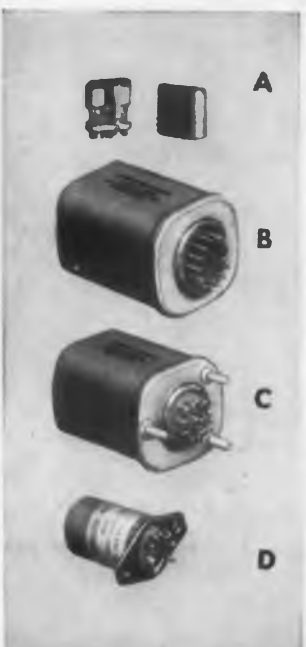
GENERAL ELECTRIC ANNOUNCES . . .

NEW, faster, smaller micro-miniature relay

LIGHT WEIGHT, SMALL SIZE: Weighs only .35 ounces and measures .34" x .781" x .84". This tiny relay utilizes balanced armature and simple design, giving you quality and more reliable operation at a consistently high level.
HIGH CONTACT RATING: For low contact resistance and long life, fine silver is used . . . contact rating is 2 amps resistive load at 30 V d-c or 115 V a-c . . . contact arrangement is 2PDT.
FAST OPERATION: With rated voltage on coil, operating time is 1.5 milliseconds. By adding series resistance in coil circuit or by applying high voltage pulse to coil . . . pickup time will be less than 1 millisecond!
LOW OPERATING POWER: 300 milliwatts for standard model . . . 150 milliwatts for current sensitive model.
HIGH SHOCK: VIBRATION RESISTANT: G.E.'s balanced armature and high tip forces withstand shock of over 50 g's and vibration of 10-55 cp's at .12" maximum excursion and 55–500 cp's at 20 g's acceleration.
HIGH TEMP OPERATION: This new micro-miniature relay gives you continuous and efficient operation at ambient temperatures of 125° C.

G.E.'s line of aircraft-type relays will help solve your space-weight problems. Contact your G-E Apparatus Sales office for more application information. General Electric Company, Schenectady 5, New York.

MAIL THIS COUPON FOR G-E RELAY DATA . . .



- ☐ **A: Micro-miniature Relay—Bulletin GEA-6346**
- ☐ **B: High Speed Relay—Bulletin GEA-6212**
- ☐ **C: Miniature Relay—Bulletin GEA-6213**
- ☐ **D: Subminiature Relay—Bulletin GEA-6211**
- ☐ **E: Have Sales Engineer contact me.**

Section L792-2, General Electric Company, Schenectady 5, New York

NAME..... **TITLE**.....

COMPANY.....

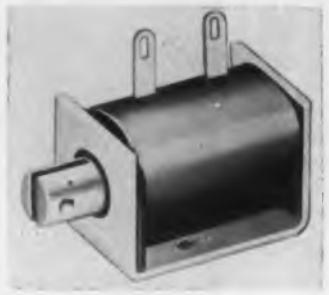
ADDRESS.....

CITY..... **STATE**.....

GENERAL ELECTRIC

Solenoid

For Limited Space Uses

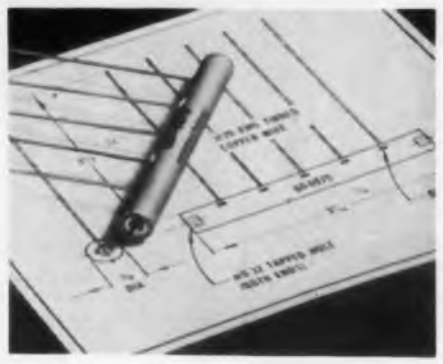


This compact solenoid is now available for limited space applications requiring high power and rugged performance. The shading coil is embedded in the plug for greater efficiency and high seated pull. It operates in any position and is supplied as standard with solder terminals or can be furnished with flexible leads. Dormeyer Industries, Dept. EDN, 3418 N. Milwaukee Ave., Chicago 41, Ill.

CIRCLE 289 ON READER-SERVICE CARD FOR MORE INFORMATION

Rectifier

Selenium Cartridge Type



This selenium cartridge rectifier, Type 60-6979, is for use in instruments requiring high transient peak currents for capacitor charging (such as strobe flash units). It is a single-phase full-wave bridge selenium rectifier delivering 9.6ma average current, 190ma peak pulse current at 495v d-c capacitative load. It is 3-1/8" long x 3/8" OD, and is supplied with 3-1/2" radial pigtail leads. International Rectifier Corp., Dept. ED, 1521 E. Grand Ave., El Segundo, Calif.

CIRCLE 290 ON READER-SERVICE CARD FOR MORE INFORMATION

Microwave Test Unit

For S-Band and X-Band

This Standing Wave Introducer is made for S-Band and X-Band operation, has high power, and has been tested up to 500kw on S-Band frequencies. It allows a duplication of settings and has the ability to reset each time at reliable check points. Microtronics, Inc., Dept. ED, 9 Porete Ave., North Arlington, N. J.

CIRCLE 291 ON READER-SERVICE CARD FOR MORE INFORMATION

Ultra-High Regulation Power Supply

Model UHR 225

For the most exacting d-c regulation, the Krohn-Hite Model UHR-225 POWER SUPPLY provides unsurpassed performance. It is low priced and compact (7½" wide x 10" high). It has 0.002% regulation and 100 microvolts ripple over the *entire operating range* (150-500 volts and 0-200 MA). For line voltages between 105 and 125 volts, full rated current can be drawn continuously with a substantial margin of safety. The internal impedance is less than 0.02 ohms for d-c and low frequencies and less than 0.1 ohm for frequencies as high as 100 kc. Transient response is 0.001 millisecond. Typical ten-hour drift is 500 ppm. In addition to the d-c output, there are two independent 6.3V a-c outputs, each rated at 5 amps. Price, $250.00 f.o.b. factory.

For Further Details Write

KROHN-HITE INSTRUMENT CO.

Dept. ED, 580 Massachusetts Ave., Cambridge 39, Mass.

CIRCLE 292 ON READER-SERVICE CARD FOR MORE INFORMATION

Rectilinear Potentiometer

In Sliding and Leadscrew Types

This precision miniature rectilinear potentiometer is designed for miniature printed circuitry applications, transistor applications, commercial, or military applications. It can be supplied as shown in the picture with sliding motion wiper, or as a sealed leadscrew type, with a nominal 50 turns covering 90% of the usable resistance length. Both models are available in resistance ranges from 100 ohms nominal to 10,000 ohms, and with Teflon-insulated lead wire. Size is 7/8″ x 3/16″ x 5/32″ high, and 7/8″ x 7/16″ 5/16″ high, respectively. Hubbard Scientific Laboratories, Inc., Dept. ED, 1292 E. 3rd St., Pomona, Calif.

CIRCLE 199 ON READER-SERVICE CARD FOR MORE INFORMATION

Instant Solder Gun

Weighs Only 8 oz

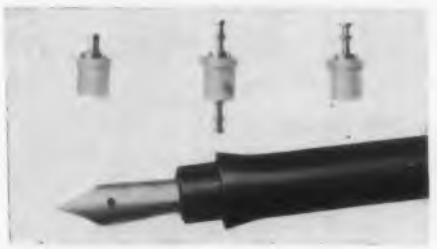
The "Instant Solder Gun" is soldering-hot in a few seconds, without the use of a heavy transformer or fragile thermostats, and it weighs only 8 oz. A special alloy "Lifetime Tip" is provided.

The heating element is in the tip. It is rated at 150w and available for 120v. It operates identically on d-c as well as a-c. Hexacon Electric Co.. Dept. ED, 299 W. Clay Ave., Roselle Park, N. J.

CIRCLE 200 ON READER-SERVICE CARD FOR MORE INFORMATION

Teflon Terminals

Mounted by Press Fit



The X-2182 series of push-in insulated terminals utilizes the properties of Teflon, both as a holding material and as an insulator. The terminals permit a press-fit into mounting panels of 1/16″ to 1/8″ thickness, with secure seating that keeps them shake-proof and firmly attached. The units feature high terminal pull strength in any direction. Cambridge Thermionic Corp., Dept. ED, 445 Concord Ave., Cambridge 38, Mass.

CIRCLE 201 ON READER-SERVICE CARD FOR MORE NFORMATION

(Advertisement)

PRECISION PHASE MEASUREMENT

0.00001 cps to 500 megacycles, accuracy ±0.1°

Type 405 Precision Phase Meter has its meter reading independent of both signal amplitude and frequency over wide ranges, 0.3 volt to 120 volts rms and 8 cps to 100 kc. The accuracy is ±¼° relative and ±1° absolute at any range for symmetrical waveforms of any shape. Price—$485.00 each.

Type 205 Precision Phase Detector can be used to measure time delay or phase angle with an accuracy of 1% or 0.1° from 100 kc to 15 megacycles. Price—$445.00 each.

Type 202 Vectorlyzer can be used to measure phase angle, vector sum or vector difference of two voltages, or magnitude and phase angle of an unknown impedance. The frequency range is 8 cps to 500 megacycles. Price—$445.00 each.

Type 1026 Phase Angle Counter can be used to measure phase angle down to .00001 cps with an error less than ±0.5° or ±1 count per 100,000. Price—$948.00 each. Write Department ED5 for data. ADVANCE ELECTRONICS CO., INC., 451 HIGHLAND AVE., PASSAIC, N. J.

CIRCLE 203 ON READER-SERVICE CARD FOR MORE INFORMATION

Plastic Film Capacitors

Take −65° to +165°C Temperatures

High-temperature "XC" plastic film dielectric capacitors feature high insulation resistance, low power factor, and low dielectric - absorption. Operating temperature range is from −65° to +165°C. Minimum insulation resistance at 25°C, measured with an applied potential of 100v and an electrification time of 2 minutes, is 75,000 megohm-mfds min, but need not exceed 200,000 megohms.

The capacitors are hermetically sealed and also meet moisture resistance and vibration specs of Mil-C-25A. In addition to tubular types, other case styles such as bathtub and rectangular are available. Capacitors are built to withstand a d-c voltage equal to 200% of the rated voltage for 1 minute at 25°C. The Gudeman Co., Dept. ED, 340 W. Huron St., Chicago 10, Ill.

CIRCLE 205 ON READER-SERVICE CARD FOR MORE INFORMATION

Ammeters, Voltmeters

Moving-Iron Vane 0.2% Accuracy

These "AEC" (Allgemeine Elektricitaets - Gesellschaft) moving-iron instruments are of the 0.2% precision class. Both ammeters and voltmeters are available in a variety of ranges (and in multi-range units) from 30/60ma to 6 amp, and 15/30/75v to 150/300/450/600v.

Frequency range of all ammeters is d-c and 15-300cy; of voltmeters is d-c and 15-100cy. Units are available with temperature compensation for frequencies to 400cy. Power consumption is low, and the instruments are easily read. Donald C. Seibert, Importer, Dept. ED, Box 281, Wilmington, Del.

CIRCLE 206 ON READER-SERVICE CARD FOR MORE INFORMATION

If you need a special component, send a brief statement of your specifications addressed to Bulletin Board, Electronic Design, 19 E. 62nd St., New York 21, N. Y. Include your complete address.

Impedance Comparator

Permits Rapid Testing

Impedance Comparator Model 1010 gives percentage deviation of impedance directly in both sign and magnitude on a zero-centered meter. Three full-scale ranges are provided: ±5%, ±10% ±20%. The impedance limits are: resistance, 5 ohms to 5 megohms; capacitance, 50mmfd to 20mfd; inductance, 100μh to 80h. Operating frequencies are 1000cy or 10,000cy. The Industrial Test Equipment Co., Dept. ED, 55 E. 11th St., New York 3, N. Y.

CIRCLE 210 ON READER-SERVICE CARD FOR MORE INFORMATION

Glow-Tip Switches

Can be Located in Dark

Every switch in this firm's "Quiette Light" switch line ("Lifetime", "Interchangeable", and "Junior") can now be supplied with a radioactive luminous button situated in the tip of the operating lever. These "Glow-Tip" buttons will glow continuously, since unlike fluorescent-type materials, radioactive luminuos material is not dependent upon daylight to build up luminous properties. The Arrow-Hart & Hegeman Electric Co., Dept. ED, Hartford, Conn.

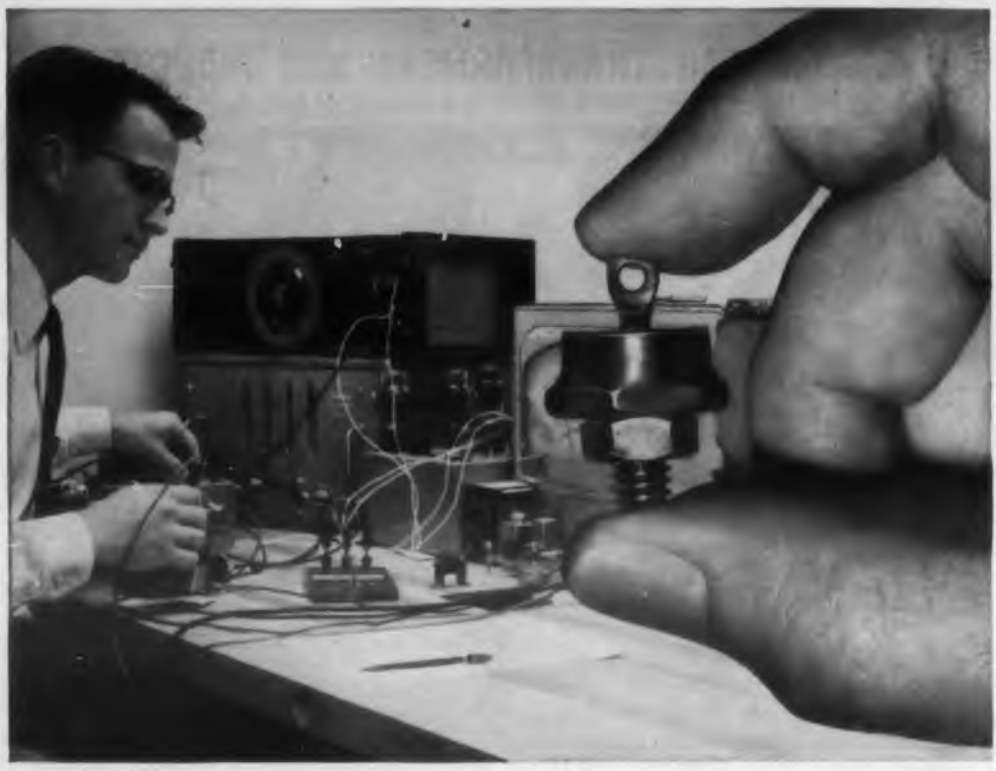
CIRCLE 211 ON READER-SERVICE CARD FOR MORE INFORMATION

Dynamic Balancer

Takes Diameters to 20"

A fully electronic dynamic balancer, Model 5V-6 will handle any rotating body from 4 oz to 100 lb, yet is simple enough that operation can be learned in less than an hour. A bench model, it needs very little space and a minimum of fixturization. Within its weight-handling range, it will balance such units as fans, armatures, blowers, pulleys, crankshafts, drums, propellers, and impellers. Micro Balancing, Inc., Dept. ED, Herricks Rd., Garden City Park, N. Y.

CIRCLE 212 ON READER-SERVICE CARD FOR MORE INFORMATION



WESTINGHOUSE
NEW SILICON POWER
RECTIFIER puts you ahead...

High-temperature operation. Exhaustive tests have shown that these units are capable of operation up to 200°C with *no* detectable aging in their characteristics.

In rectifier efficiency. Forward voltage drop reaches only *0.85* volts at 40 amperes, 190°C junction temperature. Efficiency is over 99%. Ratings up to 200 volts maximum peak inverse are available in four classifications: 50, 100, 150 and 200 volts.

In compact design. Westinghouse silicon power rectifier (shown actual size above) takes only 1/50th the volume of the comparable selenium rectifier.

Write today for your free application *Facts Folder* describing the full range of silicon power rectifier characteristics. These rectifiers are available for immediate delivery. Call your local Westinghouse sales office, or write: Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pa. J-80002

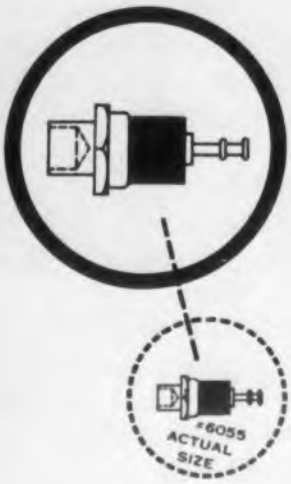
YOU CAN BE SURE...IF IT'S

Westinghouse

CIRCLE 214 ON READER-SERVICE CARD FOR MORE INFORMATION

Terminals

Insulated with Plaskon Alkyd

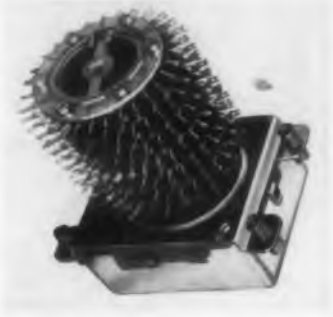


Miniature and standard sizes of Plaskon Alkyd insulated terminals are available from this firm. The terminals, with fiberglass fillers, give high mechanical strength, arc and flame resistance, and dielectric qualities. Compared with ceramic insulators, the load life is greatly improved, there is more resistance to moisture, and the terminals have improved temperature characteristics as well as ability to dissipate heat. Lerco Div., Lynn-Deatrick, Inc., Dept. ED, 501 S. Varney St., Burbank, Calif.

CIRCLE 215 ON READER-SERVICE CARD FOR MORE INFORMATION

Rotary Switch

A 30-Point 6-Level Unit



The Type E-RVF is a 30-point, 6-level rotary switch available with either two rows of contacts per level or one row of contacts and one common ring contact. Each wiper consists of two flat bifurcated springs, providing double contact surfaces at each level. These surfaces are in the form of "feet" at the end of each wiper spring. They make contact at the "heel" and break with a snap action at the "toe". North Electric Co., Dept. ED, Galion, Ohio.

CIRCLE 216 ON READER-SERVICE CARD FOR MORE INFORMATION

Temperature Probes

Provide High Outputs

High resistance (20,000 ohms) temperature probes, when used with this firm's "TME" bridge network, provide 5v output signals (without amplification) for as little as 150° temperature change. Probes are available in varied configurations for measuring fluid, surface, structure, air, hydraulic line, cylinder head, and subminiature component temperatures. Arnoux Corp., Dept. ED-4, Box 34628, Los Angeles, Calif.

CIRCLE 217 ON READER-SERVICE CARD FOR MORE INFORMATION

In

1956 ELECTRONIC DESIGN

will reach your desk

24

times

Audio Oscillator

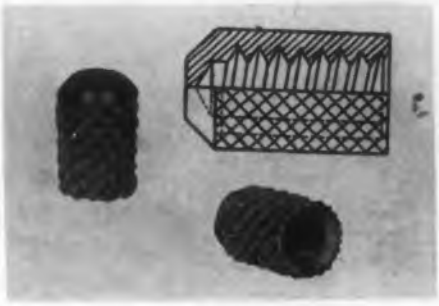
A Wide-Range Lab Unit

The Model 301A Audio Oscillator is a compact, reliable, wide-range general-purpose laboratory audio oscillator. Covering the range from 10cy to 1.0Mc in five steps, the oscillator is packaged in a unit only 9-5/32" x 7-5/32" x 8-11/16". Hum level is less than 0.1% of rated output; and distortion is less than 1%. Shasta Div., Beckman Instruments, Inc., Dept. ED, P. O. Box 296, Station A, Richmond, Calif.

CIRCLE 220 ON READER-SERVICE CARD FOR MORE INFORMATION

Aluminum Inserts

For Molded Plastics



A line of standardized aluminum inserts for molded plastics is offered by this firm. Holes are tapped to maximum depth for overall length with Class II threads (to meet ASME specifications) in sizes from 4-36 to 12-24. The outside knurl is extremely coarse, affording exceptional holding power against high torque. Yardley Precision Products Co., Dept. ED, 48 E. Afton Ave., Yardley, Pa.

CIRCLE 221 ON READER-SERVICE CARD FOR MORE INFORMATION

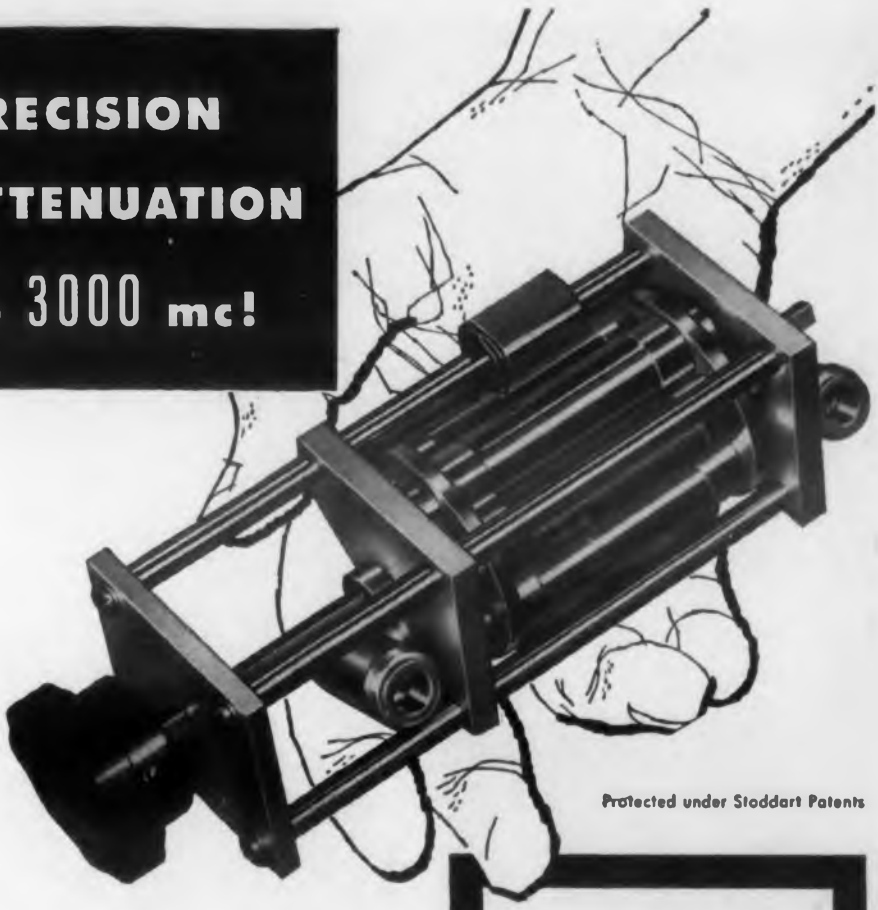
Radio Noise Filter

Weighs only 7/8 oz

This small, lightweight, dual Pi noise filter for actuator motors consists of four 0.5mfd capacitors and two 0.5mh toroids, and is rated at 2amp 200v d-c. It is only 7/8" x 7/8" x 9/16" in size, and weighs 7/8 oz. The unit brings noise level far below MIL-I-6181 requirements throughout the frequency spectrum. The dielectric is epoxy resin, for operation at 300°F. Electronic Specialty Co., Miniature Components Div., Dept. ED, 5121 San Fernando Rd., Los Angeles 39, Calif.

CIRCLE 222 ON READER-SERVICE CARD FOR MORE INFORMATION

PRECISION ATTENUATION to 3000 mc!



Protected under Stoddart Patents

six-position
TURRET ATTENUATOR
featuring **PULL-TURN-PUSH** *action*

FREQUENCY RANGE: dc to 3000 mc.
CHARACTERISTIC IMPEDANCE: 50 ohms.
CONNECTORS: Type "N" Coaxial female fittings each end.
AVAILABLE ATTENUATION: Any value from 1 db to 60 db.
VSWR: 1.2 max., dc to 3000 mc/s, values from 10 to 60 db. As value decreases below 10 db, VSWR increases to not over 1.5.
ACCURACY: ± 0.5 db.
POWER RATING: One watt sine wave power dissipation.

SINGLE "IN-THE-LINE" ATTENUATOR PADS and 50 ohm COAXIAL TERMINATIONS

This new group of pads and terminations features the popular Type C and Type N connectors, and permits any conceivable combination of the two styles. For example, the two connector types, either male or female, can be mounted on the same attenuator pad, with or without flanges, so that it may serve as an adapter as well as an attenuator. Frequency range, impedance, attenuation, VSWR, accuracy and power rating are as designated above. Send for free bulletin entitled "Measurement of RF Attenuation."

STODDART AIRCRAFT RADIO Co., Inc.

6644-J Santa Monica Blvd., Hollywood 38, California · Hollywood 4-9294

CIRCLE 223 ON READER-SERVICE CARD FOR MORE INFORMATION

MODEL MA2850

MODEL MA640

MODEL MA65

RUGGED • ACCURATE • TUBELESS

MAGNETIC AMPLIFIER DC SOURCES

(MA-NOBATRONS*)

Sorensen MA-NOBATRONS* have been designed for industrial applications and unattended installations where the utmost in maintenance-free service is required.

S P E C I F I C A T I O N S

	MODEL MA65	MODEL MA 640	MODEL MA 2850
INPUT	105-125VAC, 1Ø, 60 cycles		190-230VAC, 3Ø, 60 cycles 4-wire wye.
OUTPUT	6VDC, adj. ±10%	4.5-7.7VDC, adj.	23-32VDC, adj.
LOAD RANGE	0-5 amperes	0-40 amperes	0-50 amperes
REGULATION	±1.0% for any combination of line and load conditions		
RECOVERY TIME	0.15 seconds under worst conditions	0.2 seconds under worst conditions	0.5 seconds under worst conditions

Contact your local Sorensen representative, or write for further information. If you have special requirements in magnetic amplifier DC sources, write or call the Applications Engineering Department, and your problem will receive prompt attention.

SORENSEN & COMPANY, INC. • 375 FAIRFIELD AVE., STAMFORD, CONN.

**Reg. U.S. Pat. Off.*

CONTROLLED POWER FOR RESEARCH AND INDUSTRY

SORENSEN

CIRCLE 224 ON READER-SERVICE CARD FOR MORE INFORMATION

Directional Couplers

Cover 225-4000Mc

Four new models of wide-band coaxial directional couplers are valuable for microwave power monitoring and measurement, or as fixed attenuators. Available in 20db or 30db coupling values, each coupler covers the complete range of the most widely used bands: 225-460Mc, 460-950Mc, 950-2000Mc, and 2000-4000Mc. The coupling variation over the frequency range of each coupler is less than 1db, while the directivity is higher than 20db over the full band. The vswr of the primary arm is less than 1.15 in all models. The Narda Corp., Dept. ED, Mineola, N. Y.

CIRCLE 225 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Rectifiers

Parts Under Constant Pressure

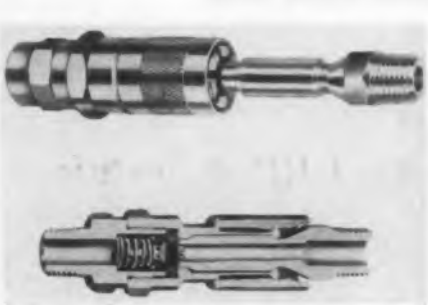
Cells range in physical size from 1″ x 1″ to 5″ x 6″ and, with convection cooling, are rated from 0.180amp to 10.0amp per cell on a single-phase full-wave bridge basis. These ratings are in accordance with the latest NEMA approved specifications for standard applications.

Featured is a "solid stack" assembly in which all mounted parts are under constant pressure provided by end springs. Union Switch & Signal, Div. of Westinghouse Air Brake Co., Dept. ED, Pittsburgh 18, Pa.

