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2 ∿ response **Phase reversible**

Cat. No.	Supply Freq. C.P.S.	Power Out. Watts	Volt. Out. V. AC	Sig. req'd for full outp. V. AC-DC R in 10K	R in 1K
MAF-1	60	13	110	1.0	—
MAF-6	400	5	57.5	1.2	0.4
MAF-6	400	10	57.5	1.6	0.6
MAF-7	400	15	57.5	2.5	1.0

MAGNETIC AMPLIFIERS

Single ended

Cat. No.	Supply Freq. C.P.S.	Power Out. Watts	Sig. req'd for full outp. MA-DC	Total resis. Contr. wdg. KΩ	Load resis. ohms
MAO-1	60	4.5	3.0	1.2	3800
MAO-2	60	20.	1.8	1.3	700
MAO-4	60	400.	9.0	10.0	25
MAO-5	60	575.	6.0	10.0	25

MAGNETIC AMPLIFIERS

Push-pull **Phase reversible**

Cat. No.	Supply Freq. C.P.S.	Power Out. Watts	Volt. Out. V. AC	Sig. req'd for full outp. MA-DC	Total resis. Contr. wdg. KΩ
MAP-1	60	5.	115	1.2	1.2
MAP-2	60	15.	115	1.6	2.4
MAP-3	60	50.	115	2.0	0.5
MAP-3-1	60	50.	115	7.0	2.9
MAP-4	60	175.	115	8.0	6.0
MAP-7	400	15.	115	0.6	2.8
MAP-8	400	50.	110	1.75	0.6

SATURABLE TRANSFORMER

Phase reversible

Cat. No.	Supply Freq. C.P.S.	Power Out. Watts	Volt. Out. V. AC	Sig. req'd for full outp. MA-DC	Total resis. Contr. wdg. KΩ
MAS-1	60	15	115	6.0	27
MAS-2	400	6	115	4.0	10
MAS-5	400	2.7	26	4.0	3.2
MAS-6	400	30	115	4.0	8.0
MAS-7	400	40	115	5.5	8.0

FREED NULL DETECTOR AMPLIFIER TYPE 1140-A

USES

A sensitive null indicator for bridge measurements, providing visual null indications or aural when used in conjunction with headphones. The unit may also be used as a high gain amplifier for general laboratory work.

DESCRIPTION

Functionally the instrument consists of a high gain linear amplifier with a 30 db. input attenuator in addition to the variable gain control. A four-inch panel meter provides visual null indications. the response of the meter circuit is approximately logarithmic over a 40 db. voltage range. Resonant circuits tuned to 60, 400 and 1000 cycles limit the amplifier transmission characteristics to the three audio frequencies commonly used for bridge measurements or it may be used as a non-selective amplifier with filter "off."

SPECIFICATIONS

Input Impedance: 1 megohm in parallel with 25 mmf. **GAIN:** 98 db. with 1 megohm load (6 mmf. shunt capacity), down 1.5 db. at 25,000 cycles, down 5 db. at 50,000 cycles, down 2 db. at 20 cycles.
Null Detector Sensitivity: At 1 kc. 100 microvolts will give a 15% meter deflection.
Selective Amplifier: 26 db. second harmonic attenuation at 60, 400 and 1000 cycles.
Power Supply: 105-125 volts, 50-60 cycles, 35 watts consumption.
Dimensions: 13½" x 8½" x 10".

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Frequency: 20 to 10,000 Cycles
Accuracy: 1% to 1000 Cycle, 2% to 10KC
Conductance: 1 Micromho to 1 MHO
"Q": 0.5 to 100
Superimposed D.C.: Up to 1 Ampere
Direct Reading: For use by unskilled operators.

ACCESSORIES AVAILABLE:
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◀ CIRCLE 1 ON READER-SERVICE CARD

ELECTRONIC DESIGN

Contents

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CIRCLE 2 ON READER-SERVICE CARD FOR MORE INFORMATION

Editorial

Reliability—At What Price?

Everything wears out. We all know that and prepare for it. Programs of planned maintenance act to reduce the possibility of unexpected equipment failures. But it's the sudden unexpected failures that can be disasterous.

Unfortunately, electronic equipment has long been tagged unreliable by many engineers who prefer mechanical to electrical contrivances. Vacuum tube burnouts, resistor and condenser failures and transformer burnouts and shorts have all too often contributed to that reputation.

More and more emphasis is now being placed upon the design of electronic equipment that won't fail suddenly. With the advent of pilotless aircraft, unattended radio transmitters and other equipment not watched over by an engineer, failure of one component can result in a costly loss.

All this brings us to an important aspect of reliability. That is, how much should we spend on reliability?

One of the first considerations in designing a piece of electronic equipment is to weigh the results of its possible failure. For example, if an automatic pilot should fail, the human pilot can take over and bring the aircraft safely home. That certainly wouldn't be classed as a 100 per cent failure. But if a vital part of a guided missile should stop functioning, the missile may not reach its destination, and may even fall on friendly territory with disasterous results. That, certainly, is 100 per cent failure.

Even the same piece of equipment may be classed as 100 per cent failure under certain conditions and only a small percentage under other conditions. A good example is an aircraft radar landing system. Failure of the system under conditions of fair visibility wouldn't have the same effect as its failure under conditions of zero visibility.

It's certainly agreed that 100 per cent reliability costs money. In the recent push to increase reliability, there is a danger of carrying it too far. All of the conditions under which the equipment will operate must be considered. Naturally, the most obvious rule to follow is to determine what will happen if the device suddenly fails. Is a human operator at hand to take over? Can the effects of the failure be compensated in other ways? The answers to these questions should determine the amount of money spent in designing reliability into electronic equipment.

Electronic News

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

Biggest Waveguide Yet?

Waveguides For VHF TV

A new invention for making corner joints has resulted in a perfect surface for rf power transmission. Megawatts of power can be channeled down the huge waveguide illustrated — ordinarily this amount of power would melt a welded joint. In the new joint, metal actually bites into the sides of the waveguide.

Manufacturing techniques have been worked out by Brach Electronics Div. of General Bronze Corp., 711 Stewart Ave., Garden City, N. Y., so that 21 by 10-1/2 in. by 10 ft waveguides (300 Mc) can be constructed with tolerances that could only be obtained previously by extrusions. It is expected that 5-ft guides for 50 Mc will prove feasible. Extremely high-power radar transmission is practical now.

Biggest use is expected to be in coupling between transmitter and antennas for over-the-horizon scatter propagation. General Bronze has developed inspection methods for evaluating the contacts, squareness, bow and other critical tolerances. In the photograph an optical device is checking reflections from the surface.

New Hi-Power "Avalanche" Diodes

Techniques for making diffused junction silicon "avalanche" diodes with lower impedance and higher power capability than have been previously available have been developed by Bell Telephone Laboratories. The breakdown voltage can be controlled over a range of about 5 to 500 v by controlling the junction impurity gradient. Knowledge of this gradient permits close prediction of breakdown voltage. Lowering the impurity gradient by increasing the depth of penetration increases the breakdown voltage.

Test is being made of a medium-power "avalanche" diode. This particular unit breaks down at 20 v, and is capable of dissipating 6 w with an appropriate heat sink. Oscilloscope trace shows abrupt "avalanche" effect.

Phosphorus is diffused into a p-type silicon wafer to form a p-n rectifying junction. The ohmic junction on the other side of the wafer is formed by diffusing boron into the silicon, then plating with nickel. Current prior to breakdown is on the order of one microampere or less for units rated 10 v and above. At breakdown, the impedance is reduced to a few ohms for currents in the milliampere range, and can be on the order of a fraction of an ohm for high current surges.

Limited quantities are available for experimental purposes in military applications. For further details contact the Radio Division at 120 Broadway, New York, N. Y.

Heat Treating Without Distortion

Distortion-free and discoloration-free heat treating of small stainless parts is possible with this special furnace developed by Allied Products Division of Hamilton Watch Company. Instrument manufacturers can thus finish machine parts and later harden them without fear of discoloration or dimensional distortion.

Furnace for heat treating stainless parts

Mobile control tower can be flown to advance air strips.

Airport Tower Rides High

Key to airport operations is the control tower and its associated electronic equipment. By making this unit mobile, communications between aircraft and airport can be set up in a hurry.

This mobile control tower can be flown to an advance air strip and put into operation in 30 min. Two men can operate the system. Developed by Craig Systems, Inc., the tower is made of aluminum skins bonded to a plastic foam core. Total weight is less than 2500 lb including heating and ventilating equipment.

Components included in the tower are uhf and vhf receivers and transmitters. High and low-frequency receivers and radio and telephone control panels are also included. Other equipment includes the usual weather instruments, signal lights, and clocks. Only the electrical power source is outside. Antenna masts, antenna and wind indicators, stored inside for transport, are quickly assembled.

Instruments have "Sixth Sense"

Special instruments equipped with a "sixth sense" have been designed to help control complicated chemical manufacturing processes at the Atomic Energy Commission's Hanford plant.

Developed by General Electric Co.'s engineers in Schenectady, N.Y., the instruments measure properties of chemical solutions continually during production runs, helping operating engineers keep close control over results and helping obtain a uniform operation.

Data from the instruments is available for immediate use and process correction. Formerly, several hours were often necessary to obtain analytical results from laboratory tests.

One of the instruments uses a by-product of plutonium production as a help in gathering data necessary to control that production. Atomic rays given off by a radioactive isotope are used to measure properties of materials under processing. By measuring the amount of radioactivity absorbed by the material, technicians can determine changes in the flow of materials under process.

Outlook for Copper is for Greater, More Stable Supply

Copper industry gives indication of maintaining steady growth for years to come.

"Greater output from mines, sustained consumption, new uses for metals, a trend to more stable prices, and copper's inherent suitability for many applications, cause the copper industry to remain optimistic about the future," said Theodore E. Veltfort, manager, Copper and Brass Research Association. Markets for any material, particularly metal, Mr. Veltfort believes, are mainly determined by: (1) economic conditions prevailing at the time a material is being considered and (2) properties and characteristics of the material. As they relate to copper, both factors portend a bright future.

It is reasonable to forecast a steady increase in copper consumption throughout the world as other countries gradually improve their living standards by developing more complex machine technologies and mass production concepts.

However, the copper supply pattern will become more favorable as greater capacity is realized from current expansion programs and newly developed free-world copper mines during the next three to five years.

High Power Transducer Perfected

Efficiency of a small ultrasonic magnetostriction type transducer has been increased by Acoustica Associates, Glenwood Landing, N. Y. to produce 66 acoustic watts per sq in. This development makes more feasible large scale ultrasonic cleaning, degreasing, descaling, plating, and other metalworking and finishing operations. By grouping 400-w, 25-kc transducers externally on present process equipment and driving them in tandem, power up to 150 kw can be produced. Magnetostriction transducers can be used with liquids above the boiling point.

New efficient transducer this small-in-size as hand-held unit shows. Tank in background is equipped with two earlier models.

Admiral Buys Raytheon's TV and Radio Set Operation . . .

Admiral Corp., Chicago, Ill., has acquired Raytheon's Belmont TV and radio manufacturing operations for $2,000,000. The price includes two plants, inventories, and equipment.

According to Ross D. Siragusa, Admiral president, the company will complete the transaction with its own capital, no stock transfer or outside capital being involved.

TV and radio set sales have been averaging about 10% of Raytheon total sales of about $175,000,000 in the past three years. However, in the current fiscal year, sales have been less than 10%. The company said that the operation has been unprofitable. Admiral will not only expand this manufacturing operation, but will move into the Hi-Fi field as well.

Lear Licensed to Build British Fuel System

Lear, Inc., has entered into a 10-year exclusive license agreement to manufacture and sell in the U. S. the turbine engine control equipment developed by Ultra Electric, Ltd., of London.

The Ultra system for advanced turbine engines uses temperature sensitive elements to monitor a jet engine's fuel input so as to maintain turbine speed and temperature in the range of maximum efficiency. Fuel flow is varied by remote positioning which utilizes an electrical connection between the cockpit and the engine, thus eliminating the need for mechanical controls.

Four-Transistor Radio

One of the transistor radios in the new Bulova series is a pocket-sized model. The volume and sensitivity is equal to most six transistor sets now on the market. It contains but four transistors however, and a crystal diode. Power is obtained from a single 9 v dry cell battery which provides 950 hours of intermittent playing time. Dimensions are: 3-3/8 in. high, 6-1/8 in. wide and 1-3/4 in. deep. It weighs 22 oz.

ew Factories Overnight

Sixteen defense experts, representing the Eastern Seaboard Armed Services Industrial Mobilization Council, witnessed the Alden Systems Co.'s answer to the problem of keeping production rolling when factories have been bombed out or wiped out by any disaster. From a bare floor start, actual production operation was set up with all equipment, operators moved in, and production was coming off the line within 29 minutes. It is feasible to set up a 100-operator factory completely in less than twelve hours. Twenty men, in less than twelve hours, could set up a 1000-position factory. A socket wrench is the only tool needed.

GE Reduces Prices On Ten New Transistors

Price reductions ranging up to 27% on ten new entertainment transistors was recently disclosed by the General Electric Co., Syracuse, N.Y., as a result of initial heavy demand and accelerated production.

The transistors affected by the price cut are used in portable and table model radios and high fidelity audio systems. They first went into production only two months ago.

The new lowered prices on these transistors could eventually be reflected in price reductions of as much as 20% on transistorized portable radios in the 1957 models.

Fire-Control for Starfighter

The Radio Corp. of America has developed and is producing a compact, lightweight electronic fire-control radar system for the world's fastest combat plane, the Air Force's new F-104 Starfighter jet.

The radar provides a continuous flow of information about the enemy plane's movement, electronically computed in terms of position, range and rate of closing.

A major feature of the system is a bright radar display which will enable a pilot to view the radar picture in broad daylight without the encumbrance of a light-shielding hood.

CIRCLE 7 ON READER-SERVICE CARD ➤

Two small units, inset, make up the Signal Corp's transistorized helmet walkie-talkie. Entire unit is inside the soldier's helmet.

Head Scratchers Confuse Enemy

Designed to provide individualized communication between soldiers, a transistorized transceiver has been fitted into a combat helmet. Limited information may be relayed by surreptitiously pressing a button on the side of the helmet. This, says the Signal Corps, makes the enemy think the soldier is merely scratching his head. In reality, they add, vital messages may be flowing back and forth.

Two metal cases, including batteries fit inside a modified combat helmet. To talk, the user flips a button and speaks into a miniature microphone. If he's in a spot where he can't talk, he touches another button on his helmet. This sends an acknowledging "beep" to his listeners, without giving his position away.

Weighing about a pound, the battery-powered device is designed for relatively short range. With an antenna atop the helmet, range can be increased to one mile. Batteries will operate the set for about five hours.

GE Cuts Prices on Rectifiers

A price reduction averaging 10 per cent on 48 different medium power germanium rectifiers has been announced by General Electric's Semiconductor Products Dept., Syracuse, N. Y. The new prices of these rectifiers bring them down to the lowest price level of such devices to date and well within the price range of other equivalent dry rectifiers.

The rectifiers affected are in the 5 to 10 amp medium power series. The growing use of these rectifiers and lower manufacturing costs in greater volume production made possible the reduction in price.

Bendix Pacific Acquires Canada Rights to Decca

Canadian rights to the manufacture and sales of the Bendix-Decca navigator system, now in use in an area 1500 miles long across Europe, have been licensed to the Pacific division of Bendix Aviation Corp. American rights were obtained in 1954.

The low frequency radiowave "grid" system provides a continuous, all-weather flight-position picture. It is particularly suited to helicopters which often fly close to the ground in areas not covered by high-frequency patterns.

High Intensity Fluoroscope

A new high-intensity fluoroscope has been developed by the Navy to permit faster detection of flaws in aircraft metal castings. The new inspection device, developed by the Naval Ordnance Laboratory at White Oak, Md., for the Bureau of Aeronautics, is being tested by Chance Vought Aircraft. At the request of BuAer, Vought is evaluating the unit on a production basis to determine its accuracy in flaw detection. Its rate of detection and general aircraft usefulness is being determined as a preliminary to modification of fluoroscopy specifications.

Small castings to be inspected in the new machine are placed in plastic globes and held in position inside it by a cushion of small rubber balloons. The sealed globe is positioned between the fluoroscope's X-ray tube and 8-in. viewing screen. Through controls in the shielded booth, the plastic ball is rotated in any direction so that it can be inspected from all angles.

Control panel of the Navy's new high-intensity fluoroscope.

Computer Remembers Hotel Rooms

No longer will weary travelers have to depend upon the memory of a hotel reservation clerk to be assured of a room for the night. Room reservations are one of the hotel operations which may be handled by a magnetic memory system devised by Teleregister Corp.

Automatic processing of room reservations up to 1 year in advance will be possible. Information on vacant space will be instantly available. Using a special display board, reservation clerks can keep watch on current-day room status.

Other operations, including billing, accounting, and inventory control may be accommodated. Restaurant sales, laundry, and telephone calls may be posted instantly on the guest accounts. By keeping bills up to the minute, checkout delays will be reduced.

Twenty-five foot antenna, background, with electronic equipment in the jeep makes up one station in a newly developed radar surveying system.

Radar Surveyor

George Washington would hardly recognize the state of the surveying art today. Electronics has moved into the field long exclusive to optical instruments.

Radar is being put to use to measure distances

far beyond the range of optical instruments. Fifty miles can be measured in a single jump instead of the 20 to 30 small hops previously required. Accuracy is reported to be within a few feet at 50 miles. Poor visibility and foliage are said not to interfere with the operation of the system.

Designed by Motorola for the Signal Corps, the system consists of two mobile radar sets. One set is used at each end of the distance to be measured. Distance measurements are based upon the time it takes a signal to make the trip between the two stations.

Each mobile set consists of a collapsible antenna and three cases filled with electronic equipment. The entire assembly weighs 200 lb. One man can set up and operate each set.

Seven Scholarships Established by Borg-Warner

Seven scholarships to Illinois Institute of Technology have been established by Borg-Warner Corp. "to develop engineering, manufacturing, and business leadership for industry." High school seniors who combine academic and technical excellence with qualities of character and leadership are eligible to apply for these scholarships.

Recipients will receive up to $750.00 to cover full tuition and will be eligible to apply for a renewal of their scholarship each year. They may also apply for summer employment in one of the company's divisions or subsidiaries.

Application for these scholarships should be addressed to Chairman of the Scholarship Committee, Illinois Institute of Technology, 3300 S. Federal, Chicago, Ill.

Electronic Components Bombarded

Tests are being conducted to determine the effect of nuclear radiation on electronic components. Admiral Corp., conducting the study for the Air Force, is using the facilities of the Argonne reactor.

Neutrons, a byproduct of the Argonne unit, are used to bombard all types of components. After six days of exposure, the components are carried in lead shielded boxes to the laboratory. Special shielded rooms in the lab contain the test equipment. Apparatus in the room is operated by remote control. Operators view the tests through special windows 2-ft thick.

Components are being tested both before and after radiation. Extent and nature of radiation damage will be determined. Recommendations will be made to the Air Force for preventing or reducing radiation damage. This study is important in the design of atomic-powered rockets and satellites where radiation will be a major factor.

Move to Get Retired Engineers to Teach

The Advisory Committee on Science Manpower, appointed by the New York City Board of Education, is considering the possibility of recommending the employment of retired scientists and engineers to meet the present shortage of science and mathematics teachers. Dr. Joseph W. Barker, president of the Research Corp., presently president of The American Society of Mechanical Engineers, and a member of the advisory Committee, recently made the suggestion.

Dr. William Jansen, Superintendent of Schools said: "If, as Dr. Barker suggests, there are a considerable number of retired scientists and engineers under the age of 70, who are willing to come to the assistance of our high schools in this emergency, I will be happy to urge Dr. James E. Allen, New York State's Commissioner of Education to consider modification of the present regulations (8 semester hours in education) in order to enable these men to teach on a part time and emergency basis.

"In order to determine if such supply of prospective teachers exists, I urge all interested scientists and engineers to write to Mr. Samuel Schenberg, Board of Education, 110 Livingston St., Brooklyn, N. Y. and enclose a brief biographical sketch of their educational qualifications and scientific and industrial experience."

Year's Outstanding "Ham" Sought

The fifth annual nation-wide search for the amateur radio operator who performs the most outstanding public service during the year is now underway.

A principal winner and several special citation recipients will be chosen in January from the nation's 140,000 licensed radio amateurs, said L. Berkley Davis, award committee chairman and general manager of the electronic components division of General Electric, sponsor of the Edison Radio Amateur Award.

Judging will be based on the amount of sacrifice, ingenuity, and greatest benefit displayed by amateurs in employing amateur radio in the public interest.

The Edison Award Trophy and a check for $500 will be presented to the principal winner at a banquet ceremony in Washington, D. C., next February. The official award rules permit any responsible person or organization to nominate a licensed radio amateur who is known to have performed an outstanding public service. The service must have been performed while the candidate pursued his hobby within the continental limits of the U. S. during the 1956 calendar year. Copies of the rules and a guide to preparing nominations are available from the secretary of the Edison Radio Amateur Award Committee, Electronic Components Division, General Electric, Schenectady, N. Y.

Washington Report

Albert Warren

Pursuit of Air Safety

Shock of Grand Canyon 2-plane collision continues to produce determined govt efforts to prevent repetition of such accidents. Among actions: (1) Congress promptly gave President Eisenhower the extra $68,000,000 he asked, so that Civil Aeronautics Administration can speed up its 5-year plan for improving air safety. Of the appropriation, $54,000,000 is for installation of air navigation facilities, $14,000,000 for operation & regulation. (2) CAA will obtain from Air Force a B-57, aims by Oct. 1 to have it operating as "a flying guinea pig for all elements of the high altitude control project—navigation aids, communications, radar, and traffic control procedures." (3) Radio Technical Commission for Aeronautics subcommittee has distributed to members a series of requirements it believes should be minimum for reducing dangers of air collisions. These minimum requirements, RTCA says, should warn pilot of penetration by another plane of space 10 mi horizontally, 800 ft above and below for altitudes up to 30,000 ft, 1600 ft above and below for altitudes above 30,000 ft (4) Air Coordinating Committee reported that during 34-day period at Washington National Airport there was complete saturation of all 10 vhf and 4 uhf radio frequencies. Periods of saturation range from 3 min to 4 hours, totaled 8 hours, 12 min during the 34 days.

Washington Trends & Briefs

Defense Dept has specified new procedure for military agencies to employ in approving new electronic systems and equipment. Procedure requires that pilot production be undertaken to insure that design makes sense from a production standpoint; that enough models be supplied to permit statistically sound determination of reliability; that opportunity for design correction be provided before quantitiy production is started. Novel instructional TV system, termed I-TV-S, has been developed by Naval Training Device Center. It comprises either vidicon or image orthicon camera mounted directly on console which in turn is on casters for maneuverability. In routine operation, it requires only one cameraman-technician per console. Advantage of equipment over regular broadcast setups, as described by Center's TV requirements coordinator Ken Thomas: "It is a self-contained system, more compact and rugged in construction, and low in cost and personnel requirements. It is completely portable, ready to plug in and operate ashore or aboard ship. The cost is considerably less than that of commercial systems and the number of men required for operation and maintenance is less thau one-third. Training and operation are also greatly simplified for an instructional closed-circuit TV."

Letters to the Editor

Wants Better Meetings

Gentlemen:

. . . The (IRE National Convention), because of its excellence, has grown so large . . . that some rather staggering information transmission problems are developing; these problems need to be faced so that the solutions which best meet the desires of the membership as a whole can be found and used for the benefit of all.

Many of the problems result from the large number of submitted papers which a meeting of this sort is bound to attract if it is accomplishing its purpose. The questions might include the following: Should preference be given any type of paper, say, new research, tutorial, symposium, invited, etc., or should the contributions be given preference, and the balance of the time filled with symposia? Should papers which have already been given a proper hearing be repeated? Should subjects that have been aired to the public press by an organization be accepted, or should such papers be accepted only if the public announcement is made at the time of the meeting? Is there a place in the program for papers presented by title only? What sort of editorial style is most suitable, bearing in mind the fact that the paper is probably being published in the Convention Record? What is the best way to take advantage of a maximum number of contributed papers, and how can the utilization of rejected papers having scientific importance be best accomplished? In addition, should more than one paper from a single author be accepted?

The wide dispersal of the (technical sessions) uptown and down-town has made very difficult the improvement of utilization in the last few years; now, however, with the next meeting once again scheduled to be located in a convenient area, it appears that another look at the problem might be in order.

As . . . . . starting point for the discussion, I . . . . . suggest several changes . . . . . The first is that a new category be established . . . . . for papers (presented) . . . . . at earlier district meetings. These papers would be read (at the IRE National Convention) by title only to bring to the attention of those attending that the paper was presented by Mr. X of the Y company at the Z meeting, and for further information, contact Mr. X.

. . . it is (further) suggested that the broad emphasis in the technical meetings be placed on new results of scientific merit and on new research techniques. These papers naturally have to be a combination of tutorial and pure research papers. As a

result, it is suggested that a newspaper form of organization be recommended for these reports, in which the author first explains his new results and their significance to the listeners, and then gives a brief review, non-mathematical in nature, of where and how his work fits into the field. The meat of the paper itself could then be published into the convention record.

. . . Possibly symposia and tutorial sessions should be scheduled in a way which does not detract from the actual technical sessions, as that might very well make easier the engineer's task of keeping abreast of some of the related fields in which he is interested. If, for example, the morning sessions were scheduled from 0930 to 1200, and the afternoon sessions, except for the last day from 1500 to 1730, then there would be three periods from 1300 to 1430 which could be used either for visiting the show or for one of the then scheduled tutorial sessions. In addition, if a second period for evening symposia were scheduled, namely from 2000 to 2200 on Monday evening in addition to the sessions already scheduled on Tuesday evening, the technical sessions, the symposia and tutorial sessions could be appreciably enlarged.

The presentation of more than one paper by an individual was not permitted for several years. Recently it has again become common. In general, the limitation seems to be desirable since it prevents monopolization of program time. Possibly the thing to do is to accept one paper from an individual in full, and up to two by title only.

. . . It might be . . . beneficial to publish in the convention record the titles and abstracts of all papers . . . rejected as . . . a definite aid to those working in . . . particular fields. . . . If the paper was of sufficient general interest, its abstract could be published in the Proceedings. . . .

K. P.
Kingsville, Md.

It costs a great deal of time, effort and money to organize and run a meeting. It also costs time, effort, and money to attend a meeting. Both planners and meeting attendees should get their money's worth. This matter deserves widespread discussion, and we welcome further comments from readers.—*Ed.*

Meetings

Sept. 11-12: Second RETMA Conference on Reliable Electrical Connections.

University of Pennsylvania, Philadelphia, Pa. Co-sponsored by the Advisory Group on Electrical Parts and the University of Pennsylvania. This conference will provide advanced study above and beyond that presented at the first conference held in Illinois in April, 1954. The technical program is based on the results of several industry surveys to determine specific problems currently in need of attention. For further information write to RETMA Eng. Dept., 11 W. 42nd St., New York 36, N. Y.

Sept. 14-15: Conference on Communications.

Roosevelt Hotel, Cedar Rapids, Iowa. Theme will be "What Will Designs of Tomorrow Have to Accomplish?" There will be exhibits. For information, write to Conference on Communications, P. O. Box 948, Cedar Rapids, Iowa.

Sept. 14-15. Sixth Annual Fall Symposium of the IRE Professional Group on Broadcast Transmission Systems.

Mellon Institute Auditorium, Pittsburgh, Pa. Sessions will feature speakers in the area of TV measurement, TV studio development, and broadcast facilities and operation. Included in TV measurements will be field strength and studio-transmitter equipment proof-of-performance measurements. Sessions on broadcast facilities and operation will include papers on the remote control of directional antennas, installation of non-rigid transmission lines, an arrangement for aural transmitter standby facilities, automatic gain control in video circuitry, sawtooth testing of audio amplifiers, and Conelrad. For information, write to IRE, 1 E. 79th St., New York, N. Y.

Sept. 16-22: Second Pacific Area National Meeting and Apparatus Exhibit.

Hotel Statler, Los Angeles, Calif. Sponsored by the American Society for Testing Materials. For information, write to American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

Sept. 17-18: *Transistor Reliability Symposium.*

Western Union Auditorium, New York, N. Y. Sponsored by the Working Group on Semiconductor Devices of the Advisory Group on Electron Tubes. Transistor life studies, designing circuits and systems for reliability, preventive maintenance, transistor performance in electronic equipment tests, and design of experiments for reliability studies are the areas for which papers will be presented. Additional information may be obtained from Mr. Howard Moss, Electron Tubes Div., Solid States Devices Branch, Evans Signal Laboratory, Belmar, N. J.

Sept. 17-21: *Instrument-Automation Conference and Exhibit.*

Coliseum, New York, N. Y. Sponsored by the Instrument Society of America. Technical sessions will offer information concerning design, manufacture, application and operation of instruments and automatic controls. Typical types of instruments and systems will be presented for every application ranging from atomic reactors to sanitation and soap processing. For additional information, write to ISA, 313 Sixth Ave., Pittsburgh 22, Pa.

Sept. 17-21: *Second Pacific Area National Meeting and Apparatus Exhibit.*

Hotel Statler, Los Angeles, Calif. Sponsored by the American Society for Testing Materials. Forty-three technical sessions and more than 200 technical papers are scheduled for presentation. For further information, write to American Society for Testing Materials, National Headquarters, 1916 Race St., Philadelphia 3, Pa.

Sept. 24-25: *Industrial Electronics Conference. Cleveland, Ohio.*

Sponsored by the AIEE, IRE and Institute of Radio Engineers. The technical program will cover such areas as electronic equipment design, automatic production, testing, gaging, process control, and data reduction and analysis. For information, write Carl F. Schunemann, Thompson Products Inc., 2196 Clarkewood Rd., Cleveland 3, Ohio.

Sept. 26-29: *Audio Engineering Society Convention.*

New York Trade Show Building, New York, N. Y. Sponsored by the AES, and held concurrently with the New York High Fidelity Show. Disc recording and reproduction, magnetic recording, transistor application problems, audio systems and components, loudspeakers and standards and measurements will be the subjects of the sessions. For information, contact G. K. Dahl, 230 W. 41st St., New York 36, N. Y.

Oct. 1-3: *Twelfth Annual National Electronics Conference.*

Hotel Sherman, Chicago, Ill. Sponsored by the AIEE, IRE, Illinois Institute of Technology, University of Illinois, and Northwestern University. More than 100 technical papers and 240 commercial exhibits will be featured. For information, write to Victor J. Danilov, Illinois Institute of Technology, Chicago 16, Ill.

Oct. 1-3: *Canadian Institute of Radio Engineers Convention.*

Automotive Building, Exhibition Park, Toronto, Canada. Technical papers are planned on medical electronics, scatter propagation, application of electronics to atomic energy projects, use of computers in automation and engineering problems, and transistors. An exposition will include many of the latest improvements in radio, radar, TV, control mechanisms, computers, and other electronic items. For information, write to Grant Smedmor, Convention Manager, 745 Mount Pleasant Rd., Toronto 12, Canada.

Oct. 1-5: *AIEE Fall General Meeting.*

Morrison Hotel, Chicago, Ill. Tentative schedule includes sessions on rotating machinery, protective devices, metallic rectifiers, insulated conductors, dielectrics, air transportation, land transportation, switchgear, feedback and control systems, electronics, computing devices, nucleonics, and management. For information, write to AIEE, 33 W. 39th St., New York 18, N. Y.

Oct. 3-5: *Fifth Annual Meeting of the Standards Engineers Society.*

Willard Hotel, Washington, D.C. Topics expected to be of particular interest to standards engineers in the electronic field are the session devoted to "Dynamic Standards for the Median Company" and the session devoted to "Drawing Practice Standardization." Registration fees for the complete three-day meeting, including technical sessions, two social hours, banquet, and luncheon are $16.00 for a member and $18.00 for a non-member. Additional information may be obtained from the Washington Section, Standards Engineers Society, 4042 N. 35th Street, Arlington 7, Va.

Oct. 8-9: *Second Annual Symposium on Aeronautical Communications.*

Hotel Utica, Utica, N. Y. Sponsored by the IRE Professional Group on Communications Systems. The symposium will stress communication requirements in support of present and future aeronautical activities. Authors of technical papers to be presented at the conference have already submitted abstracts to the committee for review. Final program and details of the entire conference will soon be available. For additional information, write to R. C. Benoit, Jr., 138 Riverview Parkway N., Rome, N. Y.

Oct. 8-12: Society of Motion Picture and Television Engineers Convention.

Los Angeles, Calif. A technical session will be devoted to a program of papers on transistors and their applications to motion pictures and television. For additional information, write John B. Olsson, Houston-Fearless, 11801 W. Olympic Blvd., Los Angeles 64, Calif.

Oct. 9-10: Computer Applications Symposium.

Morrison Hotel, Chicago, Ill. Sponsored by the Armour Research Foundation of Illinois Institute of Technology. Problems and experiences with medium-sized electronic computers will be the theme of the third annual symposium. For information, contact J. J. Kowal, Conference Secretary, Armour Research Foundation of Illinois Institute of Technology, 10 W. 35th St., Chicago 16, Ill.

Oct. 11-12: Noise Abatement Symposium.

Hotel Sherman, Chicago, Ill. Co-sponsored by Armour Research Foundation, Acoustical Society of America, American Society of Safety Engineers, National Noise Abatement Council, American Society of Planning Officials, American Industrial Hygiene Association, Acoustical Materials Association. For information, contact G. J. Sanders, Armour Research Foundation of Illinois Institute of Technology, 35 W. 33rd St., Chicago 16, Ill.

Oct. 22-26: National Industrial Exposition.

Artillery Armory, Detroit, Mich. "Atomic-Electronics Day" will be held on Oct. 24, 1956. A management-engineering conference will cover new ideas for industry. The exposition will feature industrial products, new methods and research developments. For further information, write to Denham & Co., 925 Book Bldg., Detroit 26, Mich.

Oct. 16-18: Conference on Magnetism and Magnetic Materials.

Hotel Statler, Boston, Mass. Sponsored by the AIEE, IRE, American Physical Society, American Institute of Mining and Metallurgical Engineers. Presentation of technical papers and abstracts on latest developments is proposed. For further information, write to T. O. Paine, Measurements Laboratory, General Electric Co., W. Lynn, Mass.

Oct. 18-19: Third Annual International Meeting of the Institute of Management Sciences.

Statler Hotel, Los Angeles, Calif. Theme of the conference is "Management Sciences—A Progress Report." Program plans include the presentation of technical papers on the latest developments in the application of advanced sciences to business and industrial management. For further information, please contact Al N. Seares, Vice President Remington Rand, Sperry Rand Corp., 315 Fourth Ave., New York 10, N. Y.

Low Voltage Beam S

Rudolph A. Cola
Burroughs Corp.
Electronic Tube Div.
Plainfield, N.J.

BEAM switching tubes are being applied in a wide variety of applications such as loran, radar, guided missiles, coding, electronic controls, communications systems, and computers. Described here is a new low-voltage beam switching tube, which replaces many standard tubes or transistors and their associated components. Also covered are recent advances in circuit technique, tube performance, design criteria, and various unique features provided by the basis electrical characteristics of the beam switching tube.

A cross-section of the new Burroughs or MBS tube (type *6701*) is shown in Fig. 1. It was developed by the Burroughs Research Center and is now manufactured by the Electronic Tube Div. of Burroughs Corp. in Plainfield, N. J. This device consists of ten identical arrays symmetrically located about an oxide-coated cathode, and operating in the presence of an axial magnetic field. This magnetic field is provided by a small cylindrical magnet which is permanently "bonded" to the glass envelope with a "rubberized" silicone cement. Each array consists of a spade which forms and locks the beam, a target which is essentially a constant-current source, and a grid which serves to switch the beam from array to array.

While the magnetic field strength for the type *6700*, announced previously, is approximately 450 gauss at an operating voltage center of 100 v, type *6701* is designed for operation from available aircraft voltages and those normally associated with transistor operations, at a magnetic field strength of only 150 gauss.

The mode of operation for type *6701* can be explained by referring to the spade characteristics shown in Fig. 2. Curve *(1)* is a voltage-current characteristic of the *j* spade starting with the "cut-off condition normally associated with magnetrons. Curve *(2)* is the dynamic or leading spade characteristic and is taken with the lagging spade at cathode potential, simulating conditions that exist during switching. Curve *(2)* collapses to Curve *(1)* after the switching transition at a rate determined by its own natural R-C time constant. If a load line R_s (270K) is drawn, it will intersect curve *(1)* at *a, b, c*. The intersection at *(a)* and *(c)* represents bi-stable states; *(b)* is unstable. Point *(a)* corresponds to the condition at cut-off with no beam formed; *(c)* represents the low potential state with the beam formed in the *j* position. Load lines R_m and R_M represent two extreme values of R_s. When the slope is greater than R_m, the load line will only interest the characteristic at point *(a)*, the high state and beam formation is not possible. A slope less than for R_M will intersect the leading spade characteristic only in the low potential state (point *d*). Each leading spade in sequence will have a low state, and the beam will "free-run" continuously around the tube.

The switching mechanism by which the grid of the holding array causes the beam to advance to the leading position is shown by curve *(2)*. Note that making the grid more negative in voltage alters the leading spade characteristic. The tail of the characteristic lifts so the load line R_s now intersects the characteristic at the low potential state, thereby causing the beam to switch to the leading position. The complete switching phenomena may occur in tenths of a microsecond.

In many applications it is desirable to have the MBS tube clear itself when the beam arrives in some predesignated position. The "Switch and Clear" load

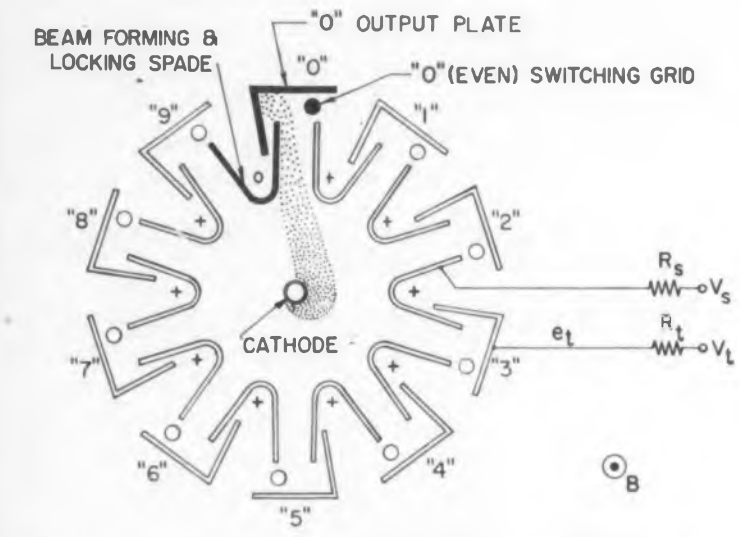


Fig. 1. Cross-section of Burroughs beam switching tube.

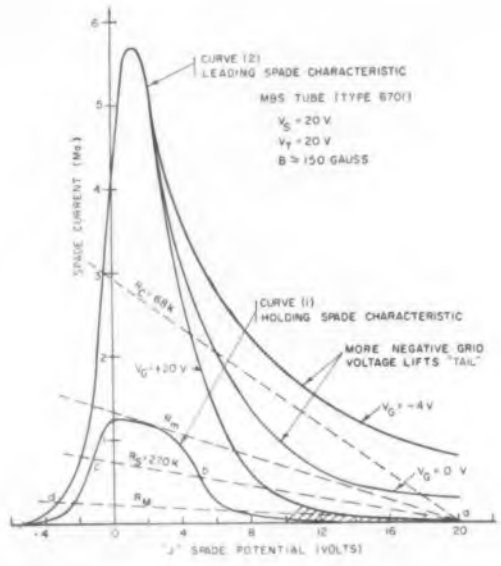


Fig. 2. Spade characteristics for low-voltage type 6701.

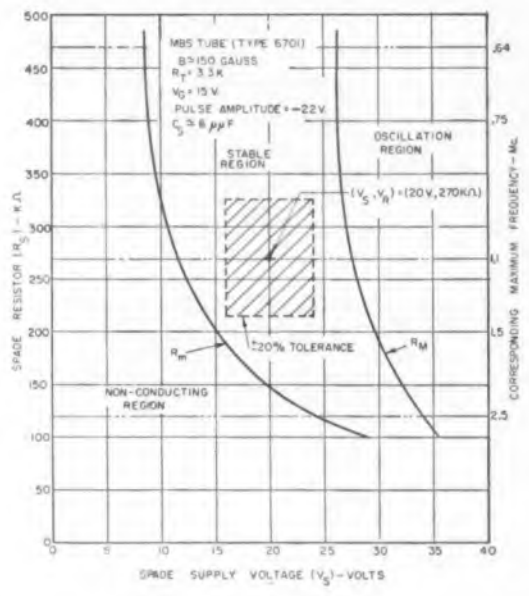


Fig. 3. Tolerance of parameters, shown on R_s - V_s plane. Low-voltage tube.

m Switching Tube

line, R_c=68K, accomplishes this objective. Because of the higher peak current normally associated with the leading or dynamic spade characteristic, a load line such as R_c may be selected to intersect only the leading spade characteristic in the low potential state. This insures that the beam will switch into the leading array (i.e. when $V_g = -4$v) and remain there until curve (2) decays toward curve *(1)*. When the "Switch and Clear" load line no longer intersects the leading spade characteristic in the low potential state, the MBS Tube will clear.