CIRCLE 226 ON READER-SERVICE CARD FOR MORE INFORMATION

Coupling

Uses Collet Principle



This coupling utilizes a modified collet principle for instant locking and unlocking. When engaged, it is free to swivel, yet has 80% of the plug shoulder in complete contact with the collet fingers. This new unit has been in constant service during two years of testing on pneumatic and fluid applications.

Double-valve and straight-thru couplers are available on special order. R. S. Corcoran Co., Dept. ED, P. O. Box 1404, Joliet, Ill.

CIRCLE 227 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Supply

Rated to 20amps at 125v

The Model "GF" Universal D-C Power Supply converts a-c to as much as 125v d-c, continuously variable. Rated for loads up to 10amp continuous and 20-amp intermittent, the unit is filtered to less than 1% a-c ripple at 10amp. Special forced-air cooling increases rectifier life and the margin of continuous operational safety. Electro Products Laboratories, Dept. ED, 4501 N. Ravenswood Ave., Chicago 40, Ill.

CIRCLE 230 ON READER-SERVICE CARD FOR MORE INFORMATION

Crystal Holder

For Use with Tripolar Diodes

The miniaturized crystal holder, SL-101, is for use with the new Sylvania Tripolar crystal diodes, types 1N358, 1N369, and 1N369A. The holder incorporates a broad-band bead, which provides a minimum bandwidth of 1 to 12.4kMc. When it is terminated in a matched load, the maximum vswr is 1.6 over the specified frequency range. Input is a type N male connector; the output is a 50 ohm "Microdot" receptacle. Sage Laboratories, Inc., Dept. ED, 38 Guinan St., Waltham 54, Mass.

CIRCLE 231 ON READER-SERVICE CARD FOR MORE INFORMATION

Mercury Vapor Rectifier

For High Voltage Uses

The high-voltage mercury vapor rectifier tube, type 6693, is designed for high and medium voltage rectification. The tube will deliver 9amp up to 12kv in a full-wave, 3-phase power supply. Three tubes, in a 3-phase half-wave power supply, will deliver 6kv at 9amp, using only one filament transformer. Difficulties due to oxidation of the base contact surfaces have been eliminated. Amperex Electronic Corp., Dept. ED, 230 Duffy Ave., Hicksville, L. I., N. Y.

CIRCLE 232 ON READER-SERVICE CARD FOR MORE INFORMATION

Dynamic Pickup

For Low Pressure Measurements

This unit measures either gage or differential pressure in the ranges 0.00-0.05psi and 0.00-1.00psi. High accuracy and resolution characteristics make the pickup particularly suitable for sensitive airflow measurements, vacuum equipment studies, precision altimeters, and medical research equipment. Special construction minimizes acceleration sensitivity. Dynamic Instrument Co., Inc., Dept. ED, 28 Carleton St., Cambridge, Mass.

CIRCLE 235 ON READER-SERVICE CARD FOR MORE INFORMATION

Phenolic Coil Form

For Printed Circuitry

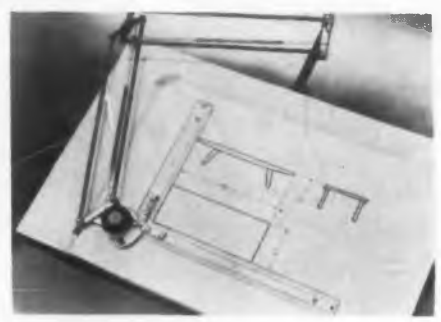
This phenolic coil form, Type SPC, is for printed circuitry. It is available in two diameters with four terminals each, and can be dip soldered after mounting.

The coil form comes complete with threaded slug. The terminal collar is securely fastened to the form. The unit mounts through four holes, as required by the number of terminals. When mounted, the smaller unit is 3/4" high x 0.219" diam, and the larger unit is 3/4" x 0.285" diam. Cambridge Thermionic Corp., Dept. ED, 445 Concord Ave., Cambridge 38, Mass.

CIRCLE 236 ON READER-SERVICE CARD FOR MORE INFORMATION

Drafting Machine

Offered at Low Cost



This accurate, Swedish, drafting machine is offered at a low price. It is constructed of cold-drawn steel tubing and accurately machined steel and plastic parts. It sets and holds any angle. The protractor head reads from 90° through 0° to 45° with automatic quick-set lock every 15°: the head also locks easily at any desired angle between the 15° stops. Walpole Co., Dept. ED, 419 Babylon St., Boston 16, Mass.

CIRCLE 237 ON READER-SERVICE CARD FOR MORE INFORMATION

Variable Delay Network

Works Between Matched Impedances

Unlike tapped delay lines which must be terminated in a high impedance at the selected tap, the No. 300 Series Variable Delay Network provides a variable delay between matched impedances. Available in ranges of 2μsec and 2000μsec, the network affords flexibility in obtaining long delays, with time delay proportional to angular rotation of the control shaft. ESC Corp., Dept. ED, 534 Bergen Blvd., Palisades Park, N. J.

CIRCLE 242 ON READER-SERVICE CARD FOR MORE INFORMATION

Mechanical Assemblies

Vacuum-Tight Units

This firm's line of mechanical assemblies, which is comprised of specially designed hermetic "Vac-Tite" seals for economy and mounting security, has been expanded and now includes color-coded terminal plates, locking safety seals, attached bracket seals, unit headers, and terminal strips. These units have integrally glassed assembly terminals which eliminate the need for soldering terminals to enclosure covers. Hermetic Seal Products Co., Dept. ED, 33 S. 6th St., Newark 7, N. J.

CIRCLE 243 ON READER-SERVICE CARD FOR MORE INFORMATION

Low Pass Filter

Suppresses Radiation Above 40Mc

This low pass filter suppresses radiation of all frequencies above 40Mc, thereby removing a major cause of TVI. It uses a constant K circuit, and is designed for coaxial cable (52 to 72 ohms).

There is negligible insertion loss; and 35db or more attenuation above 50Mc. It will handle up to 200w of r-f power. American Electronics Co., Dept. ED, 1203-05 Bryant Ave., New York 59, N. Y.

CIRCLE 244 ON READER-SERVICE CARD FOR MORE INFORMATION

here's how to get the fast, precise answers you need

for:

- ☐ AUDIO FREQUENCY WAVEFORM ANALYSIS
- ☐ ULTRASONIC WAVEFORM ANALYSIS
- ☐ RF, VHF and UHF SPECTRUM ANALYSIS
- ☐ MICROWAVE SPECTRUM ANALYSIS
- ☐ SONIC AND ULTRASONIC FREQUENCY RESPONSE TRACING

...and many other analysis and measurement problems...

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RADIO PRODUCTS, INC.

the pioneer— for instruments designed to your needs.

Shown here are just a few of the many instruments Panoramic has designed to meet your needs for rapid yet accurate analysis and measurement. Send for Panoramic's Catalog and find out how Panoramic can give you the right answer to your research, development and production problems. Our specialists are available for consultation without obligation.

LP-1—AP-1 PANORAMIC SONIC ANALYZER for Audio Frequency Waveform Analysis—20 cps—20 kc.

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SPA-1—PANORAMIC SPECTRUM ANALYZER for Microwave Spectrum Analysis—50 mc—4000 mc.

SG-1—PANORAMIC SWEEP GENERATOR for Sonic and Ultrasonic frequency response tracing—20 cps—200,000 cps with one instrument.

Write today for complete Catalog and prices. Inquiries invited for development of special Panoramic analyzers.

PANORAMIC RADIO PRODUCTS, INC.

15 S. Second Ave., Mount Vernon, N.Y., MO 4-3970

CIRCLE 246 ON READER-SERVICE CARD FOR MORE INFORMATION

Battery Charger

In Variety of Models

The "Style EW" Battery Charger is a "floating type", built to provide continuous service, with current control from a few mils to maximum. The high reverse characteristics of its selenium cells prevents the batteries from discharging through the rectifier.

Models are now available for 115v and 230v, single-phase input, and outputs of 0-1amp, 0-3amp, and 0-6amp for batteries of 12v, 24v, 48v, and 120v. The Electronic Rectifier Co., Dept. ED, 126 Argyle St., Rochester 7, N. Y.

CIRCLE 247 ON READER-SERVICE CARD FOR MORE INFORMATION

Signal Generator

Combined With Sweep Unit

The "Sweepalator" will serve as a combined signal generator and sweep generator. It features decade switching, crystal CW or center frequencies, and wide-range calibrated output. Specifications include: range, 10kc to 1.5Mc; steps, 1kc in 3 decades; interpolation, calibrated 0-1kc; accuracy, 100cy; short term stability, ±25cy; harmonic content, 3% max; output, 3v rms; attenuator, 3v, 1v, 0.3v, 0.1v, 0.03v, 0.01v full scale; meter, calibrated 0-1v and 0-3v. Decade Instrument Co., Dept. ED, Box 153, Caldwell, N. J.

CIRCLE 248 ON READER-SERVICE CARD FOR MORE INFORMATION

Vane Axial Fan

For Aircraft Electronic Units

This compact vane axial fan is less than 7" x 4" x 5-1/4". The unit delivers 60cfm at 5" pressure water gage, and 112cfm at 1". It is designed and built especially to meet the service requirements of aircraft installations, is oil proof and explosion proof. Ilg Electric Ventilating Co., Dept. ED, 2850 N. Pulaski Rd., Chicago 41, Ill.

CIRCLE 249 ON READER-SERVICE CARD FOR MORE INFORMATION

110v Power Supply

Portable, Battery-Operated Unit

The "Carter-Pak" is a complete "carry-out" power plant in a package. The carrying case contains a 12v aircraft storage battery, a frequency-controlled d-c to a-c rotary converter, and a battery charger which can be plugged into any a-c outlet to replenish the battery when required. Output is 110v a-c for operating dictating machines, recorders, amplifiers, laboratory apparatus and similar equipment. Carter Motor Co., Dept. ED, 2644-A N. Maplewood Ave., Chicago 47, Ill.

CIRCLE 252 ON READER-SERVICE CARD FOR MORE INFORMATION

Coil

Uses Ceramic Phenolic Covering

A ceramic phenolic covering holds both the coil and leads firmly in place in this unit, eliminating the need for terminals. Various colors may be provided in the covering. The OD of the ceramic form is ground to ±0.002" to insure uniform electrical characteristics. The forms are silicon impregnated. All metal parts are alloy plated. The coils meet all applicable MIL specs. National Coil Co., Dept. ED, 3001 N. Main St., Sheridan, Wyo.

CIRCLE 253 ON READER-SERVICE CARD FOR MORE INFORMATION

D-C Supply

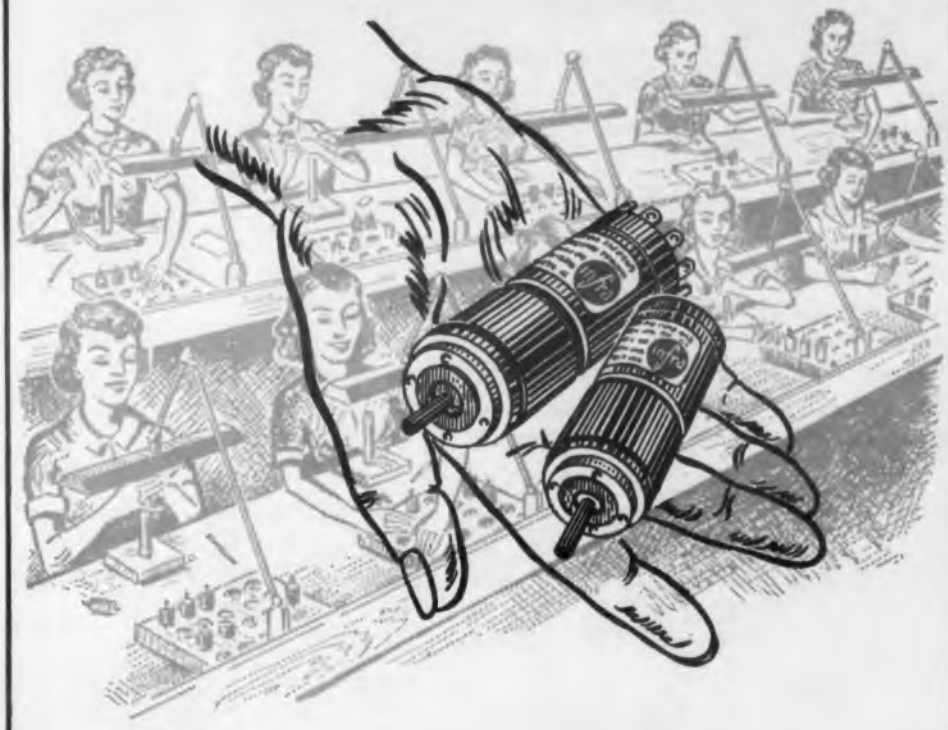
Output Set with 2mv Accuracy

Designed especially for instrument calibration work, the Model 406 D-C Supply features high resolution and excellent stability. Coarse, fine, and vernier output controls permit setting the output to within 2mv of the value desired over the entire 530v range. Regulation against 20% line voltage change or 100ma load change is 0.01% or 50mv. Ripple is less than 1mv, and short term stability is better than 0.01%. John Fluke Mfg. Co., Inc., Dept. ED, 1111 W. Nickerson St., Seattle 99, Wash.

CIRCLE 254 ON READER-SERVICE CARD FOR MORE INFORMATION

infra *announces . . .*

IMMEDIATE DELIVERY



of TACHOMETER GENERATORS

Type MG 100 (MK 16 MOD 0) (Size 18)
Type MG 110 (MK 12 MOD 0) (Size 15)

CHARACTERISTICS	MG100	MG110
Voltage excitation at 400 cps	115/115	115/115
No load speed (min. RPM)	4800	4800
Stall Torque (min. in oz.)	2.35	1.45
Power input (nom. watts at stall)	9.5	6.1
R (nom. ohms at stall)	280	490
X (nom. ohms at stall)	575	890
Z (nom. ohms at stall)	640	1030
Reff. (nom. ohms at stall)	1400	2200
GENERAL CHARACTERISTICS		
Voltage excitation at 400 cps	115	115
Power input (nom. watts at stall)	5.4	5.4
R (nom. ohms at stall)	1012	1012
X (nom. ohms at stall)	1210	1210
Z (nom. ohms at stall)	1575	1575
Reff. (nom. ohms at stall)	2440	2440
Output Volts/1000 rpm	3.2	3.2
Phase Shift (nom. degrees)	5	5

Above Units may also be supplied with High impedance control windings in motor sections.

Write today for specifications and prices!

DESIGN, DEVELOPMENT and PRECISION
MANUFACTURING OF ELECTRONIC and ELECTRO-
MECHANICAL COMPONENTS and SPECIALIZED SYSTEMS

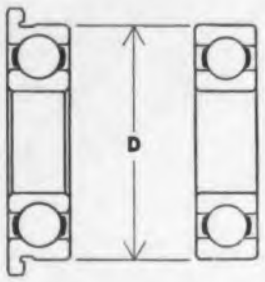
infra

INFRA ELECTRONIC CORPORATION
ROSELAND, NEW JERSEY

CIRCLE 255 ON READER-SERVICE CARD FOR MORE INFORMATION

A NEW COST-SAVING FEATURE of Fafnir Flanged Instrument Bearings

Simplification of housing designs is made possible by the addition of flanged bearings with *straight outside diameters* in several sizes that match those of Fafnir unflanged or plain radial ball bearings. Now, one-size, straight bored housings may be planned. This new series of flanged bearings is available with or without shields. For additional information, write The Fafnir Bearing Company, New Britain, Connecticut.



FLANGED BEARING NUMBERS	OUTSIDE DIAMETERS	BORE	EXTRA SMALL SERIES RADIAL BEARING NOS.
F33K3	.3750	.1250	33K3
F33K5	.5000	.1875	33K5
FS1K7	.6250	.2500	S1K7
FS3K	.8750	.3750	S3K

Atomizer Wash

PATHWAYS TO PRECISION
The atomizer wash given to Fafnir Instrument Ball Bearings illustrated at the left is typical of the extremes to which Fafnir will go to assure the maximum of consistent high quality. The operation takes place in air-conditioned areas where the air is slightly pressurized and thoroughly cleaned.

Write for latest catalog.

CIRCLE 256 ON READER-SERVICE CARD FOR MORE INFORMATION

D-C Power Supplies

In Wide Variety of Ratings

Illustrated is a typical "Sel-Rex Reactronic", a regulated d-c power supply unit for continuous output of 5-amp at 150v. Static regulation is ±1% from no load to full load. These units are available from 4 to 300v capacities, current values from 1 to 50,000amp. Bart-Messing Corp., Dept. ED, 229 Main St., Bellville 9, N. J.

CIRCLE 257 ON READER-SERVICE CARD FOR MORE INFORMATION

Non-Abrasive Grommets

For Aircraft and Electronic Uses

The S11154 series of non-abrasive one-piece grommets are fabricated of "Kelon-T" (Teflon). Designed for use in aircraft and electronic applications to guide cables and conduits through bulkheads, they resist chemical action and heat. The natural slipperiness of "Kelon-T" and smooth rounded edges minimize abrasion. They can be installed easily in blind locations. Shamban Engineering Co., Dept. ED, 11617 W. Jefferson Blvd., Culver City, Calif.

CIRCLE 258 ON READER-SERVICE CARD FOR MORE INFORMATION

Thermistor Detectors

Can Sense Infrared in 2Millisec

"Optitherm" Infrared Detectors can sense infrared radiation in as little as 2millisec, and are also rugged, stable, and long-lived devices. The sensitive elements are 0.01mm rectangular flakes of thermistor material. The detectors are available with standard silver chloride or KRS-5 windows, or with special windows on order. Housings are hermetically sealed and do not require a vacuum. Barnes Engineering Co., Dept. ED, 30 Commerce Rd., Stamford, Conn.

CIRCLE 259 ON READER-SERVICE CARD FOR MORE INFORMATION

DATA SHEET

FAIRCHILD PRECISION POTENTIOMETERS

Type 920
1" diameter

Ten-turn Potentiometer (24½" coil length)

This unit has only one-half the diameter and one-third the weight of usual standards. Its all-metal case construction results in greater rigidity and strength, and sustained higher electrical and mechanical accuracy throughout the life of the unit. The Type 920 offers superior resistance to severe environmental conditions. Available with servo, threaded bushing or pilot 3-hole mounting – and ball bearings. 200,000 ohms max. resistance; standard linearity, ± 0.25% (±0.1% special). Low starting torque of 1 oz. in.

SAMPLES AVAILABLE ON ORDER

Fairchild's more complete line can help solve all your precision potentiometer problems. For more information write Fairchild Camera and Instrument Corporation, Potentiometer Division, 225 Park Avenue, Hicksville, L. I., N. Y., Dept. 140-63N2.

CIRCLE 260 ON READER-SERVICE CARD FOR MORE INFORMATION

A Motor for LOW SPEED OPERATION

If you are now manufacturing a product or developing a product where you need motion at slow speed, here is the motor for you. Hundreds of thousands now in use on cooking appliances, vending, coin operated, amusement, and advertising displays.

These AC gear motors are precision built and are being manufactured in volume for immediate delivery. For further information, send the requirements of your application to us. Special motors are built to meet your new product needs. Write today for data sheet.

MOTORESEARCH COMPANY
1600 JUNCTION AVENUE
RACINE, WISCONSIN

Designers and Manufacturers of
SPECIAL INDUCTION MOTORS

CIRCLE 261 ON READER-SERVICE CARD FOR MORE INFORMATION

Variable Speed Reducer

1/3hp Unit Weighs only 5-1/4 lb

The Model 143 "Zero-Max" infinitely variable speed reducer has a constant torque rating of 30 in-lb throughout its speed range of true zero to 1/4 the input speed (0-450-rpm with an 1800rpm input speed). At about 400-rpm it is rated at 1/3hp. Speed can be changed while running. Heat is not developed at zero speed. It weighs 5-1/4 lb. Reveo, Inc., Dept. ED, 2 E. Franklin Ave., Minneapolis, Minn.

CIRCLE 264 ON READER-SERVICE CARD FOR MORE INFORMATION

Tube Test Kit

Takes All Radio and TV Tubes

Tube Tester Kit 327A will test all tubes in use in all current-model radio, FM, and TV sets, including color TV. Free point selector system circuitry protects against obsolescense, and double fuse protection for both the meter and transformer gives protection against damage. The tester provides for reactivating picture tubes. General Electronic Equipment Co., Dept. ED, Mantua and Glendale Sts., Easton, Pa.

CIRCLE 265 ON READER-SERVICE CARD FOR MORE INFORMATION

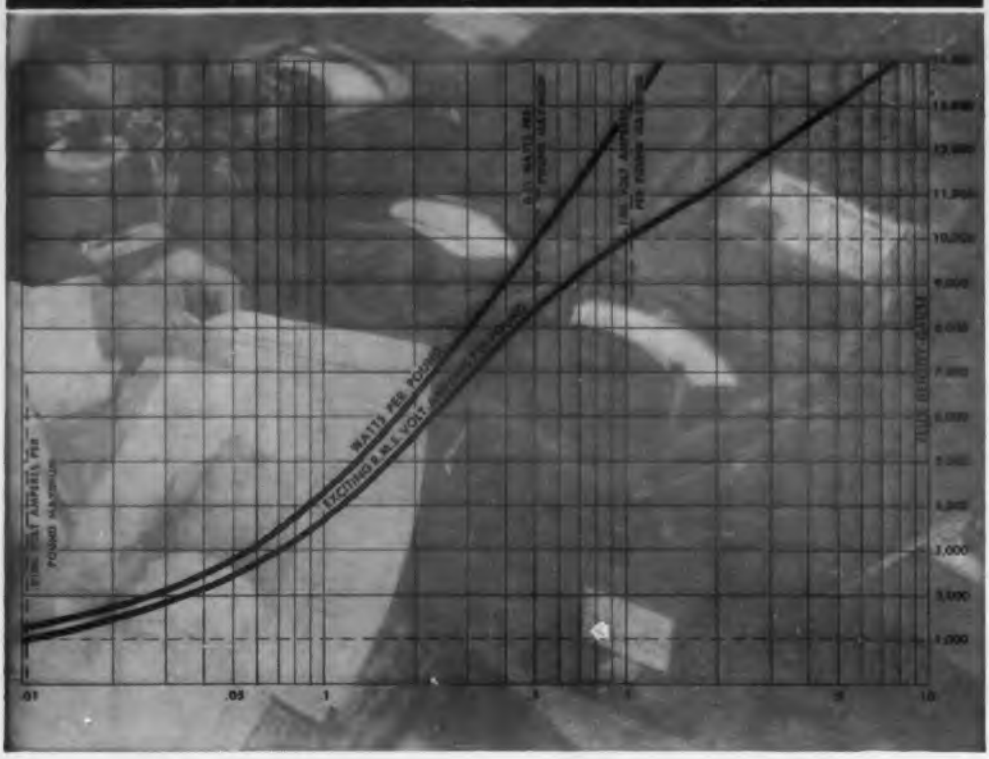
Adapter Nut

With Floating Lock

This adjustable "Glenlock" adapter nut with a "floating lock" has been used on production by one of the "big three" auto companies for over a year and is now available to industry. The "floating lock" is hinged into the nut itself by peening, so it cannot come off. Yet it is a separate piece that moves freely in locking and unlocking. They lock over milled drift slats or flats. The J. C. Glenzer Co., Dept. ED, Ferndale, Mich.

CIRCLE 266 ON READER-SERVICE CARD FOR MORE INFORMATION

Lamination users can now correlate va. and core loss figures with applications



The above curve shows the maximum va. and watt loss of EI 1¼" 29 gauge Orthosil 3X laminations.

As a lamination user, you will want to know that guaranteed maximum va. and core loss is available for standard EI transformer laminations and that you can correlate the figures for your own applications.

This valuable information is offered exclusively by Thomas & Skinner. For several years, Thomas & Skinner has accumulated data on standard EI laminations. Based upon an analysis of this information, T&S has established maximum va. and maximum core loss values of each EI lamination at 1,000 and 10,000 gauss, 60 CPS.

A MATERIAL CERTIFICATION is furnished with each shipment of T&S laminations, and gives test figures for both core loss and exciting current on each heat annealed. This CERTIFICATION attests that each shipment meets the specifications set by the customer.

To you — as a lamination user — these test figures mean elimination of need for retesting, adding up to important savings in your production.

WRITE TODAY for Technical Bulletin DMF-1 giving test details and tables showing core loss and maximum va. Also request new 40-page Bulletin No. L-355 (illustrated below), on special and standard laminations.

SPECIALISTS IN MAGNETIC MATERIALS . . .

Permanent Magnets *Laminations* *and Wound Cores*

Thomas & Skinner, Inc.

1157 E. 23rd STREET, INDIANAPOLIS, IND.

CIRCLE 268 ON READER-SERVICE CARD FOR MORE INFORMATION

Characteristic-Curve Tracer

For Vacuum Tube Analyses

The Type 570 Characteristic-Curve Tracer displays families of characteristic curves calibrated to permit current and voltage readings directly from the screen. Features include: curves per family adjustable from 4 to 12; ability to plot six different characteristic curves (E_p-I_p, E_g-I_p, E_p-I_{g2}, E_g-I_{g2}, E_p-I_g, and E_g-I_g), and a variety of ranges. Tektronix, Inc., Dept. ED, P. O. Box 831, Portland 7, Ore.

CIRCLE 269 ON READER-SERVICE CARD FOR MORE INFORMATION

Thyratron Tube Analyzer

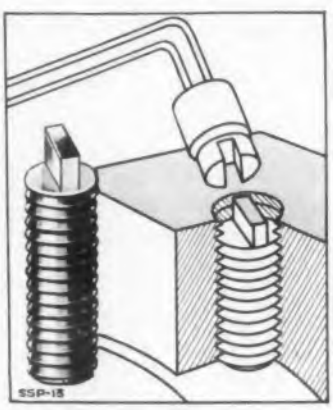
Provides Actual Operating Circuit

With this unit, a thyratron actually functions in an operating circuit with meters indicating operating points, permitting quick comparison with tube manufacturer's specifications and curves, and automatic indication of critical grid volts. An average arc drop voltmeter provides direct indication. Alectric Manufacturing Co., Dept. ED, 7842 39th Ave., Kenosha, Wis.

CIRCLE 270 ON READER-SERVICE CARD FOR MORE INFORMATION

Set Screw

Slabbed Type for Flush Mounting



"Flush-Lok" slabbed-head set screws are for applications in which the slab portion cannot extend beyond the tapped hole. In addition, there is a positive locking action that is effectively retained in all positions. Also, being flush with the surface, the screw becomes practically tamper-proof as well as resistant to accidental removal. A special wrench is provided to use when removal is desirable. Set Screw & Mfg. Co., Dept. ED, Main St., Bartlett, Ill.

CIRCLE 271 ON READER-SERVICE CARD FOR MORE INFORMATION

U-Clamp

Eliminates Tying of Wires

A U-Clamp offered by this firm is molded of type FM 10001 Nylon and will withstand constant operation at 250°F. Known as the Type 201, it eliminates tying and facilitates quick changes in the routing of wires.

The clamp is a two-piece assembly consisting of a U shape and keeper plate. The U shape is serrated and designed for permanent attachment to a chassis. The keeper is pushed over the ends of the U and comes to rest in the proper position for retaining the wires firmly in place. To change, add, or remove wires, the ends of the U are simply pressed toward each other and the keeper is removed. Dakota Plastics Co., Dept. ED, 810 N. Mayo Ave., Compton, Calif.

CIRCLE 274 ON READER-SERVICE CARD FOR MORE INFORMATION

Tolerance Indicator

For Testing of R-L-C Components

The FT-KZS Tolerance Indicator permits rapid testing of resistors, capacitors, and inductors by comparison with an external standard. Direct readings in per cent are given on a 4" meter with four tolerance ranges providing sensitivities as high as 2.5% full scale. The wide range of measurements include 10 ohm to 1 megohm, 10mmfd to 1mfd, and 100μh to 2mh with an accuracy of $\pm$5% of full scale. With a separate accessory meter, sensitivity of 0.01% division is available, equivalent to 0.5% full scale. Size is 12-1/2" x 9" x 9", and weight is 15 lb. The unit is self-contained and easily portable. Instrument Div., Federal Telephone and Radio Co., Dept. ED, 100 Kingsland Road, Clifton, N. J.

CIRCLE 273 ON READER-SERVICE CARD FOR MORE INFORMATION

If you need a special component, send a brief statement of your specifications addressed to Bulletin Board, Electronic Design, 19 E. 62nd St., New York 21, N. Y. Include your complete address.

Inductances

With Indented Turns for Tapping

"Air Dux" air-wound inductances offer two design features that give them high adaptability in meeting the engineering demands of r-f transmission equipment. They may be made with a change in the pitch of the winding for higher Q's, and they have indented alternate turns that can be utilized for greater ease of tapping. Illumitronic Engineering, Dept. ED, 680 E. Taylor, Sunnyvale, Calif.

CIRCLE 277 ON READER-SERVICE CARD FOR MORE INFORMATION

Ganged Potentiometer

Up to 17 Taps Per Section

The Series Y "Helipot" precision potentiometer is a single, continuous-rotation component designed for servo or bushing mounting. As many as 14 sections may be ganged on a common shaft during manufacture, with as many as 17 taps added to any section. Each tap is spot-welded to a single turn of resistance wire. Helipot Corp., Dept. ED, 916 Meridian Ave., South Pasadena, Calif.

CIRCLE 278 ON READER-SERVICE CARD FOR MORE INFORMATION

Pulse Delay Generator

With 0.1 μsec Increments

The 1000-A is a precision variable time delay generator which provides a positive pulse variable in delay in increments of 0.1 μsec. The delay is obtained by gating a single pulse from an accurately generated train of pulses spaced 1.0μsec apart. Orbitran Co., Dept. ED, Lakeside, Calif.

CIRCLE 279 ON READER-SERVICE CARD FOR MORE INFORMATION

Magnetic Amplifiers

A Wide Range of Stock Units

Stock units are available over wide ranges of impedance, power gain, response time, and supply frequency. Toroidally wound reactors are used throughout, and the units are available in hermetically sealed cases or plastic-encapsulated forms.

The Type 402, illustrated, is a two-stage amplifier. Power gain is 2,000,000; input impedance 200 ohms; load impedance 3000 ohms; supply frequency 400cy at 115v, and response time 1 sec. All necessary rectifiers are self-contained. Hycor Co., Inc., Dept. ED, 11423 Vanowen St., N. Hollywood, Calif.

CIRCLE 284 ON READER-SERVICE CARD FOR MORE INFORMATION

Glow Transfer Register

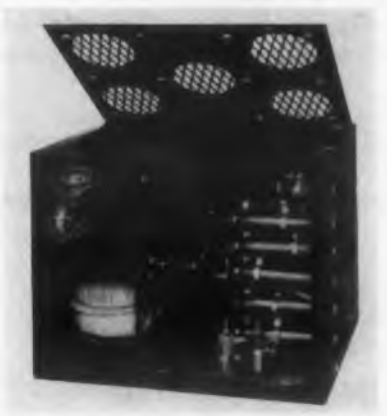
Permits Preset Counts to 1 Billion

The GT-6 Glow Transfer register is used in conjunction with this firm's Model 200 Scaler. The register is exceptional in that a preset count of any number from 10 to a billion may be selected. Radiation Instrument Development Laboratory, Dept. ED, 2337 W. 67th St., Chicago 36, Ill.

CIRCLE 285 ON READER-SERVICE CARD FOR MORE INFORMATION

Voltage Regulators

Employ Mag-Amps



A line of magnetic amplifier voltage regulators is built by this firm to customer specifications. The typical unit illustrated takes a 120v single-phase 400cy input and delivers a d-c output of 15-150v at 0.05 - 0.50amp (to fields of exciter); va rating is 50; voltage adjustment is ±10%, and regulation accuracy is ±1%. Dimensions are 13" x 11" x 10"; weight is 35 lb (approx). Perkin Engineering Corp., Dept. ED, 345 Kansas St., El Segundo, Calif.

CIRCLE 286 ON READER-SERVICE CARD FOR MORE INFORMATION

Delay Line

With 5,000μsec Overall Delay

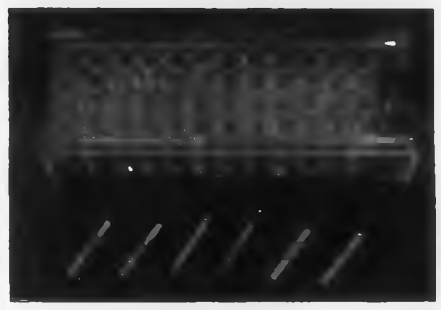
Model DL 0510-400/125 Delay Line is a precision, low - attenuation unit, developed for correlation measurements and waveform analysis covering sub-audio and audio frequencies. Overall delay is 5000μsec. Characteristic impedance is 510 ohms.

Taps are available on this unit every 40μsec. Calibration accuracy at each of 125 taps is $\pm$0.1μsec, and insertion loss is 1.7db. Cut-off frequency is 9kc, and phase linearity is $\pm$1% up to 5kc. The unit size is 19″ x 6″ x 6″ for relay rack mounting. Epsco, Inc., Dept. ED, 588 Commonwealth Ave., Boston, Mass.

CIRCLE 195 ON READER-SERVICE CARD FOR MORE INFORMATION

Tape Resistor Kit

Povides MIL-R-11A Ratings



Designed for laboratory use in experimental or development work involving the use of tape resistors, the Type RNP-1C Kit includes 10 each of the 49 standard MIL-R-11A values from 100 ohms to 1 megohms, inclusive, in 10% tolerance. The entire kit is packaged in a compartmented case of heavy-gage polystyrene plastic. Hansen Electronics, Dept. ED, 7117 Santa Monica Blvd., Los Angeles 46, Calif.

CIRCLE 196 ON READER-SERVICE CARD FOR MORE INFORMATION

Cap and Set Screws

Miniature Hex-Socket Types

A complete line of miniature hex-socket cap and set screws, in diameters from No. 0 through No. 3, is now produced by this firm. Lengths run from 1/8″ to 1/2″; cap and set screws are manufactured in both coarse and fine series, unified threads, except No. 0 and No. 1 diameters, which are standard in fine series only. Allen Mfg. Co., Dept. ED, Hartford, Conn.

CIRCLE 197 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature Oscillograph

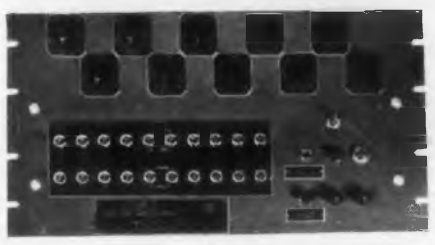
Has Precision of Larger Units

This cathode-ray oscillograph, Type 331, is particularly suited for field or laboratory testing and servicing of many types of electronic computers, as well as a variety of other equipment. The instrument weighs only 19 lb. Allen B. DuMont Laboratories, Inc., Dept. ED, 750 Bloomfield Ave., Clifton, N. J.

CIRCLE 294 ON READER-SERVICE CARD FOR MORE INFORMATION

Sequence Timer

Has 10 Stages

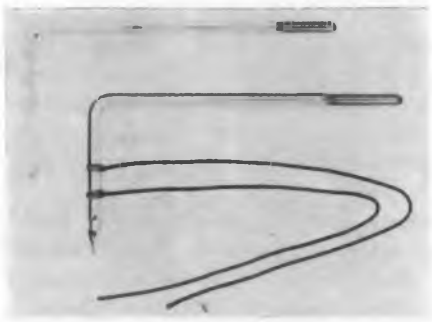


This timer, for use in the controlling of a sequence of events, contains 10 stages of thyratron-controlled time-delay circuits. The length of delay of each stage can be varied from 10 millisec to 2sec in 10 steps. Each stage may be controlled either automatically or manually by the use of switches on the front panel. Any of the 10 stages can be switched in or out of the sequence at will. Chicago Electronic Laboratories, Dept. ED, 1214 W. Madison St., Chicago 7, Ill.

CIRCLE 295 ON READER-SERVICE CARD FOR MORE INFORMATION

Thermometer/Thermostat Sets

Preset Types



A line of thermometer/thermostat sets is offered specifically for precision temperature control systems. The thermostats are 90° angle form, stem immersion type. Three standard models are offered, pre-set for operating temperatures of 125°, 190°, and 265°C, respectively. Precision Thermometer and Instrument Co., Dept. ED, 1434 Brandywine St., Philadelphia 30, Pa.

CIRCLE 296 ON READER-SERVICE CARD FOR MORE INFORMATION

5mm Equipment

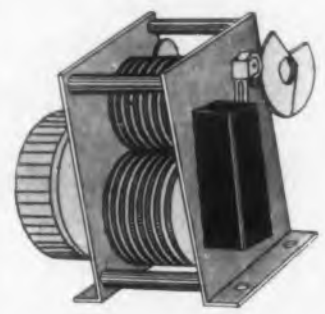
For Frequency Range of RG-98/U

A complete line of 5mm equipment, operating over the full waveguide frequency range of the RG-98/U waveguide (50.00-75.00kMc), has been made available by this firm. A slotted section, flap attenuator, tunable detector mount, E/H tuner, frequency meter, termination, sliding short, horn, harmonic generator, bends, tees, transmission line stand, klystron tube mount, and power supply are available. Equipment is also available for RG-97/U waveguide. Electronics & X-ray Div., F-R Machine Works, Inc., Dept. ED, 26-12 Borough Pl., Woodside 77, N. Y.

CIRCLE 299 ON READER-SERVICE CARD FOR MORE INFORMATION

10-Speed Timer

Operates at 1 rpm to 1 rev/month



This timer and program control instrument is offered at very low cost. It provides 10 instantly selected speeds which move a cam or program disk in one revolution per every 1, 5, or 15 minutes; 1, 4, or 12 hours; 1 or 2-1/3 days; or 1 or 4 weeks. A pick-up gear is merely slid along its shaft to the speed desired. Gorrell & Gorrell, Dept. ED, Haworth, New Jersey.

CIRCLE 300 ON READER-SERVICE CARD FOR MORE INFORMATION

Voltmeters

Accurate to ½ %

This line of d-c Expanded Scale Voltmeters for panel mounting is accurate to 1/2% of input voltage. The meters offer a linear scale which includes only the useful portion of the scale; the rest has been entirely eliminated to give highest readability. Arga Div., Beckman Instruments, Inc., Dept. ED, 220 Pasadena Ave., South Pasadena, Calif.

CIRCLE 301 ON READER-SERVICE CARD FOR MORE INFORMATION

Model "SP" ROTARY
Alaska Gray and Seal Brown

The DURANT "SP"
Predetermined Counter
(CLOSES SWITCH AT END OF PRE-SET COUNT)

PREVENTS COSTLY OVERRUNS

This SMALL, COMPACT Productimeter has hundreds of applications in all phases of industrial production. Make exact production runs to any predetermined count you set.

Extremely rugged, fast and accurate the "SP" Productimeter will eliminate wasteful over- or under-runs. It will turn on a light, ring a bell or stop the machine. Available in ROTARY or STROKE models.

Send for Catalog No. 45

DURANT MANUFACTURING CO.
1993 N. Buffum St., Milwaukee 1, Wis.
193 S. Water St., Providence 3, R. I.
Representatives in Principal Cities

PRODUCTIMETERS SINCE 1879 *Count Everything*

CIRCLE 304 ON READER-SERVICE CARD FOR MORE INFORMATION

This fastener works through thick and thin!

Spring-Lock works whether panel thicknesses run over or under specifications. Spring wire deflects automatically to handle greater or lesser thicknesses. Made in all-metal and plastic with steel insert, it can be adapted as a shelf-support, washer knob, bracket or any similar panel-mounted device.

Write for 40-page catalog on complete line, containing application examples, specifications, installation instructions and engineering data. Ask for samples, too.

Here's how Spring-Lock Works


Insert Fastener


Half-turn to lock

INSTALLATION IS:
- **BLIND**
- **EASY:** No special tools needed
- **QUICK:** Half-turn locks it in place
- **SECURE:** Spring steel locks, resists vibration

SIMMONS FASTENERS
Quick-Lock • Spring-Lock • Roto-Lock • Link-Lock • Dual-Lock

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

CIRCLE 305 ON READER-SERVICE CARD FOR MORE INFORMATION

Oscilloscopes
Available in Console Cabinets

Electromec Large Screen Oscilloscopes in all 1700 Series Models can be installed in this modern console type cabinet for greater convenience of the operator. The console oscilloscope, utilizing a 17" rectangular tube, is especially useful for test set-ups where work can be placed in front of the operator during test. The oscilloscopes are designed for detailed observation of data or complex signals. The console makes them easy to use for data plotting, production test, wave form analysis, and display applications. Electromec, Inc., Dept. ED, 3200 N. San Fernando Blvd., Burbank, Calif.

CIRCLE 306 ON READER-SERVICE CARD FOR MORE INFORMATION

A-C Power Source
With Frequency Accurate to 0.001 %

The "Invertron" is designed to provide a-c power outputs of exceptional stability and accuracy. Units are available in a series of models that provide a wide range of output frequencies and power ratings. The unit shown has a continuous power output of 160va single phase, with output frequency continuously variable from 360cy to 450cy. Behlman Engineering Co., Dept. ED, 114 S. Hollywood Way, Burbank, Calif.

CRCLE 307 ON READER-SERVICE CARD FOR MORE INFORMATION

D-C Relay
Resists Tough Shock, Vibration

The No. 64-243 Relay has vibration immunity up to 10g between 10-500cy; ability to withstand extreme shock of 30g; and it operates in the ambient range of −65° to +125°C. Contact rating is 25amp resistive at 29v d-c. These characteristics far exceed MIL-R-6106. U. S. Relay Co., Dept. ED, 1744 Albion St., Los Angeles 31, Calif.

CIRCLE 308 ON READER-SERVICE CARD FOR MORE INFORMATION

FOR RELIABILITY AND LONG LIFE IN ELECTRONIC COMPONENTS . . .

Use
NICKEL and NICKEL ALLOY
Wire and Strip

Electron tubes, lamp leads, interference shielding, magnetostrictive components, thermostat parts, fine wire springs, and hundreds of other electronic applications rely on Nickel and Nickel Alloy Wire and Strip for dependable performance and long service life. Good electrical properties, high mechanical strength, excellent resistance to high temperatures and corrosion are the properties that make the Nickel group of metals a must in electronic design. We can supply you with wire and strip in Nickel, Monel, Inconel, Nickel Irons, Incoloy and special processed Gas-Free Nickel and Gas-Free Nickel-Iron Wire for your electronic applications.

Nickel-clad and Inconel-clad copper wire are also available for applications requiring high electrical conductivity plus outstanding resistance to high temperatures. Send today for free 40-page Nickel Handbook.

Ask about our High-Emissivity Aluminum-clad Steel Strip.

ALLOY METAL WIRE DIVISION
H. K. PORTER COMPANY, INC.
Prospect Park, Pennsylvania

CIRCLE 309 ON READER-SERVICE CARD FOR MORE INFORMATION

MISSILE

SYSTEMS

PHYSICISTS AND ENGINEERS

■

Research and development in the technology of guided missiles is not confined to any one field of physics. Broad interests and exceptional abilities are required by the participants. Typical areas at Lockheed Missile Systems Division include:

- Applied mathematics such as the numerical solution of physical problems on complex computers
- Analytical systems analysis of guidance and control problems
- Ballistics and the integration of ballistic type missiles with vertical guidance
- RF propagation, microwave and antenna research and development
- Integration of ground and flight test data to evaluate dynamic performance
- Stress and structures
- Instrumentation and telemetering
- Advanced electronics and radar systems

Continuing developments are creating new positions for those capable of significant contributions to the technology of guided missiles.

■

Lockheed

MISSILE SYSTEMS DIVISION

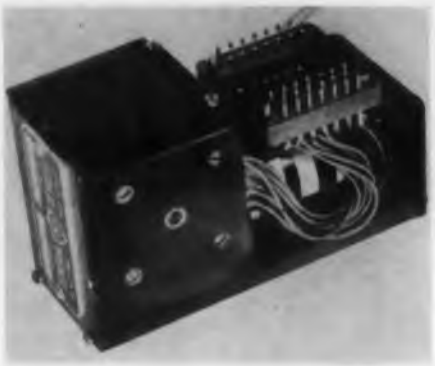
research and engineering staff

LOCKHEED AIRCRAFT CORPORATION

VAN NUYS • CALIFORNIA

Sampling Switch

For Telemetering, Recording



The Model No. 1205 is a high-speed sampling switch for telemetering, data recording, and related applications. It has two synchronized poles, with 30 contacts per pole. Fifteen alternate contacts and collector rings per pole are tied to individual plugs. The unit has a self-contained 5cy motor. General Devices, Inc., Dept. ED, P. O. Box 253, Princeton, N. J.

CIRCLE 310 ON READER-SERVICE CARD FOR MORE INFORMATION

Filters

High Insertion Loss Types

A complete series of extremely small, high-insertion-loss filters is offered for aviation and mobile electrical and electronic equipment.

These bulkhead-mounting interference filters are available in production quantities in ratings from 0.1amp to 20amp, for both 125v d-c and 125v 400cy service. Sprague Electric Co., Dept. ED, 347 Marshall St., North Adams, Mass.

CIRCLE 311 ON READER-SERVICE CARD FOR MORE INFORMATION

Brake-Motor

For 10-Minute Intermittent Duty

This unit is desirable wherever short span power (5 - minutes - on - and - 5-minutes - off) is needed. Dimensions are only 8-5/8" OD x 7-5/8" over - all length.

Starting torques of this brake-motor aro up to 500% of running torque. This provides sufficient power to overcome starting inertias of heavy loads or those stuck or "frozen". Reuland Electric Co., Dept. ED, Alhambra, Calif.

CIRCLE 312 ON READER-SERVICE CARD FOR MORE INFORMATION

American Electric Model 201D HYSTERESIS SYNCHRONOUS MOTOR FOR REFERENCE TIMING APPLICATIONS

This totally enclosed miniature hysteresis synchronous motor develops 5gm. cm. minimum torque, operates at 12,000 r.p.m. synchronous, continuous duty on 115 V., single phase, 400 cycle ac. Ambient temperature range is −55°C to +65°C. Diameter: 1.450" Length: 1.562. Weighs only 5.5 oz. Built to MIL M 7969 specifications.

Many Other Models Fully Developed

American Electric Miniatures are available for operation on 60, 400, 1600, or 2000 c.p.s. or on variable frequencies from 320 to 1200 c.p.s.

TWO TYPES:

INDUCTION — Output torque range from ½ in. oz. to 120 in. oz.

SYNCHRONOUS (Hysteresis or Reluctance Models) Output torque range from .01 in. oz. to 16 in. oz.

Ask for quotations on special requirements!

MODEL 102DA AXIAL FAN MOTOR — Totally enclosed, panel mount, screened intake, high temp. operation 20 CFM N.A.F.M. at free air. O.D. 1.45", 115 V., single phase, 400 cycle, or variable frequency models.

MODEL 430 AIRCRAFT DRIVE MOTOR — 1/12 h.p. 11,000 r.p.m. Teflon insulation. −65° F. to +160° F. Completely qualified to MIL 7969 specs.

MODEL 323 ELEVON ACTUATOR — Develops ½ h.p. at 11,200 rpm. 200 V. line-to-line, 3 phase, 4 wire, 400 cycles. Teflon insulated for −65°F. to +160°F. operation. Meets MIL M 7969 specifications.

MODEL 313 COMBINATION DRIVE & BLOWER — ⅓ h.p. at 7200 r.p.m. 400 cycle, 3 phase, 200 V. Continuous duty. Meets all general MIL specs.

FIELD ENGINEERING OFFICES in all major industrial areas in the United States and Canada.

American Electric Motors, Inc.
Miniature Components Division of
AMERICAN ELECTRONICS INC.
4811 Telegraph Road, Los Angeles 22, California

CIRCLE 314 ON READER-SERVICE CARD

Electric Counters

With Life of 300 Million Counts

Named "Super-Wizards", these improved electric counters have an average life expectancy of 300 million counts. Rated at 1000cpm, they operate at speeds to 1600cpm with suitable actuation.

Current draw of less than 5w permits dependable operation in the plate circuit of electronic tubes having an output of 5w or more. Production Instrument Co., Dept. ED, 706-34 W. Jackson Blvd., Chicago 6, Ill.

CIRCLE 315 ON READER-SERVICE CARD FOR MORE INFORMATION

Impedance-Matching Units

Dispell TV Ghosts

The Type MB units are impedance-matching devices for TV equipment. They are balun units which clear up TV pictures by reducing ghosts and reflections originating in lead lines or through mismatch. They can contribute to picture clarity over the whole range of vhf-uhf frequencies. Lynmar Engineers, Inc., Dept. ED, 1432 N. Carlisle St., Philadelphia 21, Pa.

CIRCLE 316 ON READER-SERVICE CARD FOR MORE INFORMATION

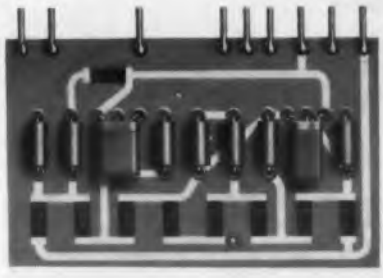
Inductance Bridge

Measures from 0 to 180h

The Type 1002-C is a wide-range incremental - inductance bridge that will measure from 0 to 5h, and 5 to 180h at any frequency from 60 to 1000cy. It is used to measure small choke coils, toroids, relay coils, audio filter coils, and similar applications. Waters Manufacturing, Inc., Dept. ED, 4 Gordon St., Waltham 54, Mass.

CIRCLE 317 ON READER-SERVICE CARD FOR MORE INFORMATION

Solar specials can solve your design problems



We'll build electro-ceramic components and assemblies for any requirement

When chassis space is too small, or ambients too high for standard components—call Solar. Ditto when you need whole circuits condensed into limited-size areas...or many components integrated into a single unit. Solar takes your problem and winds up with the needed special components or sub-assemblies.

Equipped for the job

The Solar research laboratory is amply staffed with personnel experienced in designing specials. Engineering facilities are complete—we even do our own ceramic compounding, which gives us the flexibility to design exactly what you need—or adapt to it. Extensive production facilities, recently expanded, enable us to manufacture your specials in the shortest time possible. No matter how complex your problem, send it in. We'll work with you—in confidence. .

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SOLAR MANUFACTURING CORP.
New York, N. Y.

SOLAR

SALES OFFICES: *46th & Seville, Los Angeles 58, Calif.*
4000 W. North Ave., Chicago 39, Ill.

CERAMIC CAPACITORS • PRINTED NETWORKS • PIEZO CERAMICS

CIRCLE 318 ON READER-SERVICE CARD FOR MORE INFORMATION

PRACTICE MAKES *Perfect*

Consistent quality is a *must* characteristic with Bliley BH9A units.

Resonant wire supports, precision alignment, controlled soldering and plating, are the fine points that get special scrutiny, under binocular microscopes, in Bliley production. These minute details can determine performance of an otherwise perfect crystal.

Bliley BH9A units, in the frequency range 16kc to 250kc, are supplied to individual specifications as military types: CR-37, CR-38, CR-42, and CR-50.

Bliley CRYSTALS

BLILEY ELECTRIC COMPANY

UNION STATION BLDG. • ERIE, PENNSYLVANIA

CIRCLE 324 ON READER-SERVICE CARD FOR MORE INFORMATION

New kind of catalog

Complete facts on cathodes, anodes, grid cups — their characteristics, uses, variety

For the first time, Superior Tube Company's complete line of cathodes and other vacuum tube components appears in a single catalog. Properties of the new CATHALOYS,* plus 19 other alloys, fully covered. A detailed reference for vacuum tube designers on cathode materials, types of cathodes, and fabricated tubular parts. Write for free copy. Superior Tube Company, 2050 Germantown Ave., Norristown, Pa.

Superior Tube

The big name in small tubing

All analyses .010" to ⅜" O.D. Certain analyses in light walls up to 2½" O.D.

CIRCLE 325 ON READER-SERVICE CARD FOR MORE INFORMATION

Mixer-Cleaner

1 Mc Ultrasonic Unit

Consisting of a 1-gal capacity transducer driven by an ultrasonic generator, the Mixer - Cleaner Model 1115 is useful for such diverse applications as blind-hole cleaning, degreasing, mixing of previously immiscible liquids, and removal of radioactive particles. The transducer, in resonance with the generator at 1Mc, activates the cleaning medium ultrasonically and provides positive but gentle cleaning for small fragile parts such as vacuum tube grids, meters and meter movements, printed and soldered circuits, etc. As a mixer, the unit performs such difficult operations as deglomeration, emulsification, and polymerization.

The unit operates with input of 110v 60cy 2-1/2-amp. Power is continuously variable to more than 100w. The entire weight is 60 lb. Alcar Instruments, Inc., Dept. ED, 17 Industrial Ave., Little Ferry, N. J.

CIRCLE 326 ON READER-SERVICE CARD FOR MORE INFORMATION

Maximum Temperature Control In A Minimum Of Space

These miniaturized temperature controls utilize the famous Fenwal THERMOSWITCH® principle. The outer shell is the activating element. That means short heat transfer path, built-in temperature anticipation, control stability and inherent thermostat sensitivity of less than 1°F. That's why they're ideal for such applications as aircraft, guided missiles, antennas, electronic equipment, radar, motors, computers, wave guides, crystal ovens, etc.

MIDGET. Shell is ¼" O.D. and is highly sensitive to changes over entire area. Single wire and two wire types; wide range from −50°F to 500°F; units which either make or break on temperature rise for control of gases, solids, liquids.

MINIATURE. Control within 2°F to 6°F is typical, even under 5G acceleration. Fully adjustable ranges of −20°F to 200°F or −20°F to 275°F. Hermetically sealed units −20°F to 200°F.

Get new, helpful facts on small-space temperature control and detection. Write for free bulletin MC-124, Aviation Products Division, Fenwal Incorporated, 911 Pleasant Street, Ashland, Massachusetts.

Fenwal **Controls Temperature . . . *Precisely***

CIRCLE 327 ON READER-SERVICE CARD FOR MORE INFORMATION

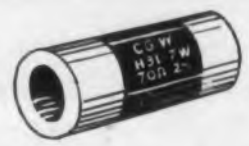
You can get **rugged, stable Corning Film-Type Resistors** in all these styles

LOW-POWER • In 3, 4, 5, and 7-watt sizes. Low-power—and low-cost. High resistance values available. Noninductive. Stocked by Erie Resistor distributors.

STYLE N • Designed for critical tolerance applications, rugged duty. Noise level very low. Extremely stable. Unaffected by moisture.

HIGH-TEMPERATURE—STYLE S • Stable performance up to 200°C. without encapsulation or hermetic sealing. For HF, test equipment, radio and TV, hi-gain amplifiers where low-noise, stable performance is needed.

WATER-COOLED—STYLE WCS • For high-frequency, high-power TV, FM, low-reactance uses. Allows mounting on 3" coax line with both water intake and outlet at RF ground potential. Interchangeable resistance elements.



HIGH-FREQUENCY—STYLE H • Combine high-power with excellent high-frequency characteristics. Resistance film is continuous, spiraled or striped according to resistance range or application. Silver metallized bands fired-on ends for termination. Silicone coated; water-cooled types uncoated.