In Fig. 3 is a plot relating the variation and tolerance of the spade parameters, $R_s - V_s$, for the same MBS Tube, type *6701*. V_s is the voltage of the nine other spades with respect to cathode.

All points to the right of R_M will result in continuous or astable oscillation. Operating points to the left of R_m make beam formation and locking impossible. The region between R_m and R_M represents an area of stable operation. The shaded area represents ±20% variation in tolerances from parameters R_s=270 K and V_s=20 v; note that it falls well within the stable operating area. A plot of the corresponding maximum frequency for values of R_s is shown by the ordinates on the right; i.e. the maximum frequency for 270 K is 1.1 Mc when the spade capacitance (C_s) is approximately 6 μμf.

A plot of the holding-target current-voltage characteristic, Fig. 4, is given for V_s=16, 20, and 24 v. The curves exhibit a pentode-type constant-current characteristic. The target current varies directly with spade voltage by the relationship: $I_t \alpha V_s^2$. Approximately 90% of the cathode current may be available as useful output, indicating a high degree of efficiency. The targets may perform such logical functions as gating, driving relays or magnetic cores, vacuum tubes, thyratrons, transistors, or light indicators such as the NE-2, the Haydu Position Indicator "Pixie" or possibly the Numerical Indicator "Nixie". The only restriction imposed on the target is that the load line should intersect the target characteristic in the constant-current region. "Bottoming" may result in erratic switching operation. In general, it may be stated that the dc load line should intersect the target characteristic between $V_s/2$ and $3\ V_s/2$. For example: When V_s=20, the limits for the region of intersection are 10 and 30 v.

In Fig. 5 switching-grid voltage vs target voltage in the holding array is plotted for spade voltages of 16, 20, 24 v. For a given solid line, the area to the right of the characteristic represents the non-switch region in which the beam will remain locked in the holding array for an indefinite period. The area to the left of the solid line represents the switch region for one or more positions. The scatter that exists in the grid switching characteristics from position to position and tube to tube is shown for V_s=16 v. The shaded region indicates an area in which the beam will switch for one or more positions. To the left of the dotted line characteristic is a region where the beam will switch for all positions when V_s=16 v. Note that the grid switching characteristic shifts to the right at higher spade voltages. Since the grids represent a very high impedance, it is suggested that the grid bias be obtained from the spade supply so that the bias voltage varies directly with spade voltage. This tends to maintain the proper relationship between the two parameters despite comparatively large variations in supply voltage.

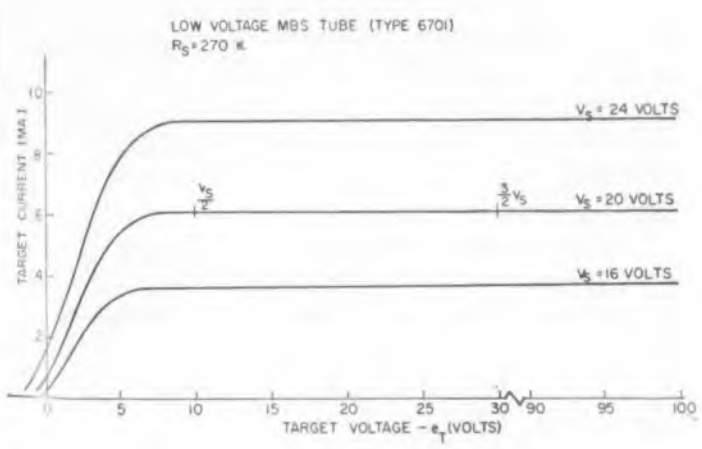


Fig. 4. Output characteristic for type 6701.

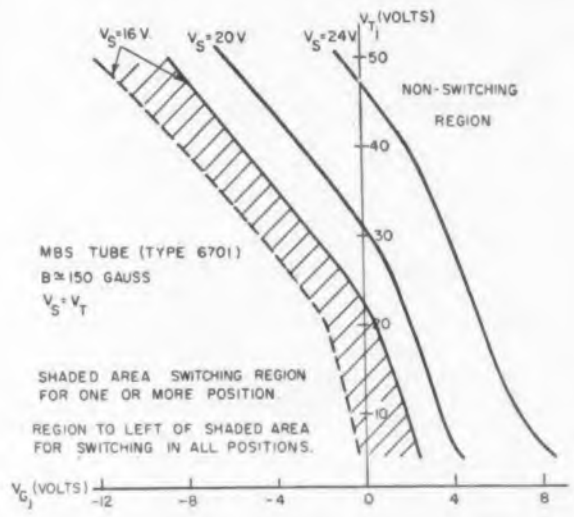


Fig. 5. Switching characteristics, type 6701.

Applications

With the characteristics shown it is possible to design circuits around the MBS type *6701* tube. A typical example of the tube's versatility and compatability with transistors is shown in Fig. 6. Repetition rates in the order of the 1 Mc are provided by the transistor flip-flop counter. The tube performs the function of distribution and counting with resolving times in the order of tenths of a microsecond. It is interesting to note that where isolation and distribution is involved, it would take approximately 20 transistors or tubes to perform the same basic functions. The beam switching tube would often be preferred because of its high impedance input, constant-current output, and temperature characteristics.

In many applications it is desirable to have the beam-zero set automatically. Various zero-setting de-

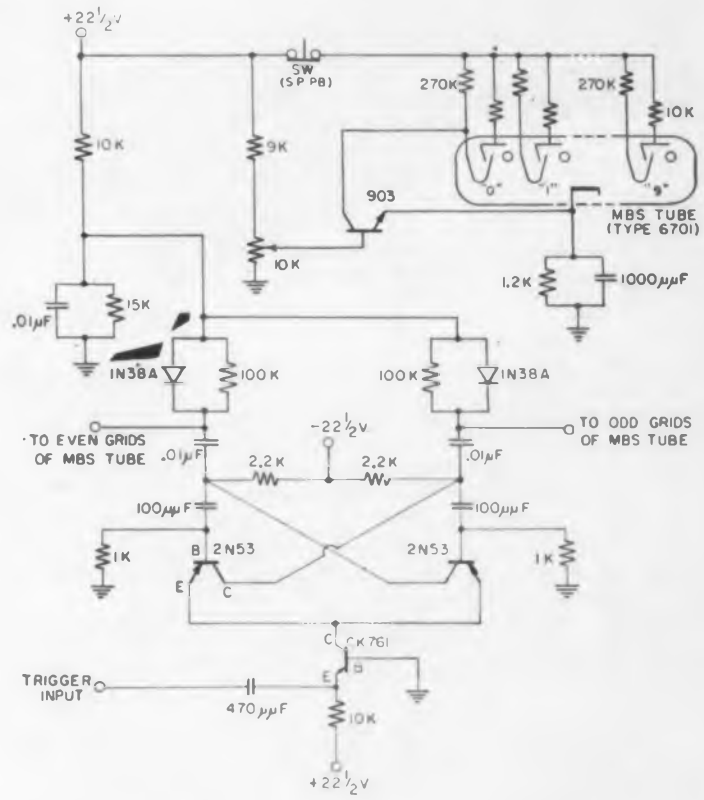
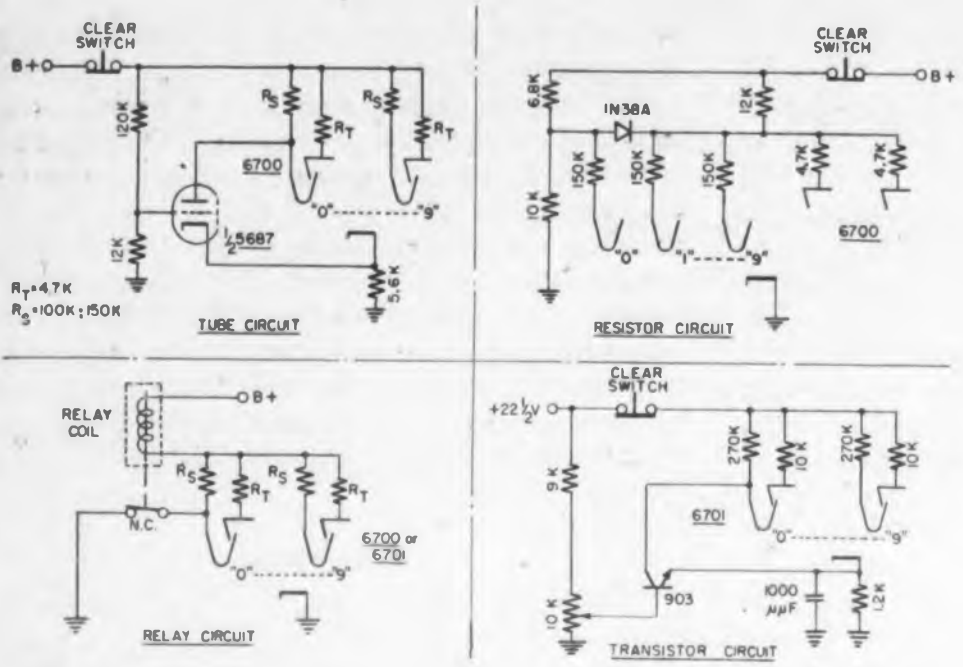
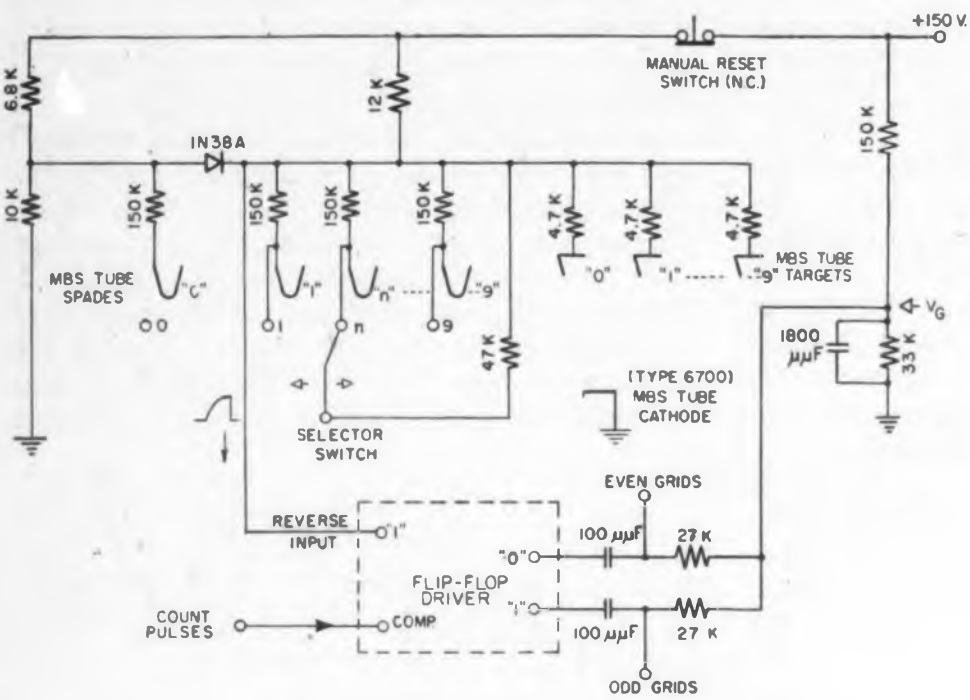


Fig. 6. Transistor driven megacycle counter using low-voltage beam switching tube.


CLEAR SWITCH
B+
120K
R_S
R_T
6700
"0"
"9"
1/2 5687
12K
5.6K
R_T=4.7K
R_S=100K; 150K
TUBE CIRCUIT
6.8K
IN38A
12K
150K
10K
4.7K
RESISTOR CIRCUIT
RELAY COIL
N.C.
6700 or 6701
RELAY CIRCUIT
+22½V
9K
270K
6701
903
1000 µµF
1.2K
TRANSISTOR CIRCUIT


+150 V.
MANUAL RESET SWITCH (N.C.)
6.8K
12K
150K
IN38A
10K
150K
4.7K
MBS TUBE SPADES
"0"
"1"
"n"
"9"
MBS TUBE "9" TARGETS
V_G
1800 µµF
33K
47K
(TYPE 6700) MBS TUBE CATHODE
SELECTOR SWITCH
EVEN GRIDS
REVERSE INPUT
100 µµF
27K
FLIP-FLOP DRIVER
COUNT PULSES
COMP
ODD GRIDS

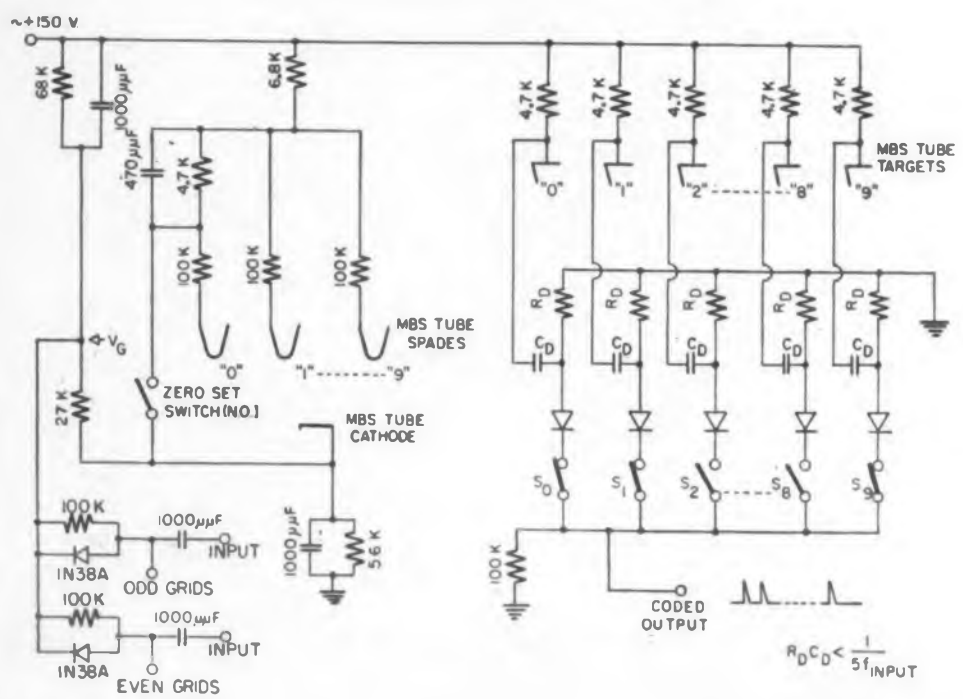

~+150 V
68K
1000 µµF
470 µµF
6.8K
4.7K
100K
MBS TUBE SPADES
V_G
27K
ZERO SET SWITCH (NO.)
MBS TUBE CATHODE
100K
1000µµF
INPUT
IN38A
ODD GRIDS
56K
EVEN GRIDS
MBS TUBE TARGETS
R_D
C_D
S_0
S_1
S_2
S_8
S_9
CODED OUTPUT
$R_DC_D < \frac{1}{5f_{INPUT}}$

Fig. 7. Basic automatic beam-forming circuits, using Burroughs beam switching tubes.

vices are shown in Fig. 7. The "resistor" circuit may be explained as follows:

Initially when B+ is turned on, the beam tube is in the clear condition. Spades one to nine and targets zero to nine are at B+. The zero spade resistor is tied to a bias voltage determined by the 6.8 K and 10 K bleeder to ground, and the *IN38A* diode is cut-off. This bias voltage on the zero spade is low enough to cause the beam to form in the zero position. Target zero immediately receives current, causing the bus voltage to drop to some value a little lower than the original bias voltage. The *IN38A* then conducts and all spades then operate at approximately the same bus voltage.

Circuits have already been published in which beam switching tubes can be interconnected to form a distributor of more than 10 positions.

A unique circuit is shown in Fig. 8 for reducing the numbers of positions in the MBS tube to any number less than 10. This is essentially a variable scale counter distributor which is capable of having its count varied from 1 to 10. The undesired positions are eliminated by simply combining two basic circuits. These are the resistor automatic beam-forming circuit shown in Fig. 7, and a method for selecting the (n-1) useful position. The latter is accomplished by applying a "Switch and Clear" load line (R_c) to the (nth) position with a selector switch.

Fig. 8. A basic variable scale counter.

The circuit is explained as follows: Initially when the supply voltage (+150 v) is turned on, the beam will automatically form in the zero position, as described previously, and the tube will henceforth operate dynamically over the normal expected range of V_s. Input pulses complementing the flip-flop will eventually cause the beam to step into the (n-1) position. The next input pulse will cause the beam to switch into the (nth) position where the spade resistor R_s=150 K is reduced to a "Switch and Clear" load line R_c of 35 K by paralleling it with 47 K.

As the (n-1) spade recovers to a higher voltage, the beam tube will suddenly clear. Upon clearing, the bus point for one to nine spades and 0 to 9 target will immediately rise toward +150 v, causing the *IN38A* diode to cutoff. Soon the bus voltage approaches the initial conditions in which the automatic beam forming circuit will reset the tube in the zero position. The time required in resetting the beam from the (n-1) to the zero position is less than 10 μsec. Alternate methods using auxiliary tubes can reduce this time to tenths of a microsecond.

Fig. 9. Pulse-train coding system.

Another feature of the circuit is the positive pulse developed at the bus for the time associated with the nth position. This pulse is used to reverse the flip-flop driver when "n" is equal to add numbers, so that the flip-flop is in the proper state for the next input pulse.

In general, with purely resistive circuits it is possible for the beam tube to appear as a distributor with one or more positions, depending only on the number of tubes used.

In certain computer, aircraft, and missile applications, it is desirable to transmit information by gen-

erating a coded pulse train. In Fig. 9 such a system is shown which suggests how the MBS Tube may be so used. By simply closing or opening a single-pole, single throw switch, the differentiated target voltage pulse developed across the 4.7 K target will or will not appear across the output load of 100 K. The diodes are used to isolate the targets and to clip out the negative part of the waveform. Since methods have been presented on how to increase or decrease the number of positions in the beam tube by these techniques, the code structure may be easily expanded or reduced. This tube appears to be the most promising for present methods of pulse-train coding.

Endurance Testers

Life expectancy of the MBS Tube may be safely assumed to be 50,000 hours. Factors which contribute to optimism on long tube life are the absence of a close-spaced control grid and the fact that the current and voltages used are many times less than those for which the cathode is rated. Also, since the holding space is approximately at cathode potential, it will tend to minimize the effects of the ion bombardment on the cathode. Tube operation is insensitive to large filament voltage variations (3.5 to 9 v).

MBS Tubes have successfully taken 350 g shock in all planes and 20 g vibration at fixed frequency.

In an attempt to make the MBS Tube more attractive in space-limited applications, a new technique has been developed which enables the tubes to be stacked almost directly adjacent to each other without any appreciable interference between magnets. Small equalizing bars of a given dimension prevent interaction between adjacent magnetic fields when inserted between stacked units, allowing a considerable reduction in space.

The information presented points out some of the obvious advantages of the "Beam Switching Tube" as a basic element, and its compatibility with hard tubes, thyratrons, transistors, magnetic cores, and relays. The circuit designer will appreciate the simplicity in design procedure, the overall reduction in components, and the MBS Tube's reliability and performance.

The basic advantages of the MBS Tube over previously available tube or transistor techniques should be emphasized. The versatile performance with high impedance input and constant-current output can only be approached or duplicated by using a great number of tubes or transistors and their associated components.

Acknowledgment is made to the many members of the Tube Research Lab, Burroughs Research Center, Paoli, Pa., who participated in the work reported.

References

1. The Magnetron Beam Switching Tube by Sin-Pih Fan *Journal of the British Institution of Radio Engineers*, Vol. XV, No. 7, July 1955.

2. Application Techniques for Use of the Switching Tubes in the ATC Transponder, M. H. Murphy, Packard-Bell Co.—Air Navigation Development Board Technical Symposium, May 1955, Washington, D. C.

Scheme for Designating Semiconductors

Richard B. Hurley
Senior Research Engineer, Convair

THE present RETMA designations assigned to semiconductor diodes (1N—) and transistors (2N—) are little more than a "catalog" number. That is, insufficient information is given to know what the device actually is other than that it is a semiconductor and has a certain number of leads. If only the letter "N" were allowed a degree of freedom such as "N" for devices using principally electrons and "P" for units in which holes are the major carrier, a great deal more information would be conveyed by the designation. Thus a p-n-p transistor would be called out as a "2P——", and the operating voltage polarities would be known.

As other than the common junction sandwich type transistor (p-n-p or n-p-n) become standard stock items, the current type designations will mean even less. Within the next few years, other geometries such as the "field effect" and the "double-base diode" may be commonplace. In addition, a sandwich type structure designed to emphasize the "avalanche" or "delayed collector conduction" mode of operation may be a commercially-available item. Furthermore, it may be desirable to include in a single labeling system semiconductor units that are not simply rectifying or amplifying electrical devices. For example, photo diodes, thermistors, "Hall effect modulators" and solar batteries could come under the code. Thus it should be of value to expand the number of letters used in the designation of a semiconductor device in such a manner that the type of device becomes known and the designation takes on "character."

To the end that practically all semiconductor devices may fall under a single designation coding system and that such a code tells what kind of a device is involved, the following coding philosophy is suggested:

The six "boxes" illustrated above indicate alternate number, letter (s), number, etc. The boxes would indicate the following:

Box 1: A number indicating the number of pertinent electrical leads or terminals. *Box 2:* A letter or set of letters indicating the kind of semiconductor device. *Box 3:* A "serial" or "catalog" number that represents the functional specifications of the particular device type. *Box 4:* A letter or set of letters indicating the type of mechanical structure, especially the external dimensions and the location of leads. *Box 5:* A "serial" or "catalog" number that represents the mechanical specifications of the particular device type. *Box 6:* A letter (absent on "first" devices) annexed to the designation of an improved device that is functionally and mechanically interchangeable with a previous device having the same symbols in the first 5 boxes. The first improvement would be annexed with an "A," the second with a "B," etc.

The emphasis in such a coding system would be on the first three boxes, the latter two or three boxes being used primarily when labeling a drawing, tabulating a parts list, or discussing a packaging problem. Only the first three boxes would normally be referred to in ordinary electronics conversations. Such a coding system allows, say, a given transistor type, to be manufactured in several different mechanical forms without the necessity of a new "electrical" designation for each packaging change. Likewise, a given set of "housing" specifications (Boxes 4 and 5) may be used, say, with many electrically-different transistors that are packaged the same.

To show how the filling of the first three boxes may be instrumented, a suggested set of rules for these boxes is given below:

Box 1: A number, one less than the number of external, electrically-different terminals that connect internally to the functional device. That is, "floating" or dead terminals or terminals connected only to the "can" are not counted.

Box 2: This box of letters contains, in general, two parts running together. The first part indicates polarity if pertinent to the application of the device. That is, a conventional "n-p-n" sandwich type transistor should be distinguished from its "p-n-p" counterpart since each operates on opposite polarity voltages. A "p-n" diode, on the other hand, may operate principally with electrons or with holes, but this distinction is of no explicit consequence in application, and thus no polarity letter should be used. The rule for the first letter, where pertinent, is:

"N" for devices operating principally with electrons such as "n-p-n" sandwich type transistors, point contact transistors on a "P" type chip, and field effect transistors with an "N" type body.

"P" for devices operating principally with holes.

The second part of Box 2, whether or not the first part is used or omitted, would make use of set of key letters to further describe the device, including those listed below but excluding the letters "N" "P", "I", of "O", "N" and "P" are excluded to prevent ambiguity with polarity designations, and "I" and "O" are excluded to prevent confusion with the numbers "I" and "O". The key lettters include—

A. Avalanche (delayed collector conduction).
B. Multi-base diodes as in a "double-based" diode.
C. Contact (point contact).
D. Diode.
E. Electrical field.
F. Internal field from reverse biased diode as in a "field-effect" or analog transistor.
G. Generator.
H. Magnetic field.
J. Junction.
L. Light, including ultraviolet, gamma rays, infrared, etc.
M. Mechanical.
R. Radiation (particles only).
S. Sandwich structure.
T. Thermal.
Z. Zener.

Box 3: A "serial" number, starting with "1" for each different combination in Boxes 1 and 2, that are associated with a set of functional specifications.

Examples—To appreciate the use of the rules for the first three boxes and the key letters, a few examples follow. In each example, it is assumed that the

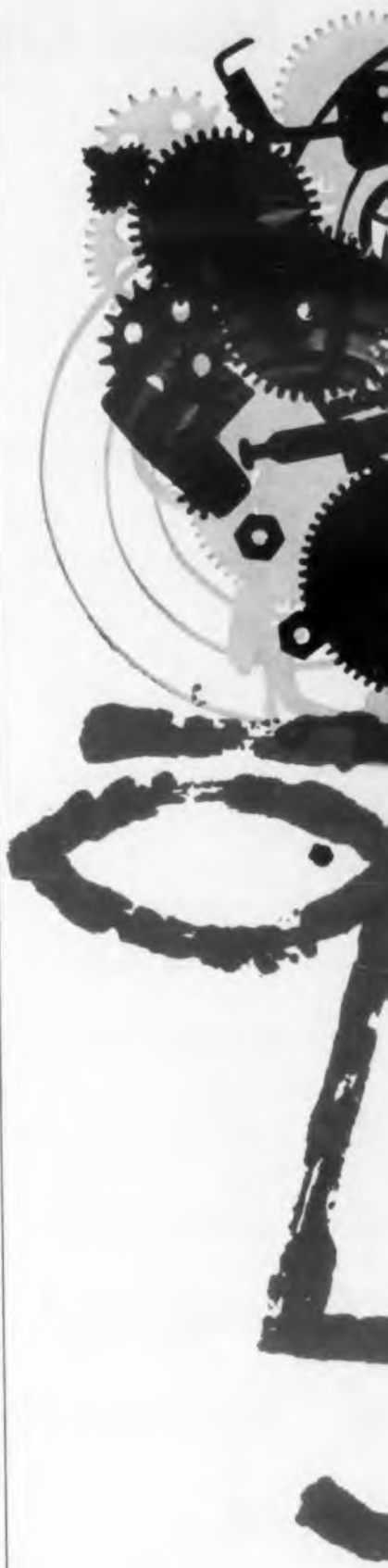
first device of a type is being designated. That is, all examples are arbitrarily assigned serial No. "1".

2JS1—A "p-n-p" or "p-n-i-p" conventional sandwich type junction transistor regardless of method of manufacture and crystal material.
3NS1—A "p-n-p" tetrode.
2NF1—A "field-effect" transistor built on an "N" type crystal.
4HI1—A "Hall" effect modulator having three leads coming from the crystal and two from the electromagnet winding.
1D1—A rectifier or diode.
1Z1—A "Zener" diode.
2PC1—A point contact transistor on an "N" chip. While no distinction was made between a junction and a point contact diode, the distinction is pertinent in the case of the transistor because of instability (alpha greater than unity) in application.
2PSA1—A "p-n-p" junction transistor designed to emphasize "avalanche" effect on current gain. Such a unit is distinguished from a conventional "p-n-p" sandwich because of instability (alpha greater than unity) in application.
1LD1—A photo diode.
1LS1—A photo transistor of junction sandwich form.
1T1—A thermistor.
1LG1—A solar battery.

It is noted that the key letters often refer to the physical form of input to the device. For example, a device used to sense beta rays would use the key letter "R", and a device with a mechanical or acoustical input would employ the letter "M". A set of pairs of key letters could also be added provided ambiguity was avoided with single letter definitions. Thus the system could grow with future needs. Obviously, a set of key letters also could be devised for describing the type of external structure, lead locations, and potting mediums, and Boxes 5 and 6 thus could be filled by a predetermined code.

Should an attempt be made to include in the coding, "ball park" information relative to such things as power ratings, maximum frequencies, operating temperatures, and voltage levels, the coding would become much too complex. Thus no distinction is made as to material (silicon, germanium, intermetallic compounds), nor is a "p-n-i-p" distinguished from a "p-n-p" junction sandwich or a "fused" (solid state fusion) from an alloyed transistor.

It is felt that the proposed method of coding would yield far more information than the current RETMA designations, would be flexible, and would add "character" to particular type devices without being excessively involved. Regardless of details, however, the purpose of this presentation is to encourage the adoption of a coding technique that yields a fair amount of pertinent information to the engineer.



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electrical design

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Communications and Navigation Group, which is responsible for the design of C/N systems in manned aircraft and installation of guidance systems in missiles. Considerable research effort is devoted to air-borne antennas and the elimination of radio interference in C/N systems.

Fire Control Radar Group, which is responsible for the installation and application of the most advanced type of fire control systems in fighter-interceptor aircraft. The work covers the installation of the equipment and associated wiring; continuing liaison with equipment manufacturers; preparation of system analysis and reports; and follow-up of system performance in the field as aircraft become operational.

Instrument Group, which is responsible for the design of instrument systems for manned aircraft and the installation of flight test instrumentation for guided missiles. Typical systems for which the group is responsible include: Flight Instruments; Engine Instruments; Instrument Panel Design; Automatic Pilots and Augmenters; Fuel Flow and Quantity Systems; and Integrated Electronic Instrument Systems.

All four basic groups originate their basic design and layouts, prepare production design releases and originate all types of tests to support flight, design and production requirements.

There are now a number of openings available for engineers in each of these groups at all experience levels. Too, there are opportunities for draftsmen with either electrical or mechanical experience.

If you qualify for any of these challenging opportunities, we invite you to contact Manager of Engineering Industrial Relations, Northrop Aircraft, Inc., Hawthorne, California, or call ORegon 8-9111, Extension 1893.

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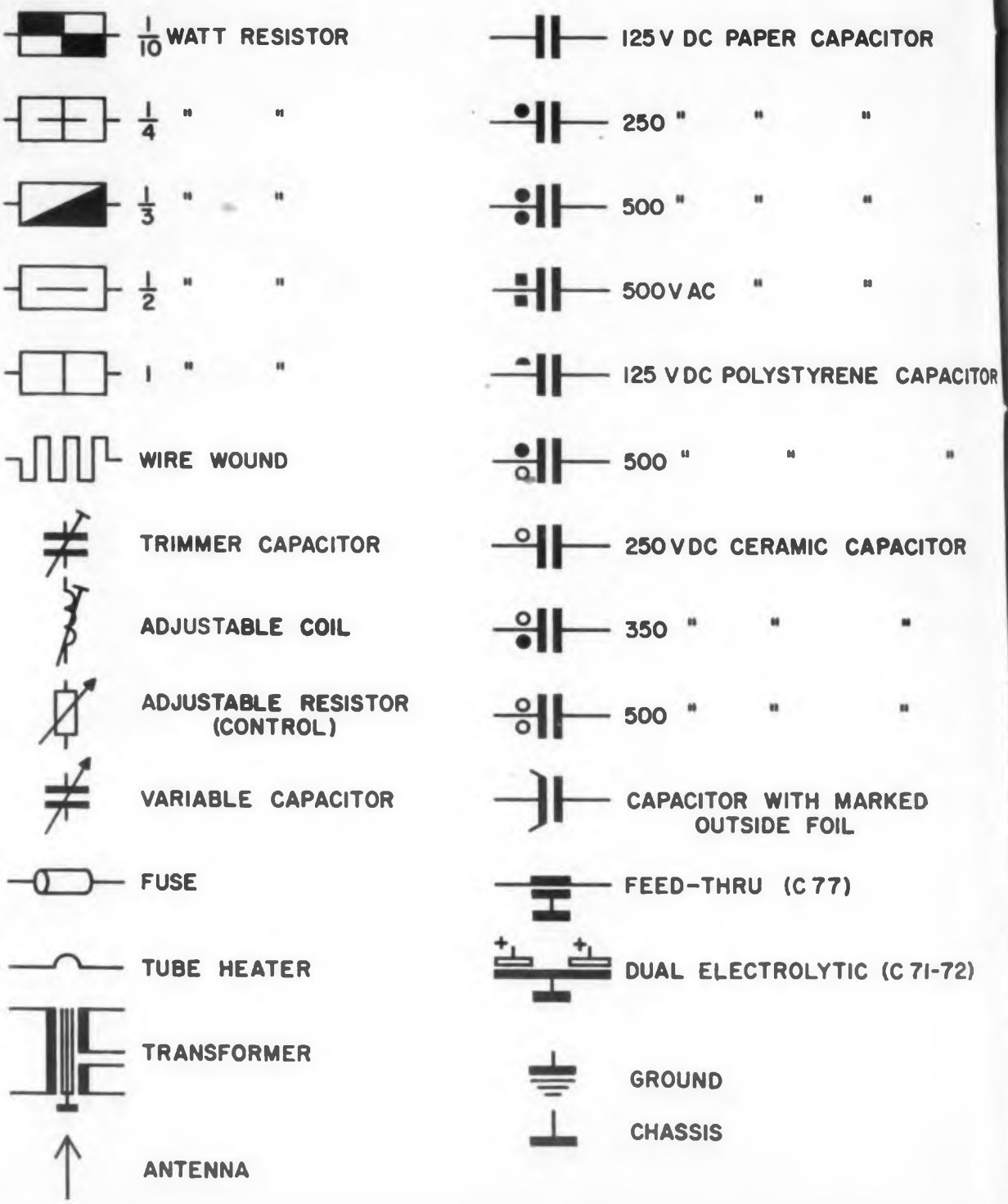
Leslie M. Balter
Consulting Engineer



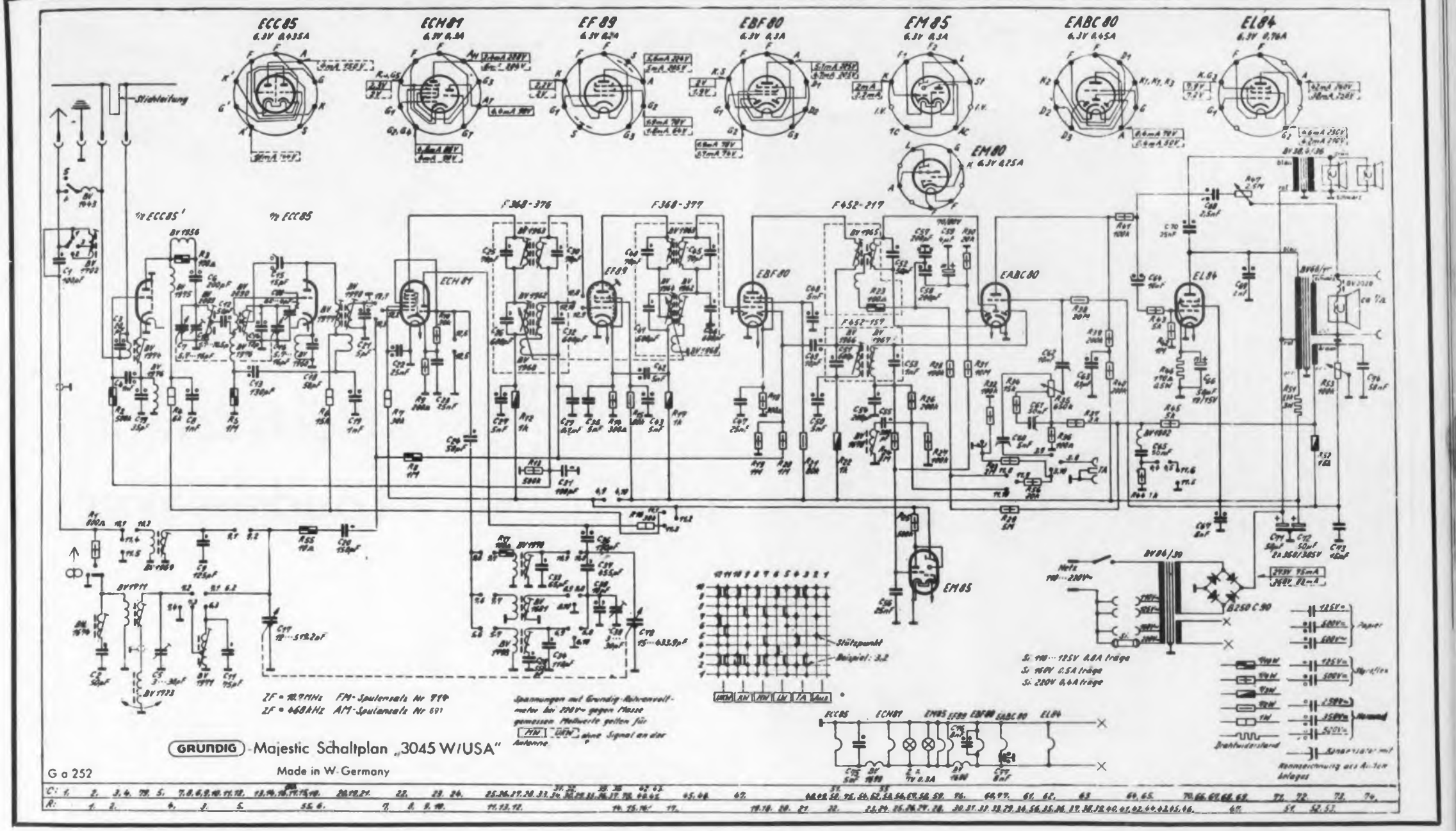


Fig. 2. Typical schematic using definitive symbols.

OCCASIONALLY, the design engineer, in the course of preparing a schematic diagram of a new item, finds his paper cluttered with special notes. That is the time he wishes for a more explicit language of symbols. The symbols and notations now employed in Western Germany were brought to this writer's attention in the course of a recent study of foreign radio receivers.

While it is not suggested that the system employed in Western Germany replace our present system of symbols and notations, it is believed however, that there is something to be learned. There are situations where a design engineer would like to lay out his diagram in accordance with a similar system of conventions. The German system of electronic symbols are more explicit than those we ordinarily use.

Fig. 1 shows the system of notations currently in use in Western Germany. This system more completely specifies many of the components which today are left to the technician's discretion. It can be seen that resistors are designated by different symbols for different wattages and types. Capacitor symbols have designations, indicating both voltage and type.

Fig. 2 shows a complete schematic of a Grundig Majestic radio. One can readily see from this diagram how very little is left to chance. Everything is completely specified—far more than it is our normal practice to do. Note also the map-like index of *C* and *R* components, to aid in locating specific items on the diagram.

Needless to say, the system can be extended and modified to meet an individual organization's requirements; the basic resistor symbols could have diagonal lines. The capacitor could have an "X" notation as well as the dot; etc.

By utilizing a more explicit system of component representation, failure or malfunction because of the use of an "almost correct" component may be avoided. There are instances when a technician constructs a piece of equipment which was put on paper by the project engineer; and it may not function exactly according to predictions, or may break down after a short period. The design engineer may have done his work properly, and the technician may have done his phase of the job competently. The trouble may have arisen because the technician used a 1/4-w resistor where a 1/2-w resistor was needed, or a paper capacitor was used where a ceramic should have been used. Because of the lack of means to readily designate a component specifically, malfunction resulted.

The project engineer is intimately familiar with the unit to be constructed and may wish to specify all components precisely, for reasons which may not be obvious to the most skilled technician. Using the presented system, he can more simply designate the component to be used.

To be sure, every contingency may be met by adequate notations. It would only be necessary therefore for the engineer to cover by written notation everything needed. A system of this type can cover every situation. Also it can become cumbersome.

It is not the writer's contention that our present system should be discarded and the illustrated method substituted, but for many types of research and design laboratories, a system of this type might offer many advantages.

Rectangular electrostatic loudspeaker of the membrane type.

Electrostatic Loudspeaker

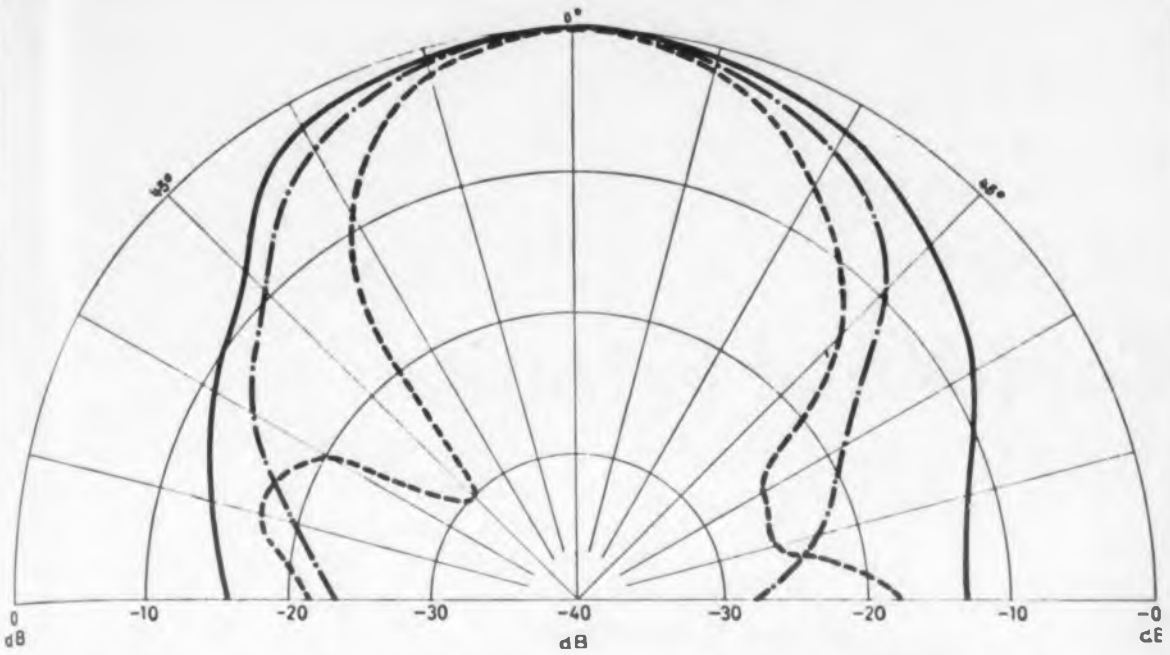
REPRODUCING extremely high audio frequencies efficiently is possible with the electrostatic-type loudspeaker. Although the principle of operation has been known for some time, commercial units have not been generally available.