HIGH-POWER—STYLE R • 25 to 1,000,000 ohms; ratings from 7- to 115-watts; non-inductive. Standard tolerance ±2% 10 to 1,000,000 ohms. Exceptionally good noise and frequency characteristics. Superior moisture resistance and overload capacity.

Now • 6 types ranging from 10Ω to 1MΩ, ratings from .5 W to 150 W, with these advantages.

Stability • You can cycle the resistive element of Corning Resistors from near absolute zero to red heat without damage to electrical properties.

Moisture-Proof • Wet won't affect them. They pass MIL-R-10509A and MIL-R-11804A moisture resistance tests.

Durable • Rough handling doesn't affect them. The film material is fired on at red heat, makes an integral bond with PYREX brand glass base. No special handling needed.

Quiet • No need to use over-size resistors to avoid noise caused by soldering. Fired-in silver bands give low-load resistance, low-noise terminations.

Compact • Couple them close—without damage or noise.

Important • New products and new prices—news in general—happens fast here. Let us keep you posted with our New Products Catalog and supplements. Send the coupon for your free copy.

Corning means research in Glass

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Please send me your New Products Catalog.

Name..... Title.....

Company.....

Address.....

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

CIRCLE 328 ON READER-SERVICE CARD FOR MORE INFORMATION

Stupakoff

CERAMIC MATERIALS

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NEW TECHNICAL DATA on *Stupakoff* CERAMIC MATERIALS

The very latest technical information on a wide range of ceramic materials is given in the new Stupakoff Technical Data Chart. Electrical and physical characteristics and the chemical composition of various grades of the following ceramic materials are included:

ALUMINA	**PORCELAIN**	**ZIRCON**
ALUMINUM SILICATE	**STUPALITH**	**ZIRCITE**
STEATITE	**CORDIERITE**	**FORSTERITE**
	MAGNESIA	

Valuable design and application suggestions included in the Stupakoff Data Chart help you engineer your ceramic parts for lowest cost and greatest satisfaction.

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Stupakoff

Write Dept. ED.

Division of The CARBORUNDUM Company

LATROBE, PENNSYLVANIA

CIRCLE 329 ON READER-SERVICE CARD FOR MORE INFORMATION

Oscillograph

In 36 and 60-Channel Models

The Series 700C Recording Oscillograph is engineered to centralize all automatic operating controls on a front panel and designed to simplify internal adjustments. Record magazines can be loaded in daylight and handle film or paper up to 12" wide. Record speeds range from 1/32 to 144ips. Heiland, Div. of Minneapolis-Honeywell Regulator Co., Dept. ED, 130 E. 5th Ave., Denver, Colo.

CIRCLE 330 ON READER-SERVICE CARD FOR MORE INFORMATION

Transistor Transformer

Measures 3/8" x 3/8" x 3/8"

Now measuring only 3/8" x 3/8" x 3/8", the redesigned No. 8901 Transistor Interstage Transformer has numerous industrial uses in audio amplifiers, hearing aids, control circuits, and other transistorized circuitry. Output and input models of this transformer are also available on special request. All three types are readily available in a fractionally larger size. E-A Div., Telex, Inc., Dept. ED, Telex Park, St. Paul 1, Minn.

CIRCLE 331 ON READER-SERVICE CARD FOR MORE INFORMATION

Vibration Mount

For Airborne Electronics

The "Finnflex" all-metal vibration mount for airborne electronic equipquirements of MILment meets all re-C-172-B. The basic construction consists of two load-carrying convex Bellville-type springs in conjunction with a circular coil spring for dampening and wire mesh pads for snubbing. T. R. Finn & Co., Inc., Electronics Div., Dept. ED, Hawthorne, N. J.

CIRCLE 332 ON READER-SERVICE CARD FOR MORE INFORMATION

Signal Generator

A Low Drift Unit

The Model 162 AM Signal Generator includes all components except the power supply, are in the r-f cavity to minimize leakage. Bands are changed by a rotating turret arrangement. Internal modulation is 400 and 1000cy from 0 to 50%. New London Instrument Co., Inc., Dept. ED, 82 Union St., New London, Conn.

CIRCLE 335 ON READER-SERVICE CARD FOR MORE INFORMATION

Terminal Blocks

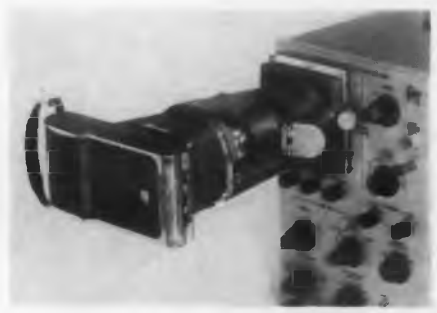
½" Center-to-Center

Type "MA" and "MAT" Terminal Blocks meet the requirements of many UL standards. They have only 1/2" center-to-center spacing of terminals while providing a full 3/8" creepage distance between terminals and to ground. The blocks consist of separate molded bakelite terminal sections held securely in place within a plated steel channel. Curtis Development & Mfg. Co., Dept. ED, 3250 33rd St., Milwaukee 16, Wis.

CIRCLE 336 ON READER-SERVICE CARD FOR MORE INFORMATION

Oscilloscope Camera

With Fast-Print Feature



The "Recordoscope 1414" is a compact, moderately priced, oscilloscope camera capable of providing accurate, single-frame photographic records of CRT phenomena 60sec after exposure of the scope image. Based on an adaptation of the small "Polaroid" fast-print magazine, it mounts easily on any standard 3" or 5" scope. Aremac Associates, Dept. ED, 50 S. San Gabriel Blvd., Pasadena, Calif.

CIRCLE 337 ON READER-SERVICE CARD FOR MORE INFORMATION

Gaussian Noise Generator

In Low Frequency Range

The Low Frequency Gaussian Noise Generator provides a random voltage whose amplitude probability distribution is gaussian to within 1%. The output frequency spectrum is flat to within 1db from d-c to 27cy in the standard model, but the frequency spectrum can be modified upon special request. The output voltage is 5v rms, regulated to within 0.1db, and available from a low source impedance. A continuously adjustable calibrated attenuator permits the output to be decreased from this value. A front panel meter continuously monitors the rms value of the output voltage.

The instrument can be removed from the cabinet and mounted in a standard rack. It is intended for use with analog computers, simulators, servo testing, and many other applications. Automatic Instrument Div., Automation Laboratories, Inc., Dept. ED, 517 W. 207 St., New York 34, N. Y.

CIRCLE 341 ON READER-SERVICE CARD FOR MORE INFORMATION

R-F Bridge

Covers 400kc to 60Mc Range

The Type 1606-A Radio - Frequency Bridge retains all the desirable features of this firm's older Type 916-A, and adds several new ones. A new broadband bridge transformer efficiently covers a range from below 400kc to 60Mc. New milled-plate variable air capacitors, which have very low losses, are used as reactance standards. General Radio Co., Dept. ED, 275 Massachusetts Ave., Cambridge 39, Mass.

CIRCLE 345 ON READER-SERVICE CARD FOR MORE INFORMATION

Sweep Generator

V-H-F Permeability Type

The Model SCA has 14 channels, including 12 TV and two intermediate frequency channels of 21Mc and 41Mc. It has a permeability sweep transformer, with an individual switch-selected core for each channel. It is frequency shift compensated for each channel. Crystal-controlled video and audio markers are automatically provided on each channel with a channel selector. Output is 1v on all channels. Invar Instrument Co., Dept. ED, 1400 N. Mission Rd., Los Angeles 33, Calif.

CIRCLE 346 ON READER-SERVICE CARD FOR MORE INFORMATION

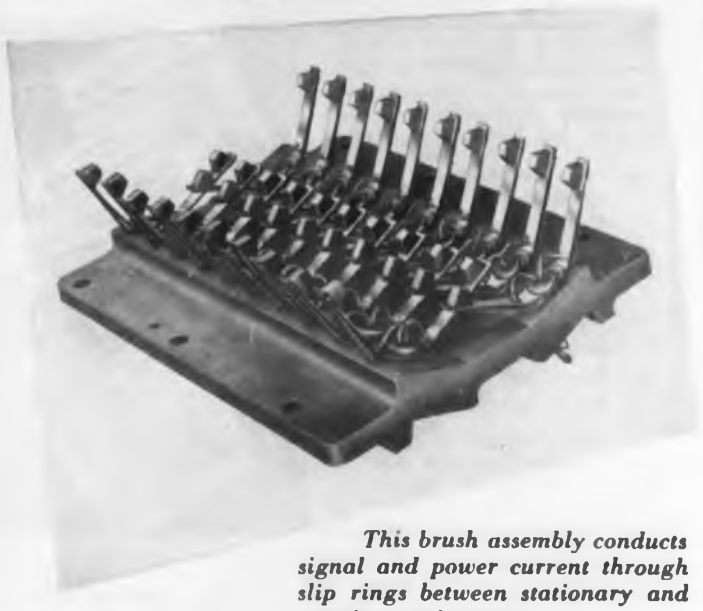
Digital Voltmeter

Automatically Measures, Displays

The Model 451 Digital Voltmeter provides automatic measurement and digital display of d-c voltages at low cost. The measured voltages are displayed in a horizontal line of four luminous numerals 1" high, plus the decimal point and polarity sign. Voltage measurements are made in ranges: 0 to ±9.999v d-c; ±09.00 to ±99.99v d-c; and ±099.9 to ±999.9v d-c. Non-Linear Systems, Inc., Dept. ED, Del Mar Airport, Del Mar, Calif.

CIRCLE 347 ON READER-SERVICE CARD FOR MORE INFORMATION

TO ELABORATE....



This brush assembly conducts signal and power current through slip rings between stationary and rotating equipment.

a *Superior* Willingness to ELABORATE

"Elaborate"? Yes, that's exactly what we mean. For, actually, "elaborate" means to *work* something *out*. Always, we at Superior are most willing to *work out* exactly what your application calls for . . . the right answer to perform a brand new operation most efficiently, to make your present equipment function more profitably, or to bring down the cost of manufacturing your product. *Please turn us loose on that next brush assembly problem.*

SUPERIOR CARBON PRODUCTS, INC.
9115 GEORGE AVENUE CLEVELAND 5, OHIO

SP J4
SUPERIOR CARBON BRUSHES
"Since 1919"

CIRCLE 352 ON READER-SERVICE CARD FOR MORE INFORMATION

Heavy-Duty Vibrator

For Communications Service

The 1700 Series Heavy-Duty Vibrator, designed especially for communications service, incorporates a design which eliminates the usual contact buttons. The spring leaves themselves, made of special contact alloy, act as contacting members, affording greatly increased contact area.

The construction increases vibration life from 50 to 100%, eliminates sticking of contacts, and provides steadier output throughout the service life, due to the lower rate of erosion at the contacts. Reduction of the mass of the contacts assures flare-proof starting without need for greater driving power. Both split-reed and duplex types (without split-reed) are available for two-way communications equipment and other heavy-duty electrical and electronic applications. P. R. Mallory & Co., Inc., Dept. ED, 3029 E. Washington St., Indianapolis 6, Ind.

CIRCLE 353 ON READER-SERVICE CARD FOR MORE INFORMATION

ARNOLD / TOROIDAL COIL WINDER

sets up quickly . . . easy to operate . . . takes wide range of wire sizes

SPECIFICATIONS:

- Min. finished hole size: .18 in.
- Max. finished toroid O.D.: 4.0 in.
- Winding speed: 1500 turns/min.
- Wire range: AWG 44 to AWG 26
- Dual, self-checking turns counting system
- Loading (wire length) counter
- Core range: ¼" I.D. to 4" O.D. to 1½" high

LABORATORY USE

- Change wire and core size in 45 sec.

PRODUCTION USE

- 1500 turns per minute
- Insert core and load in 20 sec.

write for literature
ARNOLD MAGNETICS CO.
5962 SMILEY DRIVE, CULVER CITY, CALIFORNIA

CIRCLE 354 ON READER-SERVICE CARD FOR MORE INFORMATION

Precision Potentiometers

at Popular Prices

The New G-R 970 Series Wire-Wound Potentiometers Feature

☆ *Accurate Resistance Values* ☆ *High Resolution*
☆ *Good Linearity* ☆ *Low Capacitance to Ground*
☆ *Uniform Contact Pressure* ☆ *Low Electrical Noise*
☆ *No Pressure Connections* ☆ *Total Enclosure*
☆ *Stable & Repeatable Settings* ☆ *Long Life*
☆ *Seventeen Stock Values: 2 to 500,000 Ohms*
☆ *Eight Sizes: 2 to 20 Watts* ☆ *Low Cost: $3.15 to $10.00*

Before purchasing *any* precision potentiometer, investigate these new G-R Units. Write for the POTENTIOMETER BULLETIN

GENERAL RADIO Company

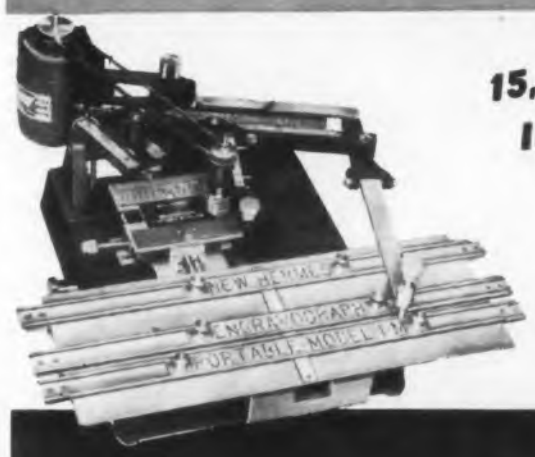
275 Massachusetts Avenue, Cambridge 39, Massachusetts, U.S.A.

90 West St. **NEW YORK 6** *8055 13th St., Silver Spring, Md.* **WASHINGTON, D.C.**
York Road & Guernsey Avenue, Abington, Pa. **PHILADELPHIA**
920 South Michigan Ave. **CHICAGO 5** *1000 North Seward St.* **LOS ANGELES 38**

CIRCLE 355 ON READER-SERVICE CARD FOR MORE INFORMATION

Every plant needs an

Engravo*graph*



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Immediate engraving with unskilled labor.
• Name plates • Dials • Panels
• Tools • Parts

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13-19 UNIVERSITY PLACE • NEW YORK 3, N. Y.

CIRCLE 356 ON READER-SERVICE CARD FOR MORE INFORMATION

METER-RELAYS

For Sensitive and Accurate Control

RANGES:

Model 261-C Range 0/200 DC Microamperes. Price $33.00

0/20 Ua. to 0/50 A.
0/5 Mv. to 0/500 V.

The trip point is adjustable to any point on the scale arc. These meter-relays are sensitive to changes of as little as 1%. One contact is carried on moving pointer. The other is on a semi-fixed pointer. When two pointers meet contacts close and lock. Holding coil is wound directly over moving coil. Reset can be manual or automatic. Spring action in contacts kicks them apart forcefully. Three sizes of clear plastic case models, 2½, 3¾ and 4½ inches (all rectangular). Two ruggedized and sealed models, 2½ and 3½ inches (round metal cases).

Contact arrangements: High Limit Single, Low Limit Single or Double (both high and low). Contact rating is 5 to 25 milliamperes D.C.

Suggested circuits for meter-relays and complete specifications including prices are covered in new 16-page Bulletin G-6, which you can get by writing Assembly Products, Inc., Chesterland 17, Ohio.

ATOMIC EXPOSITION, BOOTH 423, DEC. 10-16, CLEVELAND, OHIO

CIRCLE 357 ON READER-SERVICE CARD FOR MORE INFORMATION

---

midget water stills

only $110.00

Superior Quality, Automatic and Continuous Operation

What does it cost you to buy distilled water?* Precision Midget Water Stills can save you money and provide the convenience of...

Fresh pyrogen-free distilled water WHEN and WHERE you want it.
At a half gallon per hour rate — trouble-free operation.

Easy to install and maintain.

No plumbing connections required, compact, portable, automatic operation, easily cleaned.

Thousands of applications under varying conditions have proved their utility and performance.

Smaller than a 5-gallon bottle
Tinned copper parts in vital areas
Gas-free water at all times
Low current consumption
Efficient preheating of raw water before entering evaporator.

**The Midget costs only 7½c per gal. at 3c per kilowatt hour.*

AVAILABLE FOR IMMEDIATE DELIVERY
Send for new bulletin No. 912

Precision Scientific Company

3759 West Cortland Street • Chicago 47

CIRCLE 358 ON READER-SERVICE CARD FOR MORE INFORMATION

Circulating System

Provides Constant Temperatures

The "Temp-Trol", a portable constant-temperature circulating system used for accurate temperature control of refractometers, spectroscopes, and a wide variety of other instruments, has been redesigned. A new "Micro-Set" Thermo-Regulator is coupled with an electronic relay to provide faster, more accurate response to temperature change; temperature control is accurate to ±0.05°F. Other features include a wide temperature range (from ambient to 210°F), and a built-in cooling coil for operation below room temperature. A submerged pump provides rapid circulation (up to 5gpm at zero head). The system does not require a continuous water supply, since the 2-1/2 gal capacity is ample for continuous circulation. Precision Scientific Co., Dept. ED, 3737 W. Cortland St., Chicago 47, Ill.

CIRCLE 359 ON READER-SERVICE CARD FOR MORE INFORMATION

If you need a special component, send a brief statement of your specifications addressed to Bulletin Board, Electronic Design, 19 East 62nd St., New York 21, N. Y. Include your complete address.

---

news notes *from* **Berkeley** *division* BECKMAN

Berkeley Model 5571 FREQUENCY METER

★

1. 0 to 42 mc frequency meter (extendable to 515 mc)
2. Frequency ratio meter
3. 0-1 mc period meter
4. 1 μ sec to 10,000 sec time interval meter
5. 0-2 mc events-per-unit time meter
6. 1 mc counter

A truly universal laboratory instrument; features accuracy of ± 1 count, ± crystal stability; direct digital readout; direct connection to printer, data converter for card punches, electric typewriter, etc. Compact (21"W x 19"H x 16"D), weighs 100 lbs. Price f.o.b. factory, $1650.00.

Write today for data; please address Dept. D11.

Berkeley *division*

BECKMAN INSTRUMENTS INC.

2200 Wright Avenue • Richmond 3, Calif.

69

CIRCLE 360 ON READER-SERVICE CARD FOR MORE INFORMATION

KOILED KORDS*

THAT EXTEND AND RETRACT

Solve MANY DESIGN PROBLEMS...

KOILED KORDS retractile cords extend to approximately six times their retracted length. They are neat and orderly and never sag, droop, drag or tangle in moving mechanisms. Write for Bulletin KK-52 showing many uses.

ON MACHINES THAT MOVE

If the machine and power cord move, KOILED KORDS are the most effective and safest power cords to use.

ON COMMUNICATIONS DEVICES

KOILED KORDS are most convenient and can be quickly and neatly "stowed" either inside or outside instrument housings.

ON "IN-A-DRAWER" EQUIPMENT

KOILED KORDS make it easy to service units that are concealed and they avoid possibility of ungainly straight cords causing mechanical failures.

©1955

Koiled Kords

INCORPORATED

Box K, New Haven 14, Connecticut

*KOILED KORDS is a trade mark of KOILED KORDS, INC. Manufactured by Whitney Blake Company.

CIRCLE 362 ON READER-SERVICE CARD FOR MORE INFORMATION

the **ONLY** *instrument in the field that offers* **ALL** *these features at*

NO EXTRA COST!

- FREQUENCY Measurement
- 1 and 10 SECOND Time Base
- PERIOD Measurement
- 1 and 10 CYCLE Gate Time
- PRECISION ACCURACY Over 1-100,000 cps range
- EASILY PORTABLE Only 28 Pounds
- SMALL SIZE 14¼"W x 7½"H x 13½"D

the new

DS-6100-T

FREQUENCY-PERIOD electronic counter

A compact frequency-period counter designed for direct measurement of any mechanical, electrical or optical phenomena which can be converted to a varying voltage. Read-out in direct digital form. Ideal for use by skilled or unskilled personnel. Price **$700.00**.

Write for complete catalog data TODAY!

Visit Us in Booth 424—Automation Show Chicago—Navy Pier

Representatives in all major areas.

Detectron Trade Mark

COMPUTER-MEASUREMENT CORP.
5457 Cleon Avenue, Dept. 76-N
North Hollywood, California

CIRCLE 363 ON READER-SERVICE CARD FOR MORE INFORMATION

Tantalum Capacitors

For Transistor Circuits

Porous sintered anodes, compacted from a special grade of tantalum metal powder of carefully controlled particle size, provide a large surface area for contact with the electrolyte to permit large capacity in small space. The anodic oxide film is formed electrolytically, after which the anode is inserted, with proper insulating seals, into a fine silver case which also serves as the cathode.

Tantalum capacitors of this type are made in 58 sizes and ratings, ranging from 1.75v d-c (w) to 325mfd at 6v. The normal temperature range is from −55°C to +85°C. Hermetically sealed capacitors, also available from this company, may be operated in temperatures up to 125°C.

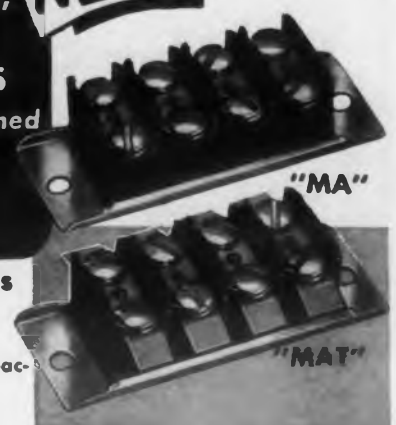
D-c leakage is remarkably low, ranging from 1.0μamp at 6v d-c to a maximum of 8μamp at 125v. Fansteel Metallurgical Corp., Dept. ED, 2200 Sheridan Rd., North Chicago, Ill.

CIRCLE 365 ON READER-SERVICE CARD FOR MORE INFORMATION

CURTIS "MA" & "MAT" Terminal Blocks

NEW

— *particularly designed for applications requiring* **UL** *approval*



"MA" & "MAT" Blocks feature:

- **Compactness —only ½" center to center spacing of terminals.**
- **Full ⅜" creepage distance — for excellent insulation between terminals and to ground**
- **#8 — 32 Screws (Brass)**
- **16 Gauge (.051) Brass Terminal Bars**
- **Metal Channel Mounting**
- **Factory assembled with 1 to 24 Terminals.**
- **Rated 300 volts — 25 amps. (67% higher current than the well known Curtis "M" Block)**
- **Economy**

Curtis Terminal Blocks Make Better Connections — Economically — Quickly. A Type for Every purpose.

Write for Bulletin DS-127. Also ask about wide selection of other Curtis Blocks available.

CURTIS DEVELOPMENT & MFG. CO.
3236 North 33rd Street Milwaukee 16, Wisconsin

CIRCLE 367 ON READER-SERVICE CARD FOR MORE INFORMATION

Cords manufactures a complete line of U.L. approved cord sets for any application. Through their extensive standardization, Cords Ltd. can reduce both your engineering and inventory costs . . . and at the same time furnish quality cord sets at a competitive price. Sales offices in principal cities.

Write Cords today for free catalog outlining complete specifications of standard cord sets . . . or for Bulletin C442 on new 3 conductor U.L. approved cord sets.

CORD SETS

CORDS LIMITED
DIVISION ESSEX WIRE CORPORATION
121 DODGE STREET, DEKALB, ILLINOIS

CIRCLE 364 ON READER-SERVICE CARD FOR MORE INFORMATION

Microscopic Welds

AUTOMATIC precision combined forming and welding operations that are accomplished on "TWEEZER-WELD" equipment have revolutionized the Electronic and Instrument industries.

Brochure Mailed on Request

Bench Welder with Capacitor Discharge power supply.

Automatic Welder 3600 welds per hour.

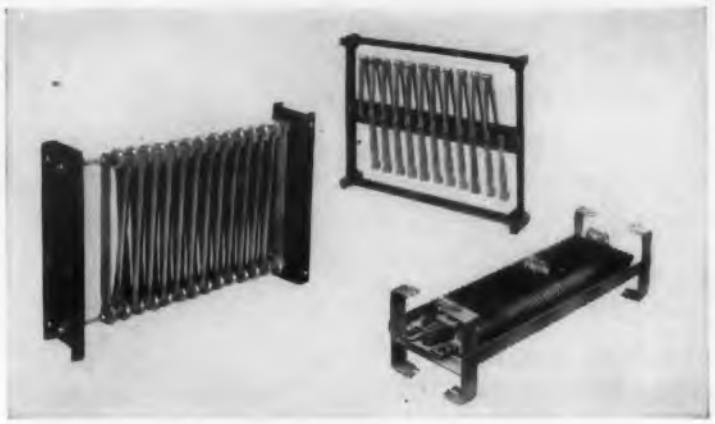
TWEEZER-WELD GUN

● **Contract Welding Service Available**

Millions of small parts have been made on TWEEZER WELDERS

FEDERAL TOOL ENGINEERING COMPANY
TWEEZER-WELD
1376 POMPTON AVENUE, CEDAR GROVE, NEW JERSEY

CIRCLE 366 ON READER-SERVICE CARD FOR MORE INFORMATION



3 heavy-duty resistors meet high-current needs

Barohm unit is used for continuous-duty battery charging, space heating, load bank, projection arc, similar equipment.

Loopohm, another continuous-duty unit, is designed for applications where mechanical shock or vibration prevail, such as crane hoists, welding and other portable equipment.

Edgeohm, an intermittent-duty unit, is used in motor starting, plugging, field discharging and similar applications.

Write for Bulletin 35 for complete details. Ward Leonard Electric Co., 77 South St., Mount Vernon, N.Y. 4.14

WARD LEONARD ELECTRIC CO.
Result-Engineered Controls Since 1892
RHEOSTATS • RESISTORS • MOTOR CONTROLS • CHROMASTER

CIRCLE 368 ON READER-SERVICE CARD FOR MORE INFORMATION

Temperature Relay

Extremely Sensitive

The glow of a cigarette at a distance of ten feet will actuate the "Infra-Ray" Relay. This device can be used to actuate, at a safe distance, any device associated with high temperature operations (turn on cooling sprays, actuate hot strip coilers, stop pouring of molten metal at the correct level, activate recorders of high temperature instruments, etc). It is a self-contained unit providing contact ratings 250va rms at any time, up to 5amp immediately prior to opening and up to 500v immediately prior to closing. Cabinet is 9″ x 12″ x 6″ deep. Power required is 115v ±10%, 60cy, 0.1amp, one side grounded. Industrial Gauges Corp., Dept. ED, Englewood, N. J.

CIRCLE 369 ON READER-SERVICE CARD FOR MORE INFORMATION

Electronic Timer

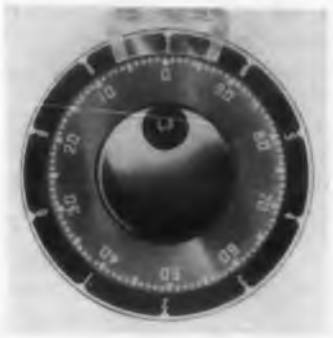
For Industrial Controls

The T-1 Timer is a simple electronic unit with ±2% repeat accuracy. It permits multiple modes of operation including interval, delayed action, repeat cycle, and single cycle timing, and it can be supplied with standard time ranges of 0.3-25sec, or 0.5-50sec. The 270° calibrated dial assembly can be removed for remote operation. Ferrara, Inc., Dept. ED, 8106 W. Nine Mile Rd., Oak Park, Mich.

CIRCLE 370 ON READER-SERVICE CARD FOR MORE INFORMATION

Turns-Counting Dial

In Four Precision Models



The 900 Series "Duodial" turns-counting dial, which replaces this firm's W series, consists of two coaxial dials: the inner counts hundredths of each turn, and the outer counts the number of completed turns. The dial is integrally mounted with the inner dial and connects directly to the shaft of the device using it, assuring accurate readings, free from backlash. Helipot Corp., Dept. ED, 916 Meridian Ave., South Pasadena, Calif.

CIRCLE 371 ON READER-SERVICE CARD FOR MORE INFORMATION

improve design
simplify purchasing
speed production
with

C-D-F SPIRAL TUBING

Looking for low-cost tubing to reduce unit costs and improve product performance? Consider the use of C-D-F Spiral Tubing, a high strength plastic made from paper or fibre that is spirally wound and cured at high temperatures. In many cases it can replace rolled or molded laminated plastics . . . at a good cost saving. Small sizes, thin walls are not a problem. For many applications, dimensional stability and moisture resistance is excellent. Coil forms, insulating tubes, paint roller tubes, shipping containers, bushings are just a few applications. Write today for 8-page Technical Folder ST-53, giving properties, sizes, tolerances on impregnated and unimpregnated round, square and rectangular C-D-F Spiral Tubing. Well illustrated. Call your C-D-F sales engineer (offices in principal cities) — he's a good man to know!

CDF **Continental-Diamond Fibre**

CONTINENTAL-DIAMOND FIBRE DIVISION OF THE BUDD COMPANY, INC.
NEWARK 107, DELAWARE

CIRCLE 373 ON READER-SERVICE CARD FOR MORE INFORMATION

Preamplifier

Produces D-C Voltages from A-C

To overcome the limitations of excessive power drain and sluggish response of a meter movement in recording the rms value of a-c voltages and currents, this circuit produces a d-c voltage proportional to the rms value. Known as the Model 150-2500 RMS Volt/Ammeter Preamplifier, it plugs into an appropriate driver amplifier-power supply unit in any Sanborn "150 Series" system.

Typical specifications, when used with associated Sanborn equipment, are voltage ranges: 25v, 125v, 250v; current ranges: 50ma, 100ma, 250ma, 500ma, 1amp; full-scale deflection: 5cm; overall tolerance: +3% of full scale, for frequencies between 50cy and 2kc. The preamplifier is usable to 4kc, and its rise time is 0.15sec. Sanborn Co., Industrial Div., Dept. ED, 195 Massachusetts Ave., Cambridge, Mass.

CIRCLE 375 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 377 ON READER-SERVICE CARD FOR MORE INFORMATION

they shall not pass!

A.W.HAYDON PRECISION GOVERNED 5600 SERIES

MOTOR insures performance of America's perimeter defenses.

5600 Series GOVERNED D. C. MOTOR

SPECIFICATIONS

1. Voltage range nominal ± 20% at 68°F.
2. Ambient temp. range minus 65°F to plus 165°F.
3. Vibration 5-55 cycles per sec. with 10g max. accel.
4. Tolerance on escapement rate:
   (a) ± 0.1% under condition 1
   (b) ± 0.3% under condition 2
   (c) ± 0.5% under condition 3
5. Shock — per MIL-E-5272A, Proc. 1 (30g for 11ms)

Rated 30 oz.-in. full load torque at 1 RPM. Torque is limited by materials used in gear train to 20 oz.-in. intermittent or 5 oz.-in. continuous duty at 1 RPM. Special gear trains are available.
Output speeds from 900 RPM down to 1 revolution in 2 hours can be provided.

WHEN TIMING POSES A PROBLEM CONSULT . . . .

(General Catalog Sent on Request)

The A.W.HAYDON COMPANY
227 NORTH ELM STREET
WATERBURY 20, CONNECTICUT
Design and Manufacture of Electro-Mechanical Timing Devices

CIRCLE 374 ON READER-SERVICE CARD FOR MORE INFORMATION

New Differential DC VOLTMETER

Read Out **432.02** VOLTS

Fast! Direct! Now! Twice as Accurate!

Mod. 800 **$315**

- **ACCURACY OF THE NEW MOD. 800 NOW INCREASED TO 0.05%.** Highly stable reference supply calibrated against standard cell: 5-dial decade attenuator uses matched, precision wire-wound resistors.
- **500-VOLT SEARCH RANGE** . . . establishes value of unknown voltage to within 2% by direct meter reading.
- **2 CALIBRATED NULL SCALES** . . . 10-0-10 and 1-0-1 volt ranges give direct reading of deviations from null. High resolution—500 volts are spread over 80 ft. of effective scale length.
- **INFINITE INPUT RESISTANCE** at null.
- **PRINTED CIRCUIT** . . . light, strong aluminum construction; easy to read illuminated dials.

Electronic Tools for Industry

JOHN FLUKE MANUFACTURING CO. 1111 W. Nickerson St., Seattle 99, Wash.

CIRCLE 376 ON READER-SERVICE CARD FOR MORE INFORMATION

WIRE-MIKE takes guesswork out of wiring

- pocket size, 4½" closed, 2 oz. weight
- heavy-gauge stainless steel
- inside and outside caliper, calibrated in 32nds
- precision-etched direct reading scales
- pipe size to i. d. conversion table
- genuine leather sheath

Frankly, we never intended to get into the WIRE-MIKE business. Our engineers designed WIRE-MIKE as a labor of love—because they felt such a tool was long overdue. We made several hundred for our friends, and thought we had heard the last of it. Not so. Before you could say "WIRE-MIKE," we were snowed under with demands for this handy gadget. Since our distributors knew we couldn't keep *giving* them away, they asked us to put WIRE-MIKE into production at a nominal price. A few improvements make WIRE-MIKE better than ever—now everyone can have this famous precision lifetime tool for instantly measuring *conductor size* (stranded, solid or ACSR), *conduit size* (rigid or thinwall), and *pipe size*. Only $1.95 at your Burndy distributor. 54-20

BURNDY ENGINEERING COMPANY, Inc., Norwalk, Connect.

CIRCLE 378 ON READER-SERVICE CARD FOR MORE INFORMATION

Meter Calibrator

Checks Variety of Instruments

This electric meter calibrator is suitable for checking all the usual electric meters, including voltmeters, ammeters, wattmeters, varmeters, power factor meters, and synchronization indicators. It consists of a power supply panel which has the various required test outputs and an instrument console including twelve precision meters used as standards for comparison with the meters under test. The power supply requires an input of 110v 60cy at a maximum current of approximately 5amp.

The console is also provided with a wheatstone bridge for checking multiplier resistors and with resistors from 10 ohms to 100 megohms for calibrating ohmeters. Overall dimensions of the calibrator are 48″ x 28″ x 26″, with a weight of approximately 500 lb. National Instrument Laboratories, Inc., Dept. ED, 6108 Rhode Island Ave., Riverdale, Md.

CIRCLE 387 ON READER-SERVICE CARD FOR MORE INFORMATION

DAP Resin-Base Laminates

For Moisture Conditions

Three new grades of thermosetting laminated plastics utilizing a DAP (diallyl-phthylate) resin base answer the need for a number of design problems involving moisture—especially electronic components used in damp, humid climates. The new grades are coded according to filler material. DAP-impregnated canvas (Grade C-104), Orlon (Grade O-104), and woven glass cloth (G-104) all show a number of outstanding electrical properties in laboratory tests. Synthane Corp., Dept. ED, Oaks, Pa.

CIRCLE 391 ON READER-SERVICE CARD

Regulated Power Supply

Compact Unit

The Model 702A Power Supply is a regulated power source of conventional circuitry featuring a compact and unique method of mechanical construction which makes efficient utilization of space with no sacrifice in accessibility of components. It provides output voltages from 0 to 600v continnously variable, with currents up to 200ma. Regulation is maintained at 1/4% or better with ripple less than 10mv peak to peak. Shasta Div., Beckman Instruments, Inc., Dept. ED, Box 296, Station A, Richmond, Calif.

CIRCLE 392 ON READER-SERVICE CARD

Magnetic Heads

For Recording/Reproducing

Adequate inter-track shielding and precise gap alignment are features of these multi-track magnetic recording and reproducing heads. Each head stack is cast in plastic and mounted in a metal housing. This guarantees immunity to such adverse conditions as shock, vibration, and wide ranges of temperature and humidity. Complete interchangeability of the various models permits use of a single tape transport for varied operation. From 7 to 21 tracks per inch are available with gaps to 0.00015". The Davies Laboratories, Inc., Dept. ED, 4705 Queensbury Rd., Riverdale, Md.

CIRCLE 393 ON READER-SERVICE CARD

CIRCLE 394 ON READER-SERVICE CARD ➤

A NEW ALLISON FILTER . . RANGING FROM 10KC TO 640KC

the model 2C CONTINUOUSLY VARIABLE PASSIVE NETWORK AUDIO FREQUENCY FILTER

Another significant engineering achievement . . . the model 2-C Allison Filter has been designed for telemetering and general electronics applications in frequencies ranging from 10kc to 640kc. It offers unprecedented technical advantages through precise performance, range and versatility of application and easy maintenance-free operation.

FEATURES

- Low Pass, High Pass and Band Pass with Continuously Variable low cut-off and high cut-off *(independently controlled)* from 10kc to 640 kc.
- Passive Network . . . No Power Supply, No Vacuum Tubes.
- Low Loss . . . Approximately 1 db. in Pass Band.
- High Attenuation Outside Pass Band...30 db/octave.
- Maximum Input 2 Watts.
- Designed for 600 Ohm Circuits.

write for engineering bulletin with complete technical data.

ALLISON LABS.

allison laboratories

14189 SKYLINE DRIVE • PUENTE, CALIFORNIA

CIRCLE 395 ON READER-SERVICE CARD FOR MORE INFORMATION

Now... MALCO AUTOMATIC PIN AND CONTACT INSERTING MACHINE FOR PRINTED CIRCUIT APPLICATIONS

. . . the Most Important Cost-Saving Advancement Yet Offered

Malco's Automatic Pin and Contact Inserting Machine can materially reduce your assembly costs — and at the same time step up production to practically any desired level.

Operation is completely automatic. Up to 40 or more self-retaining terminals are inserted into the printed circuit board in any symmetrical or non-symmetrical pattern within a 3-second cycle. A special platen engages the self-retaining snap-in feature of the terminals, and the board is ready for immediate further assembly and dip soldering.

Malco Automatic Inserting Machines can be engineered to your particular application or production requirements.

Request Bulletin 551. Better yet, give us the facts about your operation. We'll show you how your costs can be lowered and your production increased.

Malco TOOL and MANUFACTURING CO.

4027 W. LAKE ST., • CHICAGO 24, ILLINOIS

CIRCLE 396 ON READER-SERVICE CARD FOR MORE INFORMATION

Tape Recorder

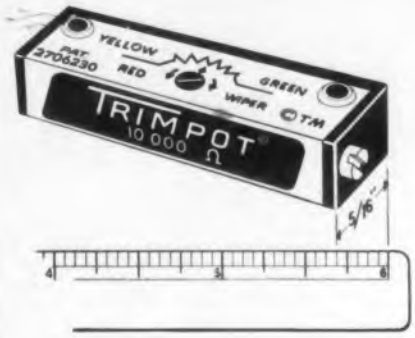
Portable and Battery Operated

This self-contained tape recorder is housed in a weather-tight aluminum case and it weighs only 19 lb. A VU meter is incorporated to act as a level indicator, and "A" and "B" battery meter. It also simplifies the correct setting of recording and playback levels to compensate for battery voltage changes. Amplifier Corp. of America, Dept. ED, 398 Broadway, New York 13, N. Y.

CIRCLE 397 ON READER-SERVICE CARD FOR MORE INFORMATION

Trimming Potentiometer

Meets Missile Requirements



The Model 160 "TRIMpot" meets aircraft and missile requirements for a subminiature trimming potentiometer having top high temperature and power rating characteristics. A —65° to 350°F range is provided. Power rating is 0.6w at 100°F and 0.4w at 200°F. Bourns Laboratories, Dept. ED, 6135 Magnolia Ave., Riverside, Calif.

CIRCLE 398 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Meter

Measures D-C to 11,000Mc

The Model F-2 Power Meter operates over the entire frequency range of d-c to 11,000Mc. Power is measured in three ranges: 0-1-mw, 0-10mw, and 0-100mw. Accuracy of readings may be quickly checked at any time by means of self-contained d-c calibration circuit. Polarad Electronics Corp., Dept. ED, 43-20 34th St., Long Island City 1, N. Y.

CIRCLE 399 ON READER-SERVICE CARD FOR MORE INFORMATION

Megohmmeter

Is Zeroed Once for All Scales

This ohmeter and megohmmeter permits measurement of high resistance values to a fraction of 1%. It has a zero adjustment which compensates for varying battery voltages; once zeroed for one scale, the adjustment is accurate for all scales. Greibach Instruments Corp., Dept. ED, Metuchen, N. J.

CIRCLE 402 ON READER-SERVICE CARD FOR MORE INFORMATION

Strip Chart Recorder

Records on 5" Paper

This miniature strip chart recorder, of the null balance potentiometer type, records on 5" translucent paper with a pen speed of 0.5sec full scale and an accuracy of 0.25%. It is available with input sensitivities of 10, 50, 100, or 500mv d-c. No standard cell or batteries are used; standardization is continuous and automatic. Chart speeds are adjustable for 4, 10, or 20ips. Westronics, Inc., Dept. ED, 3605 McCart St., Ft. Worth, Tex.

CIRCLE 403 ON READER-SERVICE CARD FOR MORE INFORMATION

Servo Valves

For 500-3000psi Systems

A line of electrically actuated, high-response, hydraulic servo valves is offered for 500-3000psi hydraulic systems. Controlled maximum output flows are 0 to 9gpm with a time constant of approximately 1-1/2"millisec from input differential current to output flow. Pacific Div., Bendix Aviation Corp., Dept. ED, North Hollywood, Calif.

CIRCLE 404 ON READER-SERVICE CARD FOR MORE INFORMATION

TO THE FINE ENGINEERING MIND SEEKING THE CHALLENGING PROJECTS IN

MICROWAVE ENGINEERING

Convair, in beautiful San Diego, now earnestly needs skilled **MICROWAVE ENGINEERS AND PHYSICISTS:** to solve design problems of an advanced nature in microwave antennas and scanners. Must be experienced in pencil beam and shaped beam designs for guided missile and airborne radar applications. For analytical and experimental work in the design of microwave components for specialized microwave radar systems and test equipment. For experimental development of components in the fields of dielectric and metallic media including familiarity with radome and microwave lens design. Unusual opportunities for senior level engineers with advanced degrees or equivalent experience.

At **CONVAIR** you will find an imaginative, explorative, energetic engineering department... truly the "engineer's" engineering department to challenge your mind, your skills, your abilities in solving the complex problems of vital, new, long-range programs. You will find salaries, facilities, engineering policies, educational opportunities and personal advantages excellent.

Generous travel allowances to engineers who are accepted.

Write at once enclosing full resume to:

H. T. Brooks, Engineering Personnel, Dept. 1011

CONVAIR

A Division of General Dynamics Corporation

3302 PACIFIC HIGHWAY SAN DIEGO, CALIFORNIA

Lovely, sunny, **SMOG-FREE SAN DIEGO,** ever-growing area of three-fourths million people, offers you and your family a way of life judged by most as the Nation's finest for climate, natural beauty and easy (indoor-outdoor) living. Housing is plentiful and reasonable.

CIRCLE 407 ON READER-SERVICE CARD FOR MORE INFORMATION

Dipped-Mica Capacitor

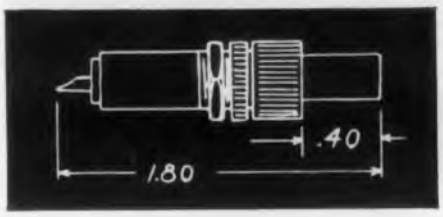
Meets MIL-C-5 Specifications

A dipped-mica capacitor with parallel leads, the "Dur-Mica" DM-20 was developed especially to meet miniature requirements and all humidity, temperature, and electrical requirements of MIL-C-5 specs. It is available in capacities up to 5100mmfd at 300v d-c(w) and up to 3900mmfd at 500v d-c-(w) with operating temperatures up to 125°C. Typical capacitance drift limits after temperature excursion of 25° to 85° to 25° to −55° to 25°C from the lowest to the highest capacities show performance better than characteristic F limits. Dimensions of this phenolic-coated mica capacitor are 7/16" x 3/16" x 3/4" long. Electro-Motive Mfg. Co., Inc., Dept. ED, Willimantic, Conn.

CIRCLE 408 ON READER-SERVICE CARD

Neon Indicator

Replaceable Bulb Type



This neon indicator, Type 1D, features a replaceable bulb and is designed to meet requirements of military and commercial specifications. With a case diameter of only 0.375", it mounts in a 3/8" hole in panels up to 3/8" thick. Overall length is 1.80".

Using a carefully designed lens of high-impact styrene, the unit provides maximum light from an NE-2A bulb. It has low interelectrode capacity (less than 2mmfd). The container is an anodized aluminum case with 3/8" x 32 NEF thread, with lug insulator of compression-molded thermosetting plastic. Bulb removal is made from the front of the panel. Eldema Corp., Dept. ED, 9844 Remer St., El Monte, Calif.

CIRCLE 409 ON READER-SERVICE CARD

Galvanometers

Will Read 200cy Signals

The first five of a "High-Performance" series of galvanometers, these instruments permit accurate recording of dynamic signals up to 200cy without amplifiers. Several of the galvanometers are electrically interchangeable with this firm's present "7-300" units, but feature extended frequency response. Other units are distinguished by extremely high sensitivity and are expected to be used where maximum resolution or recording of very low level signals is required. Types are available for direct connection to commonly used 120-ohm, 180-ohm, and 350-ohm strain gages and resistance-type pickups. No circuit revisions are necessary. Consolidated Engineering Corp., Dept. ED, 300 N. Sierra Madre Villa, Pasadena 15, Calif.

CIRCLE 411 ON READER-SERVICE CARD

Pulse Transformer

Handles 15,000v 125amp

The D211C4B is an extra-heavy pulse transformer for high power applications. It will handle 15,000v on the primary, delivering 15,000v at 125amp from secondary.

The transformer is designed to operate with pulse widths of 20μsec and features a rise time of less than 1μsec. Duty cycle is 4millisec, continuous. Total maximum variation of output pulse from nominal peak value is less than 5%. Weight is 45 lb, and size is 8" x 6-1/2" x 9", including four stud mounts on the base, but not four 3" feed-through insulators on the primary and secondary sides. The transformer is hermetically sealed, oil filled, and has a bellows-type expansion drum. Fisher Engineering, Inc., Dept. ED, Huntington, Ind.

CIRCLE 412 ON READER-SERVICE CARD

NEW — UNIVERSAL CABINET RACKS

PAR-METAL ELECTRONIC HOUSINGS

WITH OPEN SIDES AND DETACHABLE SIDE PANELS

Adaptable

TO GROWTH REQUIREMENTS

The above unit is our Type "*PR*" (with rear door only) "Universal Cabinet Rack". Type "*FR*" has both front and rear doors.

PAR-METAL Types "PR" and "FR" Universal* Cabinet Racks are made with *Detachable Side Panels* in order to assure flexibility for your future needs.

Because these are STANDARD UNITS, you get custom-quality at economical cost. They may be used *singly* or in a *group arrangement.*

Made in these dimensions:

Heights: 48⅛", 67⅜", 76⅛" and 83⅛".

Depths: 18" and 24".

Panel Widths: 19" and 24".

Built for Dependable Service

While incorporating new features of versatile assembly, there has been no sacrifice of *structural rigidity.* All PAR-METAL RACKS are *substantially welded* and *reinforced* for diversified industrial use.

STANDARD ACCESSORIES: Vertical Side Supports, Sliding Shelves, Rack Mounting Chasses, Bases, Roller Trucks, etc. are available as standard equipment.

The assembly of 5 racks shown above has 4 Type "FR" and 1 Type "PR" rack. Equal height racks may be *intermixed* with *19"* and *24"* wide panels. The end panels of the assembly have the detachable sides installed. They are quickly removable.

*Universal Cabinet Racks are also available with fixed side panels.

PAR-METAL PRODUCTS CORP.

Metal Housings for Electronic Apparatus

32-56 49th Street • Long Island City 3, N. Y.

Mail this coupon for our Latest Catalog today.

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32-56 49th St., L.I.C. 3, N.Y.

We are interested in "Universal Cabinet Racks."
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Company .....

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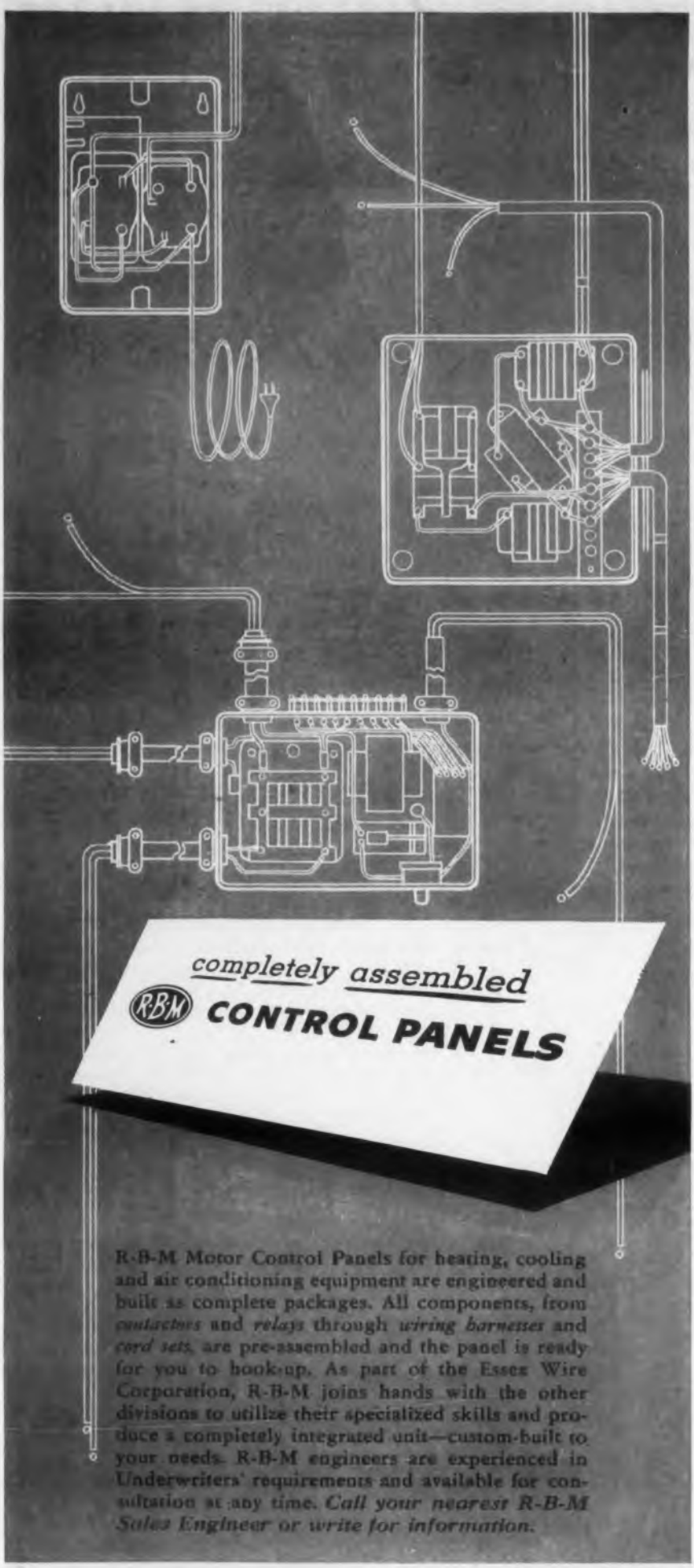
CIRCLE 414 ON READER-SERVICE CARD FOR MORE INFORMATION



R-B-M Motor Control Panels for heating, cooling and air conditioning equipment are engineered and built as complete packages. All components, from *contactors* and *relays* through *wiring harnesses* and *cord sets*, are pre-assembled and the panel is ready for you to hook-up. As part of the Essex Wire Corporation, R-B-M joins hands with the other divisions to utilize their specialized skills and produce a completely integrated unit—custom-built to your needs. R-B-M engineers are experienced in Underwriters' requirements and available for consultation at any time. *Call your nearest R-B-M Sales Engineer or write for information.*

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

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

RBM

CIRCLE 415 ON READER-SERVICE CARD FOR MORE INFORMATION

Oscilloscope

Weighs Only 8-½ lb

This portable miniature oscilloscope, Model MO-1, weighs only 8-1/2 lb and takes up less than 1/4 sq ft on the bench. The actual dimensions are 6" x 5" x 9" high.

In spite of its size, the unit is a precision instrument. Input impedance is 2 megohms shunted by 15mmfd. It has a 10:1 attenuator; vertical sensitivity of 100mv full scale; and a sweep rate of 20cy to 30kc in five steps. It is valuable for waveform analyzing and quick trouble shooting. The waveform on the 1" cathode ray tube is even sharp and clear. The device is one of the smallest complete oscilloscopes available. It has a gray enamel control panel. The Probescope Co., Dept. ED, 44-05 30th Ave., Long Island City, N. Y.

CIRCLE 416 ON READER-SERVICE CARD

Line-Voltage Regulator

Holds 220v ±½%

This automatic line-voltage regulator maintains a 220v source of power and holds output voltage within ±1/2%. The output voltage may be set at any voltage between 210v and 240v for variations of the input line voltage between 195v and 280v. This unit is designed to handle up to 8-1/2kva loads at output currents of 22amp. Correction rate is approximately 20v/sec. It will operate from a nominal 230v 3-phase source. Inexpensive and of compact size, it is designed for wall mounting. The unit can regulate a greater variance of load than present regulators and is unaffected by unbalanced loads. Elox Corp. of Michigan, Dept. ED, 740 N. Rochester Rd., Clawson, Mich.

CIRCLE 417 ON READER-SERVICE CARD

Microwave Generator

Gives 950-10,750Mc Carrier

The Model B is a code modulated microwave generator with five independently adjustable pulse channels, equipped with four interchangeable r-f microwave oscillator heads, and providing a precision oscilloscope. It is designed to provide code modulated carrier from 950 to 10,750Mc for beacons, missiles, and radar. Each of the five pulse channels has variable pulse width and delay, and also has an external pulse time modulation input. The repetition rate is variable. The instrument is rack mounted and equipped with casters. The interchangeable microwave r-f heads are self stored in the cabinet. Polarad Electronics Corp., Dept. ED, 43-20 34th St., Long Island City 1, N. Y.

CIRCLE 419 ON READER-SERVICE CARD

Power Rectifiers

Germanium Diffused-Junction Types

This series of germanium diffused-junction power rectifiers is now available in production quantities for general industrial use. The rectifiers, 1N91, 1N92, and 1N93, have a reverse current at least 20% lower than RETMA specifications for the type. They are particularly recommended for blocking, magnetic amplifier, and magnetic control applications. They can replace thermionic diodes in computers.

Respective rms input voltages for the 1N91, 1N92, and 1N93 under inductive load are 70v, 140v, and 210v. D-c output currents are respectively 150ma, 100ma, and 75ma, and peak inverse a-c voltages 100v, 200v, and 300v. Components Div., Federal Telephone and Radio Co., Dept. ED, 100 Kingsland Rd., Clifton, N. J.

CIRCLE 420 ON READER-SERVICE CARD

CIRCLE 422 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCUIT DESIGN ENGINEERS

for the

FALCON GUIDED MISSILE

So accurate and deadly is the Hughes Falcon guided missile produced in Tucson, Arizona, for the U.S. Air Force, that it has knocked maneuvering drone bombers out of the air even without an explosive warhead. Although its electronic brain can outwit any enemy bomber, it is the smallest guided missile in production.

Because of this small size and consequent extreme miniaturized packaging, new production techniques have had to be conceived. This leads to production testing of individual parts, small integrated units, self-contained components, complete integrated systems, and simulated environmental performance.