Presently available in the U.S. from International Standard Trading Corp., 22 Thomas St., New York 6, N.Y., the Lorenz LSH 518 is a tweeter of rectangular shape. A German import, the tweeter may be mounted in corners or sides of cabinets where it may be difficult to mount circular units.

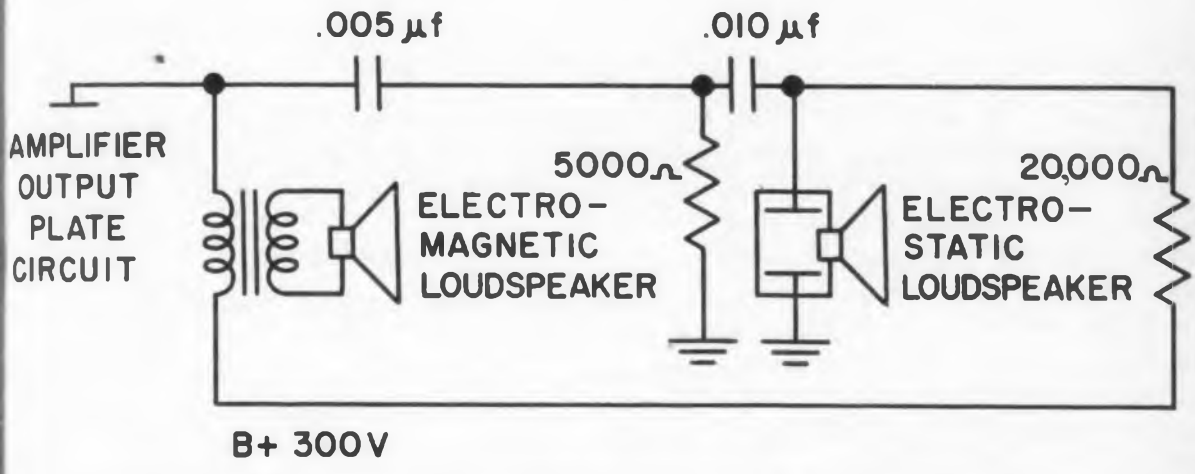
About 2-1/2 times the radiating area of conventional units is provided by this newly-introduced rectangular unit. Vertical mounting of the speaker achieves an unusually wide angle of sound radiation. Horizontal mounting will provide directivity characteristics for special applications.

To achieve an even sound distribution, the tweeter may be used as a tweeter column. Thus, the necessity of combining several small tweeters around a low-frequency speaker is eliminated.

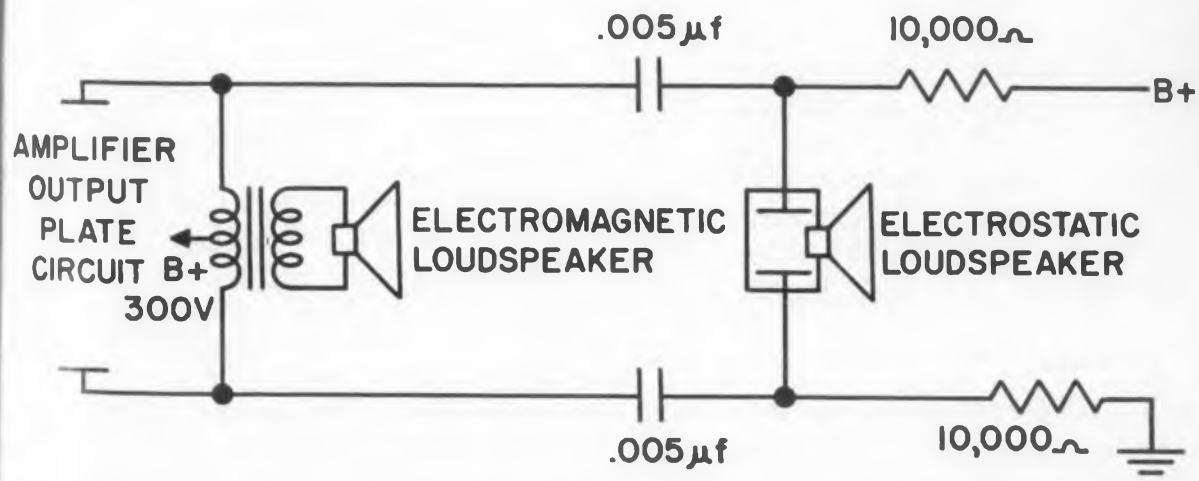
Overall dimensions of the unit are 7 x 2.5 x 0.33 in. Capacity is approximately 1200 μμf. Biasing dc voltage is 300 maximum. Maximum exciting of voltage is 60 with a maximum ambient temperature of 140 F. The membrane is self-healing after a voltage breakdown. For more information on the electrostatic loudspeaker, turn to Readers Service card and circle 22.



Directivity pattern of the Lorenz electrostatic tweeter. Solid line is at 5000 cps; dot-dash line is at 8000 cps; dash line is at 12,000 cps.



Schematic of the connections required to operate the electrostatic speaker from a single-ended output.



Schematic of the circuit for operation of the electrostatic tweeter from an amplifier having push-pull output.

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Cold Metal Extrusions—II

Edward S. Cornell, Jr.
Design Engineer
Burndy Engineering Company, Norwalk, Conn.

Last issue we called attention to a frequently overlooked method of metal fabrication—cold extrusion. Cost savings are often possible with this process, particularly with high volume production. The metallurgical qualities of the final parts are also generally enhanced by cold working.

A good metallurgical knowledge is necessary to produce parts successfully by this method. Undoubtedly, few electronics engineers will wish to experiment with the process themselves; yet, an understanding as given here and in the earlier article should help the designer understand when cold extrusion should be considered and how much freedom for the fabricator must be allowed in drawings and materials specifications.

Also, in many instances the electronics designer may need to guide the fabricator in proper technique, materials selection, lubricant, etc. Guides are given here that should be helpful when experimenting with cold extrusion for the first time.

Mechanics of Extrusion

The pressures required to make extrusions is an aggregate of forces acting upon the material, dies, and punches. It is important to recognize the necessity for lapping the dies and punches to a high state of finish. Hard chrome over a highly burnished surface provides better punch and die life and better flow characteristics.

The type and kind of material being extruded will have a great deal to do with the amount of reduction that can be made in any single operation. Under normal circumstances, and especially with non-ferrous materials, it is advisable to make the first reduction as great as possible, in most cases at least fifty percent of cross sectional area. The ultimate desired wall thickness can usually be reached in one pass when working out the more plastic metals such as copper, aluminum, lead, etc. With such materials a cross sectional area reduction of ninety percent is possible.

The work hardening of the metal during extrusion requires, under most conditions, the use of soft drawing annealed metal. In some cases the metal should be annealed to what may be called "soft as possible." For copper this would mean a grain size of 60 to 70 mm. If the metal tears apart in the extrusion process or tends to elongate when being removed from the die or stripped from the punch, harder metal at the start will probably be required. Also, additional operations must be provided including perhaps intermediate anneals, in order to produce the finished part. However, to effect economy it is best to plan for a single operation to reach final shape of part.

Pressures Needed

Calculation of pressures required must necessarily be approximate. In no case, however, will it be less than the yield point of the metal being used. Tests in a hydraulic press equipped with gage can be used to advantage. It can be assumed that higher speeds will create higher loads under impact, but this does not always follow due to the cushioning effect of the material acted upon and its ability to flow. Higher speeds are a requisite for forcing the metal to flow through restricted contours, while in other instance it will be found that slower speeds which provide a squeeze rather than high impact, will produce good results with less die and punch strain. To obtain sharp clean lines, however, impact is a requisite.

Based on the yield point and the reduction in area of the non-ferrous materials most often used in extrusions, it may be assumed that the pressures required will be the tensile strengths given by mill manufacturers in their handbooks for various anneals. Recommendations can only be approximate, however, since pressures depend on changes in die and punch characteristics and condition of the material as received from the mill (viz grain size, surface condition, etc). The true stress strain may be plotted by dividing each load by the actual area of the specimen billet and by treating strain in a like manner.

Contours

Symmetrical contour design is desirable but by no means necessary. An unbalanced design will have a tendency (as metal flows) to sweep the punch along with it. There are many ways of overcoming this, such as creating the first or other operations to provide a congregation of metal at desirable points and by subsequent operations extruding this congregated metal into the desired unbalanced contour.

Lubrication

Lubrication is an important consideration. The extensive pressures and heat generated in extrusion have a tendency to break down the lubricating qualities of the oil or lubricant used. Sulphur base oils or other lubricants having a strong resistance to lubricant break down are supplied by oil companies to meet practically any conditions encountered. No one lubricant will prove efficient if used on different metals. Complete information is readily available from any of the well known oil companies.

Die Strength

In die manufacture and design, steels are required that have resiliency and toughness, yet with strength enough not to bend or break under the extreme pressures. Dies must be able to withstand severe shock without shattering, without undue surface wear, and without deformation. The hardness of such dies should generally be from 58 to 62 C Rockwell, depending on the steel and use. The punches likewise will as a rule stand up if hardened to around 59 to 60 C Rockwell. These steels must be carefully ground in order not to decarbonize their surfaces or have excessive grinding marks. They also should be stress relieved after grinding at a temperature below their drawing

point. Carbide dies may be used but are not recommended, as such material does not have unusually good shock resistance.

In order to minimize the cost of die replacement, inserts may be resorted to. When contained in a heavy steel supporting block, inserts will provide good service at minimum cost for replacement. In fact, it is advisable to contain a die in a block of supporting metal wherever possible in order to stop breakage or distortion of the die itself.

Extrusion Principles

For practical purposes it is best to sub-divide the process of cold extrusion and plastic deformation of metals into several categories viz: (1) *Upward extrusion* performed by impact of the punch upon a billet or formed metal piece which is held in a die with a solid bottom; the metal can only flow upward in the direction of the punch. (2) *Downward extrusion* in which the metal in the billet is caused to flow ahead of the nose of the punch into an orifice in the die and even through a hole in the bottom of the die; the punch member forms a close fit with the side walls of the die, thereby preventing upward extrusion. (3) *Downward and upward extrusion* in which the metal flows simultaneously both in the direction of the punch and downward into an orifice in the die. (4) *Horizontal extrusion* in which a billet is acted upon by end actuated punches by means of cams or other mechanical means of exerting horizontal movement to the punches; the billet is contained in a split die and the metal flows into orifices in the die or is extruded along the line of the punch.

Upward Extrusion

Upward extrusion is the most commonly practiced extrusion process in which the slug or billet is placed in a solid die and subjected to impact pressure, the metal taking the shape of the die and the punch. The shapes thus generated may be straight, as in the case of round, square and rectangular shells, or may take an irregular contour in which as the metal flows upward it widens out into enlarged diameters and can be made to generate a flange if required by a shoulder stop on the punch. The punch itself may also be contoured to provide interior configurations to the part and may consist of a series of steps or enlarged diameters. The tool engineer must, however, provide proper radius and flow characteristics at the places where metal lines are to change so that proper metal flow is permitted.

The tendency for a punch to wander or deflect may be overcome by several methods the most common of which is to include a pointed end on the punch. A small boss on the end of the punch or a combination of boss and taper will generally prove successful. Tapering the punch in order to provide draft is of considerable help under some circumstances, and a back taper of about 1 deg will not only help in prevent-

ing deflection but will under some circumstances help in getting metal away from the nose of the punch. This will aid in carrying the piece on the punch when there is a tendency for it to stick in the die. Shoulder elements may be included at stages on the punch to exert greater downward pressures while increased radius will generally increase flow. The billet should fit the die as nearly as possible in order to prevent it from wandering when hit by the punch and which will help to minimize punch bending or breakage.

Downward Extrusion

Downward extrusion is accomplished by enclosing a billet in a die having an orifice large enough to accept the billet and a smaller orifice into which is extruded the metal from the billet by means of the downward thrust of the punch. In this case the punch normally has a close fit with the die in order to prevent upward extrusion, which causes all the force to be exerted in making the metal flow downward into the desired form within the die.

By contouring the die and punch a piece of irregular configuration may be secured. The slug may have a simple preform operation prior to extruding it into its final form, in which case anneals between operations may be necessary to restore plastic characteristics to the metal due to work hardening.

Hollow metal parts can be extruded by the "Hooker Process" of downward extrusion or by use of a double action press or a double action built into the die viz: The punch pierces the billet and protrudes into the mouth of the die opening thereby forming a prescribed orifice between the wall of the die and the punch partially blocking the opening. The metal is then caused to flow by a sleeve member surrounding the punch being forced downward against the slug causing the metal to flow between the wall of the die and the fixed punch. A piercing operation can remove the bottom if a tube rather than a shell is desired. In the Hooker Process somewhat similar action is obtained by preforming or machining the billet.

Upward & Downward Extrusion

Upward and downward extrusion metal from the slug occurs with flowing in both directions by shaping the punch so that an orifice is left between the punch and wall of die and an orifice smaller than the blank diameter is included in the die for downward extrusion of the metal. Shoulder elements on the punch can be made to exert additional downward pressure. When the downward resistance to the punch pressure builds up owing to work hardening of the metal and resists the flow into the desired downward contour, it will overcome the resistance of the shoulder elements and flow upward until the next shoulder contour on the punch is reached when the doubled action of such shoulders will offer greater resistance again forcing the metal to flow downward. While this flow and counter flow occurs almost simultaneously, it is never the less effective and like the duck boards on a dam can cause regulation of pressure and subsequent forming of a part with varied contour.

Horizontal Extrusions

With horizontal extrusion, the billet lies in the die in a horizontal position. The punch or punches are actuated in either a horizontal or vertical plane in respect to the billet. The punch or punches may or may not be contoured in respect to the part made viz:

A flat die with mating punch can be used in which the punch member acts on the die member in a vertical plane. The die may be made by milling, hobbing, etc. and is in general a cavity mold made of impact steel with the exception that the mating punch member is generally contained within the die in order to prevent flash. There are other applications in which flash is not a deterent or where it is undesirable due to the excessive pressure required to wholly contain the metal. The male die will then only enter the impression in the female die to the extent required to form the part. Excess metal is allowed to flow between the punch and die in the form of flash. In this application, what is accomplished is in reality cold forging in which both extrusion or plastic deformation may play a part, or where little or no extrusion is actually accomplished and cold deformation has accomplished the desired result with a minimum of cold working. The die may contain the entire contour of the piece desired and the punch member may be only a flat surface. Likewise the punch and die may both be contoured in which case the finished piece is contoured in conformity with both die and punch. In reality the last application is a mating die in which one part of the die acts as a punch member. In some sub-press applications, however, both sections of the die act on the billet simultaneously.

Horizontal extrusion will in time become more popular as its application becomes more widely known and its broad scope of application is recognized. This process not only lends itself to extrusion and deformation of a billet, square, round, hexagon, etc by endwise opposed punch pressures, but also permits the use of preformed billets to the design engineers great advantage.

The dies usually used in this process are split dies contained in a die set permitting cam or other endwise mechanical action on the punches. Air cushions can be used and in some cases hydraulic action has also been used. The general procedure is to enclose the billet in the die and exert pressure on the punches simultaneously. The die is contoured to the desired shape of the finished piece, and the punches may take the desired shape of the finished interior, or several subsequent operations may be required to contour the piece using a multiplicity of forming punches and various shaped dies. A hollow body member with desired outer and inner configuration may thus be made. A thin film of metal will have to be machined from the interior bore where the punches come to-

gether, the thin film of metal being permitted to remain between the ends of the punches to cushion them from each other.

Solid members can be made in a similar manner by blunt nose punches which flow the metal ahead of them into the desired shape in the die.

It is evident that a series of dies can be made to make preformed stages leading to the formation of a final part. This must be resorted to when excessive pressures or irregular contour makes it impossible to make the piece in one operation. This procedure is generally complicated and a thorough understanding of press working of metal is seemingly a necessity as such procedure follows to some extent the making of redrawing tools. Experience with the simpler forms of extrusion will lead to a better understanding and later success in the several stage extrusion of parts. Annealing procedures of various kinds of metals with their varied metallurgical requirements requires more than a mechanics knowledge of metal characteristics required to successfully practice multi-stage extrusion. The help that can be obtained from metal manufacturers, however, can be of great aid to those plants who do not have metallurgical advice available.

A Word of Caution

A word of caution must be given in the use of extrusion processes. One must not be carried away with enthusiasm when it is discovered that these processes will work. There are no doubt many instances in which stampings, drawn metal parts and screw machine parts can be converted to the extrusion process but at little or no gain and perhaps even at a loss. Products which should have been continued as a stamping in spite of scrap are sometimes converted to extrusion when a careful study would have indicated that it was not a proper candidate for conversion. The desire to practice something new sometimes gives way to better judgment. However, this in no way minimizes the field of usefulness of the cold plastic deformation process and with due regard to the conditions required for successful accomplishment in the field of cold metal working, surprising results can be achieved.

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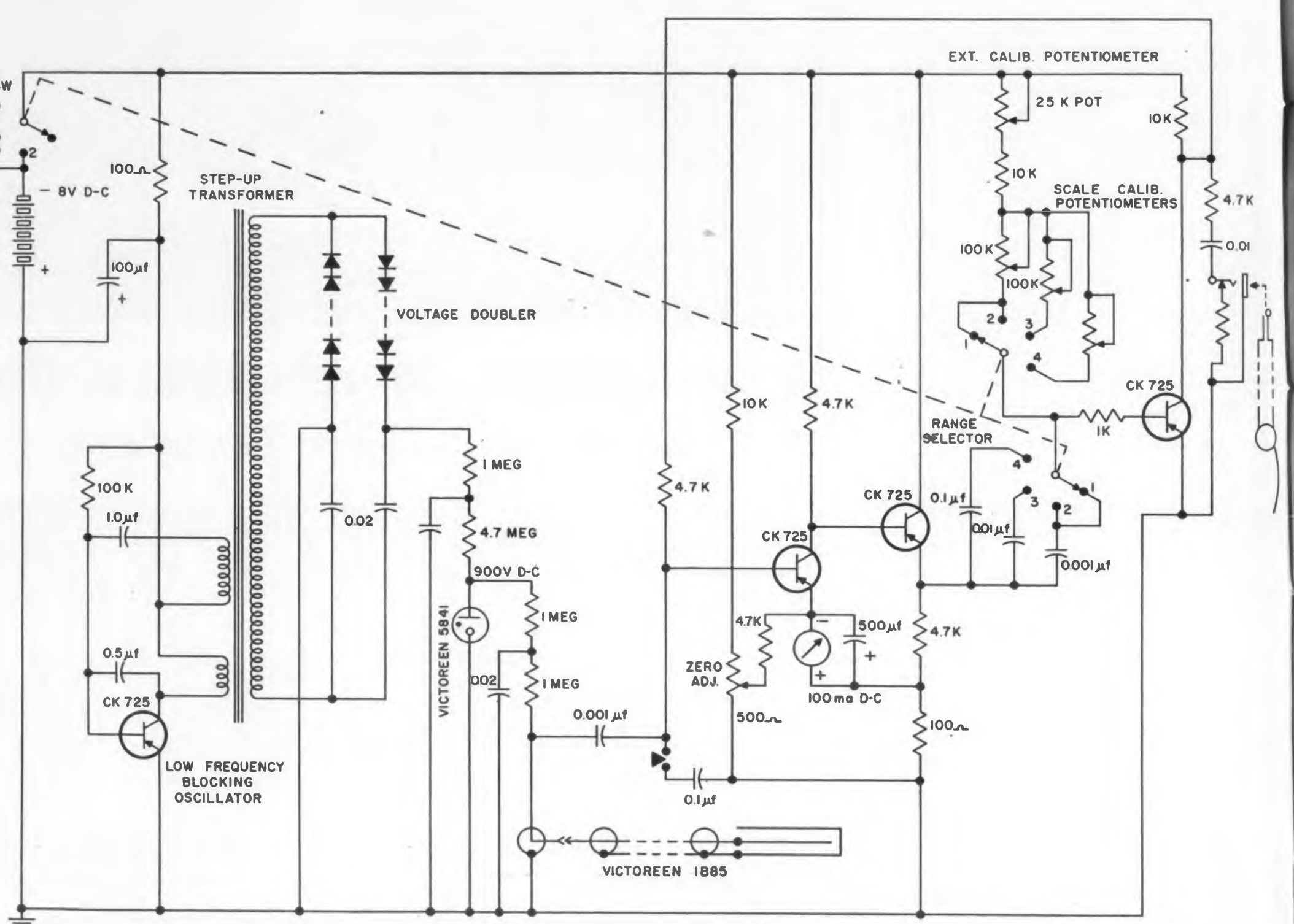
Plasticity, A. Nadai, McGraw-Hill Book Co., New York, N. Y.

Transistorized Geiger Counter

Miniaturized Geiger counter is powered by mercury batteries. A "Zero" button in the upper right corner permits checking of the electrical zero setting.



Schematic of the transistorized Geiger counter.

Design Forum

MINIATURIZING a Geiger counter starts with the power supply. Because about 75 per cent of the bulk of a Geiger counter is the battery supply, reduction of this section first involves some circuit redesign to enable the unit to operate at lower voltages.

As the first step in the design, Seezak, Div. of the U.H. & F. Mfg. Corp., substituted transistors for vacuum tubes. Then, after the final circuit was developed, miniature parts were substituted for standard components.

Geiger-Mueller tubes are operated at about 900 v. A transistor blocking oscillator was developed to produce low-level voltage pulses. These low-level pulses are stepped up in a secondary winding of the oscillator transformer. The resulting high voltage ac is rectified by a full-wave voltage doubler circuit. High voltage is held constant by a Victoreen type *5841* 900 v corona regulator tube.

A one-shot transistor multivibrator was designed which could be triggered by the pulses produced by the counter tube. Connecting a dc 100 microammeter, shunted by a 500-μμf capacitor, in series with the normally-off transistor, provides an integration circuit. Meter deflection is proportional to the pulse repetition rate.

Printed circuits and multi-deck construction result in maximum use of space. Mercury batteries supply 8 v to the collectors.

Weighing only 30 oz, the unit measures 4 x 5 x 2-1/2 in. Largest single item is the meter. Protection of the counter against rough handling is provided by a leather case.

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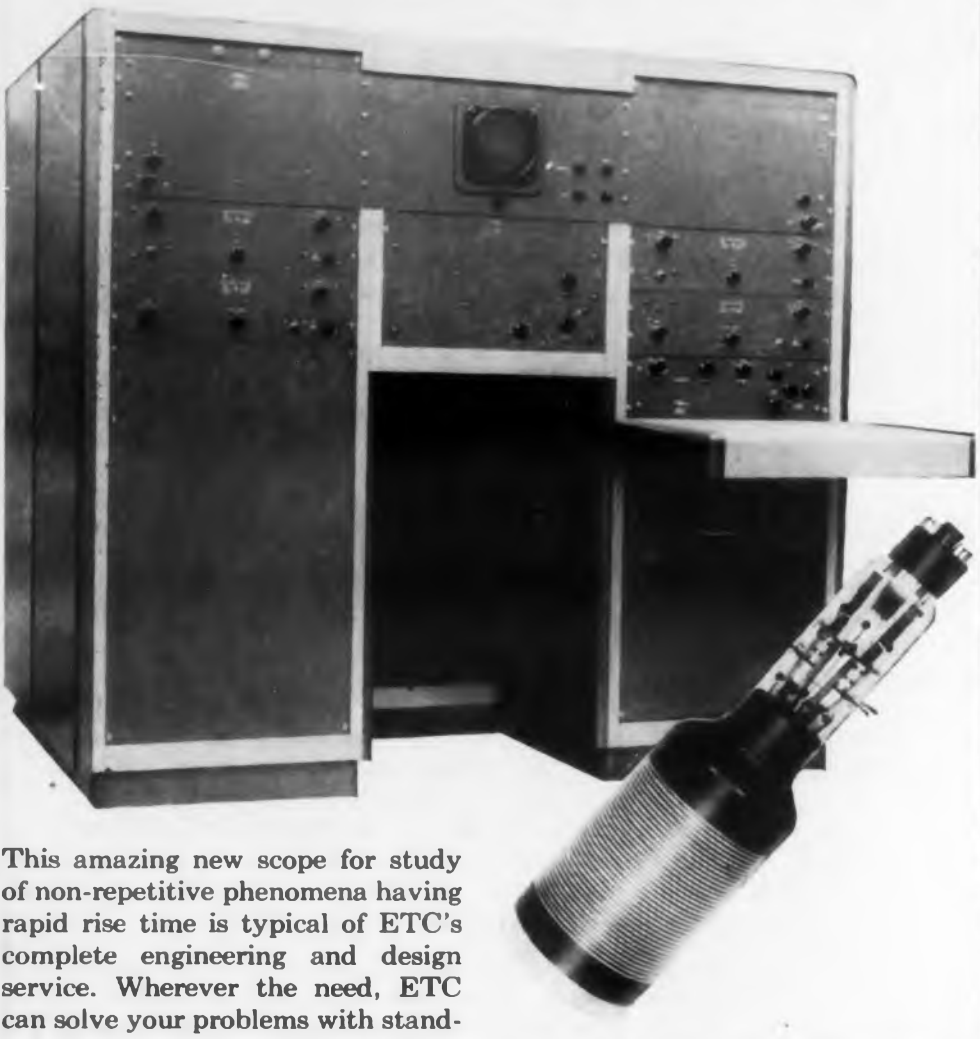

This amazing new scope for study of non-repetitive phenomena having rapid rise time is typical of ETC's complete engineering and design service. Wherever the need, ETC can solve your problems with standard or custom instruments. At ETC, instrumentation means *accuracy first*, with a versatility based on years of pioneering in electronic test equipment. Bring your requirements to ETC, now serving aircraft and electronic industries, utilities, educational and medical fields, research and test laboratories in industry and government. Also a standard line of multi-channel scopes, amplifiers, single- and multi-gun CR tubes.

MODEL 2100-A-1 (Illustrated)

Amplitude gain better than 70 db, attenuation 40 db in 20 db steps, vernier control. Input impedance 200 ohms nominal Sweep variable in steps from 50 mμsec to 100 μsec per in. Calibration at 1 μsec and 2/10 μsec intervals. 60" high, 44" deep, 65" wide, desk projects 18½". On casters for mobility in sections or as unit. CRT 52WSP2X, high sensitivity, spiral 3d anode, terminals located for use with distributed amplifier construction, developed primarily for single-trace photographic use.

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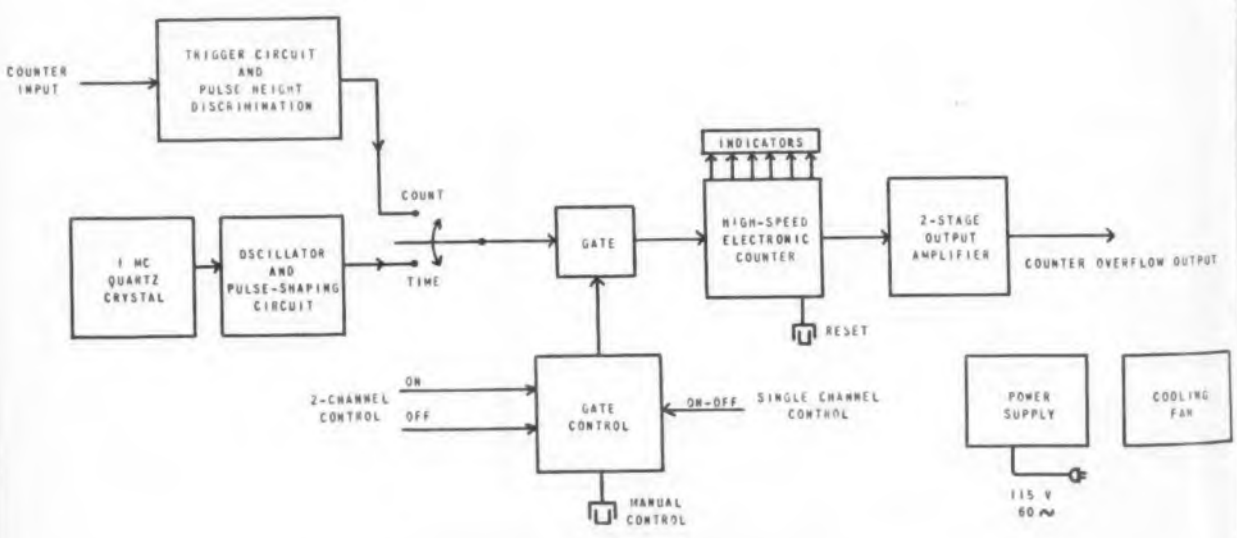
CIRCLE 28 ON READER-SERVICE CARD FOR MORE INFORMATION

Jacobs Model 401 Counter-Chronograph. Weighing only 8 lb and measuring 4-1/4 x 6-1/4 x 7 in., signal connections are made to BNC connectors on the panel (below). Presentation of information is supplied by a bank of 20 neon lamps, also on the panel.

Compact Counter

JUST announced is an instrument which for the first time combines a high-speed, high-capacity counter with a precision chronograph that measures time intervals up to one second in steps of one microsecond. It should be of special interest for applications where compactness and portability are of prime importance. Presentation is by neon lamps on the instrument panel.

Developed and manufactured by the Jacob Instrument Company of Bethesda 14, Md., the Model 401 Counter-Chronograph is portable, measuring only 4-1/4 x 6-1/4 x 7 in. and weighing only 8-1/2 lb. Unitized construction, with plug-in units, facilitates servicing when necessary. Forced-air cooling is employed, and the unit operates from a self-contained 115 v, 60 cps



Counter-Chronograph block diagram.

Chronograph

power supply. A carrying handle is provided and a reel on which the power cord can be wound.

The chronograph has a 1 Mc quartz crystal oscillator to supply the time base. Pulses from this source pass through a gate circuit to a high speed counter (see block diagram). The chronograph can be started with a signal from one source and stopped by a signal from another. Alternatively, it can be caused to measure the time interval between two signals from a signal source.

A trigger circuit precedes the counter to assure accurate counting of input signals from dc to 1 Mc, regardless of input pulse shape or rise time. It features pulse height discrimination and can be set to count only pulses whose amplitude exceeds a selected value.

Chronograph input signals required for two-channel use, are 6-v dc or pulse of 1/2 μsec or greater. For single channel use, the input pulse required is 6-v from 1/2 to 2 μsec duration. There is no specific rise-time requirement. The input impedance is 700 ohms in either case. Counter input required is 3-v dc or rms to 1 Mc. Sinewave signals or pulses of positive or negative polarity can be counted having amplitudes in the range from −10 to +50 v. Counter input impedance is 1/2 meg.

A representative two-channel application is measurement of bullet velocity. A typical one-channel application is measurement of time interval between two pulses in a computer or radar circuit.

For additional information on this product, turn to Reader's Service Card and circle No. 29.

CONVERSION factors describing tube characteristics at other than published or measured values are given in the nomograph. The conversion factor holds if all electrical values are changed in the same proportion. Although these conversion factors have been available in curve form for some time, the nomograph is more convenient to use than the log-log curves.

Lines drawn from the published value, E_{pub}, to the desired plate voltage, E_{des}, establish the value of the remaining conversion factors. Conversion factors for resistance and transconductance (F_r and F_{gm}) are plotted on the scale at the extreme left of the nomograph, and conversion factors for current and power output (F_i and F_p) on the scale at the extreme right. The dashed lines on the nomograph indicate the correct procedure when going.

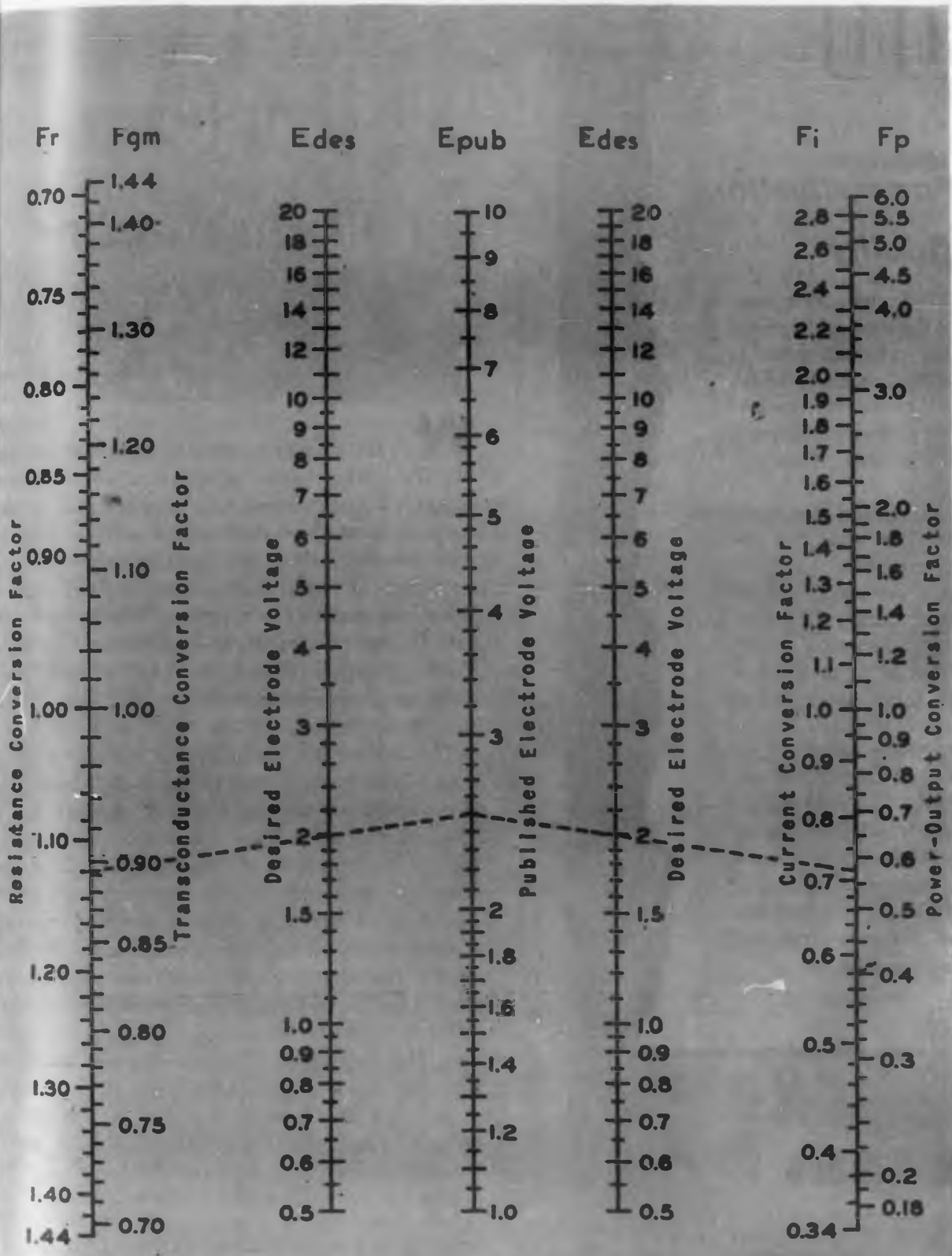
Characteristics	E_{pub}	Factor from Nomograph	E_{des}
Plate Voltage	250v	0.8	200v
Grid-No. 2 Voltage	250v	0.8	200v
Grid-No. 1 Voltage	—12v	0.8	—12v
Plate Current	30ma	F_i=0.72	21.6ma
Grid-No. 2 Current	6ma	=0.72	4.3ma
Plate Res. (Approx.)	0.13M	F_r=1.12	0.15M
Transductance	2000μmhos	F_{gm}=0.89	1780μmhos
Load Resistance	10000ohms	F_r=1.12	11200ohms
Harmonic Dist.	10%		no change
Maximum-Signal Power Output	2.5w	F_p=0.57	1.42w

Because this method for conversion of characteristics is necessarily an approximation, progressively greater errors will be introduced as the voltage conversion factor (E_{des}/E_{pub}) departs from unity. In general, it may be assumed that results obtained will be approximately correct when the ratio is between 0.7 and 1.5. Beyond these limits (down to 0.5 or up to 2.0), the results obtained can serve only as an approximation.

This method does not take into account the effects of contact potential or secondary emission in electron tubes. Contact potential, however, may safely be neglected for most applications because its effects are noticeable only at very low grid-No. 1 voltages. Secondary emission may occur in conventional tetrodes at low plate voltages. For such tubes, therefore, the use of conversion factors should be limited to regions of the plate characteristic in which the plate voltage is greater than the grid-No. 2 voltage. For beam power tubes, the regions of both low plate currents and voltages should also be avoided.

The conversion factors for tube characteristics are derived from the well-known "three-halves-power" relationship for current and voltage. *Data was supplied by RCA, Tube Division, Harrison, N. J. in Application Note, AN-164.*

Conversion Factors for Tube Characteristics



Nomograph for determining tube-characteristic conversion factors is applicable to triodes, tetrodes, pentodes, and beam power tubes when the plate voltage, grid-No. 1 voltage, and grid-No. 2 voltage are changed simultaneously by the same factor. They may be used for any class of tube operation (class A, AB_1, AB_2, B, or C).

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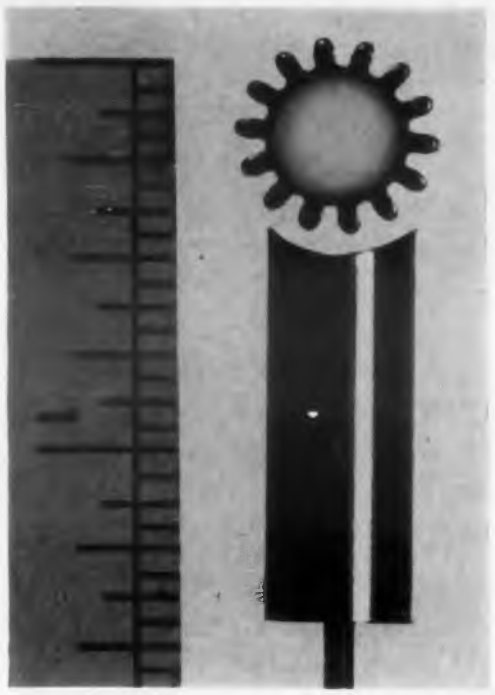
Proximity Impulse Transducer

WITHOUT any external excitation this midge impulse transducer generates an electrical signal whose frequency is proportional to any movement of ferro-magnetic materials near its sensitive end. Mechanical motion is converted to an electrical signal without mechanical contact. Where space is at a premium this midget unit may be the answer. Units can indicate speed of shafts, vibration of parts, angular or linear positions of pins, wheels, levers, cams, slots, holes, pistons, etc.

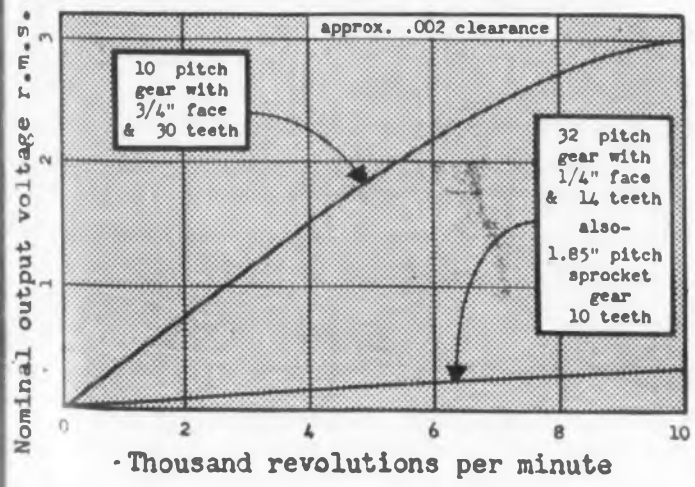
The midget 3/8 in. diam by 1 in. long transducer, built by Minatron Corp., Belle Mead, N.J., is designed around an Alnico-V magnet. For a given distance between the source and sensing end of the transducer, the output voltage increases over a wide linear range; the frequency increases in direct proportion to the number of times per second that the external magnetic field is cut. The change in the magnetic field can be caused by the passing of a tooth on a gear or any other ferro-magnetic object, such as a rivet or a key. The passing of a hole or keyway may also serve the same purpose.