The development of equipment for producing and testing of such a missile provides a continuous challenge to engineers experienced in electronic circuit design including the following:

Pulse—Power Supply—Transistor—IF and RF—Clamping—Wave Shaping—Switching—Phase Shift—Input-Output—Modulator—Discriminator—Feedback—Video Circuits.

Write to

ENGINEERING STAFF RELATIONS

HUGHES

Aircraft Company

Tucson, Arizona

CIRCLE 423 ON READER-SERVICE CARD FOR MORE INFORMATION

VTVM

With 42 Ranges

This vacuum tube voltmeter, the "777" VT-VM, is a completely self-contained, ready-to-use instrument with all accessories fitting easily into its leather carrying case. Accessories include high-frequency co-axial cable, d-c probe, a-c line cord, and an instruction manual. The unit has 42 unduplicated ranges, illuminated scales, and 3% d-c and 5% a-c guaranteed permanent accuracy. Features of this vacuum tube voltmeter include: a double-shielded 200 microamp movement, color-coded scales, 2 zero center scales for FM discriminator alignment, separate range and function switches, and unbreakable, compact metal case. Phaostron Co., Dept. ED, 151 Pasadena Ave., South Pasadena, Calif.

CIRCLE 424 ON READER-SERVICE CARD

3" Potentiometers

Inexpensive Types, Gangable

This series of fully enclosed ganging potentiometers is priced for electronic applications that do not require the extended refinement of more expensive high precision types. The units are 3" independent phasing potentiometers with a power rating of 8w. They feature precise 360° external phasing, adjustable or fixed taps, and linear or non-linear resistance elements. Contacts are made from precious metals. Standard linearity is ±1% of total resistance. Any practical number of units may be ganged on a single shaft by one-piece stainless steel clamp rings. All turret terminals pass through the housing for direct pressure and solder connection. DeJur-Amsco Corp., Dept. ED, 45-01 Northern Blvd., Long Island City 1, N. Y.

CIRCLE 425 ON READER-SERVICE CARD

Cartridge Heating Unit

Compact, with Long Life

The "Firerod", a cartridge heating unit, is designed to produce five times more heat than any standard unit of similar size. In actual tests, one unit has been operated

in open air for periods up to 720 continuous hours at a sheath temperature of 1800°F. By contrast, a standard unit of comparable size would last only minutes, even though it may be rated at much lower wattage. There is little difference between resistance wire and sheath temperature.

The unit has many applications. It is available in standard, moisture-proof, and special designs. It comes in sizes from 1-1/4″ to 12″ long and 3/8″ or 1/2″ diam. Intermediate lengths of this cartridge heating unit is also available on special order. Watlow Electric Mfg. Co., 1376 Ferguson Ave., St. Louis 14, Mo.

CIRCLE 427 ON READER-SERVICE CARD

Relay

Operates at 10Millisec

Relay 100 MS incorporates a through wiping effect and has the fast operating speed of 10millisec. Available either hermetically sealed or with dust cover, it is designed for d-c applications in contact combination from spst to dpdt.

Capacity is up to 1.5amp inductive and 5amp resistive with coil resistance to a maximum of 30,000 ohms. The bounce and chatter are eliminated by a built-in wiping action in the contact movement. Drop-out, if desired, can be adjusted to about 65% of pick-up. Wattage requirement is 250mw per pole. The standard relay is equipped with octal plug in headers. Hedlin Tele-Technical Corp., Dept. ED, 87 Dorsa Ave., Livingston, N. J.

CIRCLE 428 ON READER-SERVICE CARD

how important are these to **you**?

Time? No other terminals are installed as rapidly as Sealectro self-fastening, self-sealing "Press-Fit" stand-offs, feed-thrus, connectors. And understandably so, because "Press-Fit" technic reflects years of specialized engineering in closest collaboration with designers and assemblers who want the best.

Money? The original one-piece, ready-for-assembly Teflon terminals minimize labor and materials. No soldering, nuts, washers, gaskets. Just press-fit — that's it.

and No Headaches? None. "Press-Fit" terminals are shatter-proof, heat-resistant, vibration-proof. Immune to humidity, wide temperature range, fungus, etc.

FREE MANUAL! Tells all you want to know about "Press-Fit" terminals. Also lists the most extensive selection of types and sizes. Copy on request.

PRESS THEM — FORGET THEM

"PRESS-FIT"* TEFLON* TERMINALS

*Trade-marks

by

Sealectro CORPORATION

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CIRCLE 430 ON READER-SERVICE CARD FOR MORE INFORMATION

TUNG-SOL "Magic Mirror" ALUMINIZED PICTURE TUBE

BRIGHTER-SHARPER MORE DETAIL MORE CONTRAST

The "Magic Mirror" Aluminized Picture Tube creates the brightest, most realistic TV picture ever seen in the American home. The "Magic Mirror" Tube effectively utilizes *all* the light generated by the phosphor screen.

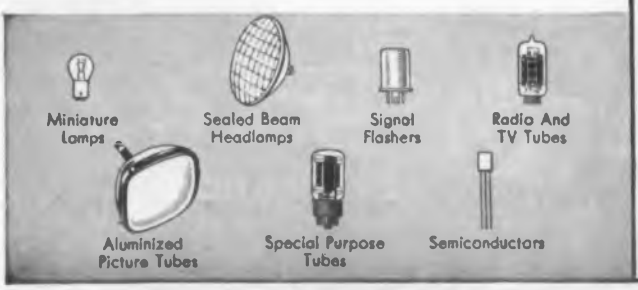
Tung-Sol has developed a unique method of backing the phosphor screen with a mirror-like aluminum reflector: Light is prevented from radiating uselessly back into the Tube. All of the intense detail of which the receiver is capable is brought out by the full light.

Tung-Sol's exacting standards of quality control, manufacture and testing further guarantee the high uniformity and maximum performance of the "Magic-Mirror" TV Picture Tube.

Let the superior qualities of "Magic-Mirror" Picture Tubes add selling advantages to your set.

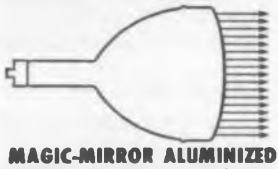
TUNG-SOL ELECTRIC INC., Newark 4, N. J.

Sales Offices: Atlanta, Chicago, Columbus, Culver City (Los Angeles), Dallas, Denver, Detroit, Montreal (Canada), Newark, Seattle.



ORDINARY TUBE—Only *half* the light produced by the phosphor screen is utilized in the picture. Other half radiates wastefully back into tube.

RESULT—A light background within the tube which reduces picture contrast.



MAGIC-MIRROR ALUMINIZED TUBE—Aluminized reflector allows electron beam through. Blocks wasted light from backing up into tube. Reflects *all* the light into picture.

RESULT—Pronounced increase in contrast to make a bright, clear, more realistic picture.

CIRCLE 431 ON READER-SERVICE CARD FOR MORE INFORMATION

New Literature

Precision Indicators 432

Data Sheet No. 10.02a gives specifications, dimensions, and operating characteristics of the Brown-Rubicon precision indicator. These instruments speed laboratory-type electrical measurements. Industrial Div., Minneapolis-Honeywell Regulator Co., Wayne & Windrim Aves., Philadelphia 44, Pa.

Plug-In Power Supplies 433

This data sheet describes a subminiature plug-in power supply for use with small instruments, preamplifiers, etc. Operating requirements and characteristics are provided. C. J. Applegate & Co., 1816 Grove St., Boulder, Colo.

Laboratory Heater 434

Bulletin No. 627 describes this firm's Type RH Heater, a laboratory heater with a built-in rheostat. The bulletin discusses features of the heater, including range, construction, and temperature reproducibility. Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.

Pressure Gage 435

A 4-page illustrated bulletin gives specifications on pressure, vacuum, compound, and test gages. Dimensional drawings and mounting instructions are provided and specifications and standard ranges are tabulated. Instrument and Systems Div., Norden-Ketay Corp., Wiley St., Milford, Conn.

Conductivity Equipment 437

Equipment for measuring and controlling solution conductivity is listed in a new catalog. The Catalog No. 22 lists a wide range of standard instruments and conductivity cells including the most recent developments in both bridges and cells. Industrial Instruments, Inc., Cedar Grove, N. J.

Plastics 438

A 12-page brochure, "How the Nosco Plant Works To Produce Your Needs In Practical Plastics", describes this firm's plant and manufacturing facilities. Case histories of difficult and unusual molding jobs are included. Nosco Plastics, Inc., Erie, Pa.

Name Plates 439

Modern identification methods and materials are described in an 8-page brochure. All materials discussed are pressure-sensitive self-adhesive. They include roll form tapes of paper, cellophane, acetate, and cloth, sheet and roll form die-cut pickoffs, and metal name plates. Topflight Corp., York, Pa.

Laboratory Facilities 440

A description of the facilities of this firm for certified qualification testing of electrical components is given in a 4-page brochure. Laboratory facilities are available for environmental qualification and reliability testing. Rototest Laboratories. 2803 Los Flores Blvd., Lynwood, Calif.

Gyro Compass 441

A 30 lb, subminiature gyro compass is described in this 24-page brochure. Applications, features, performance characteristics, and performance test results are given. Cutaway drawings illustrate construction of the instrument. Arma Div., American Bosch Arma Corp., Garden City, L. I., N. Y.

Equipment Catalog 442

The 324-page 1956 catalog of this firm lists over 26,000 items of radio and electronic parts and equipment. Special emphasis has been placed on equipment for industrial maintenance, research, and production requirements. Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill.

aircraft servo

computors

mechanical filters

navigation equipment

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NEW JAMES DPDT CHOPPER

guided missiles

mechanical gating switches

laboratory instruments

d. c. amplifiers

MODELS FOR INSTRUMENTATION AND MILITARY

- Dpdt and spdt circuits
- Hermetically sealed removable cover
- Octal header with top coil connections for minimum noise pickup
- Nine pin miniature header for minimum size
- Operating frequencies from 40 to 550 cps
- Contact closures available break before make and make before break
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- Extreme contact closure stability
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- Unique external force cancellation design provides unaffected operation under extremes of shock and vibration

A CHOPPER FOR EVERY APPLICATION AT MODERATE COST

write for engineering specifications and catalog

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CIRCLE 444 ON READER-SERVICE CARD FOR MORE INFORMATION

New CTC Coil Forms
can be soldered after mounting

CTC's new phenolic and ceramic printed circuit coil forms type SPC feature a design which allows the units to be soldered after mounting. Both the phenolic and ceramic printed circuit coil forms come complete with threaded slug and the terminal collar of each is securely fastened to the form. Each unit mounts through from two to four holes, as required by the number of terminals.

The phenolic coil form is available in two diameters. When mounted, the smaller unit is $\frac{3}{4}$" high by .219" diameter, and the larger unit is $\frac{3}{4}$" by .285" diameter.

The ceramic coil forms are made of grade L-5 ceramic and are available in two mounted heights. One has a mounted height of $\frac{5}{8}$" and the other has a mounted height of $\frac{13}{16}$". The outside diameter of each is a $\frac{1}{4}$". Both ceramic forms have a $\frac{10}{32}$" threaded powdered iron core and collars of silicone fibreglas.

CTC's new phenolic and ceramic printed circuit coil forms are available either as a form alone, or wound to your required specifications. For complete specifications and data on prices, write direct. Cambridge Thermionic Corp., 457 Concord Ave., Cambridge 38, Mass.

CIRCLE 446 ON READER-SERVICE CARD FOR MORE INFORMATION

Bobbin Winder 447

A data sheet describes a compact front loading multiple head adjustable length bobbin winder. Technical data includes dimensions, weights, types of windings, coil OD and length, maximum distance between winding centers, wire sizes, tension equipment, built-in adjustable cam, gears, slow-start and winding speed, motor equipment, etc. Geo. Stevens Mfg. Co., Inc., Pulaski Rd. at Peterson, Chicago, Ill.

Wire-Wound Resistors 448

This 8-page brochure describes various types of wire-wound resistors. It also includes an alloy characteristics chart listing symbols, alloys, trade names, nominal temperature coefficients, thermal electromotive force on copper, and a guide to proper selection. The bulletin covers fixed, adjustable, tapped multi-section, pigtail terminal, and ferrule terminal vitreous enamel, as well as wire-wound precision resistors. Precision, Inc., 730 Lyndale Ave. North, Minneapolis, Minn.

Production Facilities 449

A new 24-page booklet describes facilities and typical products made by this company. Typical products are illustrated with line drawings and photographs showing assemblies and subassemblies; aircraft industry equipment; recording and audio equipment; electronic test equipment; interphone and control equipment; electronic industry equipment; and special products and facilities. Telectro Industries Corp., 35-16 37th St., Long Island City 1, N. Y.

Silicones 450

A 4-page catalog describes the principal silicones sold by this company. Listed are the various silicones in liquid and solid forms, in the categories of water repellents; oils and oil emulsions; electrical insulating resins; silicone rubber gum stock and compounds; and silicones which make excellent anti-spatter, anti-foaming materials. Linde Air Products Co., Div. of Union Carbide and Carbon Corp., 30 E. 42nd St., New York 17, N. Y.

Oscilloscope 451

The Model 411 Easy-Six, a wide-band, adaptable, precision oscilloscope, is described in a 4-page brochure. The brochure describes method of operation and the six plug-in packages which make it possible to use the oscilloscope as a delayed or undelayed model, a gated marker generator, a TV test instrument, a video switch, and a long sweep generator. Laboratory for Electronics, Inc., 75 Pitts St., Boston 14, Mass.

Receiving-Type Tubes

This 20-page booklet (Form No. RIT-104) contains technical data on 130 small industrial tubes including Special Red tubes, premium-tubes, pencil-type tubes, computer tubes, glow-discharge tubes, small thyratrons, low-microphonic amplifier tubes, and other special types. In addition, a chart lists types for government use only. Each tube type is covered by a text description, tabular data, and a base or envelope connection diagram. Representative tube types are illustrated. $0.20. Commercial Engineering, Tube Div., Radio Corp. of America, Harrison, N. J.

Saturable Reactors 456

An 8-page publication describes applications, models, and ratings of saturable reactors. Designated GEA-6354, the illustrated bulletin describes the theory and application of saturable reactors as control equipment for individual power loads. General applications discussed are control of electrically heated equipment, automatic temperature stabilization, reduced-voltage motor starting, continuously adjustable reactive load banks, and control of X-ray equipment. The publication also contains wiring diagrams, ratings, model numbers, dimensions, and list prices. General Electric Co., Schenectady, N. Y.

Vacuum Tube Voltmeters 457

An 8-page brochure describes the outstanding features of this firm's extended-range vacuum tube voltmeters. The brochure explains their range and use. The company also has issued another laboratory report, "Basic Theory of the Type 300A Vacuum Tube Voltmeter" which discusses the design considerations, giving basic circuits and development logic. Technology Instrument Corp., 531 Main St., Acton Mass.

Proportional Controllers 458

Bulletin No. 4-11 describes this company's line of electric proportional controllers for control of dew point, pressure, temperature, etc., in batch process, combustion atmosphere, and heat treating furnace applications. Separate sections are devoted to the electric-operated control unit, the electronic relay, and the valve operator. Foxboro Co., Foxboro, Mass.

Planetary Cabler 459

A planetary cabler which fabricates intricate cables from strands of conductors, coaxial circuits, and power leads into one cable length is described in a new brochure. The cabler has direct application to the guided missile, computer, and atomic energy fields. Cable Div., Douglas Roesch, Inc., 2200 S. Figuerea St., Los Angeles 7, Calif.

for an entirely new range of time delays

Delay Intervals:

$\frac{1}{10}$ to 5 seconds

Recovery Rate:

extremely rapid

specify sturdy, dependable, application-tested

G-V Hot Wire Time Delay Relays

SERIES H

WRITE for Publication No.35–complete engineering data and drawings.

Designed for delay intervals which are longer than those produced by magnetic relays and shorter than can be produced by the usual types of thermal relays, these **G-V Hot Wire Time Delay Relays** make possible many simplified, lightened and improved designs.

How They Operate: G-V Series H Time Delay Relays employ a group of nickel-chromium alloy wires, 8 to 20 strands electrically in series and mechanically in parallel, as the actuating element. A mechanism holds these wires under tension and when the energizing current passes through these wires, heating them and causing elongation, the mechanism multiplies this and moves the contacts into or out of engagement.

Over two years of successful field service in electronic, aeronautical and industrial equipment prove these new G-V relays to be dependable, efficient and accurate.

ADJUSTABLE DELAY even though hermetically sealed
DC or **AC** of any frequency for energization
SMALL AND LIGHT. ¾" diameter, 2⅜" length. Weight: 1 oz.
WIDE AMBIENT RANGE compensated from –70°C to 100°C or higher
CONTINUOUS ENERGIZATION without damage
AVAILABLE in 7-pin Plug-in and Flanged designs

G-V

G-V CONTROLS INC.

18 Hollywood Plaza, East Orange, New Jersey

CIRCLE 461 ON READER-SERVICE CARD FOR MORE INFORMATION

Literature Index 462

Bulletin No. 100-D is a 20-P index of the industrial division's instrumentation literature. The index is broken down by subject, industry, and product. It covers catalogs, bulletins, specification sheets, data sheets, and articles from the company's Instrumentation Magazine. Industrial Div., Minneapolis - Honeywell Regulator Co., Wayne & Windrim Aves., Philadelphia 44, Pa.

Cleaning Machines 463

A new bulletin describes one of this firm's table-type airless blast cleaning machines. This machine is intended for cleaning work which does not have too many pockets or vertical edges, such as castings, forging, heat treated parts, weldments, or stampings. Installation views, engineering drawings, and mechanical and electrical specifications are given. A complete discussion of the airless abrasive blast cleaning process is also included. Wheelabrator Corp., 1750 S. Byrkit St., Mishawaka, Ind.

Water Still 464

Bulletin No. 912 describes this firm's midget water still, a laboratory still especially designed for small volume but high purity requirements. Operating economy, space economy, and convenience of operation and maintenance are discussed. Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.

Resistors 465

Comprehensive data on Types PW-7, PW-10, and PW-4 resistors is given in two technical data sheets. Information on applications, design and construction, characteristics, ranges, power ratings, tolerance, stamping, derating is shown in charts and graphs. International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.

Packaging for Glassware 466

A 4-page, 2-color bulletin describes a new packaging program for laboratory glassware, Air-pak. This program provides bursting pressure protection amounting to about 525psi. Doerr Glass Co., Vineland, N. J.

Machine Tool Control System 468

A brochure describes the application of a punched tape control system to a turret lathe for an automatic control system. Operating principles of the system are given (*see also, Binotrol in Abstracts*) and preparation of the punched tape, application of binary number coding to the lathe's functions and advantages are discussed. Barnes Engineering Co., 30 Commerce Rd., Stamford, Conn.

Metallurgy Chart 469

A revised edition of this firm's Basic Guide to Ferrous Metallurgy is available. The principal characteristics of steels are represented across the temperature range to 2900°F. The important working zones, including preheating for welding, stress relieving, normalizing, annealing, and forging are shown. At the right of the chart 24 common metallurgical terms are defined and explained. A diagram symbolizing the change in grain size with temperature is included. Tempil Corp., 132 W. 22nd St., New York 11, N. Y.

Grease 470

Bulletin No. 101, a 2-page, 2-color bulletin, describes Molykote, Type BR2, a general purpose grease with extreme bearing pressure properties. Molykote is a lithium base grease and its properties are listed. Physical specifications and test results are given. Alpha Molykote Corp., 65 Harvard Ave., Stamford, Conn.

Counting Devices 471

Automatic predetermining impulse counters are described in these data sheets. Specifications, features, and method of operation are discussed. Presin Co., 802 N. Fairfax Ave., Los Angeles 46, Calif.

Magnetic Clutches 472

Electromagnetic clutch Model C-130 is described in a 4-page bulletin. Dimensional drawings and cutaway views illustrate the clutch and graphs show torque-voltage characteristics. Dial Products Co., 7 Bergen Court, Bayonne, N. J.

PANELOC announces a new rotary latch

Saves Cost • Saves Time
Saves Space • Saves Weight

This new Paneloc Rotary Latch is a simple and economical, strong and durable fastener for access panels, electrical control panels, inspection doors, machinery doors, and other hinged or removable covers. It permits a larger access opening, operates quickly with a quarter-turn. Entire assembly on access panel itself, eliminating many installation steps; no special tools required. Only four simple parts; made of steel, cadmium plated. Three standard sizes now available, more to be added. Special sizes and finishes available on order. Cost very low, performance unsurpassed. Write for a catalog and price list for your file.

PANELOC...America's most versatile line of aircraft fasteners . . . Rotary Latches, Styles 1, 2, and 3 Panel Fasteners, High Performance Fasteners, Snap Fasteners.

PANELOC—A product of Scovill

Scovill Manufacturing Company, Aircraft Fastener Div.
47 Mill Street, Waterbury 20, Connecticut

Please send me fastener catalogs checked:

( ) Rotary Latch ( ) Style 3 (MIL-F-5591A)
( ) Styles 1 & 2 (MIL-F-5591A) ( ) High Performance (NAS-547)
( ) Snap Fasteners (AN 227)

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Address_____

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Save valuable laboratory time, avoid production delays and unnecessary overhead. Put your coil problem in the hands of experts with the experience and facilities to design and produce your coil quickly and in volume.

Send details to COTO-COIL COMPANY, INC.
66 Pavilion Avenue, Providence 5, Rhode Island
New York: 10 East 43rd Street, New York 17, N. Y.

PRECISION

Coto Coils

WOUND

CIRCLE 475 ON READER-SERVICE CARD FOR MORE INFORMATION

Production Facilities 476

Practically the whole current technology of precision mechanism manufacture is pictorially reviewed in this publication. Entitled "Production Processing and Service Facilities", the 32-page publication reviews the results of developments in tools, materials, and processes for precision manufacturing. Sections present productive capabilities in plate processing, mass production of small precision parts, tool and die production, metals processing, and assembly and development. Allied Products Div., Hamilton Watch Co., Lancaster, Pa.

Electronic Sorter 477

This firm's electronic sorter which sorts 48,000 alphabetic, numeric, black and special code punched-cards per hour is described in a 6-page illustrated folder. Double capacity feeding magazines and card receivers permit efficient output and photo-electric sensing permits sorting of 800 cards per minute. Remington Rand Div., Sperry Rand Corp., 315 Fourth Ave., New York 10, N. Y.

Plastic Welding 478

A 4-page external house organ illustrates and describes various aspects of plastic welding and fabrication. Known as the "Plastics Weldor and Fabricator", it is published six times a year. The current issue covers such topics as a discussion of the new low pressure polymerized ethylenes; tips on hot gas welding of thermoplastics; and the use of polyethylene and polyvinyl chloride in the manufacture of acid tanks. American Agile Corp., P. O. Box 168, Bedford, Ohio.

Tungsten Coils and Strand 479

Basic factors in producing effective tungsten coils and strand are presented in this brochure. Temperature nomographs on wire diameter—resistance and wire diameter—current are given. A graph shows the effect of variations from normal weight of aluminum on expected coil life and useful information is tabulated for the high vacuum evaporation of metals. Tungsten and Chemical Div., Sylvania Electric Products, Inc., Towanda, Pa.

Electronic Relay 481

Publication No. 585 describes this company's electronic relay. The relay is capable of complete follow-through action, responding to controls from a highly sensitive wire contact, no "arc" operation, and direct control of the load operating solenoid. The literature provides design and application information, circuit description, and complete dimensional and pricing data. Automatic Switch Co., 391 Lakeside Ave., Orange, N. J.

Spectrometers 482

Technical Bulletin No. 44 provides a detailed description of improved direct reading spectrometers featuring the automatic servo monitor. Operation and construction of direct readers are outlined in the 8-page bulletin with diagrams and photographs. This engineering treatment is accompanied by a file folder giving economic advantages. Baird Associates,, Inc., 33 University Rd., Cambridge 38, Mass.

Sine and Pip Generator 483

Data Sheet No. GPM-3 describes a small rotating shaft generator suited for continuous-indicating duty in radar instrumentation and similar applications. Included in the leaflet are an illustration of the unit, a dimensioned outline drawing, a list of mechanical and electrical specifications, and performance curves relating output voltage in volts to load resistance in ohms for 20cy (1200rpm) and 35cy (2100rpm) operation. Dalmotor Co., 1326 Clay St., Santa Clara, Calif.

Resistor Guide 484

Comprehensive data on this firm's complete line of resistors and special products is listed in the revised 1955-56 Official Resistor Engineering Guide. Data given includes JAN or MIL equivalent, rated wattage, standard tolerances, temperature rise, temperature coefficient, maximum operating temperature, ohmic values available, dimensions, and approximate prices. International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.

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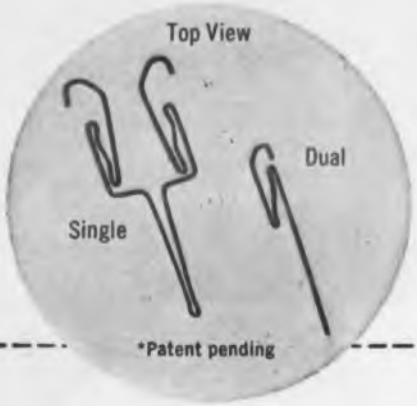

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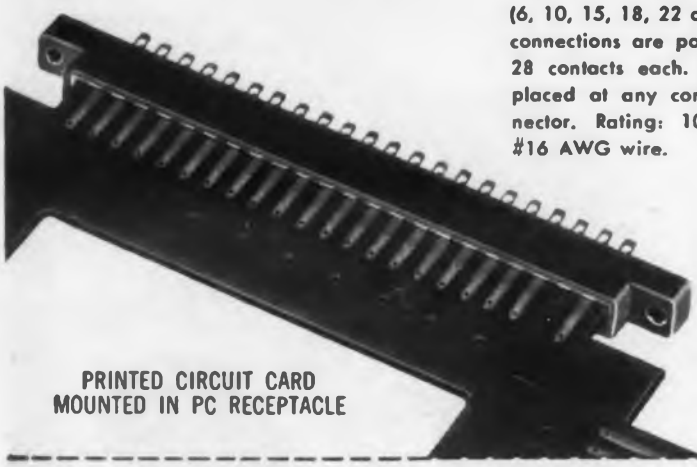
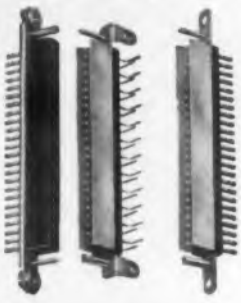


PRINTED CIRCUIT CARD
MOUNTED IN PC RECEPTACLE

SOLDERLESS WIRE WRAP CONTACTS

No soldering required. (Name and number of tool for "wire wrap" available on request.) 44 contacts (two rows of 22) accommodate three #24 AWG wires each. Receptacle accommodates .093 board.



TAPER PIN CONTACTS

Accommodates "AMP 53" taper pins. No soldering necessary. Stainless steel brackets support printed circuit assembly. Illustrated (center) is a dip solder-type plug which can be mounted at 90° to printed circuit card — a Continental Connector special design which mates with receptacle at left.

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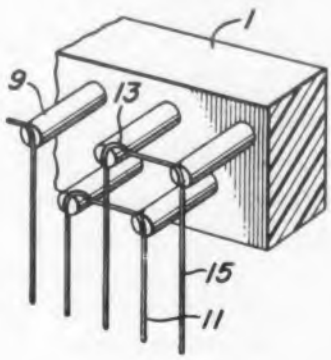
Patents

John Montstream



Detail of grid shown at right.