At a constant speed, the output voltage decreases exponentially with the increasing space between the sensitive end and the ferro-magnetic object.

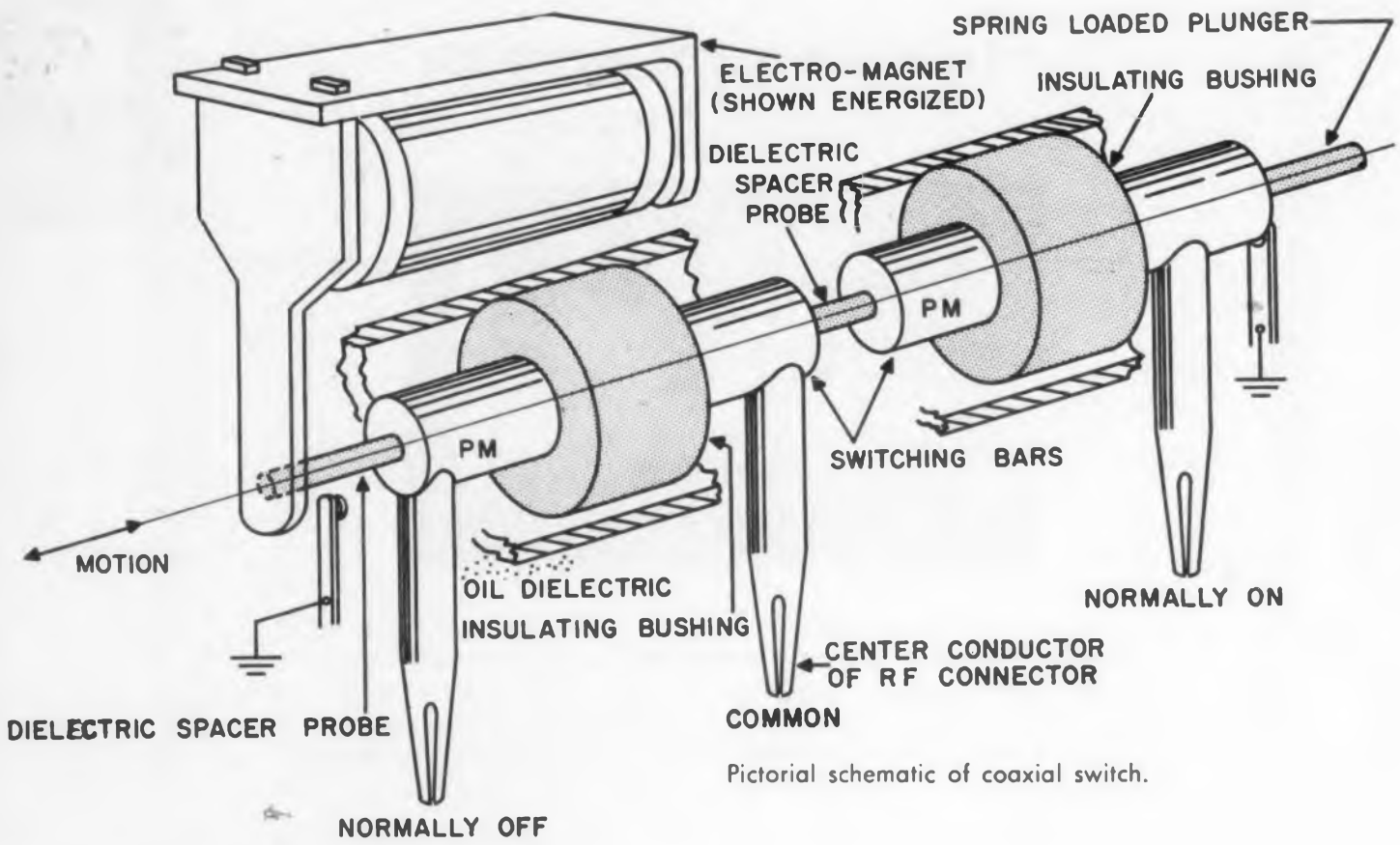


Because of its very small size, the output voltage of the midget unit is necessarily much lower than standard generators. At all speeds, it is recommended that its frequency output be utilized. If the voltage output is utilized, it may be necessary to supply voltage amplification.

The device will operate at temperatures of 200 F (500 F models are available); weight is 12 grams. Impedance at 10 kc is 5500 ohms nominal; dc resistance is 1200 ohms. For more information, turn to the Readers' Service Card and circle 34.



Tiny Coaxial Switches



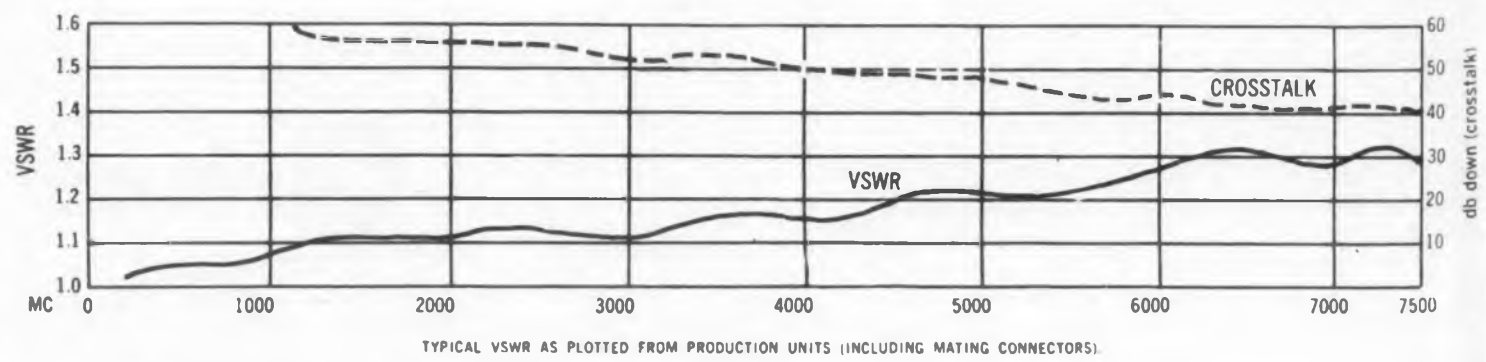
Pictorial schematic of coaxial switch.

DESIGN problems associated with broadband rf coaxial switches are basically mechanical rather than electrical. The design of the switches illustrated here attempt to embody, in the simplest possible form, the obvious requisites such as reliability, high speed, mechanical simplicity, lightness, low power consumption, and repeatability in a compact sealed unit capable of performing over a wide rf frequency the power range. A series of miniature and subminiature types for all types of rf installations up to the X band frequencies are available. The new devices also feature low operating power consumption—an 0.1 amp max at 26-v dc.

The pictorial diagram reveals their simplicity. The direct approach in solving the rf transposition problem keeps the electrical length and discontinuities to a minimum. This is accomplished by using a truly concentric system where all center conductors are of the same diameter and held concentrically by a solid-dielectric material. All remaining voids which play a mechanical function are oil-dielectric filled. Both solids and liquids ("KEL-F" oil) have the same dielectric constant. The oil dielectric provides further advantages such as a heat transfer medium for cen-

Switches may be stacked for minimum space utilization.

RF DATA



TYPICAL VSWR AS PLOTTED FROM PRODUCTION UNITS (INCLUDING MATING CONNECTORS).

CHARACTERISTIC IMPEDANCE 50 ± 2 OHMS.
MAX. INSERTION LOSS 0.3 DB.
OUTPUTS OPEN (NOT GROUNDED) WHEN CONNECTED TO COMMON OUTPUT.

Graph of rf data on type "N" switch. Other type "N" units extend to 10,800 mc.

ter conductor cooling, mechanical lubrication, arc quenching, and mechanical damping.

Grouping of several switches into space-conserving stacks for network use in aircraft for general rf switching is facilitated by the housing design and the placement of cable connectors.

Since the discontinuities are few and of low magnitude, reflections are minor and cancellation effect is virtually non-existant. Thus broadband rf applications are possible. (See graph).

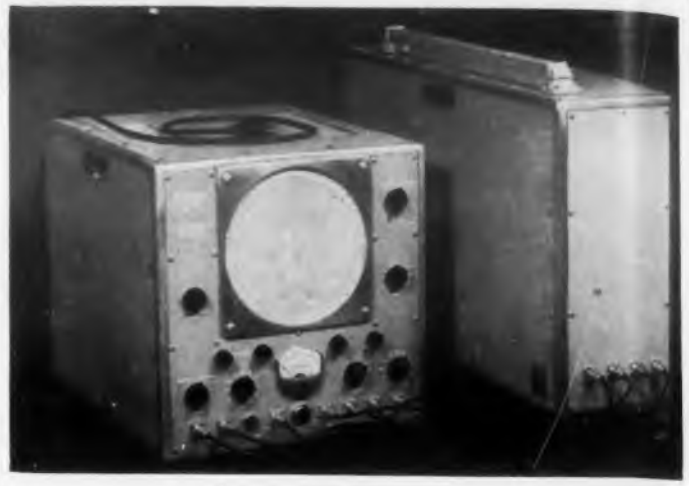
The switching bars are displaced longitudinally (by an electromagnet) sliding on the rf output center conductors. The conductors provide wiping action as well as a large area of contact. Further, because the conductors are free to rotate at random, the periphery of the switching bars serves as a potential contact area.

Positive contact pressure is provided in a number of ways depending on the switch model and type of rf connector used.The version illustrated employs permanent magnetism in the switching bars. Magnetic attraction to the probe of the rf connectors, results in relatively high contact pressure and reliability. The ideas incorporated in the switch are credited mostly to Donald H. Lanctot, Chief Engineer of the Cado Div. of Electromation Co., 116 S. Hollywood Way, Burbank, Calif.

Maximum isolation is achieved by precise displacement and grounding of the unused switching bar. This results in a blockage of the unused cavity and serves as a matched continuation of the outer rf connector shell.

Several variations of this basic design are available such as models using two electromagnets allowing versatility in selection of rf switching arrangements such as "make" before "break" in high power applications. The switches are available in SP4T, SP3T, SP2T, DP2T, DP3T (fail safe or selective), in various types of connectors. Units are designed to meet the environmental requirements of MIL-E-5272a specification. Typical weights for the units are 1.8 oz. for SP2T type 27 and 3.8 oz for SP27 type N switches.

Automatic Impedance Plotter



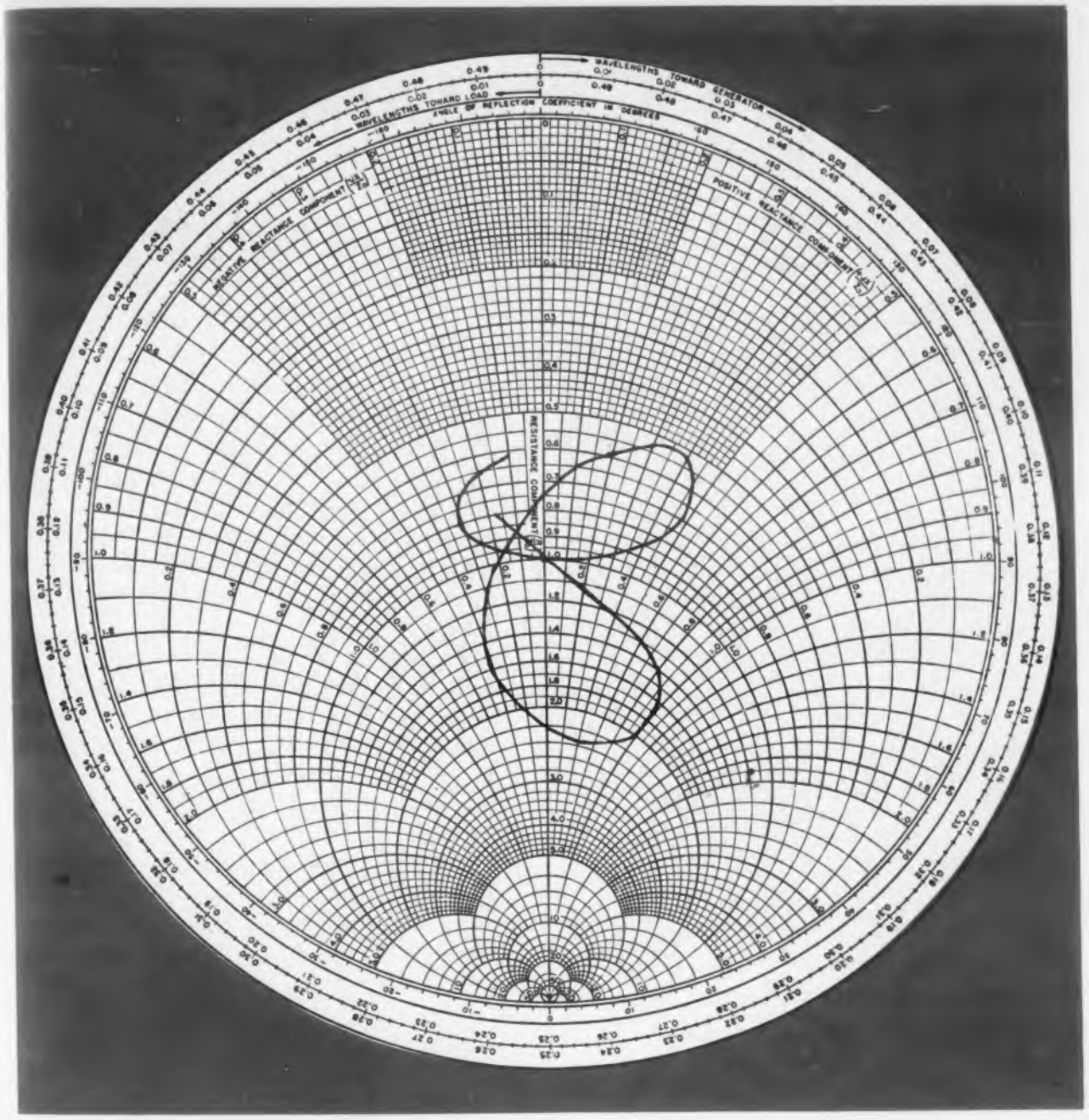
MICROWAVE impedance measurement is basically a measurement of the reflection coefficient which can be expressed in terms of resistance and reactance components of a complex impedance. This instrument, called a Z-Scope, takes samples of incoming and reflected waves and converts the resulting signal into a spot on an oscilloscope screen. The position of the spot is determined by the resistive and reactive components of the unknown impedance.

A convenient method of presentation is the Smith chart where numerical value and angle of the reflection coefficient are shown in a polar system. Impedance is read on a transparent chart placed over the face of the cathode-ray tube.

An agc system built into the instrument insures that the sample of the incoming wave will have a constant level. Samples of direct and reflected waves are both taken by couplers of the multihole type in order to have good and constant sensitivity over a wide frequency range. After delay and modulation, each of the two sample signals is split in two equal parts. One part of one of the signals is given a phase change of 90 deg.

Output from the detector crystals is amplified and applied to the deflection plates of a 7 in. cathode-ray tube. Impedance is read directly in terms of resistance and reactance components from the transparent Smith chart.

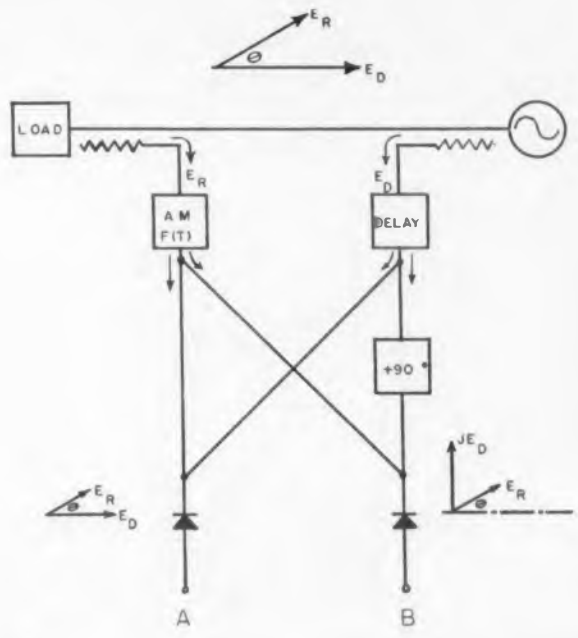
If the impedance varies or the frequency is swept, the impedance variation will be shown as a curve. To facilitate the interpretation of impedance vs frequency curves, the Z-Scope has an input for frequency marker



An example of an impedance vs frequency curve measured by the Z-Scope.

pulses which will blank out the light spot and create a break in the curves. Such marker pulses could be supplied from a tunable reference cavity with a detector or from a multiresonant cavity which would give a pulse whenever the frequency passes through one of its resonances. The normal Smith chart can be replaced by an expanded Smith chart and the amplifier gain increased correspondingly so that the 7 in. diameter tube will give a more detailed presentation.

Made by Cascade Research Corp., 53 Victory Lane, Los Gatos, Calif., the present model is designed for the X-band which is covered from 8200-12,400 mc. To make the instrument available at other bands from about 6000 mc to about 35,000 mc, it is only necessary to replace the waveguide system. Electronic circuitry would be the same. The waveguide system can be made at all frequencies where suitable directional couplers and Gyralines are available, but the bandwith covered would probably be smaller at the higher frequencies. For more information on this automatic plotter, turn to Reader's Service Card and circle 38.



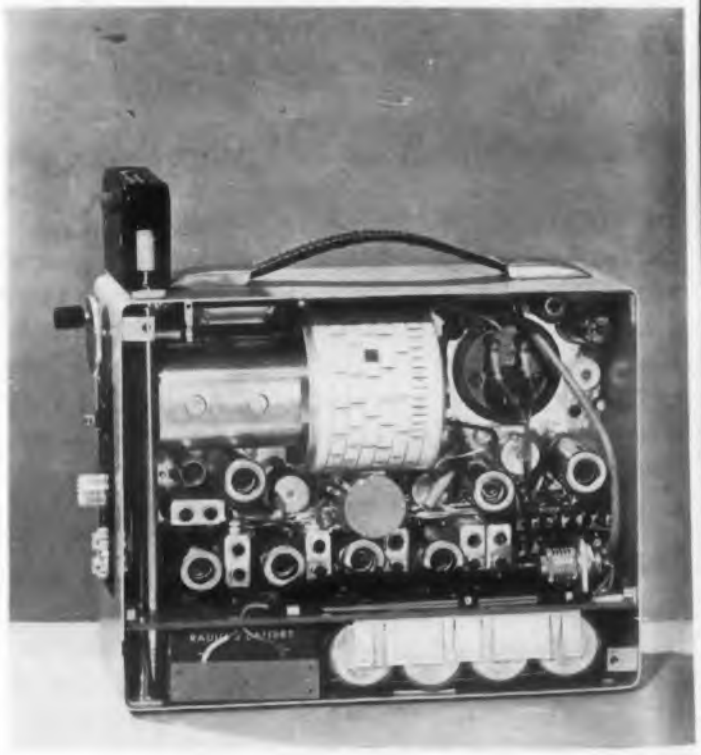
Block diagram of the operation of the Z-Scope. Signals from the detector crystals A and B may also be fed to an x-y recorder.

Portable VHF Field

LIGHT-WEIGHT, dry battery-operated v-h-h field strength indicator meter covers the frequency range 47 to 225 inc. Useful for obtaining data on field strength of vhf transmitters, the device also has many other applications. Some of these include transmitter site determination, antenna adjustment, monitoring and direction finding.

Designated FT-HUZ, the instrument is available from Federal Telephone & Radio Co., 100 Kingsland Rd., Clifton, N.J. Its 9 lb weight and self-contained power supply make it especially adaptable to portable use. A telescoping dipole antenna fits into the 9-7/8" x 8-1/8" x 4-3/4" cabinet.

Interference studies can be made using a search coil. Various components of complex antenna systems may be tested by disconnecting the antenna and using the set for voltage indication. Input voltage range is 1 μf to 100 mv. An unbalanced 70 ohm input and a balanced 300 ohm input are provided.

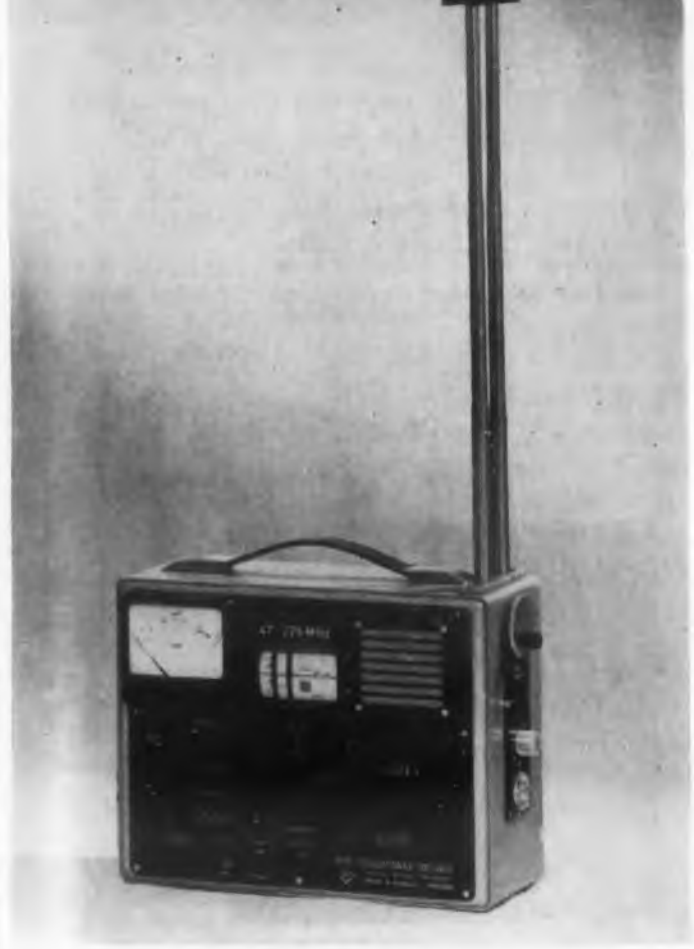


Vhf field strength meter consists of a superheterodyne am-fm receiver, a dial calibrating oscillator and dry battery power supply.

Strength Meter

Accuracy of the instrument is ±6 db. Calibration of the dial is provided by a built-in 100 mc oscillator. A built-in piezoelectric loudspeaker permits aural identification of signals. Provision is also made for headphones.

For laboratory use, the batteries may be removed and an ac power supply inserted into the battery compartment. For further information turn to Reader's Service Card and circle 41.



Portable vhf field strength meter covers vhf broadcasting, TV, aircraft and police radio frequencies.

New Products

New Diode Tester

Germanium or Silicone Diodes

Battery operated, static tester, Model DT-1, is intended for rapidly determining the forward and reverse characteristics of germanium of silicone diodes. The switch has three positions: forward, reverse, and spring return to off. The meter indicates the current flow through the diode in the desired direction. The forward scale indicates 0-2 v drop and the reverse scale indicates 0-1 ma flow. A battery test button determines the battery condition on the basis of 50 v full scale. The set is also equipped with jacks for test probes.

Pacific Industrial Electronics, Dept. ED, 252-5th St., San Francisco 3, Calif.

CIRCLE 43 ON READER-SERVICE CARD FOR MORE INFORMATION

Rotary Actuated Switch

Hermetically Sealed

Utilizing a silastic compound sealer and offering flexibility without sacrificing the mechanical life requirements, the Model H10-7 switch offers a leak rate of less than one micron per cubic foot per hour; a temperature range from —100 F to 250 F; full water-ice-vapor-dust-and-temper proofing; rotary actuation; up to 4 isolated switching actuations.

Electro Snap Switch & Mfg. Co., Dept. ED, 4218 West Lake St., Chicago 24, Ill.

CIRCLE 44 ON READER-SERVICE CARD FOR MORE INFORMATION

Relay Kits

For Prototype Work

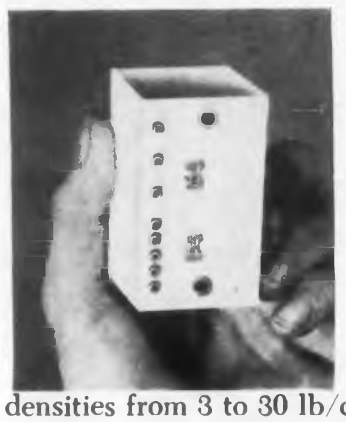
Easily assembled and with a wide range of applications, the "X" Series Relay Kits are for engineering prototype, experimental, and industrial use. They consist of standard contact assemblies and standard coils which are quickly and simply joined by a single screw at the base of the coil to form relays. The kits provide coil voltages ranging from 6 v to 115 v in both ac and dc. One coil permits the relay to be operated by vacuum tube. Kit components meet all UL requirements. All contacts are the gold-plated "fine" silver type.

Globe Electrical Mfg. Co., Dept. ED, 1729 W. 134th St., Gardena, Calif.

CIRCLE 45 ON READER-SERVICE CARD FOR MORE INFORMATION

Potting Compound

Non-Toxic Foam-In-Place



Designed to solve shock problems, E-P-FOME is light in weight, non-toxic, easy to use and safe to handle. The foaming reaction takes place at room temperature without pressure, to produce semi-rigid or rigid foams rapidly with controlled densities from 3 to 30 lb/cu ft.

Suitable for thermal insulation, E-P-FOME requires no wasteful and tedious cutting and fitting of preformed insulation. Molds can be removed and reused after 30 minutes.

Electronic Plastics Corp., Dept. ED, 675 Barbey St., Brooklyn, N.Y.

CIRCLE 46 ON READER-SERVICE CARD FOR MORE INFORMATION

Traveling Wave Tube Amplifiers

Medium Noise Figure

These traveling wave tubes in the X and L Band range, feature broadband medium noise figure (10-20 db) operation across their bands. Normally, these noise figures fall between the 10 and 15 db limits.

The greatest applications will be in fields where this improved noise figure is required in addition to their broadband and other typical traveling wave tube characteristics.

Other important operating characteristics include at least 25-30 db gain and 5-10 mw output. The L-Band unit is designated the HA-17 and the X-Band unit is designated the HA-15.

Huggins Laboratories, Inc., Dept. ED, 711 Hamilton Ave., Menlo Park, Calif.

CIRCLE 47 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Resistors

Designed for Printed Circuits

The Series KS "Standee" above - chassis - mounted power resistors are now offered with terminals featuring plug-in type installation. They are available in five sizes from 1-11/16 to 4-3/16 in. high and in 10-30 w power ratings. Values of resistance up to 21,000 ohms are available.

Clarostat Mfg. Co., Inc., Dept. ED, Dover, N.H.

CIRCLE 48 ON READER-SERVICE CARD FOR MORE INFORMATION

Ceramic Capacitors
For Printed Circuits

Designed especially for leadless insertion in printed board circuits, these new "Wejcap" capacitors are inserted manually or by placement machines in board slots. Dip soldering then makes permanent bond to the connection point.

"Wejcap" capacitors have several TV receiver applications in antenna coupling networks, avc and age networks, screen bypass and other medium-tolerance circuits, and are already in production.

These capacitors, presently available in 150, 270, 420, 820, 1200 and 1400 μμf, are 3/8 in. high, 3/8 in. across at the widest point, and 35 mils thick. They have a dense non-porous ceramic dielectric base with the silver electrode surface bonded to both sides.

Their slot-mounting in the printed wiring board does away with problems of lead placement and breakage, and minimizes problems of lead inductance. The slots to receive them can easily be punched out with the other holes in the board.

GE Specialty Electronic Components Dept., Dept. ED, West Genessee Street, Auburn, N. Y.

CIRCLE 49 ON READER-SERVICE CARD FOR MORE INFORMATION

Preset Controller Series
Counts to 1,000,000 Events

Model 310 Series Preset Controllers, to count and control to 1,000,000 events automatically, have been designed as high speed, direct reading electronic counters of the coincident type. The new series (five models, ranging from 2 to 6 decades) will control any operation or activate an alarm after a preselected total count has been reached. Any electrical, mechanical or optical event which can be converted into electrical impulses can be counted and controlled.

Computer-Measurements Corp., Dept. ED, 5528 Vineland Ave., North Hollywood, Calif.

CIRCLE 50 ON READER-SERVICE CARD FOR MORE INFORMATION

REPORTS FROM THE STRATOSPHERE

with

Vitramon® Capacitors

Almost from the first "whoosh," we groundlings must depend on instruments for guiding and reporting. Here, where only the best of electronic equipment is good enough, the leading manufacturers of guided missiles and fire-control systems specify "VITRAMON" capacitors — specify them because *only* "VITRAMON" capacitors are:

- *STABLE*
- *RUGGED*
- *LOW LOSS*
- *LOW NOISE*
- *MINIATURE*
- *VAPORPROOF*
- *WIDE TEMPERATURE RANGE*

NOW — A new design — the CY Series — adds two *additional* plus values:

- **Unitized electrode/lead construction**
- **Complete insulation.**

This new series, too, is available in values from 0.5 to 6800 $\mu\mu$f. Catalog 55-1 tells the whole story. It's yours for the asking.

"V" and "Vitramon" are Registered Trade Marks of Vitramon, Inc.

Vitramon
INCORPORATED

P.O. Box 544D, Bridgeport 1, Conn.

CIRCLE 53 ON READER-SERVICE CARD FOR MORE INFORMATION

Self-Locking Stud

Cuts Own Threads

This double-ended stud cuts its own thread when driven in an ordinary drilled hole, and locks securely in the same operation. It provides high vibration resistance. Known as the "Schweppe" Stud, it can be located accurately from the slotted end to permit hopperizing for automatic feeding and driving.

Studs can be installed at high speed with any power stud driver. No special adapters or attachments are required. They are re-usable. They can be removed from the hole without thread damage and then re-driven in any drilled or tapped hole of the same size.

The studs can be driven in steel, cast iron, aluminum, magnesium, and plastics. They are supplied in any required length, and any diameter from No. 4 through 1 in. Any desired types of threads will be furnished at the slotted and nut ends. In most cases studs operate best with a standard fine machine screw thread on the nut end and a coarse machine screw thread on the slotted end. They are made in any alloy steel, high temperature steel, stainless steel, or non-ferrous metal. Finishes can be plain, Parkerized, or plated with cadmium, zinc, brass, bronze, nickel, chromium, etc.

Pheoll Manufacturing Co., Dept. ED, 5720 Roosevelt Rd., Chicago 50, Ill.

CIRCLE 54 ON READER-SERVICE CARD FOR MORE INFORMATION

Fixed Vacuum Capacitor

Rated at 500 mfd

The Type VC500-10 Fixed Vacuum Capacitor is rated at 500-mmfd capacitance, 10-kv peak, and 42 amp rms. Dimensions are: 4 in. overall length x 3-1/4 in. diam, 3-1/2 in. mounting centers, and 7/8 in. contact diam. This unit features reversed copper-to-glass seals for maximum voltage path in minimum space. Low inductance, practically loss-free characteristics, and rugged construction are features of the unit, which is especially suited for medium and high power oscillators and transmitting equipment.

Dolinko & Wilkens, Inc., Dept. ED, 1907 Summit Ave., Union City, N.J.

CIRCLE 55 ON READER-SERVICE CARD FOR MORE INFORMATION

Shim Spacers

For Miniature Locking Nuts

A complete line of miniature shim spacers is offered for use with the Kaynar series of "Kaylock" miniature self-locking nuts. The miniature shims and nuts offer substantial space and weight savings.

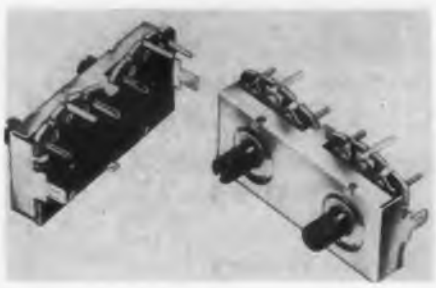
The shim spacers are available in a complete complementary line to cover all available sizes of "Kaylock" miniature nuts. They are available in 0.031 or 0.062 gage aluminum. The new TA206 and TA207 series are furnished with an anodized finish per MIL-A-8625.

Thomas Associates, Dept. ED, 4607 Alger St., Los Angeles 39, Calif.

CIRCLE 59 ON READER-SERVICE CARD FOR MORE INFORMATION

Variable Resistor

Contains Two Control Elements



The Type TV61, a twist-tab mounting variable resistor, contains two control elements and shafts mounted side-by-side on a common base, only 7/8 by 2 in. wide. In addition to the low cost of the control itself, the unit offers savings in mounting and wiring time for TV and other electronic equipment manufacturers.

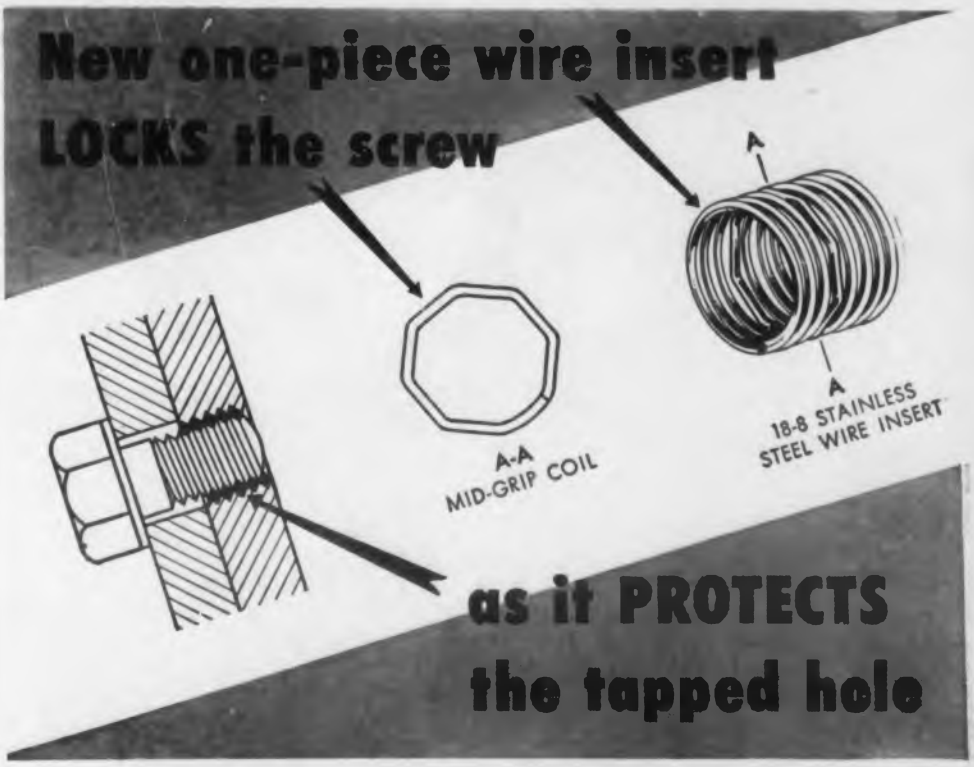
The unit has two 1/4-in. diam phenolic shafts which may be adjusted from either side of the control. The shafts on the panel side are screwdriver-slotted and cut flush with the phenolic mounting plate, making the control valuable for use in printed circuits where it is desired to adjust the control through the chassis. Shaft extensions from the rear are 3/8 in. long and are knurled for easy finger adjustment. Screwdriver slots are optional for rear extensions.

In addition to standard solder lug terminals, controls can also be equipped with horizontal or vertical printed wiring or wire-wrap type terminals. The Type TU61 is conservatively rated at 0.75 w for resistance values above 10,000 ohms, or 0.5 w for values below 10,000 ohms. Controls are fully shielded at the rear by a one-piece, nickel plated steel case.

Electronic Components Div., Stackpole Carbon Co., Dept. ED, St. Marys, Pa.

CIRCLE 60 ON READER-SERVICE CARD FOR MORE INFORMATION

New one-piece wire insert LOCKS the screw



as it PROTECTS the tapped hole

Withstands vibration, heat, corrosion — Meets AN-N-5b lock nut specifications

Here is a ONE-PIECE stainless steel thread insert that will *lock the screw against loosening* as it permanently protects the tapped hole. The secret is in the Mid-Grip coil. Shaped like a polygon, its chords exert a spring pressure on the screw thread and prevent rotation at less-than-rated torque. No loss of torque occurs at elevated temperatures or after repeated disassemblies.

NO EXTRAS—The *Heli-Coil*® Screw-Lock (Mid-Grip) Insert employs no locking rings, pins, plugs, tabs or wiring. It can be installed from the front or top. Think of the money — and assembly time — you can save!

NO PROJECTIONS — Screw-Lock Inserts furnish AN-N-5b lock nut torque *right down inside the parent piece* . . . eliminate costly weight and space . . . improve design.

NO WEAR, NO CORROSION— Like regular *Heli-Coil* Inserts, new Screw-Lock Inserts are made from 18-8 stainless steel wire, and normally outlast the unit they protect. They permit smaller, fewer fastenings, and require minimum surrounding material. Screw-Lock Inserts are available in popular NC and NF sizes with choice of two lengths.

Mail coupon for complete data—or better still, see Yellow Pages of your phone directory — "Inserts — Screw Thread" for name of your local Heli-Coil Applications Engineer. Call him now!

Regular *Heli-Coil* Inserts (no locking action) put corrosion-proof, strip-proof stainless steel threads in soft materials . . . permit smaller, fewer fastenings, lighter weight, reduced cost.

HELI-COIL **SCREW-LOCK INSERTS**

Products of Heli-Coil Corporation, Danbury, Conn.

*Reg. U. S. Pat. Off.

HELI-COIL CORPORATION

249 Shelter Rock Lane, Danbury, Conn.

- ☐ Send complete design data on *Heli-Coil* Screw-Lock Inserts.
- ☐ Send design manual on standard *Heli-Coil* Screw Thread Inserts.
- ☐ Put me on a list to receive "*Heli*-Call," case history periodical.

Name_____ Title_____

Company_____

Address_____

City_____ Zone_____ State_____ 3534

IN CANADA: W. R. Watkins Co., Ltd., 41 Kipling Ave. S., Toronto 18, Ont.

CIRCLE 61 ON READER-SERVICE CARD FOR MORE INFORMATION

Temperature Indicating Liquids

Reduced Settling Characteristics

This is an improved line of TEMPILAQ° temperature indicating liquids with greatly reduced settling characteristics. Sixty-two different Tempilaqs are available, ranging in temperature from 113 F to 2000 F. With a few exceptions (true solutions), they consist of suspensions of temperature-sensitive materials in volatile vehicles, the rate of settling out varying with the composition.

By micronizing the solid ingredients, settling has been greatly retarded, and redispersing can be accomplished by brief shaking.

Tempil°Corp., Dept. ED, 132 W. 22nd St., New York, N.Y.

CIRCLE 64 ON READER-SERVICE CARD

Weather-Tight Cabinets

For Polypoint Controls

This is a new "Weather-Tight" case for bearing monitors and other polypoint controls containing contact meter-relays. The upward-swinging front is gasket sealed and of aluminum construction. Two quarter-turn fasteners lock it firmly in place. Electrical connections are made with weather tight connectors or conduit.

The cabinet protects meter-relays used in moisture laden atmospheres, where steel chips and other materials might damage the instruments, where mild chemicals are present, or in outdoor locations exposed to the weather.

Assembly Products, Inc., Dept. ED, Chesterland, Ohio.

CIRCLE 65 ON READER-SERVICE CARD

Circle No. 300 RMC Associates ➤

Circle No. 301 Hewlett-Packard Co.

Circle No. 302 Beta Electric Corp.

Circle No. 303 John Fluke Mfg. Co., Inc.

Circle No. 304 Varian Associates

Circle No. 305 Pimex Inc.

Circle No. 306 Budd Stanley Co., Inc.

Circle No. 307 Sorensen and Co.

Circle No. 308 Kay Lab.

➤ CIRCLE 63 ON READER-SERVICE CARD

Wire Cutter and Stripper

Pocket Sized, Easy Stripping

This is a new pocket size wire cutter and stripper featuring a wire size adjustment for easy wire stripping. Designed for electrical work, radio, TV, and electronics, the tool features 5" long blades hardened and ground to cut with a smooth shearing action severing wire cleanly and neatly.

For wire stripping, the electrical worker simply sets the adjusting stop to the wire size, closes the jaws of the tool around the wire, holds firm and strips clean to the bare wire with an easy "straight pull" motion. The tool measures 5" long and weighs just 2 oz.

Jo-El Co., Dept. ED, 14209 Leroy Ave., Cleveland, Ohio.

CIRCLE 74 ON READER-SERVICE CARD

Interlock Terminals

In Loose or Chain Form

Primarily designed for use as an a-c interlock, these terminals are equally adapted for connecting speaker leads, printed circuit panels or flybacks and also as mounting lugs on transformers for printed circuit applications.

Special design features include: (1) reinforced ribs to prevent banding or deformation of any part of the terminal during continuous use; (2) male prong is bullet shaped for easy and quick insertion into line cord female; and (3) square extruded barrel and inverted tongue assure proper alignment and accurate spacing when terminals are used in multiples.

Malco Tool and Mfg. Co., Dept. ED, 4025 W. Lake St., Chicago 24, Ill.

CIRCLE 75 ON READER-SERVICE CARD

Circle No. 300 RMC Associates

Circle No. 301 Hewlett-Packard Co.

Circle No. 302 Beta Electric Corp.

Circle No. 303 John Fluke Mfg. Co., Inc.

Circle No. 304 Varian Associates

Circle No. 305 Pimex Inc.

Circle No. 306 Budd Stanley Co., Inc.

Circle No. 307 Sorensen and Co.

Circle No. 308 Kay Lab.

CIRCLE 76 ON READER-SERVICE CARD

Meter-Relays, VHS Relays, Simplytrol and Versatrol Automatic Controls, Panel Meters and Indicating Pyrometers

40 PAGE ASSEMBLY PRODUCTS CATALOG 4-A

Contents include:

"Circuitry"—6 pages of diagrams and text, including response time tables and discussion on non-locking contacts.

Ordering information.

Prices and detailed specifications for:
Clear plastic, black bakelite and ruggedized-sealed styles of:
- Meter-relays
- Indicating meters
- Indicating pyrometers

VHS Relays

Plug-in relays, power supplies

Automatic pyrometers

Automatic control packages and components

Bearing monitors

Oven pyrometers and millivoltmeters

Kiln pyrometers

Shunts

Transformers

Write for Catalog 4-A.
Assembly Products, Inc.
Chesterland 17, Ohio
HAmilton 3-4436
(West Coast: Desert Hot Springs 17, Calif. Phone 4-3133 or 4-2453).

Meter-relays provide control of mechanical operations or chemical processes through alarm and automatic shut-off, or continuous on-off control. Applications include: Bearing temperature alarm and shut-off on pumps, turbines, generators. Automatic speed controls for machines and conveyors. Computer shut-off if power supply voltage varies. Warning and control in radiation measuring equipment and processes. Automatic switching of standby equipment in microwave communications. Continuous control of pH. Signal detection in radar warning systems.

Booth 1614, Instrument-Automation Show, Sept. 17-21, New York Coliseum

CIRCLE 285 ON READER-SERVICE CARD FOR MORE INFORMATION

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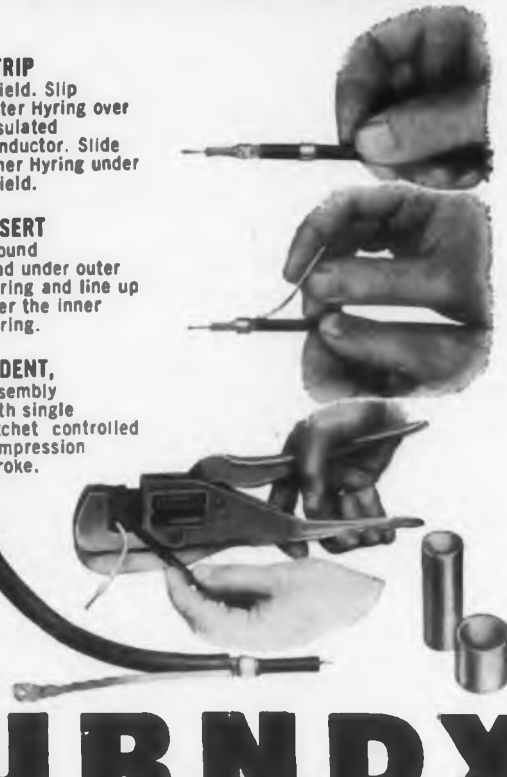
coaxial and shielded cable grounding completed in 90 seconds with

HYRINGS



STRIP
shield. Slip outer Hyring over insulated conductor. Slide inner Hyring under shield.

INSERT
ground lead under outer Hyring and line up over the inner Hyring.

INDENT,
assembly with single ratchet controlled compression stroke.

COMPLETED
assembly, with Burndy Hylug attached to free end of ground lead.

BURNDY

Norwalk, Connecticut · Toronto, Canada · Factories: New York, California, Toronto · Export Philips Export Company

CIRCLE 286 ON READER-SERVICE CARD FOR MORE INFORMATION

Insulating Material

Available in Sheet Forms

Micaramic is a new insulating material made from flake mica and a mineral binder. Possessing the properties of heat distortion at 1700 F, complete flame resistance and arc resistance with no carbon tracking, as well as excellent dielectric strength and workability, the material has been used in appliances, controls, and industrial heaters.

A wide range of other electrical insulation applications are considered, as the material is available in thin sheets (20 mils to 1/2″), and can be easily punched and shaped as well as extruded.

Spruce Pine Mica Co., Dept, ED, Spruce Pine, N.C.

CIRCLE 78 ON READER-SERVICE CARD FOR MORE INFORMATION

Random Generator

Speeds Generation of Random Numbers

Considerable time may be saved in obtaining truly random numbers by the utilization of the Stochastic generator. This machine eliminates the necessity of transcribing by hand from tables or drawing numbers from a bowl. The continuous generation of random numbers, 10 per second, is possible with this generator.

As an electronic computer accessory, the unit is able to feed in random numbers through a suitable converter. It is also capable of generating normal as well as rectilinear distributions.

Loyola Laboratories, Dept. ED, Box 45074, Airport Station, Los Angeles 45, Calif.

CIRCLE 79 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature Connectors

Lock Very Simply

Miniature push-pull connectors that connect and automatically lock by being pushed together, and disconnect merely by being pulled back, meet applicable MIL-C-5015 AN "E" requirements. Since they operate in the direction of plug travel, without twisting or lockwiring, they are well-suited for crowded installations, and as umbilical or breakaway units that can be remotely disconnected.

Deutsch Co., Dept. ED, Los Angeles, Calif.

CIRCLE 80 ON READER-SERVICE CARD FOR MORE INFORMATION

MILLIVAC

TYPE MV-22B

EXTENDED RANGE VIDEO VOLTMETER
20 cps to 10 megacycles, 300 uV full scale

CIRCLE 287 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW—UNBRAKO socket set screws with Nylok*

The Nylok self-locking feature locks these screws securely in place, *seated or not*. They won't workloose. Use them in holes tapped in soft materials or against hardened shafts. Can be used as self-locking adjusting screws. Can be used repeatedly. Tough, resilient nylon locking pellets permanently installed. Successfully resist temperatures ranging from —70 to 250° F. Deep, accurate hex sockets for positive, nonslip internal wrenching. Heat treated alloy steel, continuous grain flow, fully formed Class 3A threads for high strength and exact fit. All standard point types—including knurled cup point—available. Sizes #6 to 1 in. Also available in plated finishes and in stainless steel. Write for Bulletin 2193. Unbrako Socket Screw Division, STANDARD PRESSED STEEL Co., Jenkintown 12, Pa.

*TM Reg. U.S. Pat. Off., The Nylok Corporation

STANDARD PRESSED STEEL CO.

UNBRAKO SOCKET SCREW DIVISION

Unbrako Products are sold through Industrial Distributors

SPS
JENKINTOWN PENNSYLVANIA

CIRCLE 288 ON READER-SERVICE CARD FOR MORE INFORMATION

(Advertisement)

New Silver-plated Battery Clips Ideal for transistorized circuitry

New clips with new features! CTC's new silver-plated battery clips, type X2233 (1 cell) and X2234 (2 cell) are compact, easy to mount and are readily used in circuits, printed or otherwise.

The first of a family of CTC battery clips, these are made of phosphor bronze. The clips are designed to lock simply yet stand up and remain secure even under extremely rough handling. Featuring a positive, low resistance contact, the clips are uniquely designed and the silver plating resists corrosion even under battery leakage.

CTC's new clips take up a minimum chassis area and mount simply with only two rivets or eyelets. They are designed for use with one or two cell mercury batteries.

They may be the answer to *your* battery-securing problem. For complete specifications and data on price, write direct. Cambridge Thermionic Corporation, 457 Concord Ave., Cambridge 38, Mass.

CIRCLE 289 ON READER-SERVICE CARD FOR MORE INFORMATION

AGASTAT

Compact . . . Dust-Proof

TIME DELAY RELAYS

solenoid actuated—pneumatically timed

Introduces time delays into a-c or d-c circuits. Easily adjusted to provide delays ranging from 0.1 second to five or more minutes.

The AGASTAT is small, light, and operates in any position. Dust-proof timing chamber assures long operating life with a minimum of maintenance.

AGA DIVISION

Elastic Stop Nut Corporation of America

1027 Newark Avenue, Elizabeth, New Jersey

A15—924

CIRCLE 290 ON READER-SERVICE CARD FOR MORE INFORMATION

Analog Filters

For Audio and Sub-Sonics

First of a series of analog filters for sharp band-pass performance at audio and sub-sonic frequencies, the Model BP-160 features completely independent control of high and low frequency band limits, cut-off being at the rate of 160 db per octave in each case. This type of unit produces a voltage-frequency characteristic which is an exact analog of a multi-section passive LC filter. Since the analog is achieved without inductances, no conventional low frequency design limitations apply as in the case of passive filters.

While the complete series will include units suitable for a variety of frequency ranges, the initial version covers a band of 0.83-424 cps or fractions thereof, adjustable in steps of one-half octave. The frequency intervals are based on those adopted in the American Standard for Octave Band Filters, and any segment of the specified band may be selected consistent with this system of intervals. Filters are designed to fit a standard relay rack 19 in. wide.

Spectrum Instruments, Inc., Dept. ED, 44-05 30th Ave., Long Island City, N.Y.

CIRCLE 83 ON READER-SERVICE CARD FOR MORE INFORMATION

Torque Transducer

Operates Without Brushes and Slip Rings

This new variable permeance torque transducer operates without brushes and slip rings. It is designed for either static or dynamic torque measurement and features reduced length and increased sensitivity over earlier models.

Reproducibility of 0.1% and resolution of 0.02% permit one instrument to serve over a wide range of torque measurement scales. Various models are available for ambient temperatures from —145 F to 1200 F. Linearity of all models is 2%. Only corrosion resistant materials are used for all standard models.

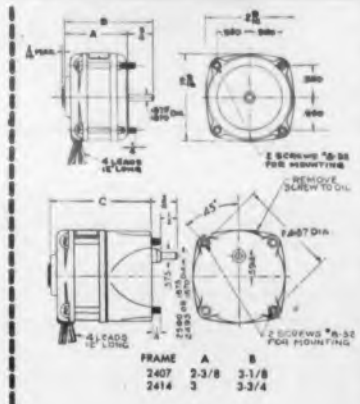
Crescent Engineering & Research Co., Dept, ED, 11632 McBean St., El Monte, Calif.

CIRCLE 84 ON READER-SERVICE CARD FOR MORE INFORMATION

For Servo Applications

HOWARD MODEL 2400

CAPACITOR OR 2 PHASE TYPE SERVO MOTOR



Dept. ED9
HOWARD INDUSTRIES, INC.
Racine, Wisconsin
Divisions: Electric Motor Corp.
Cyclohm Motor Corp.
Racine Electric Products

This four pole motor is designed for servo applications. Low inertia rotor provides quick response and high impedance stator windings can be matched to vacuum tube plate circuits. Center topped windings can be provided. As a 2 phase motor, the speed can be varied by varying the phase angle. Responds to a wide range of frequencies. Gear units are available with ratios from 2½ :1 to 3600:1. For complete data, write today.

CIRCLE 291 ON READER-SERVICE CARD FOR MORE INFORMATION

CLOSURES

- **Metal or Plastic Caps or Plugs to protect threads, tubes, machined parts, reamers, cutters, tools.**
- **Protect against thread damage, dust, dirt, and moisture.**
- **For inside and outside application. All sizes. Immediate delivery.**

Clover closures are made in metal and tough plastic polyethylene. They are made in caps, plugs and special shapes to fit parts tightly, offering completely sealed protection during manufacture, shipping and storage. Backed by years of closure experience. Write for low prices and complete information.

Send coupon today!

METAL
Threaded caps for AN & SAE external threaded parts.

PLASTIC
Tapered parts for use either as a cap or plug.

METAL
Threaded plugs for AN or SAE internal threaded parts.

PLASTIC
(L.T. Series)
Non-threaded push-on caps for tubing, AN & SAE Fittings, reamers, etc.

Gentlemen:
Please send samples and prices of closures in
Polyethylene ☐ Aluminum ☐
Name.....
Address.....
City.....

CLOVER INDUSTRIES, INC. 584 Young Street Tonawanda, N.Y.

CIRCLE 292 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC SYSTEMS SPECIALISTS

Here are some typical problems Sylvania engineers and physicists meet and solve at our Buffalo, N. Y. and Waltham, Mass. plants.

AT BUFFALO:

1. How do you design 10 similar microsecond timing circuits whose delay times can be varied over a range of 100 times by analog control voltage maintaining a tracking accuracy of ±0.1% in an environment of —65°C to +125°C at sea level to 100,000 feet?

2. If you know which bits of a code group are in error, can you modify the hamming code to use this data to provide maximum information capacity in a noisy channel?

3. Can you design a crystal mixer to operate with latest production type crystals and having a noise figure less than 12db above KTB operating in the "S"- band?

AT WALTHAM:

4. Under what conditions can signal fluctuations improve radar performance?

5. What are the limitations on allowable smoothing time for target tracking radars?

6. Under what conditions can random noise introduce systematic errors in radar measurements?

Continuing product diversification means long-range security and advancement... and both locations offer good housing and ample leisure-time activities, as well as unusual opportunities for advanced studies.

If you believe that you can assist us in the solving of these problems, please write:

WALTHAM LABORATORIES	BUFFALO LABORATORY
Erling Mostue 100 First Ave. Waltham, Mass.	E. F. Culverhouse 175 Great Arrow Ave. Buffalo 7, New York

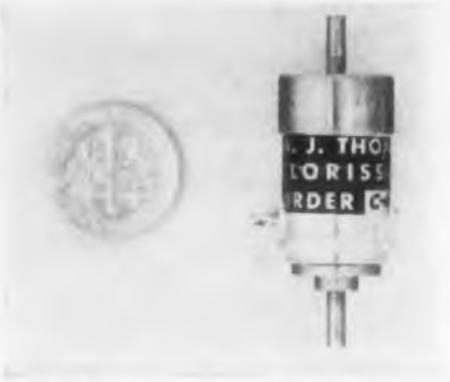
SYLVANIA

SYLVANIA ELECTRIC PRODUCTS INC

Your inquiries will be answered within 2 weeks.

Miniature Electromagnetic Clutches

Concentric Servo Mounting



A new line of miniature electro-magnetic clutches for electronic and instrument applications, couples that input hub to the output shaft when energized. Both the hub and output shaft are free when de-energized.

The servo mounted units are available with output shaft at either or both ends. Controlled torque output under vibration meets requirements of MIL-E-5272A. Units operate on dc voltage.

Performance specifications of the C-4 Model are 0.59 in. dia. by 0.93 in. long (excluding input and output shafts), weighs 0.8 oz and transmits transmits 4 in.-oz. of torque. The C-6 Model is 0.83 in dia. by 1.34 in. long (excluding shafts), weights 2.3 oz and transmits 16 in.-oz of torque. The C-10 Model is 1.37 in. dia. by 1.765 in. long and transmits 60 in.-oz of torque.

A. J. Thompson, Dept. ED, Route 1, Box 812, Florrisant, Mo.

CIRCLE 88 ON READER-SERVICE CARD FOR MORE INFORMATION

Coaxial Power Pad

Increases Powermeter Range

The Model 528 Coaxial Power Pad is rated 3 w. 34.8 db, dc to 600 Mc, and 50 ohm impedance. It has type "N" connectors. The unit is used to extend the 10mw frequency sensitivity range of commercial powermeters to 30 w.

Power sensitivity (change of attenuation) is less than 0.1 db/10 w. Max input vswr under full rated power is 1.20, and max output vswr under power is 1.10. Typical frequency sensitivity (change of attenuation with frequency) is 0.3 db. Calibration supplied is: insertion loss of low power—dc, 200, 300, 400, 500, and 600 Mc; insertion los sat 30 w input—dc, 400, 600 Mc.

No forced cooling is required. The unit is a 7-section tee-pad containing carefuly aged film resistors resulting in long-term stability.

Weinschel Engineering, Dept. ED, 10503 Metropolitan Ave., Kensington, Md.

CIRCLE 89 ON READER-SERVICE CARD FOR MORE INFORMATION

Magnetic Amplifier

For Instrumentation and Control

Ferrac amplifier, a ferromagnetic amplifier for analog computers, is a dc to dc amplifier powered directly from a 115 v, 400 cy line. Full linear output of ±7.5 v is obtained with ±300 μamp input. Bandwidth is at least 8 cy per each 1000 ohms in a control loop.

Two independent control windings enable the Ferrac amplifier to be used in summing and multiplying circuits. Lead and lag networks can be introduced as readily as with electronic amplifiers. Two signals can be mixed in a Ferrac amplifier even though they have no common ground. Complete analog computers, simulators, and automatic controls can be assembled using Ferrac amplifiers as basic building blocks.

Airpax Products Co., Dept. ED, Middle River, Baltimore 20, Md.

CIRCLE 93 ON READER-SERVICE CARD FOR MORE INFORMATION

Tape Recorder

Simplifies Editing and Cueing

The P-60-ACX "Editor" is a rack-mount tape recorder with advanced facilities for instantaneous editing and cueing. It is powered by three-motor direct drive with a two-speed hysteresis synchronous drive motor and operates instantly from pushbutton controls. For editing, the operator merely opens the head cover and moves the tape for marking or cutting. Cueing is accomplished by the single operation of grasping each reel and gliding the tape over the heads with the tape lifter knob in manual cueing position.

Separate erase, record, and playback heads are completely shielded to prevent crosstalk and hum, and make it easier to monitor directly from the tape while recording. A phono jack provides monitoring input to the record head or the playback output of tape while recording, and a 4-in. VU meter enables the user to read record, playback, and bias levels at a glance.

Magnecord, Inc., Dept. ED, 1101 S. Kilbourn Ave., Chicago, Ill.

CIRCLE 94 ON READER-SERVICE CARD FOR MORE INFORMATION

SUBMINIATURE TRIMMING POTENTIOMETERS FOR THE HOT SPOTS IN YOUR ASSEMBLIES

BOURNS *Model 160* TRIMPOT®

—new high temperature, high power design

This instrument operates reliably in high ambient temperatures, or wherever closely massed components generate localized hot spots. The TRIMPOT will withstand temperatures up to 175° C. (347° F.) with unimpaired efficiency. Lead wires are Teflon insulated. High power dissipation— 0.6 watt at 50° C. (122° F.)

You'll find every outstanding feature of the original Model 120 TRIMPOT—standard of the industry—built into the Model 160. 25-turn adjustments are made with a screwdriver on the slotted shaft. The shaft is self-locking, to provide stable settings. Resistance element is precision wound with low temperature-coefficient resistance wire. Unit withstands severe shock, vibration and acceleration. To assure its dependable performance under extreme environmental conditions, Bourns designed the Model 160 TRIMPOT to meet or exceed rigid government specifications.

Write for new descriptive literature.

BOURNS LABORATORIES

General Offices: 6135 Magnolia Avenue Riverside, California
Plants: Riverside, California—Ames, Iowa

CIRCLE 95 ON READER-SERVICE CARD FOR MORE INFORMATION

For the *right* pot, rely on DAYSTROM!

Model 300-00 is the tiniest, precision-built, wire-wound trimming potentiometer this side of "Lilliput." Despite its flyweight size, it easily handles **exacting** jobs throughout extreme temperature ranges.

For higher resistance ranges, the Model 303-00 fills the bill — using very little more space than the Model 300-00.

The **Potentiometer Division** of Daystrom Pacific Corporation is staffed with highly skilled engineers and technicians who dearly love to grit their teeth and come up with optimum solutions to all kinds of potentiometer problems.

So, rely on **DAYSTROM** for your right pot!

Some outstanding characteristics:

	Model 300-00	Model 303-00
Size	0.5" square by 0.187" thick	0.75" square by 0.28" thick
Weight	2 grams	7 grams
Resistance Ranges	10 ohms to 50K	5K to 125K

Write today for literature on these or any of the many other production or custom-made precision potentiometers available. Names of local representatives on request.

Openings exist for highly qualified engineers.

POTENTIOMETER DIVISION

Daystrom PACIFIC CORPORATION

11150 La Grange Ave. West Los Angeles 25, Calif.

A SUBSIDIARY OF DAYSTROM, INC.

CIRCLE 97 ON READER-SERVICE CARD FOR MORE INFORMATION

Analyzer

For Vector Measurements

This instrument can be used to measure vector sum or difference of two voltages; to measure phase angle between two voltages; and to measure imaginary voltage. It also can be used as a vtvm to measure voltage across two points which are both above ac ground potential. In conjunction with an oscillator, it may be used to measure magnitude and phase angle of an unknown impedance.

There are five phase angle ranges, 0-2, 0-4, 0-20, 0-60, and 0-180 deg. A panel switch is provided for inserting 180 deg phase shift. Accuracy is: binding post, ±1.5% either direct or through amplifier for voltage measurement; 0.05 deg or 1.5% (whichever is larger) for phase measurement. The probe is ±3% below 100 Mc and increases slowly up to 8% at 500 Mc for both voltage and phase measurements. Voltage ranges are 0.04, 0.4, 4, and 40 v rms for binding post input; 0.4, 2, and 4 v full scale for probe input. The stability is better than 0.1% for 10% variation of line voltages. The frequency range for binding post is 15 cps to 2 Mc without amplifier. The upper limit decreases to 200 kc with amplifier. The frequency range for probe is 100 kc to 500 Mc.

Advance Electronics Lab., Inc., Dept. ED, 451 Highland Ave., Passaic, N.J.

CIRCLE 98 ON READER-SERVICE CARD FOR MORE INFORMATION

"L" Band Slotted Line

Residual VSWR Less Than 1.05

Model SL-28 "L" band slotted line is a rugged and stable instrument for the accurate measurement of the magnitude and phase of VSWR in standard "L" band waveguides at frequencies from 1120 Mc to 1700 Mc.

This unit, for use with any standard probe, provides a residual VSWR of less than 1.05 with probe in position and has negligible slope and leakage. A rugged waterproof transit case is available for storage and transportation.

Vectron, Inc., Dept. ED, 1583 Trapelo Rd., Waltham 54, Mass.

CIRCLE 99 ON READER-SERVICE CARD FOR MORE INFORMATION

Porous Tubing

In Several Degrees of Porosity

Known as "Poro-Tube" this laminated fiberglass-epoxy tubing is produced to result in controlled porosity of the tubing wall. Several degrees of porosity are achieved through variations of fiberglass weave, epoxy formula, and impregnation process. It has high temperature resistance (up to 350 F) and is available in a wide range of diameters (down to 0.062 in. ID). Wall thicknesses are available down to 0.005 in., and there is a choice of round, square, oval, and triangular cross-sections. Standard lengths are up to 9 ft, with greater lengths upon request. Weight is 0.03 lb/cu in. The material is impervious to most gases, fuels, oils, and chemicals, and it is easily machined without unraveling or shredding.

The characteristics of "Poro-Tube" make it a valuable material for: high temperature, Class H motor housings, replacing metal; internal spacers in electrolytic capacitors (allows current flow); reusable filters where corrosion resistance is critical; low cost, reinforced forms for potting and impregnating coils, resistors, and terminal boards; and for many other uses.

Lamtex Industries, Inc., Dept. ED, 51 State St., Westbury, L.I., N.Y.

CIRCLE 103 ON READER-SERVICE CARD FOR MORE INFORMATION

Tube Sockets

Permit 90 Deg Installation

These sockets permit installation of tubes in a position parallel to the printed circuit chassis, thus conserving space where height is limited. Brackets are designed to maintain rigidity and cannot be loosened from the chassis. A low center of gravity offers greater resistance to vibration and shock. All electrical and mechanical characteristics are in accordance with military specifications.

Both 9-pin and 7-pin sockets are available, with or without shield base. (Illustrated is the 9-pin type without and with shield base, and in rear view.) All sockets are rated 660 v 1 amp, with a withstanding voltage (see level) of 2000 v rms.

Elco Corp., Dept. ED, Philadelphia 24, Pa.

CIRCLE 104 ON READER-SERVICE CARD FOR MORE INFORMATION

Westmold and Westseal types resist moisture and heat

NEW WESTMOLD TRANSFORMERS— offer exclusive dimensional fidelity, flame resistance and greatest resistance to moisture penetration ever available in an open-type transformer (where MIL-T-27 grades 2 and 5 are required). This new type is molded in a plastic material which maintains its flexibility at extreme temperatures. Will withstand shock of being heated to 130°C, then plunged into −55°C alcohol-dry-ice. Ten of these cycles are passed without cracking, complying with Type C thermal shock test, MIL-C-16923. Dimensional fidelity is assured as the shape of the transformer is fixed by the mold in which it is poured.

NEW WESTSEAL TRANSFORMERS— Small, lightweight power transformers and filter chokes have been developed for radar, airborne electronics and other applications demanding good resistance to humidity and high temperatures (where MIL-T-27 grades 2 and 5 are required). They are impregnated with a newly developed solventless silicone resin and sealed with an impervious coating of silicone rubber.

The compound is firmly bonded to the transformers and to the terminals, eliminating any "wick" action. Coils are completely filled, free of voids. Result —corona-free operation in the 5000-volt range.

For further details, circle the proper number on the Reader-Service Card, see your Westinghouse Sales Engineer or write to Westinghouse Electric Corporation, Specialty Transformer Division, P. O. Box 231, Greenville, Pa. J-70772

WESTMOLD

WESTSEAL

WATCH WESTINGHOUSE!

COVER THE PRESIDENTIAL CAMPAIGN ON CBS TV AND RADIO!

CIRCLE 105 ON READER-SERVICE CARD FOR MORE INFORMATION

Spherical Orientation Connectors

Self-Aligning

A new spherical orientation (rack and panel) electrical connector, which will self-align and mate in blind connections, has three integral keys and keyslots. Compression springs make the self-aligning possible without match plates or guidance pins.

The connector, available in 19- and 37- contact models, meets applicable MIL-C-5015 AN "E" requirements. Quick-disconnecting, positive locking, moisture sealing, as well as vibration, corrosion and pressure resisting, they are operative from -67 to 250 F, have continuous dielectric separation and a visually inspected lock that automatically seals before locking. No wet process is necessary, but the connectors can be potted if required. Combed construction provides wire separation and support.

The Deutsch Co., Dept. ED, 7000 Avalon Blvd., Los Angeles 3, Calif.

CIRCLE 108 ON READER-SERVICE CARD FOR MORE INFORMATION

Vacuum Gage

Has High Readability

This vacuum gage, a single meter type with a range of 0-100 microns Hg full scale, has a 4 in. indicating meter with knife edge pointer for direct reading on a logarithmic mirror meter scale. Half scale on the dial face is 15 microns, providing high readability for low micron measurements. The instrument is highly accurate throughout the entire range.

The instrument operates on 115-v ac and includes an internal voltage regulator to eliminate any effects from line voltage variations. The basic circuit is the same proven type as employed in other vacuum and pressure measuring instruments made by this firm.

Hastings Instrument Co., Inc., Dept. ED, Hampton, Va.

CIRCLE 109 ON READER-SERVICE CARD FOR MORE INFORMATION

Socket Screws, Bolts

Have Self-Locking Nylon Insert

This firm has added the Nylok self-locking insert as an optional feature to its precision socket head screws and aircraft bolts. The Nylok process makes use of the resilient properties of nylon to provide self-locking action on threaded fasteners which might otherwise loosen under severe vibration.

A nylon pellet is inserted in a hole drilled part way through the threaded portion of the bolt. When the bolt is installed in a tapped hole or a standard nut, the exposed portion of the nylon pellet is compressed between the mating threads. In an attempt to regain its original shape, the nylon forces the threads together under pressure. This pressure increases the friction between the metal surfaces, thus resisting the tendency of the bolt to loosen in service in vibrating machinery, vehicles, and appliances.

The nylon retains its resilience in the temperature range from —70 to +300 F, even through repeated uses.

The Standard Pressed Steel Co., Dept. ED, Jenkintown, Pa.

CIRCLE 111 ON READER-SERVICE CARD FOR MORE INFORMATION

Capacitors

Highly Stable Metal Tubulars

Built for use in various types of military computers and other electronic devices, these metal tubular polystyrene capacitors are offered from 0.001-1 mfd, and voltage range is 100-1600-v dc. Both inserted tab and extended foil constructions are available, as well as various circuit styles and bracket arrangements in accordance with MIL-C-25A. The units also can be supplied with a vinyl sleeving. A principal advantage is that all of the elements of polystyrene as a dielectric are provided in the small sizes of CP-04 through CP-11 case styles of MIL-C-25A.

Dielectric absorption is 0.05%, and insulation resistance at 25 C is 1×10^{12} ohms. Power factor at 1 kc is a maximum of 0.05%. Stability is to 0.1% per cycle. Temperature range is —55 to +85 C, with a coefficient of —100 parts per million per C.

Condenser Products Co., Dept. ED, 140 Hamilton St., New Haven, Conn.

CIRCLE 112 ON READER-SERVICE CARD FOR MORE INFORMATION

Linear Bearing

Adjustable Diameter

Adjustable diameter ball bushings are linear motion bearings, split longitudinally to provide line-to-line or slight preload fits when mounted in an adjustable diameter housing.

Free-running, no-play linear motion enables the tolerance on both the shaft diameter and bearing bore to be adjusted out simply and practically. In addition, the principle provides for compensation for wear that might eventually develop in severe applications.

The bearings are used in a housing that is merely split and provided with an adjusting screw.

Adjustable Diameter Ball Bushings are available in standard sizes for shaft diameters ranging from one inch to four inches.

Thomson Industries, Inc., Dept. ED, Manhasset, N.Y.

CIRCLE 116 ON READER-SERVICE CARD FOR MORE INFORMATION

Stepping Relay

Has High Stepping Speed

This stepping relay, Type 7500/12, is characterized by long life and high stepping speed. It consists of a 12-point arc assembly, rotor assembly, and driving motor. Made by I. T. & T. System Co., Bell Telephone Manufacturing Co., Belgium, it has a stepping speed of 80 steps/sec with stepping pulses of a 50/50 make-break ratio.

An impulse type driving motor is used in the standard unit with a 48-v dc 244-ohm coil. Driving motors can also be supplied for 24-v, 110-v, and 120-v dc, or 110-v ac. The driving motor is fitted with a self-interrupter contact for driving the motor from a continuously applied voltage. An interrupter cam is fitted to stop the motor when the rotor is in the normal position.

The terminals of the relay are arranged so that the connection can either be soldered on or plugged into the relay tags. The relay can be mounted on a mounting plate or on a rectangular mounting bar. It has a life in excess of 10,000,000 revolutions. Overall size is 4-3/4 x 1-1/16 in., with a projection in front of the mounting plate of 3-1/8 in.

International Standard Trading Corp., Dept. ED, 22 Thames St., New York 6, N.Y.

CIRCLE 117 ON READER-SERVICE CARD FOR MORE INFORMATION

New Aircraft Controls Catalog Just Off Press

New Fenwal Publication Gives Data on Accessory Controls for Aircraft, Guided Missiles and Ground Control Apparatus

LATEST AUTHORITATIVE DATA on accessory controls comes from Fenwal, originators of famous THERMOSWITCH® unit and pioneers in many advanced ideas in aircraft, guided missiles and ground apparatus. Copies without charge.

Here is new reference data everyone interested in aviation accessory equipment will want to have within reach.

It describes Fenwal Midget and Miniature THERMOSWITCH® units — logical answers to "tight-spot" temperature control problems. Gives general and specific data for standard and special applications according to government and or customer specifications.

If your problems include temperature control of liquids, solids or gases in any area, the information in this catalog should be valuable to you. Write for FREE catalog, "Accessory Controls", Aviation Products Division, Fenwal Incorporated, 99 Pleasant Street, Ashland, Massachusetts.

CIRCLE 118 ON READER-SERVICE CARD FOR MORE INFORMATION

A-D Converter

Eight-Bit Sine-Cosine Unit

The Eight-Bit Sine-Cosine Analog-to-Digital Converter consists, basically, of two disk-type commutators with pick-off brushes. The double-brush V-scan system is used to avoid ambiguity. The input shaft is scaled at 360 deg per revolution full-scale input. No intermediate gearing is necessary.

Coding is in continuous serial binary form in increments of 2-8 for values of the functions from zero to 1. A 9th bit is included to enable the encoding of the value one. The instrument is coded such that each quadrant is divided into 257 parts, each part representing equal values of the functions. Both sine and cosine values are simultaneously available.

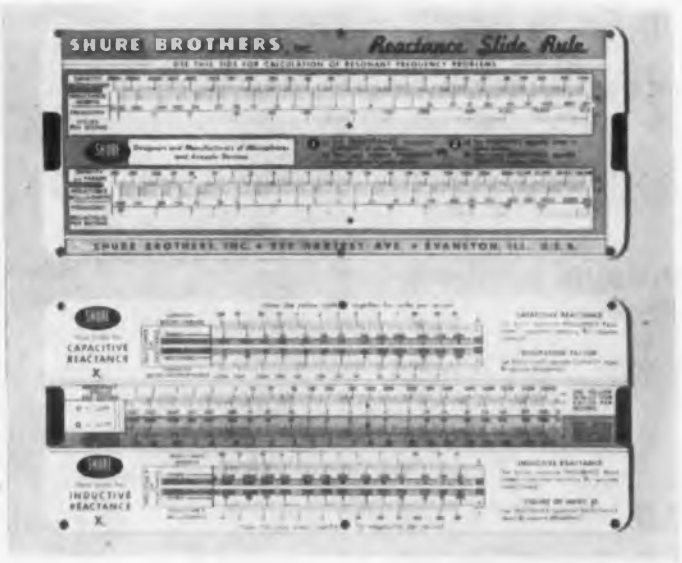
The converter is compactly packaged in a cylindrical housing approximately 4 in. diam x 3-1/2 in. long, including the stationary portion of an electrical connector. A standard synchro-mount is provided on the input shaft end of the unit. Weight is approximately 20 oz.

Librascope, Inc., Dept. ED, Glendale 1, Calif.

CIRCLE 123 ON READER-SERVICE CARD FOR MORE INFORMATION

Reactance Slide Rule

For Engineers



Reactance Slide Rule is again available. The slide rule is a time-saving means for simplifying calculations of resonant frequency range from 5 cycles per second to 10,000 megacycles.

Shure Brothers Inc., Dept. ED, 222 Hartrey Ave., Evanston, Ill.

CIRCLE 124 ON READER-SERVICE CARD FOR MORE INFORMATION

New Masking Tape
Has High Strength

Hi-Strength pressure sensitive flat-back masking tape, Permacel 728, has a 4 mil rope paper backing in an off-white color. The backing has been especially treated to give the tape high tear resistance coupled with thinness and high tensile strength. Recommended for the new tape are heavy-duty packaging applications.

In addition to adhesion to steel of 50 oz/in. of width, Permacel 728 has extremely high adhesive value to a wide variety of surfaces, making it suitable as a holding tape with job permanence.

Permacel Tape Corp., Dept. ED, New Brunswick, N. J.

CIRCLE 128 ON READER-SERVICE CARD

Printed Circuit Kit
Speeds Circuit Layout

A complete kit for accurate and simplified production of engineering or prototype models of printed circuit parts has been developed, so that an etched electrical circuit, ready for assembly, may be had in about 30 minutes. A newly developed drawing pen is used to draw the pattern.

The kit, self-enclosed in its etching tray and cover, consists of the drawing pen and etchant resist ink, 4 bottles of etching powder, a drawing guide, 10 copper laminated Bakelite sheets (5 with copper laminate on two sides), 10 most popular tube sockets and detailed instructions for use.

Photocircuits Corp., Dept. ED, Glen Cove, N. Y.

CIRCLE 129 ON READER-SERVICE CARD

Trimmer Piston Capacitor
1 μμf to 10 μμf

A new precision trimmer piston capacitor, the VC11A, features a fused quartz dielectric with an invar tuning slug. The low dissipation factor remains constant, even with an ambient temperature rise of 100 C.

JFD Mfg. Co., Dept. ED, 6101 Sixteenth Ave., Brooklyn 4, N. Y.

CIRCLE 130 ON READER-SERVICE CARD

◀ CIRCLE 127 ON READER-SERVICE CARD

Receiving Tubes
New Renewal Line

Thirteen tube types, including six designed for color television receivers, have been added to Sylvania's renewal line of receiving tubes.

Besides six special types for color television, the additions also include three series string types, three other television receiver types, and a miniature cathode type full-wave rectifier for special equipment use.

The type numbers are: 3A2, 3A3, 5V3, 6BJ8, 6BK4, 6CL5, 5CL8, 5CM8, 6BH8, 6BS8, 6CL8, 6CU5 and 6BW4.

Sylvania Electric Products Co., Dept. ED, 1740 Broadway, N. Y. 19, N. Y.

CIRCLE 131 ON READER-SERVICE CARD

Solar Grade Silicon
For Solar Energy Use

Suitable for use in solar converters, a special grade of silicon known as "Solar cell" grade, is available for $180 a pound.

While it must be exceptionally pure, the new grade of silicon used in so-called "solar batteries" does not require the extreme purity of semi-conductor silicon.

E. I. DuPont De Nemours and Co., Inc., Wilmington 98, Del.

CIRCLE 132 ON READER-SERVICE CARD

Silicone Rubber Compounds
Use Standard Molds

Three advanced silicone rubber compounds, particularly suitable for producing O-rings, comply fully to AN, MS, SAE, JIC and NAS dimensions and tolerances. They may also be used for fabrication of many other silicone rubber parts. These compounds, supplied in durometer hardness of 60, 70, and 80 and useful over a −80 F to +500 F temperature range, have the shrinkage properties of organic rubbers.

The compounds are non-toxic, making them suitable for food, ice cream and beverage processing applications, and they have zero moisture absorption, even when completely submerged in boiling water.

Goshen Rubber Co., Dept. ED, Goshen, Ind.

CIRCLE 133 ON READER-SERVICE CARD

CIRCLE 134 ON READER-SERVICE CARD ➤

Colored Printed Circuits

Using Ball Point Pen

Liquid resist, in ball point dispensing tubes, for printed circuits withstands even nitric acid used in the etching operation.

The resist comes in several colors, making it possible to color code the printed circuitry to aid in checking out prototype units. Since it is a nonconductor, it can be left on as a permanent protective coating to the copper circuit against corrosion and dirt. The process is low in cost.

Techniques, Dept. ED, 178-84 Central Ave., Hackensack, N. J.

CIRCLE 136 ON READER-SERVICE CARD

Polyester Glass Mat Laminates

Have High Impact Strength

Polyester resin glass mat laminates, having properties similar to reinforced plastics, have good dimensional stability, high impact strength, and above average arc resistance.

Their chemical resistance makes them useful materials in areas of high humidity and chemical fumes of an acid nature.

National Vulcanized Fibre Co., Dept. ED, 1056 Beech St., Wilmington 99, Del.

CIRCLE 137 ON READER-SERVICE CARD

New Phenolic Laminate

Low Cold Flow

A new electrical grade laminate, Phenolite E-2040, is a paper-base sheet laminate bonded with a special phenolic resin. In addition to its cold flow properties, the new grade features low moisture absorption, good dielectric strength (both perpendicular and parallel to the laminations), and ease of hot punching and shearing.

Grade E-2040 is available in sheets up to 39x47 in. and thicknesses from 0.010 to 1/4 in. Color is natural with dull finish.

National Vulcanized Fibre Co., Dept. ED, 1056 Beech St., Wilmington 99, Del.

CIRCLE 138 ON READER-SERVICE CARD

◄ CIRCLE 135 ON READER-SERVICE CARD

Sealed Trimming Potentiometer

For Extreme Environmental Conditions

A sealed trimming potentiometer, subminiature in size, offers dependable performance under extreme environmental conditions. Designated the Trimpot Model 230, this unit is designed to meet or exceed military humidity specifications (MIL-E-5272A).

The potentiometer is furnished with wire wound or carbon resistance element. The wire wound 230 Trimpot will operate at 135°C and dissipate 0.4w at 50°C. It is screwdriver adjusted over 25 turns, with a self-locking shaft for stable settings. Ruggedly constructed, it will withstand severe conditions of shock, vibration, acceleration, sand and dust.

Bourns Laboratories, Dept. ED, 6135 Magnolia Ave., Riverside, Calif.

CIRCLE 140 ON READER-SERVICE CARD FOR MORE INFORMATION

Binding Posts

For Instrument Applications

Series No. 29 Binding Posts, quality units for fine instrument applications, are equipped with non-turn "D" washers and banana plug receptacles. They are available in red or black phenolic.

Model No. 29-1 shown at right) has a trim design with an OD of only 1/2 in. and is for 3/8-in. mounting holes on 3/4-in. centers. Model No. 29-3 has a 5/8" OD and is available for 1/2 in. mounting holes in existing equipment or for wider spacing. It is shown at left.

Metal parts are brass, cadmium plated 0.0003-0.0005 in. thick to withstand 50-hr minimum salt spray exposure. Thermosetting phenolic parts are of MIL-P-14, Type CFG; this material will withstand approximately 295 F without distortion. Back-of-panel studs provide for both screw and solder connections.

Grayhill, Dept. ED, 561 Hillgrove Ave., La Grange, Ill.