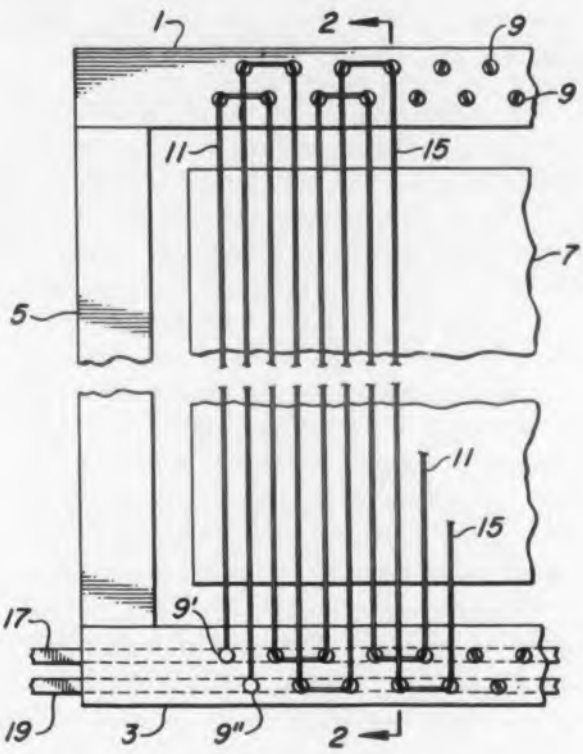
Grid Structure for Cathode-Ray Tubes . . . *Patent No. 2,695,372. E. O. Lawrence. (Assigned to Chromatic Television Laboratories, Inc., San Francisco, Calif.)*

Another variation of the grid structure of the Lawrence color tube has now been patented. Like previously patented grids, it is mounted a short distance from the phosphor screen. This grid has two functions: first to focus the electron beam to a relatively small dimension at the screen to prevent the beam from spreading over more than one color area on the screen and, secondly, to direct the beam to the desired color band or strip of phosphor.

A continuous wire strung from arm to arm is illustrated. However, the pairs of arms may carry a single strand. These wires are about 2/1000" diam and are spaced apart in conformity with the width of a set of strips of three color phosphors on the tube screen. Where a continuous wire is used, the overlapping wires do not touch but are spaced apart sufficiently so

that they do not contact at the point of crossover. There are, therefore, two sets of grid wires with the wires of one set alternating with the wires of the other set.

The grid wires are connected with a source of potential in the neighborhood of 4000v, one set of wires being connected with conductor *17* and the other set being connected with *19* (at right). The grid will focus the electron beam to a relatively small dimension so that it is slightly narrower than the color strips of the screen. By changing the potential upon one set of grid wires, the beam will be deflected. With the same potential upon the two sets of grid wires, the beam will not be deflected and will engage the center strip of the three color phosphors. If the wires of one set are made slightly positive with respect to the other, the beam is deflected to impinge upon one of the adjacent strips of phosphors. In this way, the beam is directed towards the desired color strip to produce a color picture.



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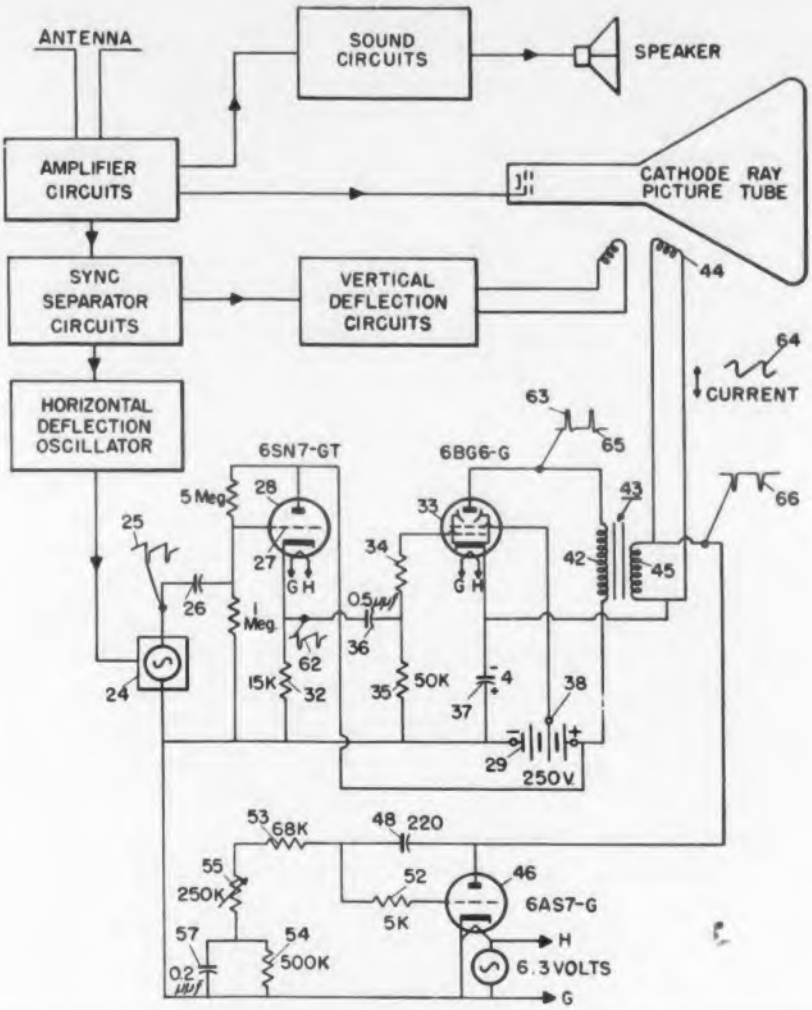
Television Deflection Circuit . . . *Patent No. 2,695,975. E. E. Sanford (Assigned to Allen B. DuMont Laboratories, Inc., Clifton, N. J.).*

The illustrated TV receiver circuit provides a saw-tooth current of large amplitude using a relatively low-voltage-B supply. Such a saw-tooth current is needed for a wide deflection angle and resulting shorter TV picture tube.

A source of saw-tooth voltage (*24*) provides in its output, a signal of form *25* having a negative impulse component. This saw-tooth wave form is presented to the grid of a cathode follower tube (*28*) so that essentially the same form of signal (*62*) appears at the cathode of this tube. Signal *62* is applied to the control grid of a deflection drive tube (*33*), the output signal of which is peaked. This signal also has a negative voltage peak (*65*) that is substantially absorbed in a damper tube (*46*). The plate circuit of deflection drive tube *33* is the primary winding of a transformer (*43*) so that the signal, which is applied to the deflecting coil (*44*) of the tube, is a saw-tooth wave form.

Damper tube *46* also is connected with the secondary winding (*45*) of the transformer and the negative peaked signal (*66*) appearing in the circuit causes the damper tube to draw current and charge the capacitor (*37*) in the cathode circuit of drive tube *33*. This arrangement provides a negative bias for the cathode of this tube. With a B power supply (*29*) of 250v and with an additional −125v provided by the grid current through the grid leak resistor (*35*), an effective voltage of 375v is produced between the grid and plate. A negative bias of about 100v at the cathode added to the 250v B supply results in approximately 350v between the cathode and anode of the drive tube. The grid is then biased by 25v with respect to the cathode.

With the circuit of the patent, a substantial reduction in the cost of the B power supply is achieved. Also by the design of a circuit having a damper tube the cathode of which is operated at ground potential, dispenses with a separate cathode current source and achieves a further reduction in cost.



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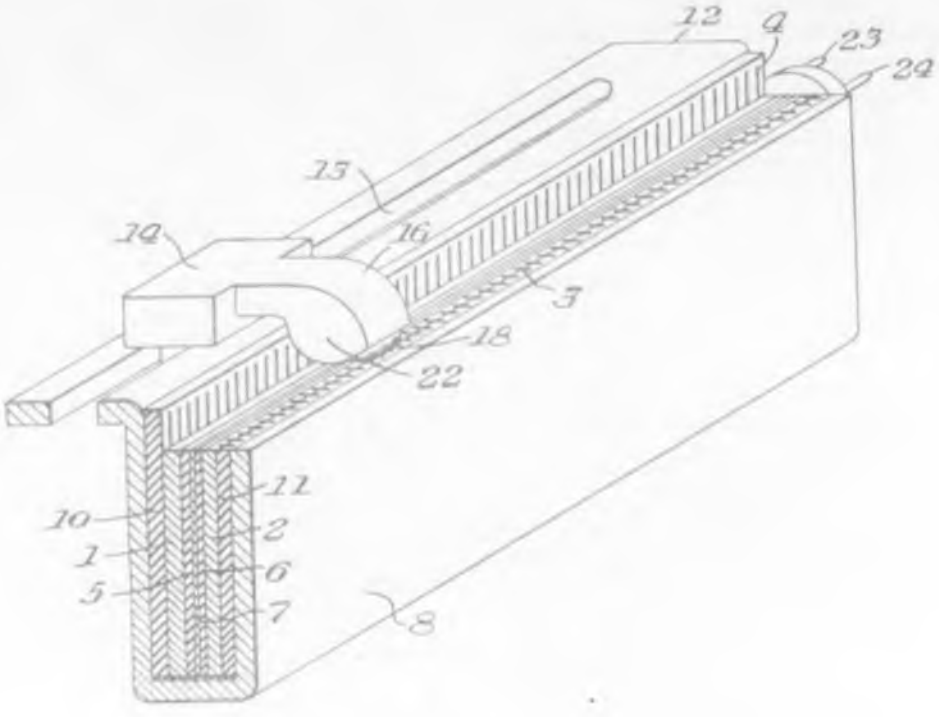

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Cylindrical Rheostat . . . *Patent No. 2,694,127. R. L. Fearn (Assigned to Syntron Co., Homer City, Pa.)*

A ball is the contact element in the rheostat described in this patent. The ball has a wiping action that keeps the contact surfaces free of foreign material.

A non-inductive ribbon such as of sinuous form, serves as the resistance element, but it does not encircle an insulating core or carrier. Two such resistance ribbons (*1* and *2*) are used, arranged parallel to each other and separated from each other by an insulating strip or strips (*5* and *6*). Insulating strips (*10* and *11*) engage the outer sides of the resistance elements. These parts are clamped together in a casing (*8*). A series of horizontal conductors (*3*) are connected at spaced intervals to one resistance element *11*, such as at the folds. A series of vertically disposed conductors (*4*) are similarly connected with the other resistance element *10*.

The resistance elements are bridged by a ball (*18*) of conductive material which is mounted in a suitable rider arm (*22*) of insulating material. The rider arm is received in a slot (*13*) so that the ball is held by the rider against the conductors of both resistance elements, and guided in its movement by the slot. By shifting the position of the rider and its conducting ball, the latter is moved to other points of contact with the conductors *3* and *4*.

The rheostat may be constructed in cylindrical and pancake form which is shown in other views of the patent. One of the advantages in the rheostat is that heat generated in the resistance elements is readily conveyed to the metal case and dissipated rapidly thereby so that a cool rheostat is secured.

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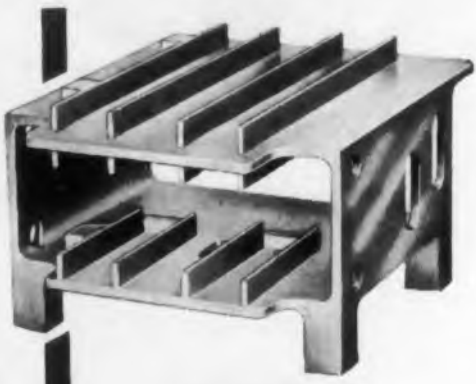

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Books

Handbook of Engineering Materials . . . *edited by Douglas F. Miner and John B. Seastone, John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y., $17.50.*

Electronic design engineers in the past did not have as many material selection problems as the other classifications of engineers. Chassis were always made of aluminum and cabinets of wood, and that was that. As electronic devices are increasingly used in unusual environments, frequently requiring hermetic sealing, complicated by the growing shortage of certain vital materials, the electronic engineer is faced more often with the need for making a choice between two different materials. This handbook should be of great help in making such choices. It contains over 1000 pages of closely printed material.

The handbook is divided into four sections: "General Information on Materials", "Metals", "Non-metals" and "Construction Materials". The first section is divided into four parts: Material Specifications and Standards, Statistics and the Applications of Materials and Mathematical and Physical Tables. This handbook with over 1000 pages is part of the well-known Wiley Engineering Handbooks series and resembles the others in physical appearance.

The Automatic Factory: A Critical Examination . . . *by Steven A. June et al, 81 pages. Instruments Publishing Co., Pittsburgh 12, Pa. $1.50.*

Electronic design engineers developing computers and control instrumentation for automatic factor operations are only expected to be concerned professionally with their design problems. However, it is obvi-

ous that new technology of electronic control has important management and social implications. This slim volume discusses some of these implications. It is the work of seven men, all students in the manufacturing course at Harvard Graduate School of Business Administration.

Among the subjects covered are mechanization vs. the automatic factory, obstacles to the automatic factory, the status quo in automation, and social implications of the automatic factory. There are four appendixes dealing with project "Tinkertoy" general terms, control terms, and machinery terms. Bibliographies are included.

Theory of Groups of Finite Order . . . *By W. Burnside, 512 pages, Dover Publications, Inc., 1780 Broadway, New York 19, N. Y. $3.95 clothbound, $2.00 paper-bound.*

This is a reprint of the second edition of well-known text on groups first published in 1897 and long since out of print. It is published as part of a program of reprinting out-of-print classic texts in the various sciences. The first half of the book explains the notion of substitutions, the latter chapters deal with group properties, substitution groups, the isomorphism of a group within itself, graphical methods of representation, the theory of groups of linear substitutions and their variance. Sample problems are given with each of the twenty chapters. The author was formerly Professor of Mathematics at the Royal Naval College, Greenwich, England.

Proceedings of the Eastern Joint Computer Conference . . . *92 pages, paperbound, American Institute of Electrical Engineers, 33 West 39th St., New York 18, N. Y. $3.00.*

A good review of the current status of computer technology can be obtained by reading from this slim volume. Among the papers presented at the last Eastern Joint Computer Conference and published here are: "Characteristics of Currently Available Small Digital Computers", "Techniques for Increasing Storage Density of Magnetic-Drum Systems", "Redundancy Checking for Small Digital Computers; Panel Discussion", "Automation of Information Retrieval, Discussion", and "Applications of Automatic Coding to Small Calculators".

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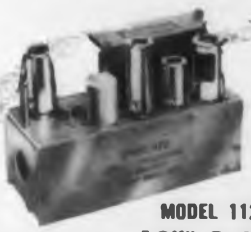

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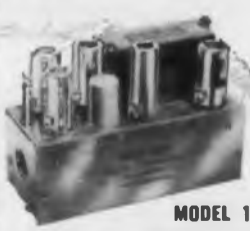

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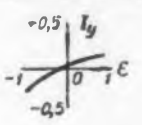
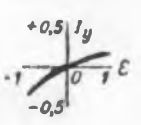
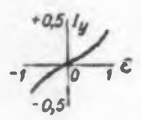
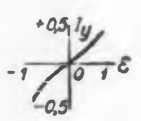
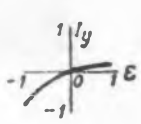
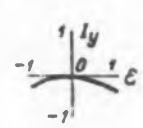
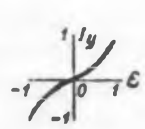
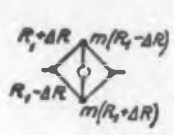
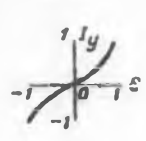
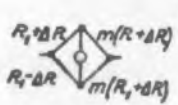
Abstracts

Pertinent condensations from foreign journals, house organs, reports, and periodicals of related technologies that frequently miss the attention of electronic designers

Emphasis on the use of the Wheatstone bridge as a null-measuring device has made us almost forget the variation of the current flowing in the bridge meter—except perhaps as an exercise in courses on network theory. We do not make full use of the bridge as an open-loop design component. It was therefore interesting, as we scanned material for our Russian translations program to find a most useful compilation of design data on Wheatstone bridges in a Russian book on meteorological instruments (by V. N. Kedrilovskiy and M. S. Sternzat, Hydrometeorological Publishing House, Leningrad, 1953). The editors of ELECTRONIC DESIGN feel this compilation will prove stimulating and valuable to circuit designers, particularly since it suggests a novel method for generating certain functions.

Unbalanced Bridge Characteristics

Diagram	Current in Meter Circuit I_y	Sensitivity at Null Point S_o	Relative Sensitivity in Arbitrary Units	Most Suitable Value of Meter Resistance R_y	Degree of Scale Non-linearity $D = \frac{I_y^\circ - I_y}{I_y}$	Character of Scale for $m = n = p = 1$, $U_o = 1$, $R_1 = 1$.
	$I_y = \frac{U_0}{R_1} \frac{\varepsilon}{4(1+n)+\varepsilon(3+2n)}$	$S_0 = \frac{U_0}{R_1} \frac{1}{4R_1(1+n)}$	1	$R_y = \frac{1+n}{2} R_1$	$D = \frac{3+2n}{4(1+n)} \varepsilon$	
	$I_y = \frac{U_0}{R_1} \frac{\varepsilon}{4(1+m)+\varepsilon(4+m)}$	$S_0 = \frac{U_0}{R_1} \frac{1}{4R_1(1+m)}$	$\frac{1}{(m=n)}$	$R_y = \frac{2m}{1+m} R_1$	$D = \frac{4+m}{4(1+m)} \varepsilon$	
	$I_y = \frac{U_0}{R_1} \frac{\varepsilon}{2(1+n)-\varepsilon^2}$	$S_0 = \frac{U_0}{R_1} \frac{1}{2R_1(1+n)}$	2	$R_y = \frac{1+n}{2} R_1$	$D = -\frac{1}{2(1+n)} \varepsilon^2$	
	$I_y = \frac{U_0}{R_1} \frac{\varepsilon}{2(1+m)-\varepsilon^2 \frac{2+m}{1+m}}$	$S_0 = \frac{U_0}{R_1} \frac{1}{2R_1(1+m)}$	$\frac{2}{(m=n)}$	$R_y = \frac{2m}{1+m} R_1$	$D = \frac{2+m}{2(1+m)^2} \varepsilon^2$	
	$I_y = \frac{U_0}{R_1} \frac{2\varepsilon+\varepsilon^2}{2\left(2+\frac{1}{p}+p\right)+\varepsilon\left(4+3p+\frac{3}{p}\right)+\varepsilon^2\left(1+p+\frac{1}{p}\right)}$	$S_0 = \frac{U_0}{R_1} \frac{1}{R_1\left(2+\frac{1}{p}+p\right)}$	$\frac{2}{(p=n)}$	$R_y = R_1$	$D \approx \frac{3p^2+4p+3}{2p^2+4p+2} \varepsilon$	
	$I_y = -\frac{U_0}{R_1} \frac{\varepsilon^2}{2\left(2+\frac{1}{p}+p\right)+\varepsilon\left(p-\frac{1}{p}\right)-\varepsilon^2\left(1+p+\frac{1}{p}\right)}$	$S_0 = 0$	0	$R_y = R_1$	$D \approx \frac{p-1}{2(p+1)} \varepsilon - \frac{p^2+p+1}{2(p^2+2p+1)} \varepsilon^2$	
	$I_y = \frac{U_0}{R_1} \frac{\varepsilon}{(1+n)-\varepsilon^2 \frac{1+n}{2}}$	$S_0 = \frac{U_0}{R_1} \frac{1}{R_1(1+n)}$	4	$R_y = \frac{1+n}{2} R_1$	$D = -\frac{1}{2} \varepsilon^2$	
	$I_y = \frac{U_0}{R_1} \frac{\varepsilon}{(1+m)+\varepsilon(1-m)-\varepsilon^2 \frac{2m}{1+m}}$	$S_0 = \frac{U_0}{R_1} \frac{1}{R_1(1+m)}$	$\frac{4}{(m=n)}$	$R_y = \frac{2m}{1+m} R_1$	$D = \frac{1-m}{1+m} \varepsilon - \frac{2m}{(1+m)^2} \varepsilon^2$	
	$I_y = \frac{U_0}{R_1} \frac{\varepsilon+\varepsilon^2}{2(1+m)+\varepsilon(1+4m)+2\varepsilon^2(m-1)}$	$S_0 = \frac{U_0}{R_1} \frac{1}{2R_1(1+m)}$	$\frac{2}{(m=n)}$	$R_y = \frac{2m}{1+m} R_1$	$D = \frac{1+4m}{2(1+m)} \varepsilon + \frac{m-1}{m+1} \varepsilon^2$	

RELATIONS between the diagram, meter-circuit current, scale non linearities, along with null sensitivity values are shown in the table at the right. The various equations are not derived here, but an indication of the method of derivation is given below.

Consider first the variation of the galvanometer current. Its value is best determined by Thevenin's theorem

$$I_y = \frac{\text{source voltage with galvanometer disconnected}}{\text{bridge resistance with galvanometer disconnected and source shorted}}$$

The overall expression is quite complicated; it can be simplified by expressing the individual bridge resistances in terms of the unknown resistance R_1, the relative change ΔR_1 producing the unbalance in the bridge (more precisely, in terms of $\epsilon = \frac{\Delta R_1}{R_1}$), and the various arms ratios (designated m, n, or p), as shown in the diagrams of the first column of the table. The simplified final equations are given in the second column (in conformance with European notation, the source voltage is designated U_0).

The sensitivity, given in the third column, is obtained by differentiating the equation in the second column. A measure of the relative sensitivities is contained in the fourth column.

A little known fact about unbalanced bridges is that the sensitivity depends not only on the galvanometer and battery internal resistances, but also on the relative locations of the two (i.e., interchanging the battery and the galvanometer sometimes changes the sensitivity). The value of the galvanometer resistance required for maximum sensitivity is given in the fifth column.

It is evident from the equations of column 2 and from the graphs of column 7 that the galvanometer deflection is not proportional to the current flowing in the galvanometer. The extent of this non-linearity is given in column 6. Here I_y^0 is the (incorrect) value of current that would be read on a linear galvanometer scale, while I_y is the actual galvanometer current.

Abstracts

Binotrol

Hole allotment for each function

BINOTROL is a compact, punched tape control system that has been applied to a turret lathe (Jones and Lamson). The lathe is completely controlled by punched tape. It is automatically cycled and provides rectilinear motion with precise control of the end points. It gives end-point positions and speeds for three motions. Hydraulic servos power the carriage, cross-slide and saddle motions. Accurate lead screws control hydraulic servo valves.

In addition to the commands to the three basic motions, the tape controls: (1) Choice of 16 spindle speeds at any time and without stopping the spindle. (2) Indexing of six-position turret to any face at any time. (3) Indexing four-position turret on cross-slide to any face at any time. (4) Operation of hydraulic-powered collet chuck and bar feed. (5) Coolant (on or off). (6) Hood (close or open). (7) Resetting of tape to repeat cycle.

The feed motor is electronically controlled. The rest of the system uses telephone type relays. Geared to the lead screw is a Binotrol device which divides lead screw rotation into 30,000 parts for a full tool slide stroke. Thus, feedback is provided every 0.001". This signal is compared to a similar signal from the punched tape reader. Relays operate if there is a difference. The end point is anticipated to slow speed to prevent over travel.

The plastic tape is 5" wide and a maximum of 32 holes appears across the tape. Each row commands one motion to travel a certain location at a certain feed rate and spindle speed. Each change of speed or position requires a separate row of holes and about 1" of tape (length) is required for each cutting operation performed by the lathe. The tape is formed into a loop so that the machine can recycle.

Binary-number coding makes it possible to measure 32.767" in increments of 0.001" using

FUNCTION	DIGITS
Address—carriage, cross slide, saddle, misc.	2
Linear position—32 in. by 0.001-in. units	15
Feed rate—choice of 16 feeds plus fast motion	5
Dwell time (at end of stroke)—0, ½, 1, 1½ sec	2
Tape index—carriage, cross slide, saddle, misc.	2
Spindle speed—16 speeds fwd, & rev.	5
Spare—to control auxiliaries, etc.	1
Total	32

only 15 digits. Each hole position, across the tape, starting with one, is double its predecessor as 1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096, 8192, and 16,384. By selecting a series of holes or "digits", any number from 0.001 to 32.767 is obtained.

For selecting a function, the same kind of hole in a different location on the tape is used in a variation of the binary code. Two digits permit four possible functions. As each of these combinations appears on the tape it selects a specific function such as zero dwell, 1/2sec dwell, 1sec dwell, or 1-1/2sec dwell. For example, feed-rate instructions on the tape use four holes to provide a range of 16 feeds and a single hole to indicate whether or not fast motion is required.

To determine how many holes are required to provide a unique pattern for each of a given number of functions, it is only necessary to raise 2 to whichever power provides the number of unique patterns desired. The exponent is equal to the number of holes you will need. Thus 5 holes (2^5) provide 32 unique patterns or will control 32 functions.

Flexibility is apparent. Any order of instructions punched into the tape will be executed by the machine in the same order. There is no need to set up cams or stops, only plug-in tools and the tape.

Tape control does a better job than humans operating a turret lathe in practically all respects. The set up is planned by an engineer so unskilled operators can get the machine ready. Short runs are more feasible with tape control machines. A machine bolt can be produced at 3000rpm including threading. Surface finish is 2mu-in rms.—*Adapted from articles appearing in* TECHNIQUE, *Barnes Engineering Co., Stamford, Conn., and* AMERICAN MACHINIST, *Aug. 1, 1955.*

When the gun failed, they used a tablespoon

HE LEARNED acting the hard way, barnstorming frontier towns by barge and stagecoach, playing in sheds and taverns.

Once a Texan even suggested the troupe tour through Indian country, carrying their stage weapons for protection. Joe Jefferson declined. He later said he shivered when he imagined himself facing a hostile Indian and armed only with a stage pistol whose tendency to misfire had several times "compelled our heavy villain to commit suicide with a tablespoon."

By the 1860's Jefferson was America's favorite actor. They loved him everywhere because he was a genius at making people happy. And his sunny outlook on life still sparkles in the spirit of modern America. Like Joe Jefferson, Americans still know how to travel a hard road to reach their goals, how to smile when the going's roughest.