CIRCLE 141 ON READER-SERVICE CARD FOR MORE INFORMATION

Crosley Engineers ARE PUTTING THE EYES AND EARS IN SPACE!

Do you fit into this Engineering drama?

The daring approach . . . probing the dark recesses of the unknown. CROSLEY Electronics Engineers are taking the calculated risks which offer great discoveries as the triumphant reward.

Research and development in Communications and Radar now offer exciting possibilities. Here are areas now being explored.

- Radar—all phases
- Control Systems
- Digital Techniques
- Airborne Navigational Equipments
- Transmitters and Receivers
- Audio Circuitry
- Amplifiers
- Transistor Circuit Design

High calibre Engineers are needed to enter into these unusual programs. All benefits are available plus modern facilities. Relocation costs plus a 15 day subsistence allowance are paid by CROSLEY.

Please Send A Written Resume To:
D. B. Nason
Vice President and Director of Engineering
Dept. No. T-9

Crosley DIVISION
AVCO MANUFACTURING CORPORATION

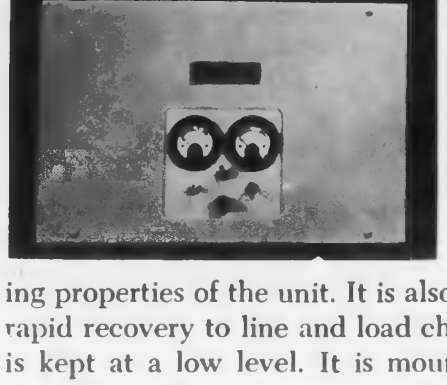
2630 Glendale-Milford Road, Evendale, Cincinnati 15, Ohio

"Known for the NEWEST—Respected for the BEST!"

CIRCLE 142 ON READER-SERVICE CARD FOR MORE INFORMATION

DC Power Supply

Regulated to ±0.2%



The Model 910 "Reactrol" Power Supply provides an output voltage adjustable over a limited range without affecting the regulating properties of the unit. It is also characterized by rapid recovery to line and load changes, and ripple is kept at a low level. It is mounted in a cabinet complete with meters and ready for operation. A rack-mounted version is also available.

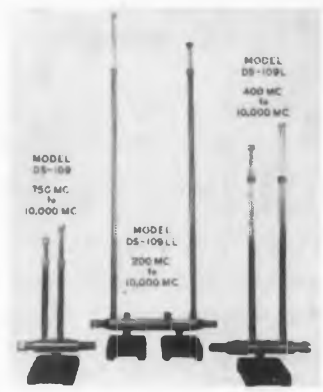
Output voltage is 28 v dc, variable ± 10% of the nominal value with rated accuracy and down to –20% with lesser accuracy. Regulation is ± 0.2% for line voltage variations from 100 v to 130 v and for load changes from 10% to 100% of maximum load rating. For no load, regulation will decrease to approximately ± 0.5%. Output current is 10 amp. Ripple voltage is 0.25% at 60 cps. Input frequency is 60 cps ± 5%. Ambient range is –20 to +35 C. Size of the cabinet unit is 14 x 21-3/4 x 15-1/4 in. deep.

Deltron, Inc., Dept. ED, P. O. Box 192, Glenside, Pa.

CIRCLE 145 ON READER-SERVICE CARD FOR MORE INFORMATION

Double Stub Tuners

Cover 200-10,000 Mc Range



Three tuners offered by this firm cover the frequency range of 200-10,000 Mc. Their sliding contacts are placed outside of the high current region and permit smooth, low-noise adjustments. Each sliding contact is machined from a solid phosphor bronze rod. Collet locks have been added to each stub, permitting quick locking of the tuning position; the relative position of the two stubs is readily adjustable to either of three positions.

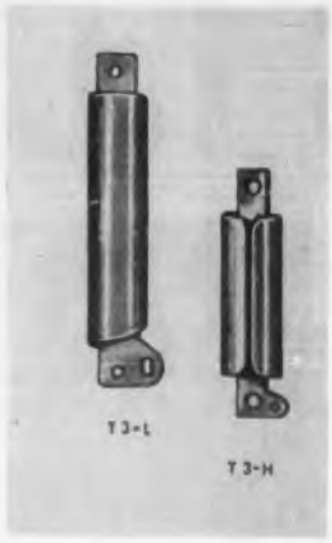
The tuners can be used to match loads such as bolometer mounts; match rf sources for maximum power transfer; make direct measurements in a 70 ohm system using a 50 ohm slotted line, matching a 70 ohm load to 50 ohms; to provide a dc return; and to suppress 2nd harmonics.

Weinschel Engineering, Dept. ED, 10503 Metropolitan Ave., Kensington, Md.

CIRCLE 146 ON READER-SERVICE CARD FOR MORE INFORMATION

Shield Mounts

Two Phosphor Bronze Units



Two new Sheildmounts have been announced by this firm. The T-3H is designed for heavy-duty use and when higher periods of vibrations are encountered. It is made of 0.015 in. thick phosphor bronze.

The T-3L is designed for use with T-3 bulb size tubes 1-3/4 in. long. The greater surface contact area provides a higher degree of clamping and more surface contact area provides a higher degree of clamping and more surface area for additional heat dissipation. It is made of 0.008 in. phosphor bronze. Both units can be provided in plain, silver-plated, or black finish.

Nems-Clarke, Inc., Dept. ED, 919 Jesup-Blair Drive, Silver Spring, Md.

CIRCLE 152 ON READER-SERVICE CARD FOR MORE INFORMATION

Indicator Light

For Transistor Circuits

A miniature indicator light for use with transistor flip-flop circuits, this unit incorporates a biasing-limiting resistor network within its 3/8 in. diam case. The bias voltage is adjusted to a point at which the transistor can gain control to switch the light on and off. The neon lamp is pre-aged and selected for a specified operating voltage range. The unit is used in computers and other transistor switching circuits. It may also be used in conventional vacuum tube circuits where the control signal swings over a narrow voltage range.

Overall length is 2-1/2 in., and full advantage is taken of the extremely small diameter body through the use of slotted mounting nuts of 1/2 in. diam. Extra wrenching space around the unit is not needed. as when using hex nuts. The aluminum case can be provided with a flat to prevent turning in the panel. Lenses are available in clear, red, and amber plastic.

Eldema Corp., Dept. ED, 9844 Remer St., El Monte, Calif.

CIRCLE 153 ON READER-SERVICE CARD FOR MORE INFORMATION

SIGNER'S

G-E switchboard and panel instruments save you space, enable easy readability

Clear, uniform illumination of the scale is the result of General Electric's new shadow-proof covers in its line of long-scale switchboard instruments. This new design eliminates scale shadows caused by overhead lighting and enables you to read the instruments clearly regardless of the angle of illumination. Sturdy construction, good readability, and high degree of accuracy coupled with small size are features of G.E.'s line of miniature panel instruments. Panel instruments are particularly useful in radio equipment and industrial installations where space is at a premium. For complete information on these and other G-E instruments, write for Bulletins GEC-1016B, GEC-218, GEC-336.

Amplidyne† provides fast, precise electrical control

In continuous process manufacturing applications and in Ward Leonard systems, the General Electric Amplidyne provides the accuracy of performance necessary in complex electronic control systems. It will help your machine control system provide required adjustment of speed, current, voltage, or position.

Unique use of a short circuit and compensating winding in the General Electric Amplidyne creates such precise electrical balance that the smallest electrical signals release kilowatts of output capable of controlling the most powerful machinery. The amplidyne has found its greatest use in feedback control systems.

Wherever an electric signal can express the need for a change in process or operation the amplidyne can serve you. When applied on tracer control, the amplidyne's instant response cuts seconds off each pass, increases productivity.

In operations where positive control of several factors such as tension and speed in paper, printing, and textile machines, the rugged amplidyne is ideal. For further information write for Bulletin GEA-4053B.

† *The Amplidyne—rotating amplifier developed by General Electric—the heart of this and many other systems requiring the maximum in reliability and precision.*

ELECTRIC

CE CARD FOR MORE INFORMATION

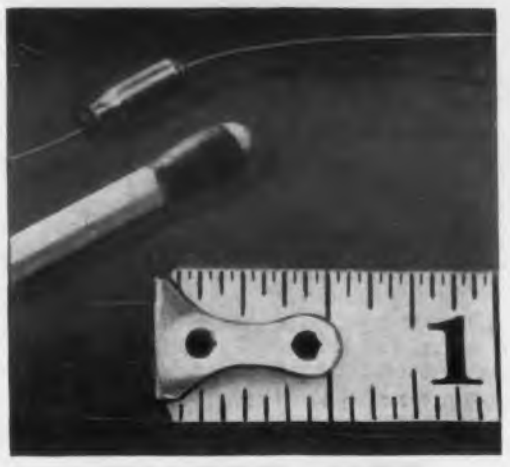
DIGEST

GENERAL ELECTRIC COMPONENTS
FOR ELECTRONIC MANUFACTURERS

Specify Tantalytic* Capacitors to meet critical size and temperature requirements

85 C TANTALYTIC CAPACITOR

125 C TANTALYTIC CAPACITOR



MICRO-MINIATURE CAPACITOR

Small size, wide temperature range, and high reliability are features of General Electric's three separate lines of tantalum electrolytic capacitors. Designed for applications ranging from transistorized electronic equipment to guided missile electronic systems, Tantalytic capacitors can help solve your most critical design problems.

Their high quality assures longer, more dependable operation at a real savings in circuit space. High temperature General Electric capacitors in rectangular and tubular forms meet the varying requirements of modern electronic design. Available in polar or non-polar types for a-c and d-c circuits, Tantalytic capacitors operate at full rated voltage. Write for Bulletin GED-2620.

*Reg. Trade-mark of General Electric Co.

Actuator-Switchettes simplify electrical switch problems

When your application calls for a switching mechanism where space is limited and long life is required, specifiy General Electric's line of precision, snap-action switchettes.

General Electric switchettes can be used anywhere an electrical switch is needed, in any position, and in temperatures of −70 to 200 F. They not only resist corrosion and vibration, but are small, lightweight, consistently accurate, and extremely reliable.

Small size and light weight are shown below in the Size 1 Switchette which is approximately 1¼ inch by ½ inch by ½ inch and weighs only 9 grams. This compact design makes it ideal in such applications as machine tools, portable power tools, and in other machines and components where special circuit arrangements are necessary.

In addition to those units pictured, the collar-mounted limit switch is ideal for panel and door applications. These units are rugged and highly dependable, even in such severe operations as automatic reverse-action machine tools.

The snap-action, double-break construction gives the standard switchette a high current rating of 10 amperes at 115 or 230 volts a-c. Designed in a wide variety of contact arrangements, they are equipped to handle a 115-volt, ½-hp motor.

Whatever your electrical switch needs are, G-E switchettes will help you solve your most difficult actuator-plus-switch problems.

For further information write for Bulletins GEC-796A, 949A.

BASIC TERMINAL ARRANGEMENTS are available with any actuator for immediate shipment. Whatever your requirements are, General Electric can provide the right terminal arrangement.

LEAF-ACTION AND ROLLER TYPES simplify electrical switch problems. Leaf type operates under low force, small movement. Roller types are for fast-moving cams.

Versatile General Electric photoelectric relays assure inexpensive, dependable operation

High sensitivity and high speed for a wide variety of applications are possible with General Electric's complete line of photoelectric relays. Seven standard combinations of relay and accessories meet many applications such as counting, controlling, and signalling operations.

Responding to light changes as small as ½ foot-candle, these high-speed relays are capable of up to 600 operations per minute. In most cases, the high contact rating eliminates the need for an auxiliary relay. The magnetic relay can operate a motor, motor starter, indicating lights, solenoids, electric counters, or similar devices.

Installation and adjustment are accomplished easily, and only a screwdriver is required to set the relay to operate at different levels.

To select the model best suited to your individual requirements, write for Bulletins GEA-5920A, 5921, and 3533D.

GENERAL ELECTRIC COMPANY, APPARATUS SALES DIVISION, SECTION B 667-34
SCHENECTADY 5, NEW YORK.

Please send me the following bulletins:

√ for reference only × for planning an immediate project

☐	GEA-5920A	Photoelectric Relays	☐	GEA-5935	Vac-u-Sel Rectifiers
☐	GEA-5921	Photoelectric Relays	☐	GED-2620	Capacitors
☐	GEA-3533D	Photoelectric Relays	☐	GEC-796A	Switchettes
☐	GEC-1016B	Catalogue of Measuring Equipment	☐	GEC-949A	Collar-Mounted Switchettes
☐	GEA-6273	Vac-u-Sel Rectifiers	☐	GEA-4053B	The Amplidyne
☐	GEC-218	Long-scale Switchboard Instruments	☐	GEC-336	Panel Instruments

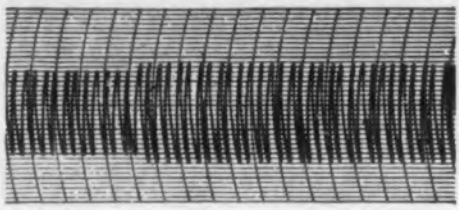
NAME.....

COMPANY.....

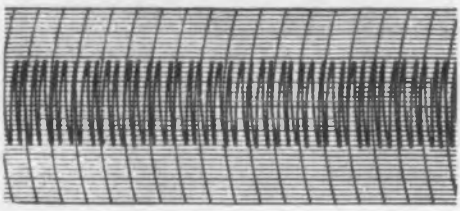
CITY.....STATE.....

CIRCLE 156 ON READER-SERVICE CARD FOR MORE INFORMATION

Regulation in *less than 1/50th cycle* . . .



Output of typical electromechanical regulator in response to step change in input voltage. Average correction rate of 6v. per sec.



Output of Curtiss-Wright Distortion Eliminating Voltage Regulator from same input. Full recovery in 330 microsec.

Simultaneous two-pen recording of 60 c.p.s. voltage

PLUS Pure Sine Wave Power

CURTISS-WRIGHT LINE REGULATOR

- **Electronically regulates r.m.s. and peak voltage simultaneously to ±1%.**
- **Reduces typical power line distortion to less than 0.3%.**
- **Furnishes 1.4 KVA of distortion-free power.**
- **Introduces no phase shift between input and output.**
- **Simultaneously provides additional 4 KVA of ±1% electromechanically regulated power.**

Faster recovery time (less than 1/50th cycle, or 330 microseconds) plus the unique ability to *eliminate* line distortion — these are the reasons why the Curtiss-Wright Distortion Eliminating Voltage Regulator has been chosen by more and more laboratories and production test departments. Besides general laboratory use, this line regulator provides simpler, more accurate calibration of meters . . . better design of transformers, synchros, motors . . . easier testing of such components, with fewer rejects . . . easier, more accurate measurement of magnetic properties and receiver sensitivity . . . better a.c. computer performance . . . elimination of fast line transient effects. Write for details.

Electronic Component &
Instrument Sales Department

ELECTRONICS DIVISION
CURTISS-WRIGHT
CORPORATION · CARLSTADT, N. J.

CIRCLE 157 ON READER-SERVICE CARD FOR MORE INFORMATION

New Literature

Drafting Template 158

A new drafting template of standard self-locking anchor nuts is now available covering standard anchor nuts conforming to AN362 and AN366, in addition to single-lug, corner-type, and floating anchor nut styles. Guides for drawing recessed head screws in plan and profile views are included.
Kaynar Co., Kaylock Div., 820 E. 16th St., Los Angeles 21, Calif.

Detector Cells 159

Brochure No. TB 1300-1 has been offered describing thermistor bolometers as effective detectors of infrared radiation in the spectral region from 1 to 12 microns or more. These fast, sensitive, rugged, and long lived units are designed for use in heat detection, measurement of control systems where direct contact with the source is inadvisable or impossible. The brochure provides information on the basic nature and construction of thermistor bolometers, static characteristics, dynamic characteristics, noise, level, infrared transmitting windows, and circuit design consideration are described and amply illustrated.
Servo Corp. of America, 20-20 Jericho Turnpike, New Hyde Park, N. Y.

Bearing Chart 160

A chart has been published showing the complete chemical, mechanical, and work characteristics of a wide range of sintered bearing materials. The proper material for sintered bronze or iron bearings has always been a major problem to design engineers. The chart is easily read so that the best material for most applications can be selected by a draftsman in a matter of minutes.
Bound Brook Oil-Less Bearing Co., Bound Brook, N. J.

Warning Signal 161

Bulletin No. 623 has been published giving information on the "Gyralite" flashing warning signal for accident prevention and other purposes. The signal maintains a maximum warning effect and lower maintenance cost and is mounted in a heavy cast aluminum housing. It flashes 96 times a minute in red, clear, and colored light. It is recommended for open manholes, emergency vehicles. The Type 15360 "Gyralite" is available for a wide range of voltages.
Pyle-National Co., 1334 N. Kostner Ave., Chicago 51, Ill.

Facilities and Operations 162

A brochure has been issued that provides a picture of present day modern plant operation. Included in this well-illustrated pamphlet are the people and machines at work. The plant manufactures a wide range of heat and moisture resistant wires and cables. In addition, insulations are made of asbestos, varnished cambric, nylon, glass, Teflon, Kel-F, polyvinyl, polyethylene and silicon rubber.
Continental Wire Corp., Wallingford, Conn.

Tabulation 163

A brochure No. R-8812 has been published describing a simplified method for typewriter tabulation. Adapted from the book Typing Simplified, this brochure outlines five simple steps for obtaining perfectly centered tabulation without complicated arithmetical calculations. Using the company's typewriter with a perfect positioning scale with zero center, the process is simpler, with two of the five steps eliminated.
Remington Rand, Div. of Sperry Rand Corp., 315 Fourth Ave., New York 10, N. Y.

Potentiometers 168

A data sheet has been offered specifying the many variations of the linear travel potentiometer. The unit is designed to meet requirements of MIL-E-5272, and is currently undergoing tests to determine maximum limits of the various sections of the specification which it will successfully pass. It is satisfactory over a temperature range of —55 C to 140 C, which is the range specified for current production. It is anticipated that this range will be extended contingent to tests being run now. In addition the booklet includes rotary models that were designed and produced to particular customer specifications. One unit was for a drone auto-pilot application wherein the rotating shaft was required to withstand a 40 lb side load, and sealing against immersion was also specified.

Minco Engineering & Mfg., 801 8th St., S.E., Minneapolis 14, Minn.

Scintillation Detector 169

A data sheet has been offered describing the Model DS-3A scintillation well counter, an efficient detector for the measurement of gamma emitting radioactive samples. Some of the features covered in this booklet are a large sodium iodide "well" crystal which accommodates a test tube or centrifuge tube containing the radioactive sample. The counting geometry provided by the "well" permits rapid measurements and enables the user to obtain maximum statistical accuracy with minimum amounts of radioactivity. The counter has found wide application in medical applications. It serves as a sensitive unit for measurement of gamma ray emitting isotope in liquid or solid form.

Nuclear Instrument & Chemical Corp., 229 W. Erie St., Chicago 10, Ill.

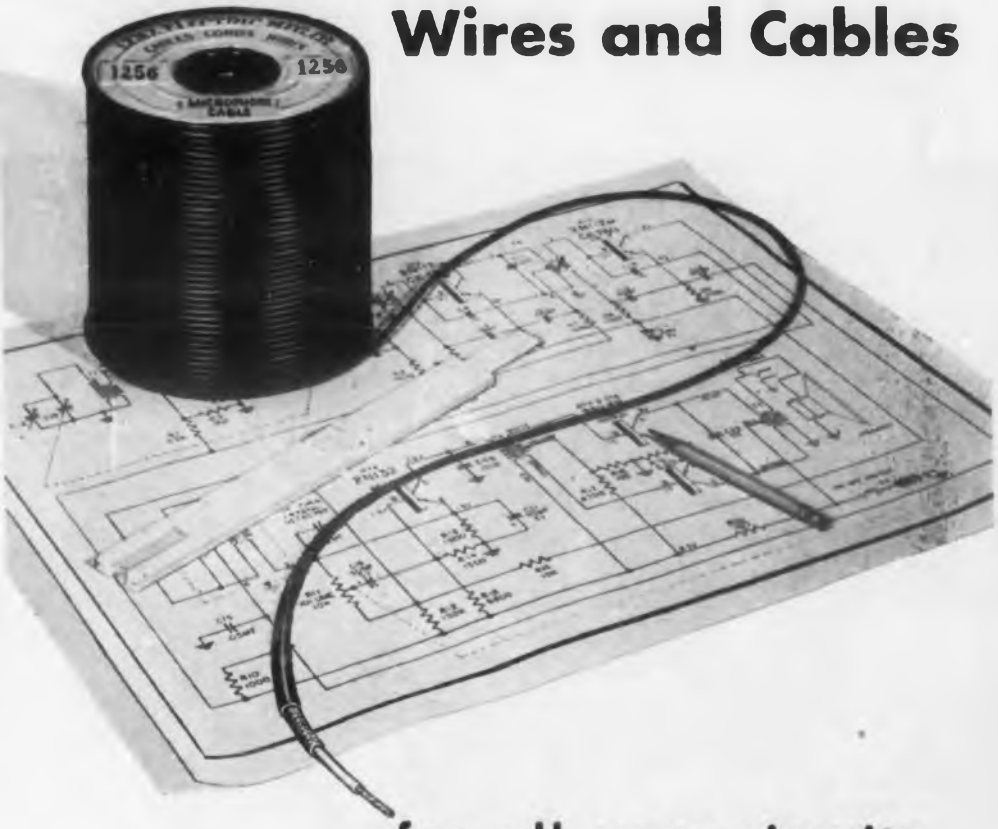
Rectangular Shaped Motors 170

A 2-color catalog has been released describing the company's new line of rectangular shaped motors. The motors, which are available with a 12 v capacity and outputs up to 115 oz in., feature a special pole pattern which makes possible a flux path that is axial with the armature shaft, rather than concentric with the shaft as in conventional motors. All-welded construction, extra large bearings, welded heavy stampings which resist twisting, flexible instalaltion, are some of the motors' principal features. Applications include window regulators, seat adjusters, air conditions, windshield wipers, defrosters, heaters and many others. The illustrated catalog contains detailed specifications, operating information, and representative performance data.

Leese-Neville Co., 1374 E. 51st St., Cleveland 3, Ohio.

LENZ

Wires and Cables



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Since 1904, Lenz has been producing the wires and cables needed for communications equipment. When the Electronic Industry was born, and ever since, Lenz has devoted the major part of its engineering resources and manufacturing facilities to the production of the specialized and standard wires and cables required by Radio, TV and Electronic end use equipment and associated component parts. This long experience and the technical background Lenz has acquired in this field has proved extremely helpful to many of the leading producers of electronic equipment.

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- **Microphone Cable**
- **Low Capacity Co-axial Cable**
- **PA and Inter-Com Cables**
- **Telephone Wires and Cables**

*Circuit Courtesy Raytheon Mfg. Co.

LENZ CABLES and WIRES

LENZ ELECTRIC MANUFACTURING CO.

1753 North Western Avenue Chicago 47, Illinois

CIRCLE 171 ON READER-SERVICE CARD FOR MORE INFORMATION

Flexible Shafts 178

Bulletin 570 recently issued illustrates typical installations using flexible shafting. It furnishes complete information on all sizes of shafting, from 1/8″ to 1-5/8″ in diameter, for either power drive or remote control applications. Rugged power drive shafts, with built-in bearings, are also illustrated. Standard fittings and ferrules available for these connections are shown in the bulletin.
Stow Mfg. Co., 79 Shear St. Binghamton, N. Y.

Parts for Heavy Wear 179

A brochure describing the supergray vulcanized fibre and thermosetting plastic has recently been issued. The supergray is of exceptional hardness and density combined with resilience.

The thermosetting plastic is used where dimensional stability, as well as wearing quality, may be required under severe operating conditions. Both materials are light in weight, highly resistant to corrosion and quiet operation.
Spaulding Fibre Co., Tonawanda, N. Y.

Transducers 180

A 4-page bulletin has been issued describing a new series of proximity transducer systems. The bulletin describes a standard and high sensitivity system. Both systems are capable of sensing operations in excess of 1000 per sec and are used with electronic counters, recording devices, batch counters, oscilloscopes, and dc volt meters. They are designed to operate under conditions of oil, moisture, vibration, and a wide variety of temperatures.
Electro Products Laboratories, 4500 N. Ravenswood Ave., Chicago 40, Ill.

Stroboscope 181

Catalog Sheet No. 18A-1 is a combined descriptive and instruction sheet on the Model 18A, and inexpensive 60-cycle stroboscope. It includes a table showing the revolutions per minute corresponding to different numbers of marks on the stroboscope disk when the stroboscope is operated on a standard 60-cycle power source.
Berkshire Labs., 578 Bank Village, Greenville, N. H.

◀ CIRCLE 177 ON READER-SERVICE CARD

Plastic Containers 188

A pamphlet has been released entitled "Plastics Weldor and Fabricator." The illustrated pamphlet describes various types of plastic, their advantages and applications. Of particular interest is a chart which covers the relative chemical resistance of several container materials. One article in particular illustrates and describes the company's newly introduced polyethylene pillows which are used to retard evaporation in open tanks and vessels as much as 70%. Also included are tips on the hot gas method of gas welding.
American Agile Corp., P.O. Box 168, Bedford, Ohio.

Load Cycle Counter 189

A pamphlet has been issued describing a telemetering load cycle counter that will accurately count only work or operations actually performed. It differentiates between idling, dry run and load cycle and counts only the load cycle. The unit is adaptable for accurate proximity or impact counting. It can also be used as a warning and/or counting instrument for material change of characteristics, dull tools, etc. Included in the pamphlet are specifications describing the load cycle counter which eliminates the inaccuracies of mechanical "no load" counts and the necessity for physical counting. The mechanism is sealed in a dust-proof, tamper-proof and locked box. Available with resetable 6-digit counter—speed up to 1000 counts per minute—power consumption 25 w—no heavy wiring required. Sensing and telemetering uses low voltage —long life components—cabinet 14-gage—supplied standard, JIC or NEMA 12-8″ x 10″ x 4-1/2″.
Ram Meter Inc., 1100 Hilton Rd., Ferndale, Detroit 20, Mich.

Tubing 190

A pamphlet, Data Memorandum No. 4, has been published describing tubing in sizes with outer diameters from 5/8 to 2-1/2 in. and with wall thicknesses of 0.035 in. and less. The large diameter thin-wall tubing is produced in seamless and Weldrawn grades for application to a wide variety of products. The data memorandum gives useful information on bending, beading, flaring and welding the thin-wall tubing. A table on standard production limits lists sizes and wall thickness for more than 20 analyses in which this type of tubing is produced. Types include stainless, nickel and nickel alloy, carbon and alloy, berylium, copper, and titanium. Other tables give the standard tolerances for size, ovality, straightness, and length.
Superior Tube Co., 1521 Germantown Ave. Norristown, Pa.

UNION

SPACESAVER "Selenium Slim" Rectifiers

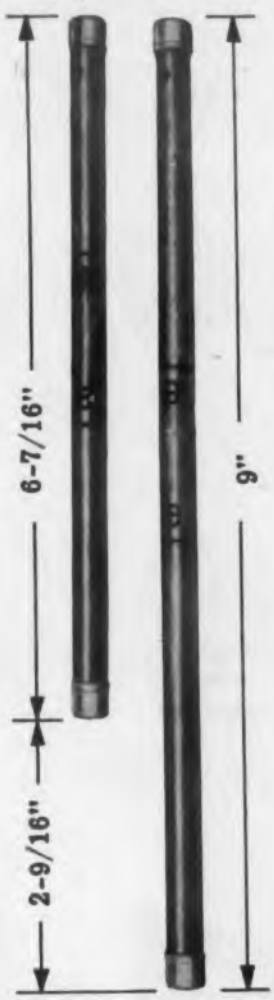
A COMPLETE line of UNION "Selenium Slim" Rectifiers is now made with a new cell which has a reverse voltage rating of 33 volts rms and is approximately 20% thinner than the previous cell.

These Spacesaver rectifiers offer more compact, efficient rectifier units and permit rigid space and performance requirements to be met. What's more, UNION's radically different manufacturing method for these miniature cells results in lower prices.

UNION Selenium Tubular Rectifiers, especially developed for high-voltage, low-current applications, are available in physical cell sizes from ⅛ to ½ inch in diameter and are rated 1.25, 2.5, 5, 10 and 20 milliamperes, D. C. per cell, in a half-wave circuit supplying a capacitive load. They are made for fuse-clip type mounting or with axial end leads. Available in both phenolic or heremetically sealed glass tubes.

A new, 33-volt, UNION selenium power rectifier cell is also available. Cells range in physical size from 1" x 1" to 5" x 6" and are designed for stud, bolt or bracket mounting. Ratings range from .180 to 10.0 amperes per cell on a single-phase, full-wave bridge basis in accordance with the latest NEMA approved specifications.

Write for complete information.



New Spacesaver "Selenium Slim" Rectifier using 33-volt cells is 2 9/16" shorter than regular 9" rectifier using the original 26-volt cells. Voltage and current ratings are the same.

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PITTSBURGH 18, PENNSYLVANIA

CIRCLE 191 ON READER-SERVICE CARD FOR MORE INFORMATION

Performance through Precision

AIR MARINE MOTORS . . . leading manufacturers of high specification rotating equipment . . . is your outstanding source for fans, motors and blowers to meet most sub-fractional power requirements.

Adaptability through Variety

A15BD-8

115 Volt 60 cycle double blower. 46 CFM at .28" static pressure.

B20B-7

115 Volt 60 cycle (or 400 cycle) blower. 50 CFM at 1.5" static pressure.

A15AD3

115 Volt 60 cycle axial blower. 35 CFM at .2" static pressure.

60-1

115 Volt 60 cycle blower. 100 CFM at 2.5" water gauge.

60-6

115 Volt (or 220 Volt) 60 cycle blower, 1 or 3 phase. 250 CFM at 2.5" water gauge.

A11A-4 115 Volt 400 cycle single phase propeller type blower using 4" 4-blade fan. Delivers 250 CFM at 0" static pressure.

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Air Marine Motors equipment features stainless steel thru-bolts . . . die-cast aluminum housings . . . riveted stators . . . positive bearing alignment . . . uniform air gap . . . ball bearings . . . shock and vibration resistance . . . humidity and fungus resistance . . . omni-position mountings . . . temperature lubrication.

Write for specific information and brochure about any of these units . . . and use the Air Marine advisory services without obligation.

AIR MARINE MOTORS, INC.

air-marine motors, inc.

369 Bayview Avenue • Amityville, N. Y.

West Coast Factory 2055 Pontius Avenue • Los Angeles 25, Calif.

CIRCLE 197 ON READER-SERVICE CARD FOR MORE INFORMATION

Transformers 198

A 24-page catalog with new design format and readable type face has been released describing transformers. Selection is simplified through a cross index of part numbers and by type of application. The catalog lists transformers for TV, radio, communication, industrial, and other electronic applications. A separate section discusses TV replacement transformers. It includes a quick preference listing of exact replacement flybacks arranged by original manufacturer and original part number. All the transformers are listed with detailed specifications, dimensions, and illustrated mounting styles.

Chicago Standard Transformer Corp., 3501 W. Addison St., Chicago 18, Ill.

Instruments 199

This 4-page brochure recently issued describes airmeters, vacuum gages, manometer-flowmeters, and electronic standard cells. Illustrated are various models with specifications. Included also are other instruments of interest.

Hastings-Raydist, Inc., Newcomb Ave., Hampton, Va.

Relays 200

A 4-page catalog sheet, R-29, has been published giving complete information on relay models—DOS, DOSY, DO and CRU, which are available in 65 different types. Models DO and DOS fill many industrial needs for a compact, lightweight relay that handles power loads usually requiring much larger, heavier units. Electrical and physical characteristics for the various units are given.

Ohmite Mfg. Co., 3637 Howard St., Skokie, Ill.

Silver Plating Process 201

An 8-page brochure has been offered describing the company's Silvrex Bright silver plating process. The booklet covers in detail such vital topics as bath make-up and maintenance; anodes, tanks, temperature; current densities; agitation; plating procedure; and simplified removal of solution impurities. The process gives a mirror bright finish directly from the bath through a complete range from flash to extra heavy deposits, and produces hard, and highly ductile deposits.

Sel-Rex Precious Metals, Inc., 229 Main St., Belleville, N. J.

207

A catalog No. P-2b has been published describing types PW-5, PW-7 and PW-10 resistors. Three high temperature resistors, rated at 5 w, 7 w, and 10 w, are the latest additions to the company's expanding line of power resistors. The resistors have a high degree of automatic assembly and offer practical possibilities of cost savings. The maximum temperature coefficient is between −55 C and +110 C. Comprehensive data on construction, design, applications, ranges, ratings, tolerance, identification, dimensions, and charts and graphs.
International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.

Resistor Engineering Guide 208

A data sheet is now available on resistors and special products. Data includes JAN or MIL equivalent, rated wattage, standard tolerances, temperature rise, temperature coefficient, maximum operating temperature, ohmic values available, dimensions, and appropriate prices.
International Resistance Co., 401 N. Broad St., Philadelphia, Pa.

Shaft-position Encoder 209

A bulletin has been published describing Type 309-13 shaft-position encoder. The unit is a precision photoelectric analog to digital converter for direct readings of shaft positions to an accuracy of one part in 8192. It is used in mechanical testing, missile guidance, radar, optical tracking and other applications in which the angular position of a rotating shaft expressed as digital information is required. The bulletin describes and illustrates the principle of operation, and gives full specifications as to accuracy, readout rate, size and mounting. Also described are other shaft-position encoders with non-linear readouts and accuracies up to one part in 65,536.
Electronics Corp. of America, Dept. 500, 77 Broadway, Cambridge 42, Mass.

Glassware 210

Two data sheets have been released in a continuing series on laboratory glassware. Featured in the first data sheet is a logical "two-way" test formula designed to facilitate laboratory glassware purchases. Data Sheet No. 2 features centrifuge tubes.
Doerr Glass Co., Vineland, N. J.

CIRCLE 212 ON READER-SERVICE CARD FOR MORE INFORMATION

ENGINEERS: ARE YOU QUALIFIED?

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Radio Corporation of America
Camden 2, New Jersey

RCA SERVICE CO., INC.

Copper-Base Alloys 218

A 36-page booklet has been issued giving complete descriptions of the refractory copper-base alloys. Included in this booklet are specification information and applications for phosphor, bronze, nickel silver, beryllium copper, and cupro nickel. In addition the book contains weight tables for sheet, strip, rod, and wire; gage and decimal equivalents; definitions of trade terms; and a discussion of temper. The many industrial applications which are included make this booklet of interest to design engineers and metallurgists.

H. K. Porter Co., Riverside Metal Div., Riverside, N. J.

Telesync 219

A data sheet describing the Type TS-1 telesync equipment has been issued describing the requirements for a high quality unit for generating RETMA sync signals when used in conjunction with a high fidelity TV receiver. Also included are descriptions, block diagrams, and specifications.

Nems Clarke, Inc., 919 Jesup-Blair Dr., Silver Spring, Md.

Regulator 22

A 4-page brochure has been publish describing the NUMAR Model C-1 ma netic field control system, a precision reg lator for the stabilization and control electromagnetic fields. The C-1 system designed to be an electromagnet contr for mass spectrometers either singly or tandem, high-energy particle accelerator cyclotrons, beta-ray spectrometers, micr wave spectroscopy magnets, and other la oratory instruments utilizing magnet fields. The brochure describes the oper tion of the C-1 and lists its specifications.

Nuclear Magnetics Corp., 154 Boylston S Boston, Mass.

Opportunities 22

A brochure has been issued describin current opportunities in the fields of phy ics, electrical engineering, mathematics an psychology. Doctors and graduate eng neers interested in the possibility of wor ing on classified projects may secure copy of the bulletin by writing to the ad dress below.

M.I.T. Lincoln Laboratory, Box 24, Lexing ton, Mass.

Plastics 227

A complete catalog and price list has been issued describing plexiglas, cadco, acetate, nylon, teflon, styrene, vinylite, polyethylene, kel-f, fiberglass, and phenolic. This catalog has a thumb index and is broken into categories of sheets, rods, tubes, etc. for convenience. Included also is a table of properties.
Cadillac Plastic Co., 2111 Olive St., St. Louis, Mo.

Potting Shells 228

A data sheet has been published illustrating various shapes and sizes of potting shells. Potting electrical connectors provides complete protection of solder cups and wires by means of a sealing compound applied in a molded plastic potting shell when the connectors are wired. It seals the connector against moisture and prevents cable strain under extreme vibration and periodic connect and disconnect of plug and receptacle. The sheet contains specifications and dimensions.
DeJUR-Amsco Corp., Electronic Sales Div., 45-01 Northern Blvd., Long Island City 1, N. Y.

Thermostats 229

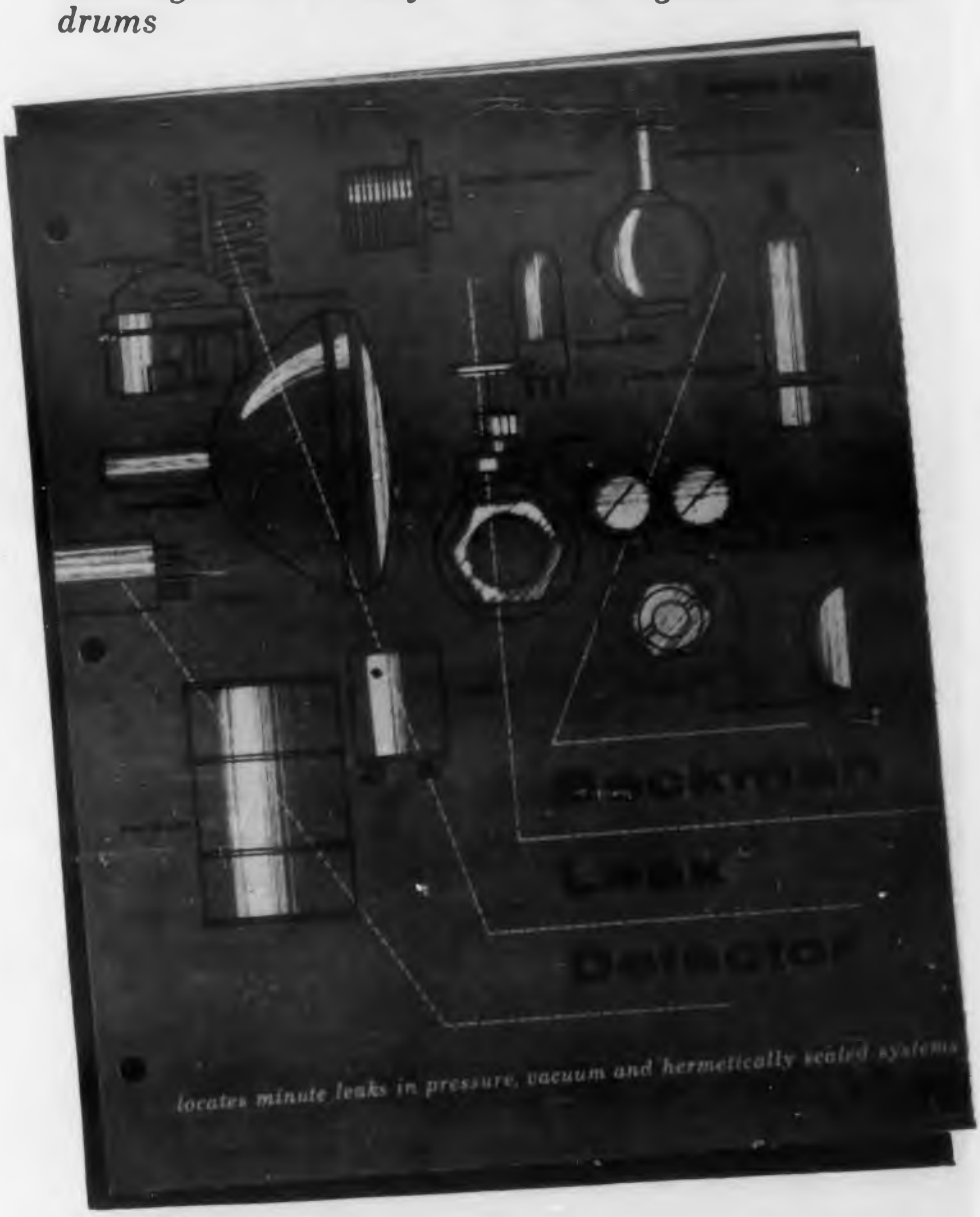
A 4-page, 2-color catalog has been prepared for miniaturized thermostats and surface mounted thermostats. It describes the physical, electrical and performance data required for specifying types of Thermoswitch controls. In addition to engineering and performance specifications, catalog MC-124A presents a useful summary of design and installation factors.
Fenwal Inc., Ashland, Mass.

Stationary Batteries 230

A catalog has been published describing improvements in stationary batteries which are expected to extend the service life up to 10 per cent and reduce maintenance requirements. The catalog describes flat plate batteries which are intended for use in the electric utility field, signaling, telephone service, emergency lighting, and other industrial operations. A recently developed battery grid alloy, Silvium, has a high resistance to corrosion and ability to withstand overcharging, increases efficiency, and lengthens service life of the battery.
Electric Storage Battery Co., Exide Industrial Div., Dept. TC, Box 8109, Philadelphia 1, Pa.

your guide to INSTANT LEAK DETECTION

compressors · hermetic connectors · vacuum containers · coil assemblies · vacuum tubes · hermetic terminals · picture tubes · valves · oscillators · pressure regulators · relays · current regulators · steel drums



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Because of its compactness, sensitivity, instant response and simplicity of operation the Beckman Leak Detector is an ideal quality control instrument for your production line. It will insure the shelf life of "sealed" units, detect leaky components before complete assemblies are made, test the porosity of materials, eliminate production rejects, and meet military leakage specifications.

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Scientific Instruments Division, Beckman Instruments, Inc., Fullerton, California

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Even under extreme conditions of temperature and abrasion, Metal-Cals remain bright and easy to read for years. Metal-Cal, the original aluminum foil applique, is made of .003 inch aluminum, backed with an amazing adhesive requiring no screws, pins, rivets or heat for normal application.

And the eye appeal of Metal-Cal's shiny or matte aluminum finish plus a choice of deep, rich colors . . . anodized, dyed and etched right into the metal, is a real sales tool in itself.

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Pat. Pending

CIRCLE 237 ON READER-SERVICE CARD FOR MORE INFORMATION

Patents

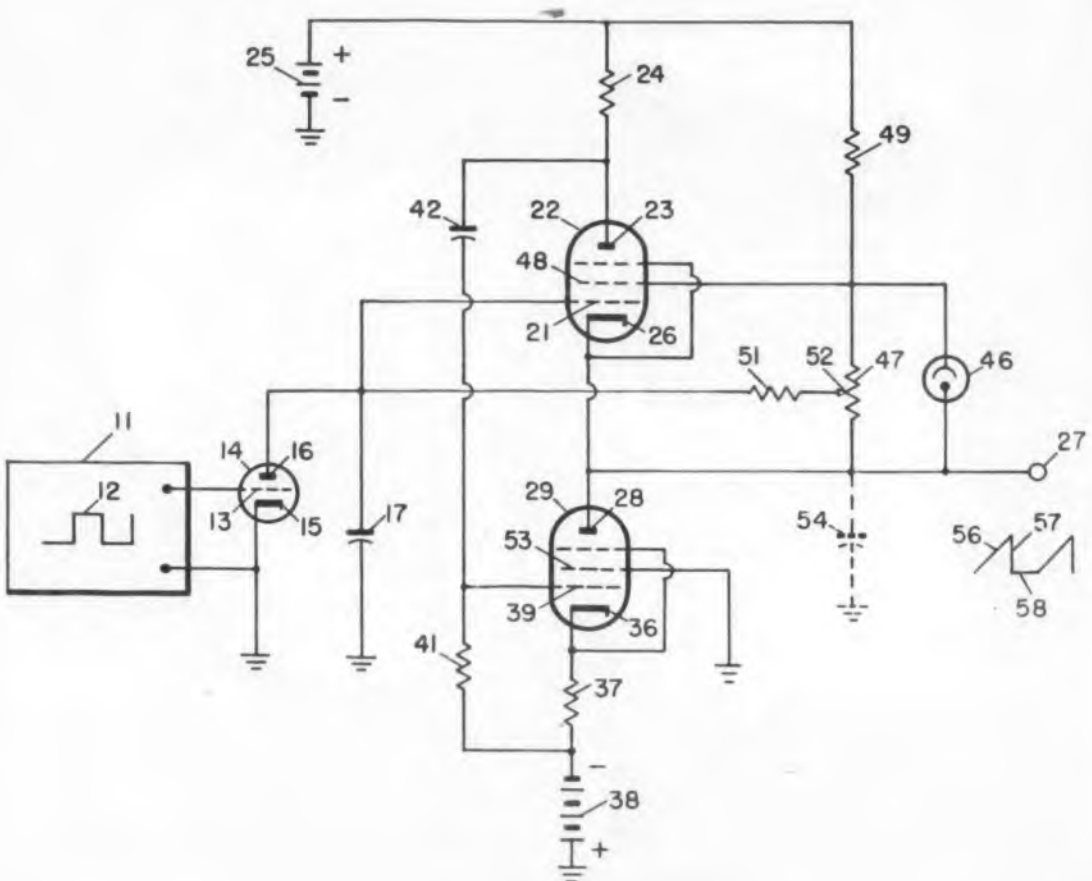
Sweep Circuit

Patent No. 2,748,271. R. F. Casey. (Assigned to Allen B. duMont Laboratories, Inc., Clifton, N. J.)

Sawtooth wave generators at high frequencies have stray capacitance which lowers the impedance to these higher frequencies. Such devices usually employ a pentode tube as a constant current device and because of the reduced impedance caused by the stray capacitance, the tube will not operate at a constant current. This causes variations in the output signals for different frequencies.

The circuit shown in the figure compensates for the effect of stray capacitance *54* so that a substantially constant current passes through a cathode follower tube *22*, shown particularly as a pentode. Changing frequencies, therefore, do not effect the constant current through the tube. The circuit uses a charging condenser *17* which is charged from the dc source *25* through resistors *49*, *47* and *51*. The condenser is periodically discharged through a tube *14* under the control of a pulse source *11*. The cathode follower tube *22* has its anode connected to the power source *25* through a resistor *24*. A load tube *29* is in series with the cathode *26* of the tube *22*.

If the current flow through the cathode follower tube *22* should increase because of stray capacitance *54*, the potential on the anode *23* will drop. With the anode of tube *22* coupled through a capacitor *43* to the control grid of the load tube *29*, this potential variation is applied to the grid of tube *29*. The current through the load tube is reduced thereby, maintaining the current constant through the cathode follower tube so that it operates at the desired current. With this circuit, the sawtooth generator can be used at much higher frequencies than is customary in such circuits. The adjustment is accomplished automatically.



Electrical Resistance Elements

Patent No. 2,734,978. D. Bulgin. (Assigned to Dunlop Tire and Rubber Corp.)

Electrical resistance elements are commonly used in structures which are sensitive to strain in the forming of so-called strain gages. In such gages bending or elongation of the resistance element changes its resistance sufficiently so that a volt meter reading will provide an indication of the strain exerted. Metal resistance elements change their electrical resistance by about 2% for a maximum of 1% strain, and their range is limited. It has been proposed to make the resistance element of rubber which is rendered electrically conducting by inclusion of carbon black. Such resistance elements have shown variation in resistance due to changes in temperature and strain.

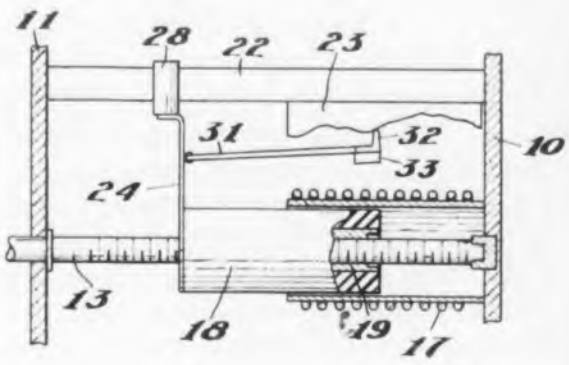
The patent discloses a resistance element which is made up of sponge rubber of the cellular type in which the internal cells are interconnected. The rubber is impregnated with conductive material such as pulverulent graphite or a metal. The impregnation of the sponge rubber with the conducting material may be accomplished in several ways. With such a resistance element an elongation of less than 4% results in a resistance increase of 10% or more. The relationship is logarithmic. For an elongation of about 150%, the increase in resistance will be in the neighborhood of a million times. Such a resistance element for use in a strain gage provides a substantial improvement in the gage.

Semiconductor Devices

Patent No. 2,734,154. J. I. Pankove. (Assigned to Radio Corp. of America)

A transistor uses emitter and collector electrodes in contact with the semiconductor. These electrodes are fine wires in order to secure a small area of contact with the surface of the semiconductor. With electrodes of about one mil in diameter, it is difficult to avoid distorting them when pressure is applied. Also, the dissipation of heat from such small wires presents difficulties. The patent describes a transistor which does not use wires for these electrodes.

The improved transistor mounts the semiconductor in a capsule having a flange for engaging the semiconductor to form a base electrode. The surface or surfaces of the semiconductor and capsule are then coated with an insulating material. The coating is perforated for a point contact, or scratched with a line for line contact, with the crystal. The capsule is then filled with a conducting material, such as mercury, which provides an electrode for the semiconductor. If both electrodes are to be a fluid conductor, then the semiconductor may be centrally located in the capsule providing a chamber on each side for the conducting fluid and electrode. A transistor so constructed avoids the difficulties enumerated.



Inductance Corrector

Patent No. 2,731,608. L. V. Mifflin. (Assigned to Collins Radio Co., Cedar Rapids, Iowa)

Tunable inductances are provided with a core *18* which is adjustable longitudinally within the winding in order to vary the tuning of the inductance. To secure the desired variable control, it has been common practice to use a variable pitch for the winding of the coil, or to use a lead screw *13* with a variable pitch. These methods many times do not provide the precise variation desired and also make production manufacture difficult.

In the variable inductance means shown in the figure, a magnetic mass *33* is attached to an arm *31* so that it is movable with the core *18*. The mass is located exterior of and adjacent to the winding. A cam *23* is provided adjacent to the mass so that when the core is adjusted, the mass is moved towards and away from the winding in any desired pattern depending upon the form of the cam. This mass varies the external reluctance path for the inductance means and hence the inductance. With this construction the screw and winding of the inductance may be made standard thereby effecting manufacturing economies. It is a simple matter to vary the contour of the cam *23* to secure the precise correction desired in inductance.

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Grounded Grid U-H-F Amplifier with Gain Control and Constant Input Impedance

Patent No. 2,739,189. Winfield Rudolph Koch. (Assigned to Radio Corp. of America.)

An amplifier circuit employing two grounded grid triodes with the input applied to both cathodes. The first tube has a gain control bias applied to the grid and delivers an output at the anode. The second tube does not produce any useful output but serves to maintain an essentially constant input impedance regardless of the gain control bias on the first tube.

Pulse-Operated Timing Circuit

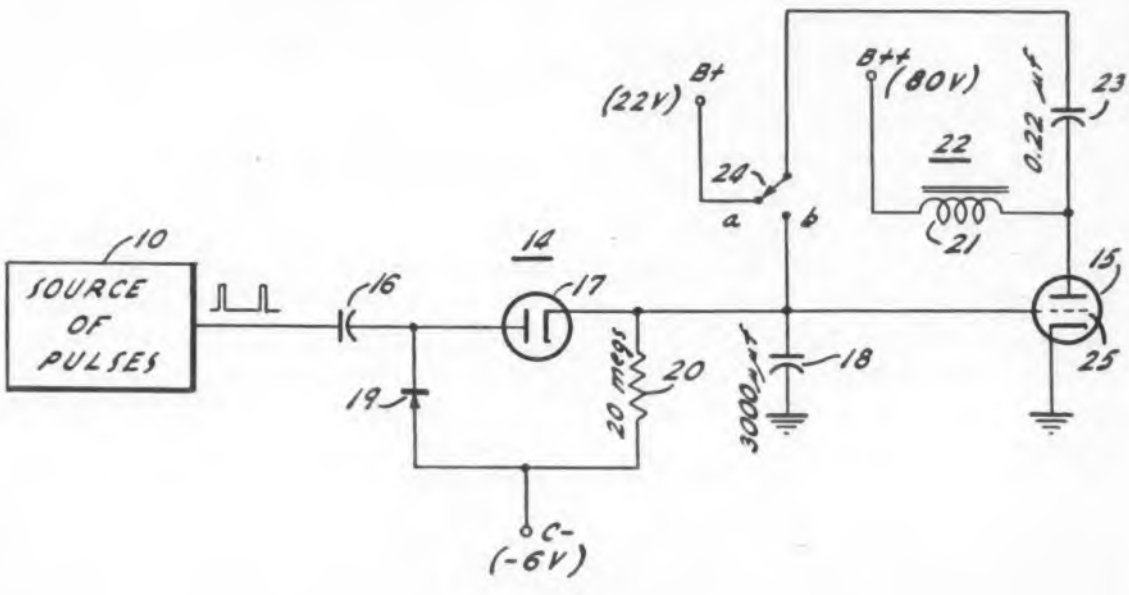
Patent No. 2,729,742. F. N. Brauer. (Assigned to Philco Corp.)

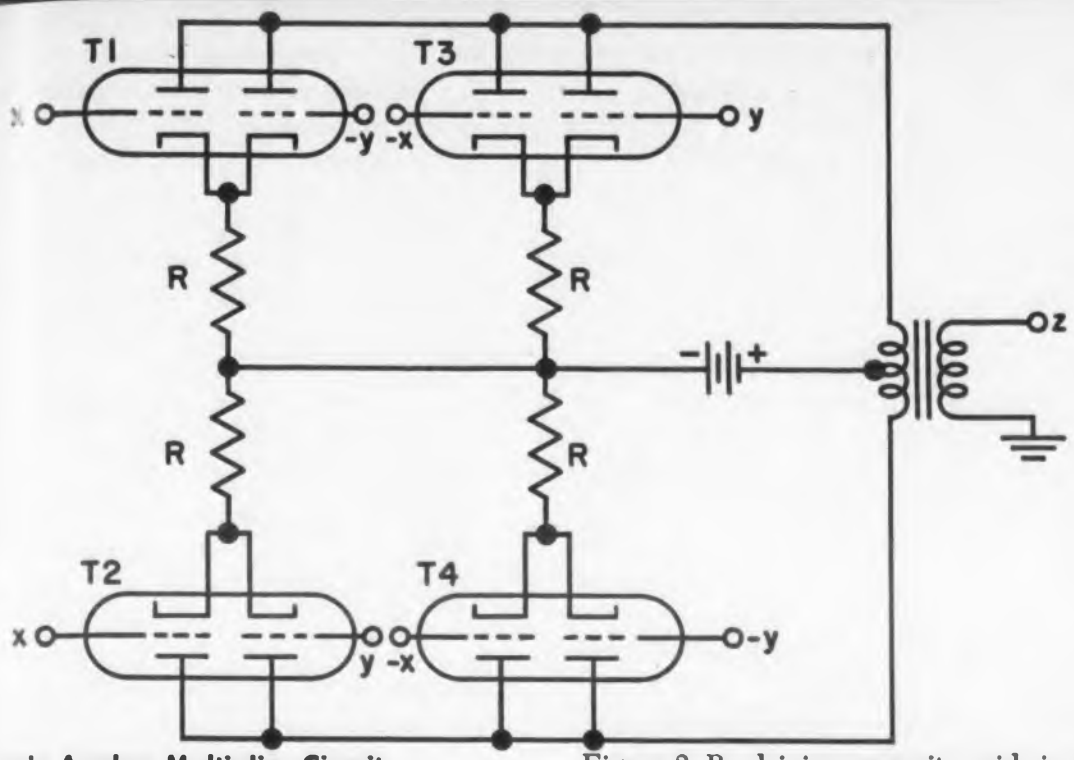
In the operation of a sonobouy or other device which is operable without personal attendance, there is need for a simple circuit which is normally inoperative. A circuit of this type will conserve the battery charge which is the source of power supply for such device. The circuit is triggered by and continues in operation from a series of impulses of very short duration. When the pulses cease, the circuit continues in operation for a relatively long period of time.

The circuit illustrated includes a source of pulses *10* which charge storage capacitor *18* through integrating circuit *14*. This latter circuit includes diode *17*, rectifier *19* and resistor *20*. The storage capacitor is connected with the grid of tube *15*. Potential source *C* biases the control grid of tube *15* below cut-off. Upon application of the short pulses, a charge is built up on storage capacitor *18* to a point which carries the grid bias of the tube above cut-off. Current passes through the tube and energizes coil *21*, which operates switch *24* to contact *b*, to connect capacitor *23* between the anode of the tube and the grid. In position *a* of switch *24*, a 22 v battery supply charges capacitor *23*, so that upon operation of switch *24* to contact *b* this additional voltage is applied to the grid. The potential of capacitor *23* therefore boosts the grid bias positive by a substantial amount. However, at this high bias, grid current flows to immediately restore the potential on the grid to zero bias, which is above the cut-off potential of the tube. The continuance of the pulses, however, maintains the grid on about zero potential and, therefore, current continues to flow through the tube and coil *21* to hold the relay switch on contact *b*.

Upon termination of the pulses, the charge on capacitor *18* leaks off slowly for a considerable period of time. A point is reached where the current through tube *15* is insufficient to hold the switch on contact *b*, after which the decay of the charge on capacitor *18* leaks off more rapidly. When the grid bias reaches cut-off point, the current drops off at a greater rate to restore the circuit to its initial condition.

With this circuit, capacitor *18* may be made small, so that the pulses build up its potential rapidly above the cut-off potential of the tube grid. A circuit such as the one described has biased the grid above cut-off potential on the fourth pulse. With the pulses being of 2.5 μsec duration and spaced apart at intervals of 2500 μsec, it can be seen that the circuit is triggered very quickly after initiation of the triggering pulses.

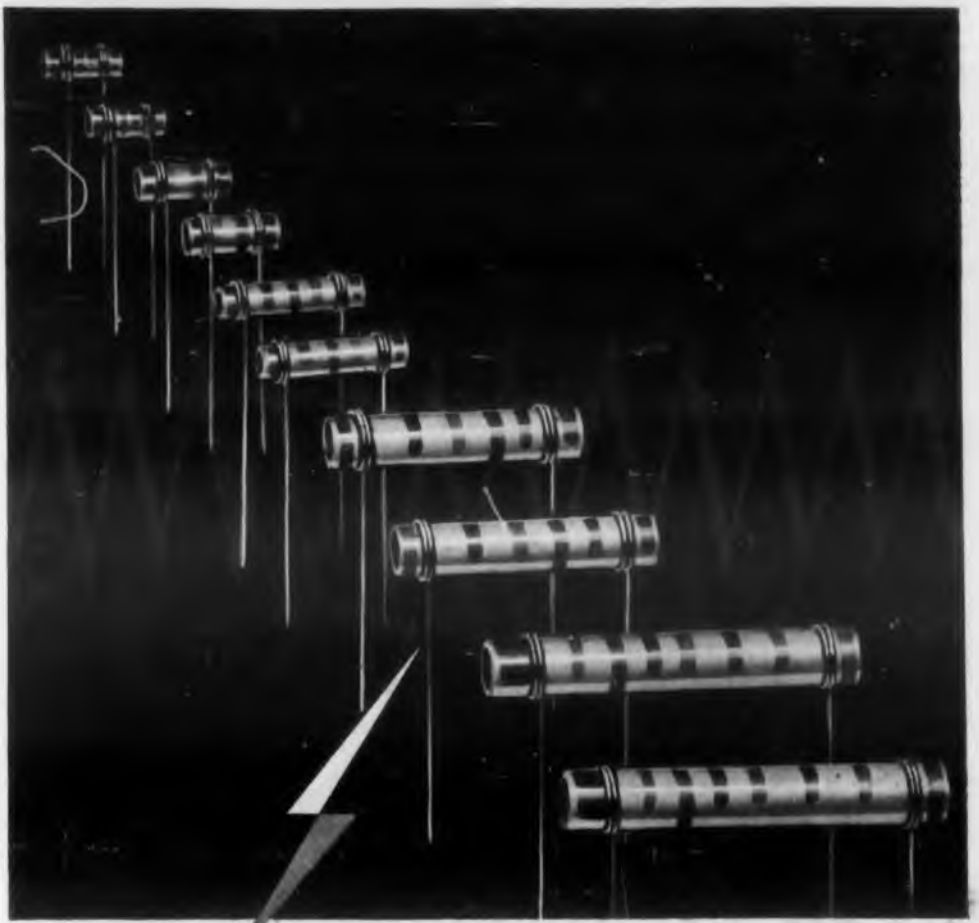




Electronic Analog Multiplier Circuit
Patent No. 2,735,615.

Electronic Multiplier Circuit
Patent No. 2,735,616. Harvey O. Hoadley. (Assigned to Eastman Kodak Co., Rochester, N. Y.)

A symmetrical electronic analog multiplier for obtaining the product of two applied voltages. A simplified diagram of the circuit of Patent 2,735,616 is shown in Figure 3. By driving opposite grids in phase and connecting the plates out of phase multiplication is effected because of the nonlinear characteristics of the tubes. In operation this circuit is similar to the balanced diode modulator except that amplification is achieved, and a common ground is possible. Patent 2,735,615 is similar except that a diode bridge is used to replace tubes 3 and 4 in Figure 3.



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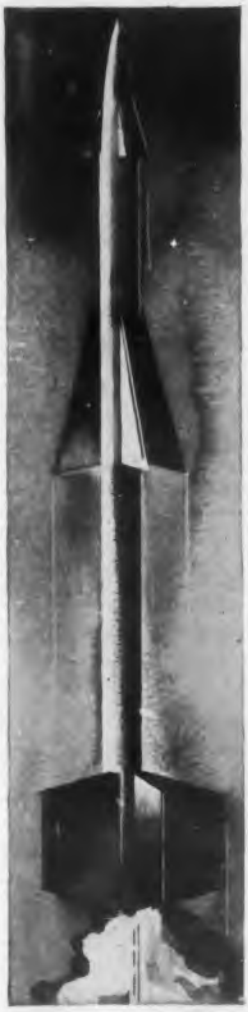

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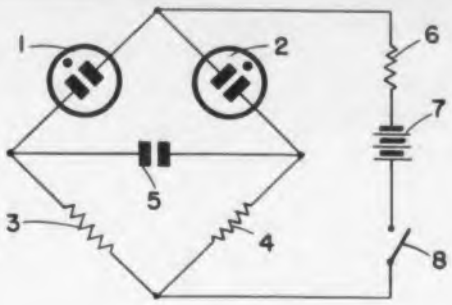


Frequency Divider Apparatus

Patent No. 2,728,030. R. G. Green. (Assigned to North American Aviation, Inc.)

A circuit is described and illustrated which generates an oscillation or pulse by successive firing of two or more glow discharge tubes. The tubes fire in succession and at a constant frequency so that a frequency division or a pulse of predetermined frequency may be secured.

The circuit in its simplest form is shown in the figure. The circuit parameters are selected so that the discharge tubes will not fire from the current supplied by power source *7* alone. When switch *8* is closed, the full potential of the power source is applied to the discharge tubes. One tube only fires because of a lack of equal characteristics of each tube and its circuit.

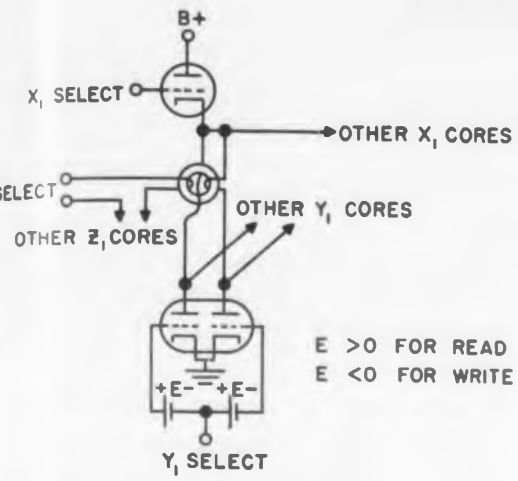
Assume that tube *1* fires, whereupon the current is supplied from the power source through resistor *3* and also from capacitor *5*. The current supplied from the capacitor passes through resistor *4*, which reduces the potential across discharge tube *2* and assures that it does not fire. The current supplied to the discharge tube from the capacitor decreases exponentially so that a point is reached where the current is insufficient to support the discharge. Tube *1* then becomes extinguished. When this occurs the potential across discharge tube *2* becomes such that it fires and transmits current until the decrease in current is insufficient to support conduction. When this occurs, discharge tube *1* again fires and the cycle repeats.

Seismic Depth Gauging System

Patent No. 2,735,303. Richard J. Haase. (Assigned to Shell Development Co., Emeryville, Calif.)

A fluid pressure indicator which measures pressure by comparison with the force in a calibrated magnetic plunger. In operation, current in the magnetic plunger is increased until the electromagnetic force exceeds the fluid force at which time the plunger moves and causes an indicator

light to flash. The current flowing in the coil when the light flashes is a measure of the fluid pressure.



Magnetic Element Memory Matrix
Patent No. 2,739,300. Munro King Haynes. (Assigned to International Business Machines Corp., New York, N.Y.)

Apparatus for storing binary information electrically by magnetization of cores in a magnetic memory matrix. A simplified schematic diagram is shown. If a positive voltage is applied to "X_1 select" and a positive voltage applied to "Y_1 select" with E greater than zero, then a current will flow through the core as shown and produce a Z_1 output if a one had been stored and no output if a zero had been stored. To write a one into the core, it is necessary only to reverse the polarity of E so that the core can be remagnetized to the one state. Any number of X, Y, and Z planes can be used according to the amount of information it is desired to store. A system with x triodes in the X selection, y double triodes in the Y selection, and z planes in the Z selection can thus store xy words with z binary digits in each word.

Multifrequency Keyed Oscillator Circuit
Patent No. 2,735,940. Harold A. Norby. (Assigned to Hughes Aircraft Co.)

An oscillator circuit which can be made to oscillate at any of several predetermined frequencies. Under normal conditions all of the tuned circuits are disconnected from the oscillator tube by diode circuits. The application of a keying pulse to one of the diodes activates one of the tuned circuits, thereby causing the circuit to oscillate at the resonant frequency of the selected tuned circuit.

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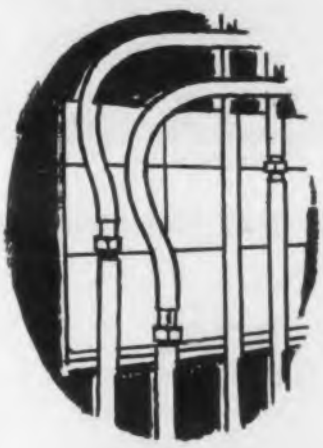

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Books

Superheterodyne Converters and I-F Amplifiers

Alexander Schure. John F. Rider Publisher, Inc., 480 Canal St., New York 13, N. Y. 56 pages.

This book is volume 12 in the Rider Electronic Technology Series, suitable for all who are studying the operating principles of superheterodyne receivers. It provides a clear explanation of the theory underlying the operation of mixers and converters, and the theory of the i-f amplifier. The various facets of performance and design relating to these portions of the superheterodyne receiver are presented in a very lucid style, making both the function and design factors clearly understandable.

Scattering and Diffraction of Radio Wave

J. R. Mentzer, Pergamon Press, Ltd., 12 E. 56th St., New York, N. Y. 134 pages price $4.50.

This book is intended to bring research workers and instructors up to date in the methods of determining the scattering and diffraction behavior of obstacles at radio wavelengths.

As a result of this, the material presents the latest mathematical methods for the calculation of scattering, especially back-scattering cross sections, with a brief review of the well-known classical methods of solution included for continuity and self-consistency.

Emphasis is placed on theoretical

ethods of the determination of the scat-ered (or diffracted) electro-magnetic field round an obstacle in a prescribed incident eld.

CA Transmitting Tubes

Tube Division, Radio Corp. of America, Harrison, N. J. 256 pages. Price $1.00.

The new manual RCA Transmitting ubes, is a book containing technical data n 112 types of power tubes having plate-put ratings up to four kilowatts and on 13 pes of associated rectifier tubes.

Covering basic theory of power tubes and eir application in an easy-to-understand yle, it contains information on generic be types; tube installation and applica-on; rectifier circuits and filters; and the ep-by-step design of af power amplifiers d modulators, rf power amplifiers, fre-ency multipliers, and oscillators. Simple lculations are given for determining op-ating conditions for Class C telegraphy rvice, Plate-Modulated Class C Te-phony Service, Frequency Multipliers, d Class AB and Class B af Amplifiers.

Rapid selection of a power tube or recti-r tube for a specific application is facili-ted by reference to a series of five classifi-cation charts immediately preceding the tube-data section.

This manual contains 16 circuit diagrams showing the use of RCA tubes in repre-sentative transmitting and industrial appli-cations.

Engineering In History

R. S. Kirby, S. Withington, A. B. Darling, and F. G. Kilgour, McGraw-Hill Book Co., 330 W. 42nd St., New York, N. Y. 530 pages. Price: $8.50.

This book contains a historical discussion of the interaction of engineering with so-ciety. It presents the history of engineering as one of many human activities and shows various factors in the physical and cultural environment conditioned engineering ad-vance and how, in turn, engineering has had its impact on the rest of society.

Information is given about developments in the United States. Original sources have been located and used, and whenever pos-sible, original rather than secondary sources are employed. Included also are special branches for military and chemical engi-neering.

A short bibliography is at the end of the book and selected bibliographies following most chapters.

Russian Translations

What the Russians Are Writing

J. George Adashko

Akusticheskii Zhurnal Vol. 2, No. 1, Jan.-Mar. 1956

High-Intensity Ultrasonic Installation for Irradiation of Micro-organisms, I. V. Skarde (9 pp, 12 figs)
The claims made for this equipment (Fig. 1) are: (1) cooling system to maintain constant irradiation temperature; (2) stable intensity of irradiation; (3) special degree to adjust the degree of cavitation produced in the irradiated substratum. The resultant equipment produces a maximum intenstity of 100 w/cm² and a maximum temperature differential of 5°C between the irradiated liquid and the cooling liquid. Reference is made to several articles in *Jl. of Appl. Phys. and J. Acoust. Soc. of Am.*

Acoustic Properties of a Finely Laminated Medium, S. M. Rytov (13 pp, 1 fig)
Theoretical investigation, using classical methods. Refers to article "Elastic Wave Velocities in Laminated Media" by J. E. White and F. A. Angona, *J. Acoust. Soc. Am.*, 1955, 27, 311-317.

Integration of a System of Self-Modelling Equations in the Problem of Short-Time Shock in Cold Gas, V. B. Adamskii (7 pp, 5 figs)
Advanced Hydrodynamics.

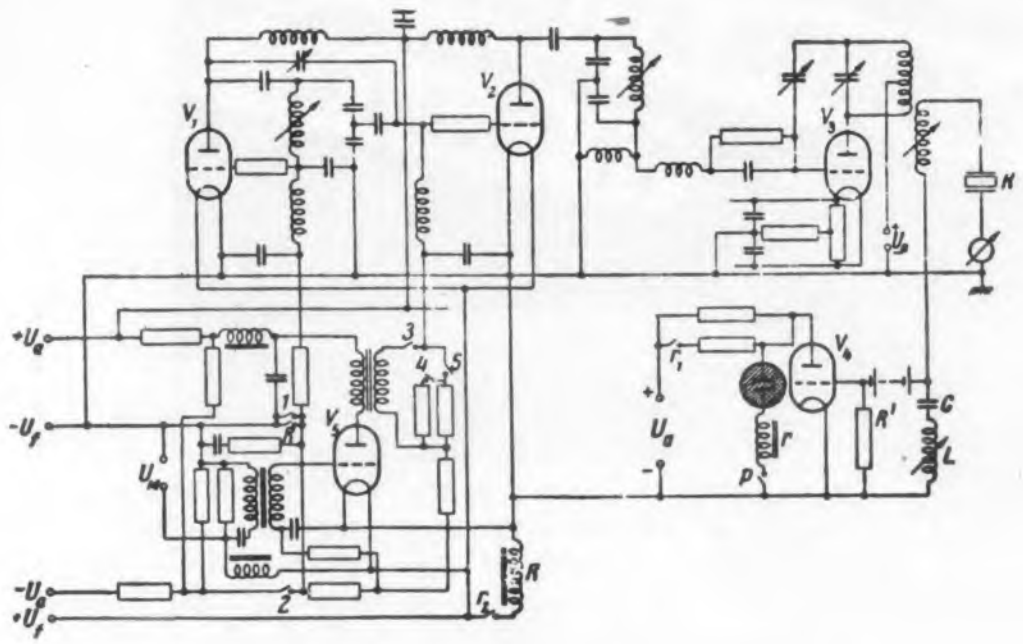


Fig. 1. Principal diagram of ultrasonic oscillator. V_1—oscillator, V_2—buffer stage, V_3—driver stage, V_4—automatic regulator, V_5—modulator, K—radiator, 1, 2, 3, 4, 5—contacts (contacts 3, r_2, and R are closed for modulated oscillations; contacts 5, 2, r_2, and R are closed for unmodulated oscillations).

Calculation of Audibility of Non-Linear Distortion Produced in an Electro-Acoustic Channel, A. V. Rimskii-Korsakov, (11 pp, 3 figs, 2 tables)
Statistical methods are used to determine the audibility of non-linear distortion by calculating the probability that, under conditions peculiar to a given auditorium, the non-linear distortion products will exceed the masking threshold produced by the basic signal transmitted by the channel and the audibility threshold.

An approximate theoretical calculation is made for this probability for the very simple case when the input signal has an equal-amplitude frequency spectrum and the non-linearity is quadratic in character. In this case the real "audibility threshold" for the distortion corresponds to a harmonic distortion of 2-3%.

Velocity of Sound in Various Pure and Mixed Liquids, B. B. Kudriavtsev (12 pp, 16 figs, 3 tables)
Theoretical and experimental study.

Non-Directional Ceramic Sound Receivers (Microphones), A. A. Anan'eva (18 pp, 20 figs, 3 tables)
Discussion of piezo-electric microphones with spherical and cylindrical directivity patterns, consisting of thin shells of barium-titanate ceramics. The concept of the coefficient of transformation of mechanical stresses is introduced, and it is shown that if the character of the transformation is properly chosen and the electrodes are properly placed, the usually low sensitivity of such microphones can be raised and the directional properties improved. Many patterns are given for various types of shells (spherical, cylindrical). Reference is made to an article by R. A. Langevin, "The Electro-Acoustic Sensitivity of Cylindrical Ceramic," *J. Acoust. Soc. Am.*, 1954, 3, 421-427.

Dielectric and Piezoelectric Properties of the Solid Solutions $(Ba,Sr)TiO_3$, $Ba(Ti,Sn)O_3$, and $Ba(Ti,Zr)O_3$, N. A. Roi (9 pp, 11 figs)
Experimental investigation. Reference is made to article by W. P. Mason in *Bell Labs Record* entitled "Barium-Titanate Ceramic as an Electromechanical Transducer."

Radiation of Sound by Rotating Dipole, L. N. Sretenskii, (6 pp, 1 fig)
Mathematical study of the acoustic field produced by a dipole, the axis of which either rotates in space, or carries out harmonic oscillations about a fixed direction in space. Mathematical discussion.

Motion of Gas under the Influence of Short-Time Pressure (Shock) Ia. V. Zel'dovich, (11 pp; 3 figs)
Mathematical approach, with reference to Courant-Friedrichs.

THE July 15 issue of ELECTRONIC DESIGN contains an abstract of an article on the Russian EMU-5 analog computer, which employs diode elements as function generators. A brief description of these diode elements was contained in that article. The following abstract of an article by one of the co-authors of the previous article discusses in greater detail the properties of diode circuits.

The general block diagram of a diode function generator is shown in Fig. 1. The linear dc amplifier with amplification factor K, the input block f_x, and the feedback block f_y, all serve to convert the voltages E_x and E_y into currents I_x and I_y, subject to the following equations:

$$I_x = f_x\,(E_x,\ E_o) \quad (1)$$
$$I_y = f_y\,(E_y,\ E_o) \quad (2)$$
$$I_o = I_x + I_y \quad (3)$$
$$E_o = RI_o \quad (4)$$
$$E_y = KE_o \quad (5)$$

Reference to (5) shows that if K is large and E_y is to be kept within a certain limit, E_o must be small and the point Σ should be virtually grounded.

In all such circuits, the generated function is approximated by a series of tangents to the desired function, and the function generator consists of individual diode elements, one for each tangent. The diode element produces in effect an elementary increment in the slope of the function, starting at a certain value of the argument. Fig. 2a shows such a basic element, with Fig. 2b representing the corresponding current-voltage characteristic (i vs. E_x; E_c is the voltage at which the diode starts conducting). Such a circuit is impractical because it contains an ungrounded voltage source.

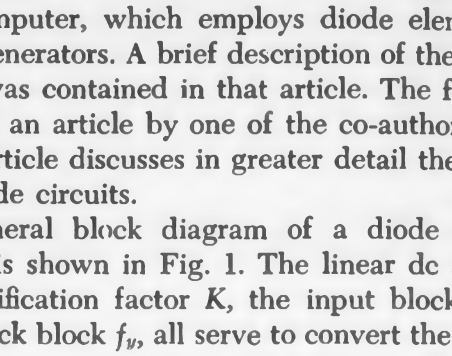


Fig. 1

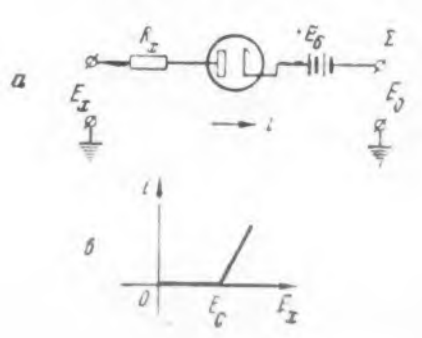


Fig. 2

Diode Function Generator Design

J. George Adashko

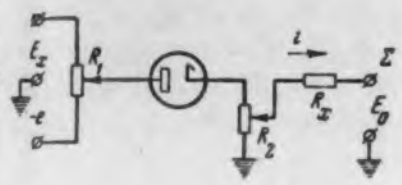


Fig. 3a

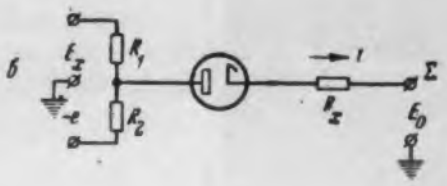


Fig. 3b

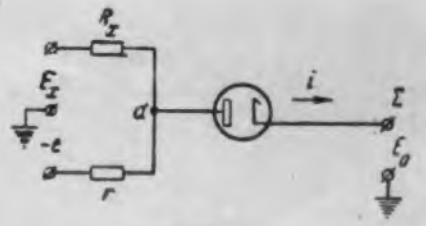


Fig. 4

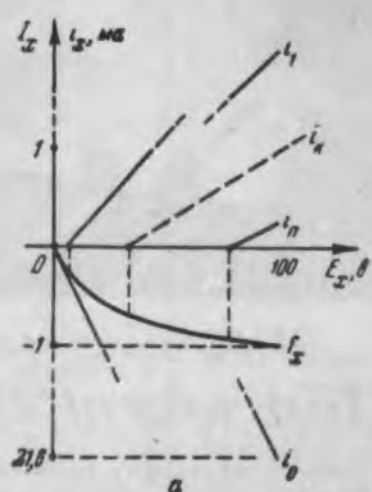
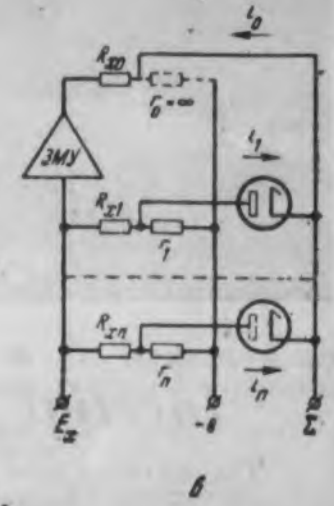


Fig. 6



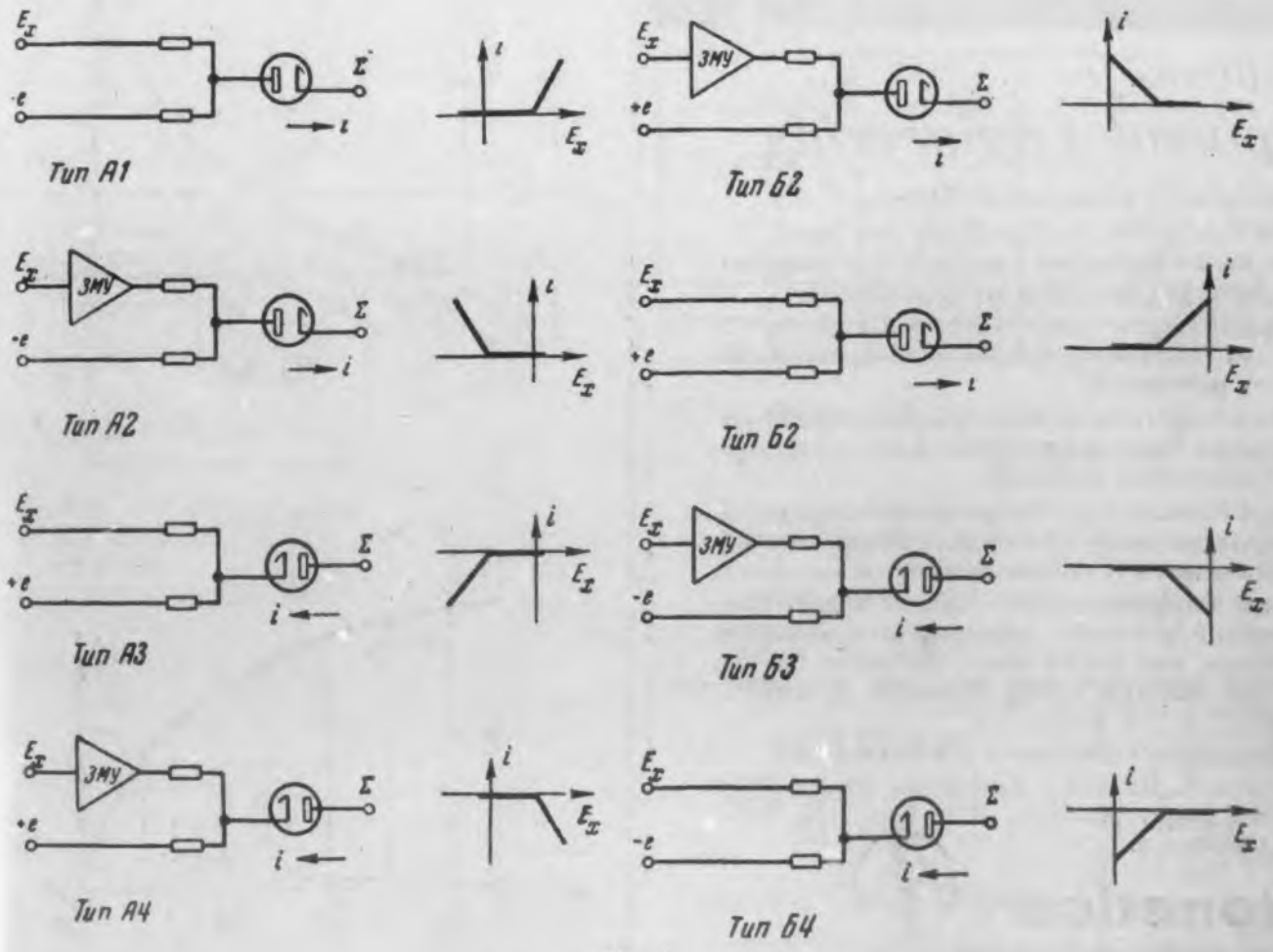


Fig. 5

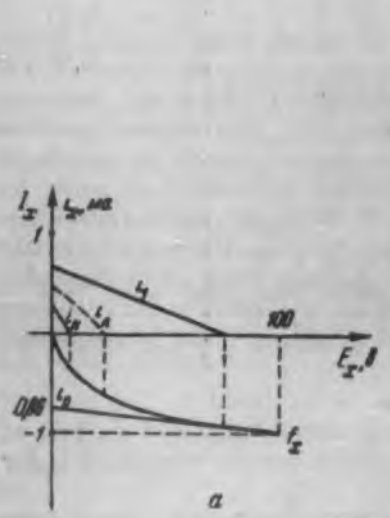
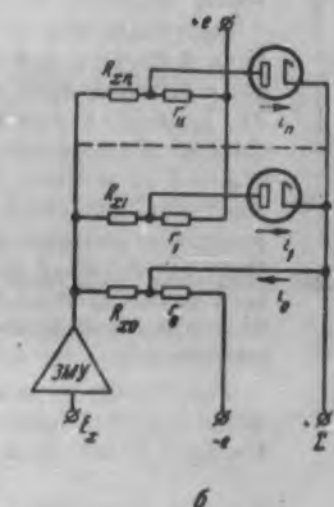


Fig. 7



A more practical circuit is shown in Fig 3a, where potentiometer R_1 adjusts the bias voltage, and potentiometer R_2 sets the slope of the current-voltage characteristics. Obviously, for fixed values of bias and slope the two potentiometers can be replaced by three resistors, as shown in Fig. 3b.