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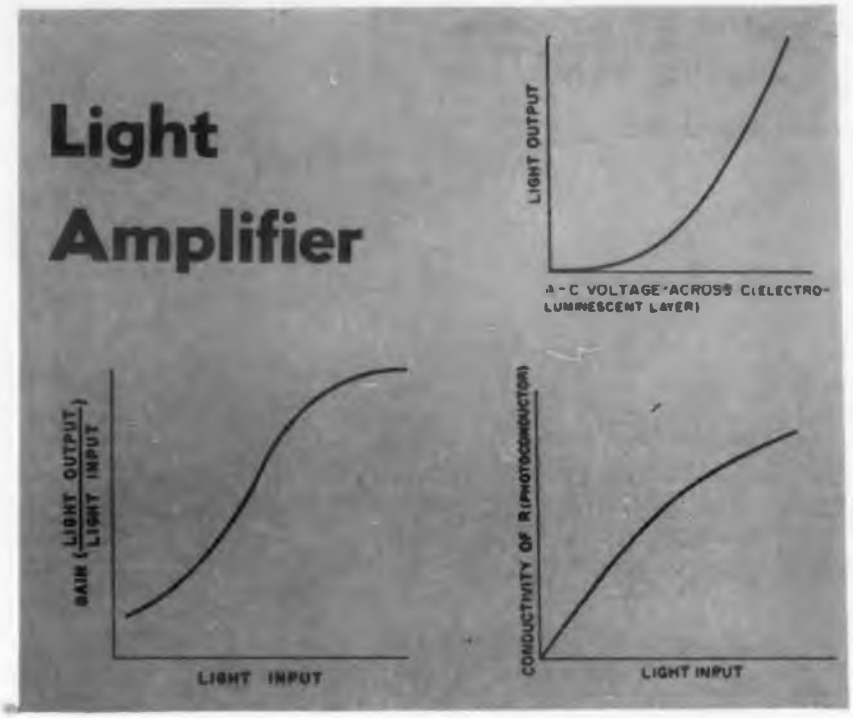
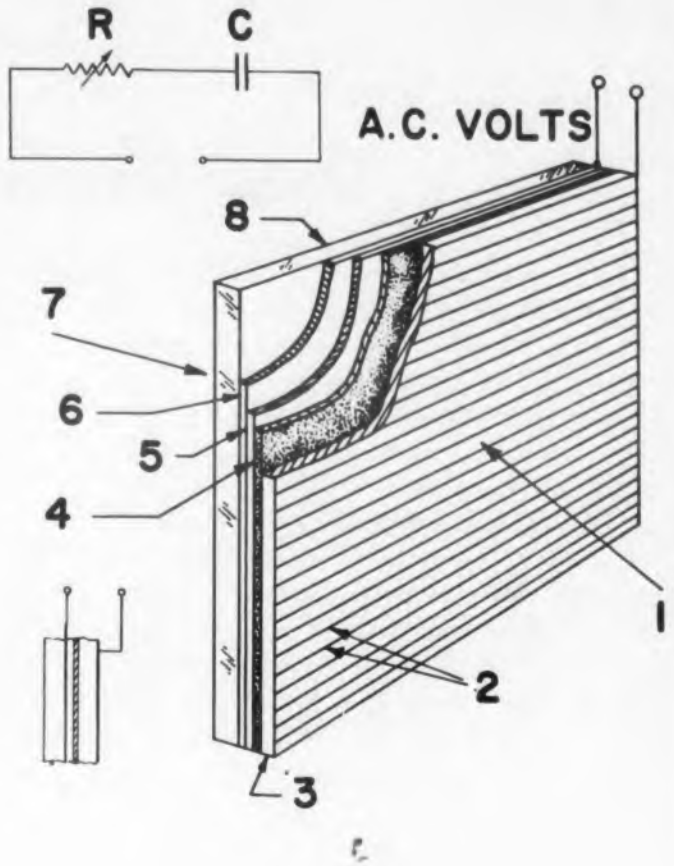
Abstracts



LIGHT amplifiers must provide a method of converting electrical energy into light and a method of controlling, by means of light, the amount of energy converted. Light is considered in this article as radiant power specified by a spectral distribution giving watts per unit wave length. The light amplifier is thus essentially a power amplifier. Two ways of converting electrical energy into light are cathodo-luminescence whereby power of an electron beam on striking a phosphor is converted into light and electro-luminescence whereby the power of an a-c or d-c source on application to a suitable phosphor is converted into light. The amount of electrical energy converted into output light may be controlled by the input light level with the aid of materials which are photosensitive.

Older types of light amplifiers included a photoemissive surface which emitted electrons as input light struck it, a 20kv accelerator, and a cathodo-luminiscent phosphor. Gains of greater than unity could be obtained. An aluminum film was put on top of the phosphor which was transparent to electrons but opaque to light to prevent regenerative feedback output light. Limitations of this type were need for high vacuum, limited size and need for high voltage power supply.

The newer thin panel amplifier illustrated which can be made in any size does not have the above limitations. Besides the electroluminescent sheet which converts the a-c electrical power into light, there is a photoconductive sheet, which by controlling the amount of light incident upon it, determines the amount of electrical power converted into light. In addition, there is included a sheet which is opaque to light in order to prevent feedback of light from output to input. Such feedback, if excessive, would completely prevent the reproduction of half-tone pictures. A single element of the amplifier is shown in cross-section along with its equivalent circuit. The variable resistor corresponds to the photoconductor and the capacitor to the electro-luminescent phosphor. The opaque sheet having negligible impedance is not included. The light output from the phosphor increases rapidly with the voltage across it as shown in the graph. The conductivity of the photoconductor varies



1. Input picture
2. Conducting lines
3. Photoconductive layer
4. Opaque layer
5. Electroluminescent layer
6. Transparent conducting coating
7. Output picture

with the input light, approximately, as shown graphically.

In the operation of the amplifier, a fixed alternating voltage is applied across the photoconductor (R) and phosphor (C). In the dark, the resistance of the photoconductor is very high and only a very small fraction of the applied a-c voltage will appear across C and the phosphor will essentially not emit any light. If there is light incident on the photoconductor, the resistance R is reduced and an appreciable fraction of the applied voltage appears across C and the phosphor emits light.

The spectral, decay and transfer characteristics of a light amplifier correspond in a general way to the frequency, delay and transfer characteristics of an electrical amplifier. There are, however, significant differences. The frequency or color of the output light generated need have no direct relation to the frequency or color of the incident light. As a result, the light amplifier is characterized by an input frequency characteristic (photo-sensitivity spectral response) and an output frequency response (spectral emission of luminescence). The decay characteristic of the light amplifier is presently determined primarily by the photoconductor. The transfer characteristic of the panel amplifier is non linear, i.e., gain is a function of the light input.

In general, the brightness gain of a light amplifier need not correspond to power gain, because the output light may not be the same color as the input light. Distinction should be made between amplifiers, amplifier-converters, and mere converters.

The resolution of the panel amplifier is in general limited by the thickness of the layers used. In the case of the 12" laboratory model, the resolution was found to be over 500 television lines and has been tested with a television picture input. The amplified picture did not suffer in resolution or contrast range but because of the transfer characteristic, the gamma of the amplified picture was greater than the input picture. Using the panel as an amplifier, a maximum power gain of about 20 was obtained—*"Principles of Light Amplification" by D. W. Epstein*, RCA Engineer, *June-July, 1955.* This magazine is not available to the industry, therefore, this abstract contains practically all of the original technical information.

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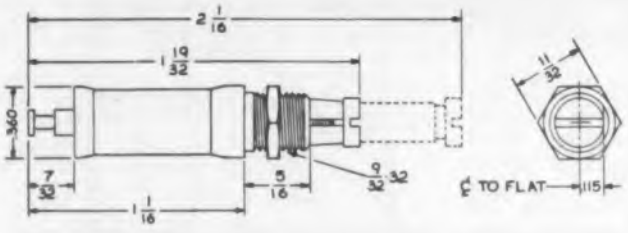
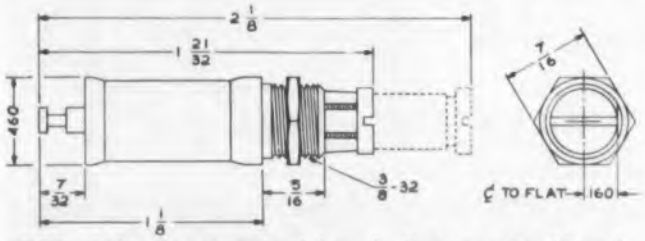
Stability is provided by two sets of spring fingers which tightly grip the rotor assembly. This assures positive electrical contact and maximum mechanical resistance to shock and vibration. Fine thread (64 to an inch) and rhodium plating assure smooth vernier action.



TYPE 1807—Min. capacity 0.4 mmf.; Max. capacity 12 mmf.



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Abstracts

USSR Thermistors

Thermistors are expected to play a big role in Soviet industry and science according to an article in *Radio*, No. 7, 1955. Accordingly, the article described basic characteristics in tabular form and illustrated various sizes and shapes with drawings. Details on the main kinds of thermistors produced by the USSR industry and available for use were included in the article. Tabular material is presented here.

Illustrations of volt-ampere characteristics of direct-heating thermistors were given. A graph showed the dependence of thermistor resistance on temperature. Exterior views of measuring types and special thermistors with pigtail, axial, and radio leads were presented. Plug-in types were also illustrated. A circuit for measuring temperature was described and illustrated. A bridge circuit for switching a thermistor to either measure temperature or control the circuit was given. Another circuit arrangement showed an automatic switching scheme for control. A circuit for regulating the output level of an amplifier was included also.

Direct Heating Thermistors

Type	Nominal Voltage	General Limit of Stabilization (volts)	Operating power in current (ma)	Average Operating current (ma)	Life in hours
TP 2/0.5	2	1.6-3.0	0.2-2.0	0.5	5000
TP 2/2	2	1.6-3.0	0.4-6.0	2.0	5000
TP 2/6	6	4.2-7.8	0.4-6.0	2.0	5000

Measuring Thermistors

Type	Operating Power Maximum (mw)	Resistance at Operating point (ohms)	Top Allowable Operating Current (ma)	Life in Hours
T8D	9-16	150	15	500
T8C	6.5-30	120	15	500
T9	4-25	125	15	500

Parameters of Indirect Heating Thermistors

Designation of Parameters	Unit of measurement	Magnitude Min.	Medium	Max.
Current of heater: a-c or d-c	mw	—	15	20
Power dissipated by heater at average current	ma	12.8	16	19.2
Cold resistance of thermistor	kohm	10	—	—
Resistance at maximum current of heater	ohm	300	—	—
Allowable overload, not more than 15 min.	ma	—	—	28
Puncture voltage between heater and thermistor	volt	50	—	—
Life	hours	3000	—	—

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What the Russians are Writing

Including annotated tables of contents of leading Soviet journals that publish papers on electronic circuit design and behavior.

Radiotekhnika, June 1955

Passage of a Signal and Noises through a Limiter and a Differentiating Device, by V. I. Bunimovich. Determination of average number of pulses and distribution of pulse amplitudes, resulting from the passage of a sinusoidal signal, accompanied by noise, through a limiter and a differentiating device. Employs statistical theory.

Reception of Pulse Signals using the Mutual Correlation Method, by V. I. Chaikovski. Determination of the ratio between a signal and fluctuating noise when receiving signals, with the mutual-correlation method. The resulting ratio is compared with the corresponding ratio prevailing at the output of an ideal bandpass filter. Refers to *Proceedings of the IRE*, vol. 38, and *Journal of Applied Physics*, vol. 23.

Steady-State Processes in the Detection of Pulse Signals, by A. A. Kulikovskii. Considers a method of computing the steady-state pulse-signal voltage at the load of the detector, using the Duhamel integral for a slowly-varying d-c component. Suggests an approximate method, conveniently integratable, for approximate determination of the d-c component of the detector current, the characteristic of the detector being approximated by straightline segments.

Triode Frequency Converters for Meter Waves by I. I. Levenstern & G. G. Kostandi. Considers optimum circuits for triode frequency converters for meter waves, satisfying the demands made on frequency converters in modern AM-FM broadcast receivers. Discusses two types of circuits—one with inductive bridge in the grid circuit, another with a capacitive bridge.

A Method for Investigating Transients in Linear Systems by R. D. Leytes & L. I. Gutman. Tho article considers an approximate method of transient analysis, based on the application of the theory of finite difference to the integral equation under consideration. It is shown that introducing special coefficients leads to a simple expression relating the input and output system voltages. This expression permits solving many problems in transients in amplifier. A stage with anode correction is used by way of an example.

Propagation of Plane Electromagnetic Wave in a Space filled with Plane Parallel Grids. The article is devoted to investigation of propagation of plane electromagnetic waves in artificial dielectrics. The method of difference equations is used.

Comparison of Communication Channels at Various Modulation Systems, based on their Transmission Ability. Analysis of the fundamental equation of the static communication theory. This equation is used to derive equations for the channel carrying ability in two cases: (a) signal limited in amplitude and (b) signal limited in average power. The existing modulation systems are compared with respect to their transmission ability (effectiveness).

Increasing the Effectiveness of Reactance Tubes by A. D. Artym. Discussion of method for increasing the effectiveness of reactance tubes used for frequency modulation. It is shown that increasing the effectiveness of reactance tubes permits increasing the stability of the central frequency.

Standards and Specs

Sherman H. Hubelbank

This department surveys new issues, revisions, and amendments, covering military and industry standards and specifications. Our sources of information include the Armed Services Electro-Standards Agency (ASESA), the cumulative indexes to Military Specifications, Vols. II, IV, American Standards Association (ASA) and other standards societies.

Batteries

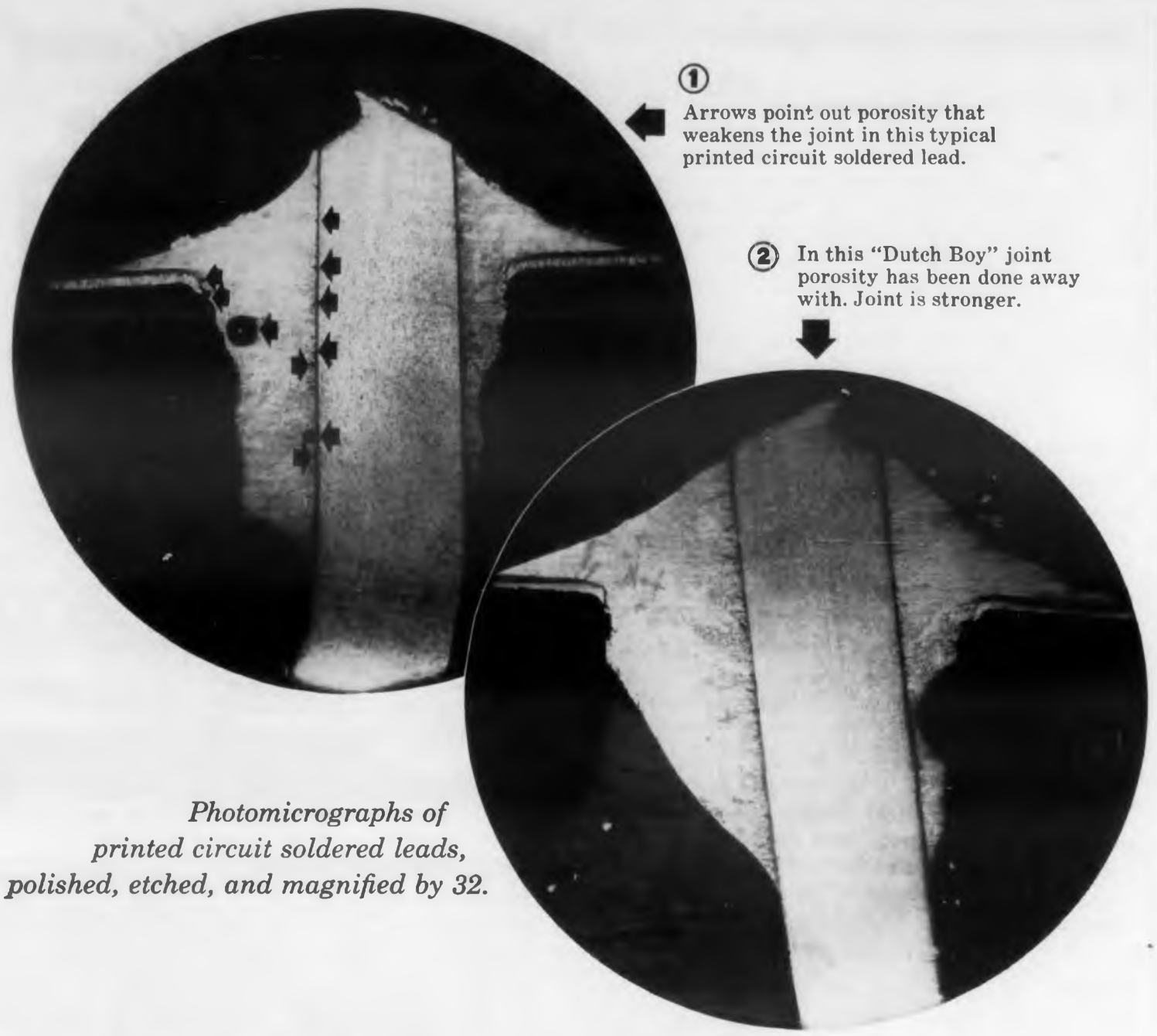
ASA C18.1-1954, SPECIFICATIONS FOR DRY CELLS AND BATTERIES . . . This spec is a revision of C18.1-1947. It covers for the most part: standard cell sizes and designations, battery dimensions, terminals, test methods and performance requirements. This new spec, the fifth edition of the standard, has been broadened to include the miniaturized cells, such as, the so-called mercury cells, the air-depolarized cells, and the flat cells which have been developed and manufactured in the past few years. Performance requirements and test methods for photoflash type dry cells are also given in this standard. A smaller size battery than the penlight battery is covered in this edition. New intermittent tests and three new hearing-aid battery tests are also included. Certain types of cells have been removed from the lists in the standard because of their infrequent use.

Design

MIL-F-14072 (SIG C), FINISHES FOR GROUND SIGNAL EQUIPMENT, 25 MAY 1955 . . . This spec supersedes Army spec No. 72-53. Requirements for finishes necessary to protect ground signal equipment from the effects of climatic and service conditions are covered in this spec. Finishes defined in the spec are applicable to complete equipments and piece parts. The intention of this spec is to guide designers and engineers in the selection of compatible materials and finishes. Specific finish numbers have been assigned for the various acceptable types of finishes. A table has been included in the spec to cross-reference the finish numbers with the equivalent finish of spec 72-53.

Rectifiers

MIL-R-18281 (NAVY), METALLIC RECTIFIERS: SELENIUM, COPPER OXIDE, AND MAGNESIUM-COPPER SULFIDE TYPES, AMENDMENT 1, 18 MAY 1955 . . . Production drawings in accordance with MIL-D-963 were added by this amendment. The description of the performance test was modified. The procedure for requesting authorization of qualification tests was changed.



① Arrows point out porosity that weakens the joint in this typical printed circuit soldered lead.

② In this "Dutch Boy" joint porosity has been done away with. Joint is stronger.

Photomicrographs of printed circuit soldered leads, polished, etched, and magnified by 32.

"Dutch Boy" gets inside story on printed circuit soldering

...develops solders and fluxes that give stronger joints, coat more uniformly, show higher conductivity

"Dutch Boy" researchers keep a close eye on printed circuit soldering.

For example, they cross-section soldered leads, polish, and examine the polished sections under the microscope.

Most such joints prove too weak

The photomicrograph above left shows why. Notice this typical joint is honeycombed with porosity. Arrows point to holes.

Now look at the photomicrograph on the right. This joint is strong. Non-porous.

How was joint on the right made stronger?

No great trick. A "Dutch Boy" Solder Specialist simply worked out slight improvements in flux and solder formulae and operating conditions.

Maybe this would help improve *your* printed circuits.

"Dutch Boy" solders develop maximum surface tension. They don't form "tear drops" when coated boards are lifted from the bath...they improve coating uniformity. The residual flux is both non-corrosive and non-conductive, and can be left on the soldered board.

So, if you feel there is room for improvement in your printed circuit soldering, look first to "Dutch Boy". Write, giving details if possible, to National Lead Company, 111 Broadway, New York 6, N. Y.

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Wire & Cable

MIL-C-3432, Addendum No. 1, Cable, Flexible, 300 and 600 Volts, 2 May 1955 . . . This ten page addendum to the spec has added multiconductor cable containing ground wires. An intermediate grade for 300 volts has been added. Many of the tables defining the construction of the cables have been revised.

MIL-W-76A, Amendment 1, Wire and Cable, Hook Up, Electrical, Insulated, 5 August 1955 . . . The use of soft or drawn copper has been clarified for all sizes and types of wire. The requirements for tolerances of strands in a stranded conductor have been withdrawn. Standardized Group B sampling has been substituted for that procedure shown in Table XVIII. The cross-index of types has been revised and given more information concerning the applications of the various types of wire covered by the spec. A cross-index to MIL-W-12410(Sig C) has also been added.

Parts

MIL-D-26715(USAF), Descriptive Identification Data to Be Furnished by Government Suppliers, 11 May 1955 . . . This spec covers the requirements for obtaining Air Force stock numbers and details the procedure for preparing item descriptions for Air Force items of supply procured through the provisioning methods. Fig. 3 to this spec depicts the flow of work and the time factors involved in stock number assignments. Briefly 80 to 95 days are involved in obtaining AF stock numbers, plus 30 days mailing time, according to this new spec. The appendix to the spec contains special rules applicable to the preparing of item descriptions.

MIL-E-17362A(Ships), Amendment 2, Electronic Maintenance Parts Requirements, 3 June 1955 . . . The definition of maintenance parts has been changed to incorporate the three types of replacement parts as subsequently defined. The descriptive data required for the maintenance parts list has been changed. The table that provides the variables for computing the quantities of spares has been modified.

Design

AF Bulletin No. 114, Use of Improved Electron Tubes, 20 April 1955 . . . Nine tubes were added to the list of improved electron tube types for use in the design of new equipment. Twelve new tubes were added to the list of improved electron tubes for use as supply and maintenance replacements or for use as replacements in production and reordered equipments.

Dynamotors

MIL-D-24A, Dynamotors, 15 August 1955 . . . All the dynamotors presently included in the spec are no longer for airborne use at altitudes over 10,000 feet. The detail data that appeared on individual spec sheets has been included in the body of the spec. Ten dynamotor types are indicated to be inactive for new design.

Resistors

MIL-R-18546A(SHIPS), RESISTORS, FIXED, WIRE WOUND, POWER TYPE, CHASSIS MOUNTED, 15 JUNE 1955 . . . This spec covers one type of power-type wire-wound, fixed resistors that utilize a metal-mounting surface to dissipate heat. MIL-R-18546(SHIPS) dated 17 March 1955 has been superseded by this revision.

JAN-R-19, AMENDMENT-7, RESISTORS, VARIABLE WIRE-WOUND (LOW OPERATING TEMPERATURE), 18 JULY 1955 . . . The list of referenced specs and publications have been revised. The methods of packing and packaging have been simplified by the establishment of immediate use, short time storage, and overseas shipment groups.

Jacks

MIL-J-641A, JACKS, TELEPHONE, 15 AUGUST 1955 . . . Jack JJ-037 has been deleted from this issue of the spec. Five new jacks, applicable to Naval use have been added. Requirements and tests for temperature cycling, shock, vibration, salt-spray, and moisture resistance have been revised to specify the applicable methods and tests of MIL-STD-202. Production sampling tests have been revised to read "groups A, B, and C acceptance tests". An appendix has been added to cover the procedures for qualification approval and a plan for submission of samples.

Shock Tests

MIL-S-901B(NAVY), AMENDMENT 1, TESTS FOR SHOCKPROOF EQUIPMENT, CLASS HIGH-IMPACT, SHIPBOARD APPLICATION, 1 JUNE 1955 . . . Three grades of shockproof equipment have been established by this amendment. Grade I does not permit the use of either external or internal resilient mountings. Grade II permits the use of either or both type of mounting. Grade III is without the use of either external or internal resilient mountings and also with the use of only external resilient mountings. The marking requirements have been changed as have the forms required for recording tests at both a commercial and a goverment facility.

Standards Society

The Standards Engineers Society Annual Meeting included discussions on organization of company standards, standardization of electrical equipment, standards in consumer goods, standards and automation, standards in sports, national strength and standardization, and the future of standards. Elected to fellows in the society were R. E. Gay, Director of Cataloging, Standardization and Inspection, Office of the Assistant Secretary of Defense; Dr. W. R. G. Baker, Vice-president and General Manager, Electronics Div., General Electric Co.; H. R. Terhune, Manager of Standards, Federal Telecommunications Laboratories; and Stanley Zwerling, Assistant Chief, Tests and Approvals Div., ASESA.

Fuses

MIL-F-18899(DOCKS), FUSES, PLUG, TIME DELAY ELEMENT TYPE, 0-39 AMPERES, 125 VOLTS, 16 JUNE 1955 . . . Nonrenewable, threaded plug type fuses with time delay elements rated between 0 and 30 amps at 125v are covered by this spec. These fuses have been divided into two classes. Class 1 covers plug type fuses threaded for medium screw base sockets. Class 2 covers special size plug screws requiring an adapter to fit the medium screw base sockets.

Terminals

MIL-E-1636B (SHIPS), PRESSURE GRIP ELECTRICAL CLAMPS AND LUG TERMINALS, AMENDMENT 1, 23 MAY 1955 . . . This amendment added a new type of lug terminal and corrected some typographical errors of the original spec.

Electron Tube Bases

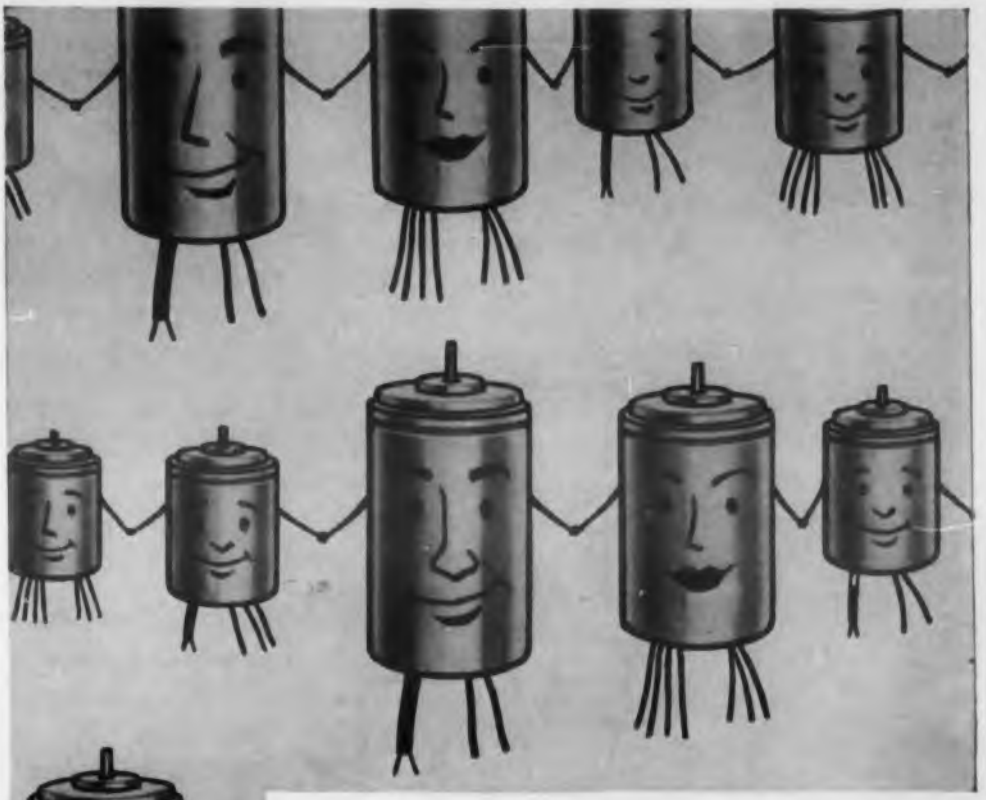
RETMA STANDARD ET-106-C, NEMA PUBLICATION No. 503-C, RETMA-NEMA STANDARDS FOR ELECTRON TUBE BASES, JUNE 1955 . . . This standard was adopted and issued jointly by RETMA and NEMA and was formulated by the Joint Electron Tube Engineering Council. The standard consists of three sections. The first section defines standard alignment gauges for base terminal spacings and standard ring gauges for base diameters. The second section shows typical drawings of typical accessory weights for base pin alignment gauges. The third section has drawings for standard base alignment gauges. Copies of this standard may be obtained from either RETMA or NEMA.

Relays

MIL-R-5757C, RELAYS, ARMATURE (FOR ELECTRONIC AND COMMUNICATION EQUIPMENT) 27 JULY 1955 . . . Qualification tests now require the submission of one additional specimen as a replacement for the allowable failure in test group one. Sealed relays no longer have material requirements for the materials inside the relay. A new shock test in accordance with method 202 of MIL-STD-202 has been added, in addition to a tumbling test. A list of drawings for the equipment necessary to perform the tumbling test has been included. The life test is now specified to be performed at the maximum temperature of the applicable range. Drawings of the various relays are included as figures and incorporated in the basic spec.

Specifications listed on these pages are for information only and government contractors should be guided by their contracts. Copies of military specs should be obtained from sources recommended by procuring officers. ASESA bulletins may be obtained from Fort Monmouth, N. J. ASA standards may be obtained from American Standards Agency, 70 E. 45th St., New York 17, N. Y., unless otherwise noted.

Advertising Index



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