A further improvement is the "potentially grounded" diode element shown in Fig. 4, for a single voltage divider sets both the slope of the current-voltage characteristic and the value of the required bias voltage. That this is so can be seen by simply calculating the dependence of i on E_x in Fig. 4. Neglecting the resistance of the conducting diode as compared with R_x and r we get

$$i = E_x/R_x - e/r, \; E_x \geqq E_c, \qquad (13)$$
$$i = 0, \; E_x \leqq E_c$$

But if $E_x = E_c$ we have

$$e/r = E_c/R_x \qquad (14)$$

and therefore

$$i = E_x - Ec/R_x, \; E_x \geqq E_c \qquad (15)$$
$$i = 0, \; E_x \leqq E_c$$

from which it follows that for $E_x > E_c$

$$dE_x \; di/dE_x = 1/R_x$$

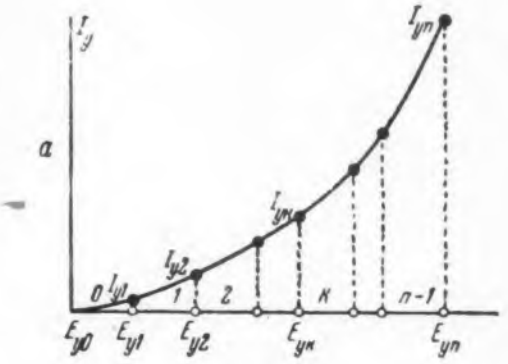


Fig. 8a

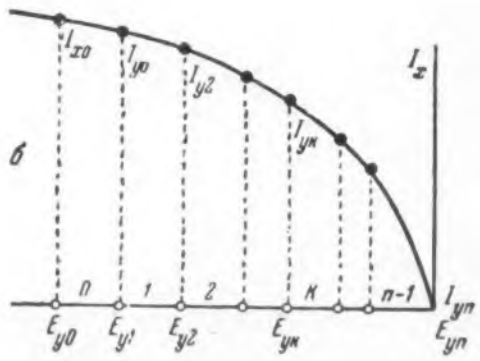


Fig. 8b

i.e., the slope of the characteristic depends only on R_x. The value of the bias voltage is given by Eq. (14).

Fig. 8 shows several types of diode elements and the resulting current-voltage characteristics. Note that the group to the left consist of off-on operation elements, and that to the right consist of on-off elements. Figs. 6 and 7 show the same function, namely $Ey = 21.6\ \sqrt[3]{E_x}$, can be generated with elements of both types. Calculations show, however, that the current drain is much less in the case of Fig. 7 than in the case of Fig. 6. The reverse holds for other equations, say $E_y = 1/1000\ E_x^3$, where off-on elements are preferred. A function generator for the cubic equation $E_y = 1/10{,}000\ E_x^3$ is shown in Fig. 9.

Fig. 10 shows a procedure for checking and adjusting such a diode element. The current i_Σ is measured with a low-resistance meter, and its value is adjusted with precision-resistance box *MC*.

The article contains also many practical hints concerning the practical choice of reference voltages (marked +e and –e on the diagrams) and resistance values. *Translated and condensed from an article "Design of Diode Function Generators" by A. D. Talantsev,* Avtomatika i Telemekhanika, *No. 2, 1956.*

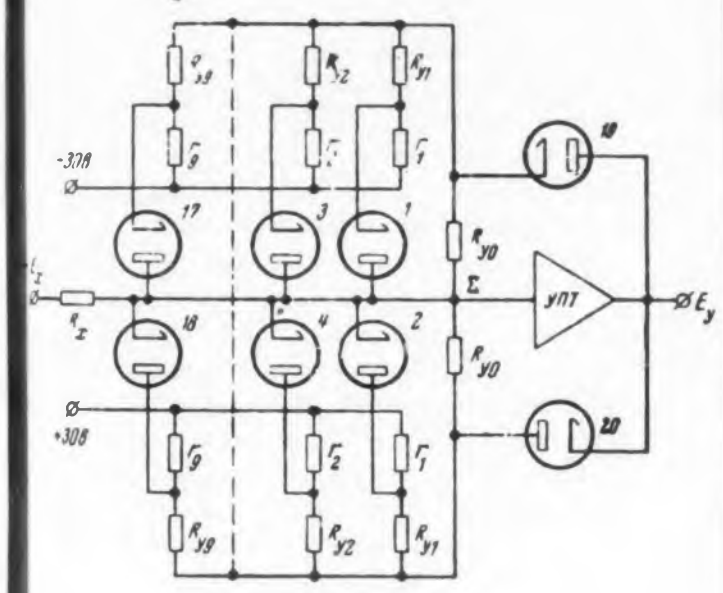


Fig. 9

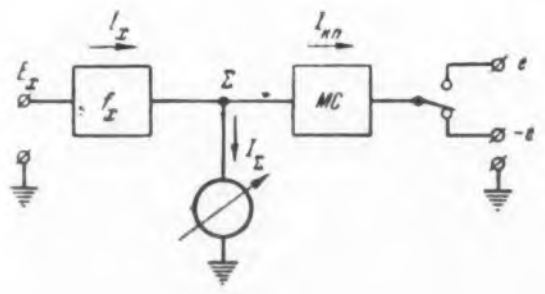


Fig. 10

The Modular Co

IN THE modular concept of electronics a module single, unitized electronic component part—al cha called a module—performs all the resistive, ca The pacitive and inductive functions of a vacuum afers, tube circuit. The module is the equivalent to th hickne 6 to 28 components that must normally be care hey w fully positioned, wired, and soldered to form a hysica vacuum tube circuit. Often a small termina nents strip also must be provided in the conventiona afer circuit on which common leads and common cir Each cuit voltages are connected. Rivets and lugs, too or val must be inserted somewhere on the chassis t erami accommodate some lead or component part. The nent a module eliminates all of these circuit "acces- is ag sories." ng op

Resistive, capacitive and inductive element modul contained in a module are all mounted on ocket ceramic wafers having very desirable thermal rical electrical, and physical properties. The mounted A fu wafers are then stacked skyscraper fashion t een form the module—a completely functioning com- ange ponent part when placed in a circuit in associa- alues tion with a vacuum tube or transistor. apaci

The three dimensional approach made pos- ize c sible by the modular design concept requires a lm slight modification in the thinking about product apac design. Coupled with printed circuitry, the old hen, cake-pan approach for the design of typical elec- an tronic equipment is eliminated. But of particular Large importance, when designing the modules, the ersal engineer goes directly from the circuit diagram o the to the final form factor of the product. Thus, the q. In final chassis design is less a compromise between micro electronics and packaging. Ab

In the case of the manufacture of the module bert mechanized techniques are also used. Every Engi

lar Concept

ics … module is fully tested for its electrical and physi-
part- …al characteristics.
e, ca- The module is composed of a stack of ceramic
…uum- …afers, each of which is a uniform size and
to th… …hickness. The machines are designed so that
care- …hey will accept only wafers within very narrow
…rm … …hysical tolerances. All of the component ele-
mine… …ents that are mounted on the surfaces on the
tiona… …afer also fall into narrow size limits.
n cir- Each component element is electrically tested
…, too… …r value and tolerance before it is placed on the
sis t… …eramic wafer. The assembly of component ele-
. Th… …ent and wafer—resistor, capacitor, or inductor
…cces- …is again electrically inspected after the mount-
…g operations are complete. Finally, the whole
nent… …odule—wafer mounted component and tube
d on… …cket—is inspected for its physical and elec-
…rmal… …rical characteristics.
…unted A full range of RETMA values of resistors has
…n to… …een developed for modular use. Resistances
com- …nge from 5 ohms to 10 megohms and wattage
…socia- …alues from 1/2 w to 2 w. Overlapping ranges in
…apacitance allow the mounting of a uniform-
pos- …ize ceramic wafer, a uniform length of plastic
…res a… …m capacitor, and a standard size of glass
…oduct… …apacitor. The capacitance range in modules,
e old… …hen, is 1 μμf to 0.5 μf. Small values of inductance
elec- …an be printed on the surface of the wafer.
…cular… …arger values, in the form of toroids and uni-
, the… …versally wound coils, have dimensions compatible
…gram… …o the size of the wafer, which is always 7/8 in.
…s, the… …q. Inductors are produced with values from 0.25
…ween… …icrohenry to 10.0 millihenry.

Abstracted from The Modular Concept, Herbert H. Rosen, ACF Electronics, Amphenol Engineering News, *January 1956.*

Abstract

Transistorized Ma

CURRENTLY being investigated at Bell Labor stor *R* tories is the feasibility of a large coincidence gain st current magnetic core memory which is operated en round tirely by transistors. Transistor circuits have bee hich c developed and are being tested for use in such to the memory. Experience to date indicates that a transisto g. driven memory of this kind is entirely feasible an The quite attractive.

A block diagram of the memory system is shown i oltage Fig. 1. It includes the memory proper, or storage a utput ray, magnetic core switches for selecting the desire e basi memory locations, and transistor amplifiers. The

Two basic types of amplifier circuits are employe rrange in the memory: *drive amplifiers,* which provide cu ets the rents for switching the magnetic cores; and *rea* ddress *amplifiers,* used to amplify the signal obtained fro e obt a switched core to a level which can drive circuits a sociated with the memory.

Drive amplifiers. Three drive amplifier design known as the digit inhibit, selection switch set, an memory drive, are employed in the complete memor system. To switch the memory cores, a drive of 32 milliampere-turns lasting at least 4 μsec is required The memory is operated with coincident currents ap plied to single turn windings on the memory core Therefore, the digit inhibit and memory drive ampli fiers must provide current pulses of about 160 ma last ing at least 4 μsec. The cores in the magnetic selecto switch have multiturn windings. The selection switc set amplifier should provide current pulses of about 7 ma lasting for 5 μsec.

A schematic of the digit inhibit amplifier in show in Fig. 2. Two germanium alloy junction transistors one a low-level (*TR1*) and the other a high-level uni (*TR2*), are employed in this amplifier. Normally *TR* is conducting, so that its collector is near ground po tential. Thus *TR2* is cut off and no current flow through the magnetic core load. When a digit inhibi signal is received, *TR1* is cut off and its collector start toward −8 v. This carries the base of the outpu transistor negative and it starts to conduct. Collecto current very quickly reaches a value set by limiting re

Magnetic Core Memory

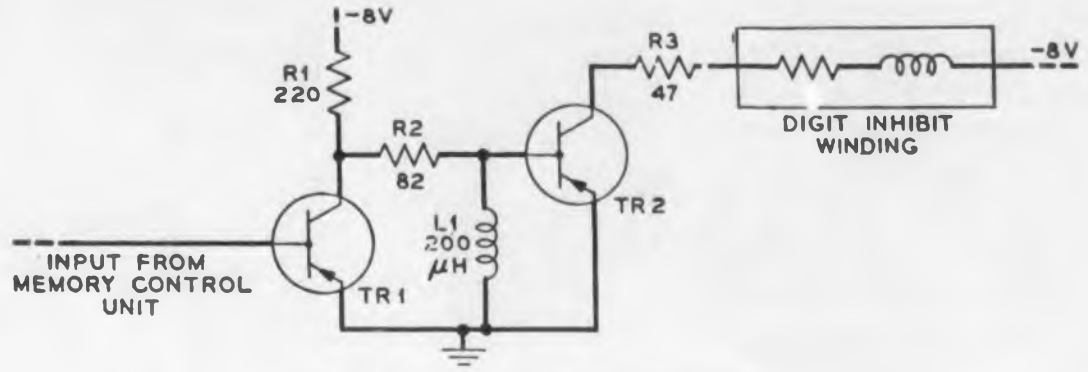


Fig. 2. Schematic of Digit Inhibit Amplifier

stor *R3*. At the end of the digit inhibit signal, *TR1* gain starts to conduct, bringing its collector near ound and turning off *TR2*. Current through *L1*, hich cannot drop to zero abruptly, is forced to flow to the base of *TR2*, resulting in a very rapid switch-g.

The selection switch amplifier is quite similar to ig. 2 except that *R3* is 300 ohms, and the applied oltage at the selection switch set winding is —20 v. utput current requirements are less than 100 ma, so e base input is decreased by increasing *R1*.

The memory drive amplifier, very similar in general rrangement to Fig. 2, supplies the current which re-ts the selection switch and flows through the selected ddress of the memory. The required 200 ma pulses e obtained from a circuit where the collector supply voltage is —20 v and *R3* is about 70 ohms.

Read Amplifier. The read amplifier must accept the output of a digit plane and develop an output which can control a base current of about 1 ma in a memory control unit transistor. The digit plane output may be a pulse of either positive or negative polarity, making it necessary for a polarity-reversing scheme to be employed so that an output of the same polarity will be obtained regardless of the polarity of the input pulse. This can all be done by the circuit shown in Fig. 3.

Transistor *TR1* is biased so that it amplifies both positive and negative pulses. These pulses are fed to a full-wave bridge rectifier so that regardless of polarity, each input pulse to the bridge produces an output pulse which is further amplified by *TR2*.

Output of the read amplifier is combined with an accurately-timed "strobe" signal in a gate circuit. In order for the voltage at point *F* (Fig. 3) to change, both *TR3* and *TR4* must be cut off simultaneously, which occurs when the output of the read amplifier is a "one" at the same time that the strobe signal is applied.

Over-All Memory System. The complete developmental magnetic core memory can store 1024 eighteen bit numbers. To accomplish this, 18,432 memory cores and 48 switch cores are employed. Transistor complement includes 98 low-level and 62 high-level units. Ttotal power consumption is less than 50 w.

From a paper by E. LeRoy Younker, Bell Telephone Laboratories Inc., presented at the 1956 National Conference on Aeronautical Electronics at Dayton, Ohio, May 14-16, 1956.

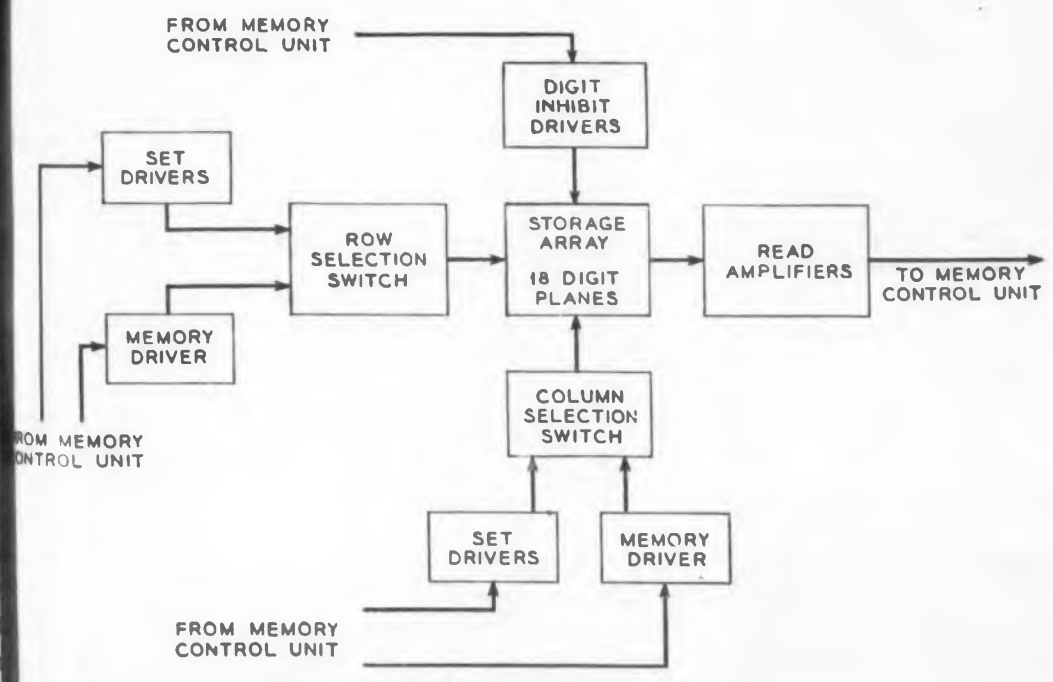


Fig. 1. Block Diagram of Memory System

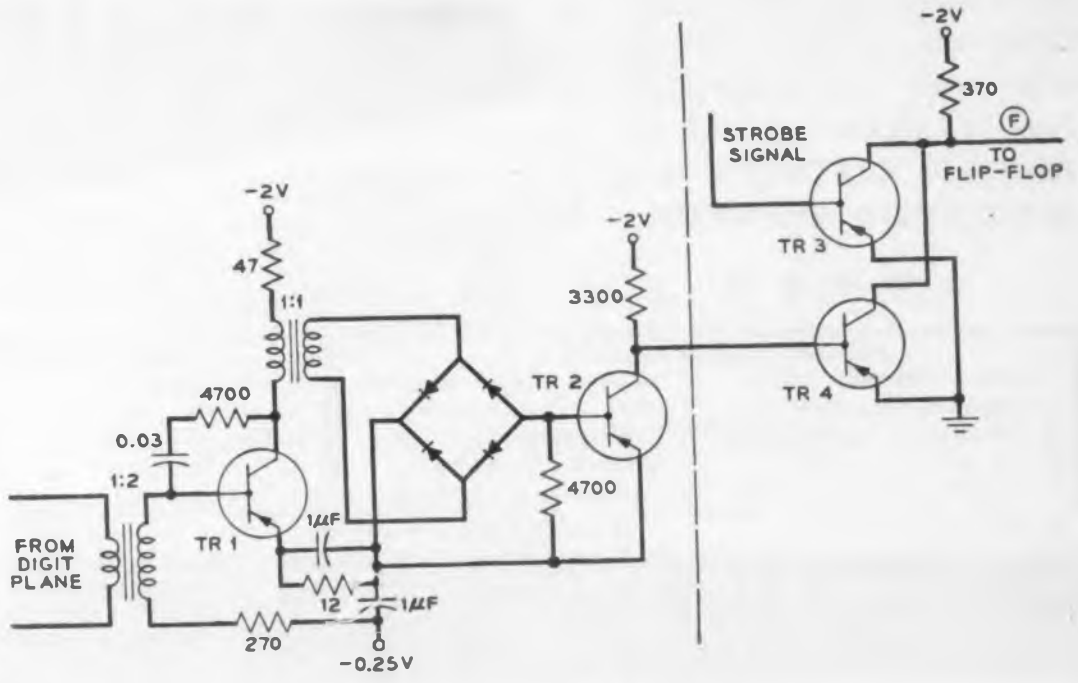


Fig. 3. Read Amplifier and Strobe Circuit

Government Reports

High-Speed P

RESEARCH at the National Bureau of Standards on the logical design of electronic computers has resulted in a method for adding two 53-binary-digit numbers in 1 microsecond. When incorporated into a computer's arithmetic unit, this adder will provide a saving in time over the currently used parallel adders in solving long, complex scientific computation and data-processing problems.

High speed of the adder results from a logical arrangement that permits the simultaneous formation of large groups of "carries," i.e., the numbers that are carried over to the next more significant digital positions in addition problems.

In the Bureau's method of addition, whole groups of adjacent carries are formed simultaneously and independently of each other. An analysis using Boolean algebra techniques shows that it is feasible to generate all carries in a limited number of time periods. Specifically, for a 53-binary-digit adder, all 52 carries are formed in only 3 steps of a 5-step operation.

The complete addition operation is performed in 5 steps, briefly described as follows:

1. During the first step, each of the two operands to be added is made available in parallel, usually from a parallel memory because of its rapid success.

2. During the second step, the four least significant carries, C_1 through C_4, are generated in parallel from the four least significant digits of each operand. Because the logical gating structure is restricted to a limited number of inputs, not more than four carries can be economically generated during this step. However, the remaining digits of the operand generate an array of auxiliary carries at the same time the true carries, C_1 through C_4, are generated. These auxiliary carries are formed by examining groups of digits in the addend and augend, and permit the subsequent formation of true carries during later steps in the operation. They are formed at certain selected digit positions to check for many of the

ed Parallel Adder

onditions prerequisite to the formation of actual arries.

3. During the third step, the second and larger roup of carries, C_5 through C_{20}, is generated in arallel by means of the appropriate operand igits and auxiliary carries.

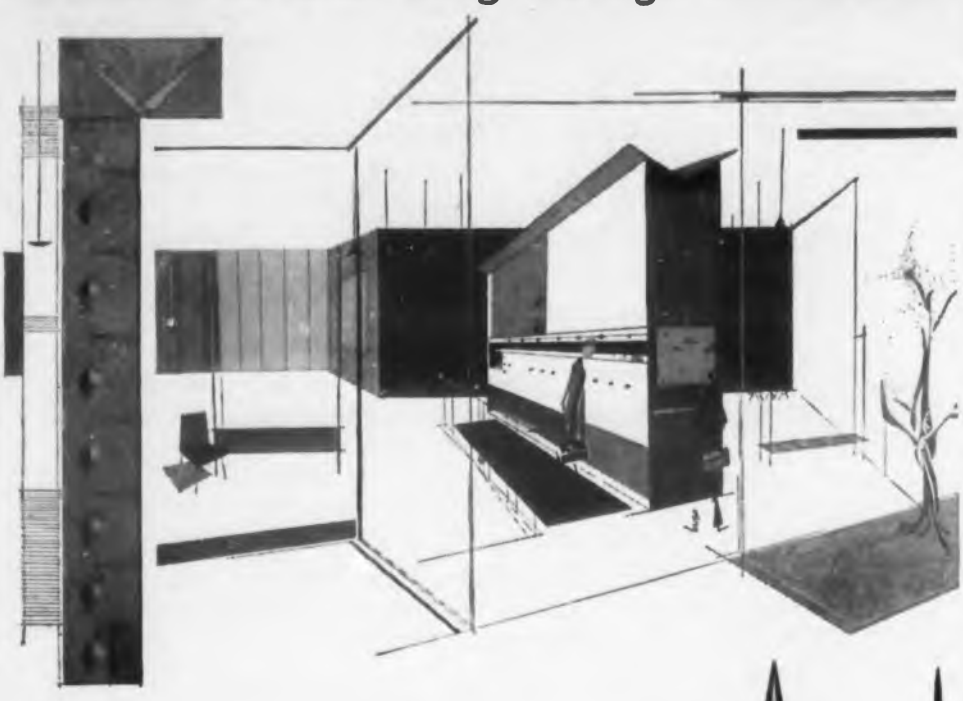
Simultaneously, a second array of auxiliary arries is formed from the first array to aid in the ubsequent formation of the third and final group f carries.

4. During the fourth step, the last and largest roup of carries, C_{21} through C_{52}, is generated in parallel by means of the appropriate operand digits and auxiliary carries.

5. Finally, after all the actual carries, C_1 through C_{52}, are obtained, all the sum digits are ormed in parallel during the fifth step in a conventional manner, each by means of the corresponding addend and augend digits together with the carry from the previous digit position.

The adder can be constructed from basic SEAC-type pulse repeater stages. The circuitry consists essentially of three levels of diode gates in an OR-AND-OR (mixer-coincidence-mixer) logical array followed by a transformer-coupled pulse amplifier. The rate at which successive pulses pass through such a stage is determined by the 1-Mc clock frequency. The transit time of a pulse through a stage, however, is much less than 1 μsec. For this reason, the clock pulses are made available in several phases so that successive gating-amplifying units can be timed by clock pulses of successive phases. With a five-pulse clock, signals can be dispatched sequentially through five sets of OR-AND-OR gating units in 1 μsec. The five steps of the complete addition operation can therefore be performed during the five successive clock-phase periods occurring in 1 μsec. *Abstracted from A High-Speed Parallel Adder for Electronic Computers. National Bureau of Standards Technical News Bulletin, June 1956, Vol. 40, No. 6.*

MARS outstanding design **SERIES**



chef-less restaurant

This concept of Sue Vanderbilt, Pratt industrial-design graduate now designing GM auto interiors, would assemble a whole meal and cook it by microwave in a few seconds. Customer would merely check picture menu, insert money, push buttons. By the time he reached the far end of the counter the meal would be waiting, piping hot. All components already exist.

Many designs that will make news tomorrow are still in the "bright idea" stage today. No one knows which will flower into reality. But it will be important in the future, as it is now, to use the best of tools when pencil and paper translate a dream into a project. And then, as now, there will be no finer tool than Mars—sketch to working drawing.

Mars has long been the standard of professionals. To the famous line of Mars-Technico push-button holders and leads, Mars-Lumograph pencils, and Tradition-Aquarell painting pencils, have recently been added these new products: the Mars Pocket-Technico for field use; the efficient Mars lead sharpener and "Draftsman's" Pencil Sharpener with the adjustable point-length feature; and — last but not least — the Mars-Lumochrom, the new colored *drafting* pencil which offers revolutionary drafting advantages. The fact that it blueprints perfectly is just one of its many important features.

The 2886 Mars-Lumograph drawing pencil, 19 degrees, EXEXB to 9H. The 1001 Mars-Technico push-button lead holder. 1904 Mars-Lumograph imported leads, 18 degrees, EXB to 9H. Mars-Lumochrom colored *drafting* pencil, 24 colors.

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Abstracts

Government Reports

Electron Physics Tables

A publication, which was designed to facilitate the computations of scientists working in the field of electron physics, replaces the out-of-print and partly obsolete tables published in 1941 as Part II of Miscellaneous Physical Tables, Planck's Radiation Functions and Electronic Functions, National Bureau of Standards Mathematical Tables 17.

Calculations of the tables were done on the NBS automatic digital computer, SEAC, with each of the eight tabulated quantities given in eight significant figures. Electron energies range from 0.206 ev. to 3.353×10^{12} ev. Quantities which are more in line with the changed requirements in physics and engineering today were used for this tabulation.

The quantities tabulated are: potential differences in absolute volts required to impart a kinetic energy E expressed in electron volts to an electron initially at rest; effective relativistic potential difference; product of magnetic field in oersteds and the radius of curvature of electron path in centimeters; de Broglie wavelength of electron; the momentum of the electron measured in units of m_0c, where m_0 is the rest mass of the electron and c is the velocity of light; the kinetic energy, m_0c^2; total energy of the electron measured in units of the rest energy; and the ratio of the electron velocity to the velocity of light. *Electron Physics Tables, by L. Marton, and W. G. Hall, National Bureau of Standards Circular 571, March 30, 1956, 83pp, 50 cents.*

Electrical & Electronic Patents

Described in this book are 1915 Government owned inventions applicable to the electrical and electronic apparatus industry, covered by patents active as of December 31, 1953. For each invention the title of the invention, the United States patent number, the name of the inventor, the name of the Government agency administering the patent, and an abstract of the patent on the invention are given. Evaluation of the invention with respect to its industrial application can be made by examining the technical data contained in the abstract. Inventions are divided into over forty classifications.

The material in this publication has been prepared by the Office of the Chairman of the Governments Patent Board and is based upon the records of the Index of Inventions maintained at that Office. It has been published by the United States Department of Commerce and the Small Business Administration as a service to American business. *PB-111468, Office of Technical Services, U.S. Department of Commerce, Washington 25, D.S. $4.00.*

Analog Computation with Magnetic Cores

A rugged, fast, static method of performing analog computations has been developed by Naval Research Laboratory. The method utilizes a square loop magnetic core in conjunction with switching transistors. Computations are dependent only upon the waveform of periodic functions and the ability of a high remanence magnetic core to store a given number of volt-seconds for a half cycle of a supply frequency. A large number of computations can be performed, and the accuracy of 2% or better has been obtained. *PB111900 Transcendental Function Analog Computation with Magnetic Cores. D. H. Schaefer and R. L. Van Allen, Naval Research Laboratory, Feb. 1956. 11 pages. 50 cents.*

Capacitor Research

Research conducted in an attempt to produce a hermetically sealed, oil filled, three-gang tuning capacitor for the Signal Corps is reviewed in detail in a report released to industry. Although it was concluded that mechanical tolerances, particularly of ceramic parts, necessary to obtain the required performance made it impossible to achieve the ultimate goal, there is recorded in the report a large amount of data believed to have substantial value in related fields, such as fixed capacitors, air dielectric concentric trimmer capacitors, and ceramic dielectric capacitors. *PB 111-961 Development of Capacitor, Variable, Hermetically Sealed, Three Sections. Sprague Electric Co. for U.S. Signal Corps. June 1955. 139 pages. $3.50.*

Tests for Treated Magnesium Surfaces

Research toward development of an accelerated performance test for treated magnesium alloys is described in an Air Force report released in industry. Test methods for evaluating the quality of chemical and electro-chemical surface treatments with respect to corrosion resistance afforded by the treatments to the base metal, and the adherence between paint type coatings and the base metal afforded by the treatments, are needed to determine the acceptability of magnesium alloys submitted to the military services. Corrosion resistance tests included pH increase in 1.ON KC1, open circuit potential comparisons, short circuit current comparisons, and hydrogen evolution rates in 1.ON KC1 (gasometric method). Tests of adhesion to zinc chromate primer to the treated surfaces included adhesion in shear (wrought alloy specimens), adhesion in tension (cast alloy specimens), and impact, ultrasonic vibratory, and pressure-sensitive type tests (qualitative). *PB 121140 Research on Treated Magnesium Surfaces, S. E. Rohowetz, Bjorksten Research Laboratories Inc., for Wright Air Development Center. July 1955, 187 pp. $4.75.*

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.

ASTM Standards

METALLIC MATERIALS FOR ELECTRICAL HEATING, ELECTRICAL RESISTANCE AND ELECTRICAL CONTACTS

This spec is being revised to include a standard method of test for Maximum Loading Stress at Temperature of Thermostat Metals (Cantilever Beam Method). The standard method for test for Flexivity of Thermostat Metals is being revised.

MATERIALS FOR ELECTRON TUBES AND SEMICONDUCTOR DEVICES

The tentative methods of Testing Sleeves and Tubing for Radio Tube Cathodes is being revised. It is also proposed to revise the tentative spec for Molybdenum Wire under 20 Mils in Diameter.

Resistors

MIL-R-11B, RESISTORS, FIXED, COMPOSITION (INSULATED), NOTICE-1 17 MAY 1956

The spec sheets previously required with this spec have been cancelled and replaced by "MS" Military Standards. The previous standard sheet MS91374, entitled "Standard Resistance Values with Corresponding Color-Code Markings" has also been cancelled.

MIL-R-19438 (NORD), PRECISION WIRE-WOUND VARIABLE RESISTORS, 1 MAY 1956

Accurate wire wound variable resistors having a maximum resistance tolerance of 2% are covered by this spec. These resistors are suitable for continuous full load operation at any ambient temperature up to 65 C (150 F).

Cables

MIL-C-19381 (SHIPS), CABLES, SPECIAL PURPOSE, ELECTRICAL, (NUCLEAR PLANT), 29 FEBRUARY 1956

Electric cable for operation in high ambient conditions aboard Naval vessels are covered by this spec. This type of cable must pass 24 hours at 500 F with no visual external derangement, such as end drip or sheath exudation.

Capacitors

MIL-C-3965, CAPACITORS, FIXED, ELECTROLYTIC (TANTALUM), 2 MAY 1956

Three specs MIL-C-14006 (Sig C), dated 21 March 1955, MIL-C-18211 (NAVY), dated 21 February 1955, and MIL-C-25102 (USAF), dated 2 September 1955 are superseded by this spec. This spec covers tantalum, electrolytic, fixed capacitors, polarized and nonpolarized, for use in filter and bypass applications requiring large capacitance values where close tolerances are not an important factor. Although the scope of this spec includes nonpolarized types, none are included at the present time. The basic style designation for these capacitors is "CL". Qualification approval testing will be required.

Standards

ASA Z24.17-1955, Design Construction And Operation Of Class HI (High-Impact) Shock-Testing Machine For Lightweight Equipment

By means of the standardized design of a shock-testing machine described in this standard, the ability of various types of equipment to withstand shock loadings may be compared. This standard does not attempt to establish criteria for acceptance or rejection of specimens shock-tested by the machine. The standard covers general design and construction, principles of operation, method of operation, and care and maintenance. An assembly drawing of the machine is included as well as views of the shock machine foundation and typical methods of mounting of test apparatus. Copies of this standard may be obtained from ASA for $1.00.

ASA Z24.18-1955, Ultrasonic Therapeutic Equipment

Suitable methods for calibration of the intensity and distribution of the ultrasonic beam produced by therapeutic equipment are recommended by this spec. The recommendations are in a form to permit both manufacturers and supervising agencies to provide proper labelling. This spec relates only to the physical characteristics of ultrasonic therapy equipment employing circular transducers in accordance with present practice. Included are terminology, safety and control, tolerances, calibration procedure, and labelling. Copies of this spec are available from ASA for $0.75.

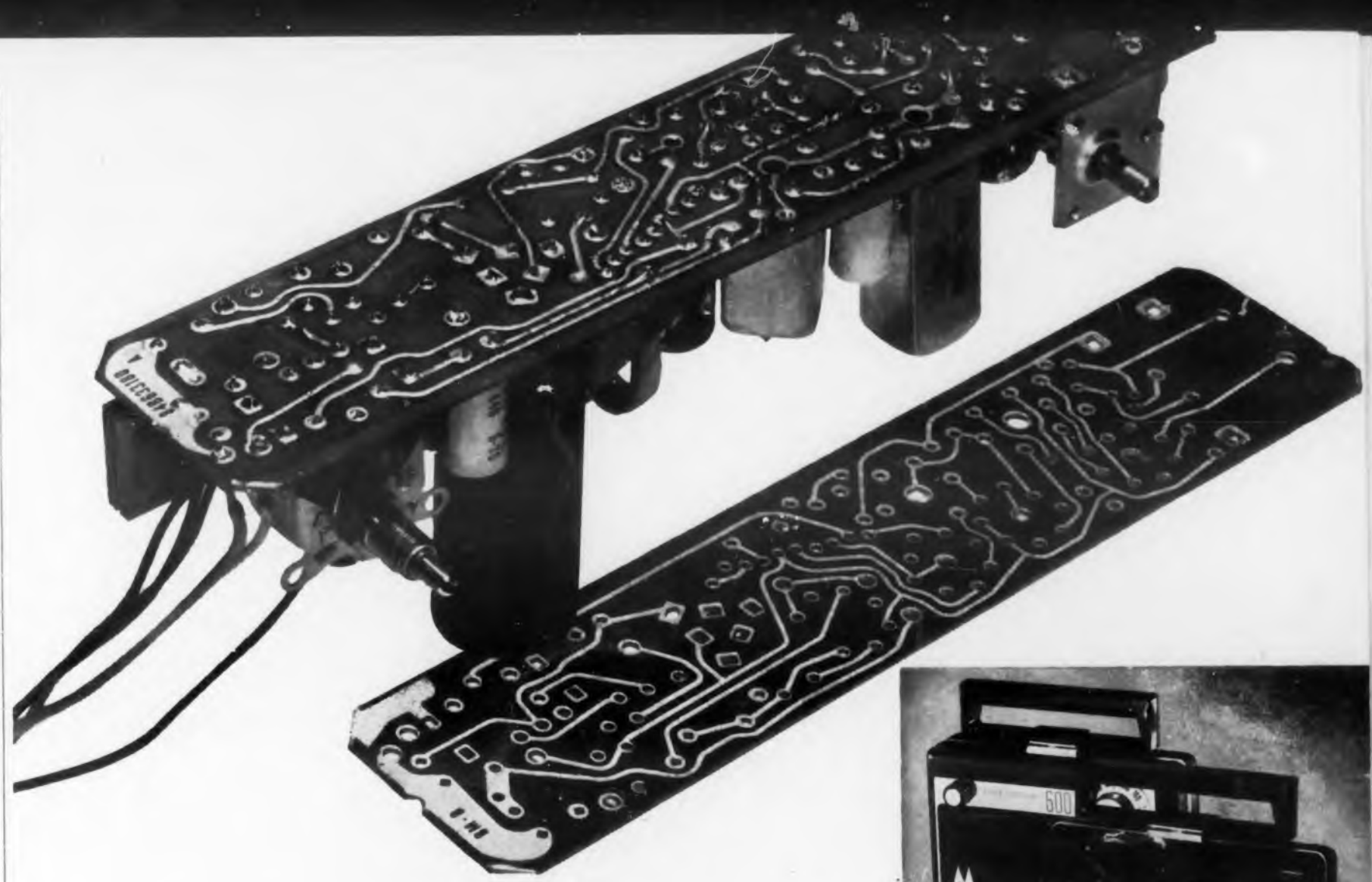
Lacing

MIL-T713A, Twine And Tape, Lacing And Tying (For Use In Electrical And Electronic Equipment), 11 May 1956

This revision supersedes JAN-T-713 and MIL-T-14014 (Sig C). Waxed nylon narrow tape and Type P waxed nylon twine have been added. Type VCR viscose rayon twine has been deleted. Tape has been added since it is less likely to cut through insulation. Waxed twine and waxed tape have been added since they are easier to tie. Cotton has been added as one of the materials that can be used in manufacturing Type N twine.

ADVERTISING INDEX

September 1, 1956



The Motorola "Ranger" achieves compact, sturdy construction and fast assembly with plated circuits on laminated stock produced by **Farley & Loetscher Mfg. Co.,** Dubuque, Iowa, using BAKELITE Laminating Varnishes.

What this resin does for Motorola's plated circuits

- **. . . gives a good base for bonding of copper firmly to the laminate**
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- **. . . withstands 500° F. heat of dip-soldering**
- **. . . results in a lamination that exceeds U. S. Government standards and NEMA specifications.**

All these advantages are found in BAKELITE Brand Phenolic Resin CLSA-3914, a superior hot punch laminating varnish used in the Motorola "Ranger" portable radio shown here. When high surface resistance is needed, CLSA-3914 is used on paper stock pre-treated with 12 to 16 per cent of a water-miscible resin, such as BAKELITE Phenolic Resin BLL-3913. Both XXXP and XXXP-1R grade laminates are produced by this method.

Technical information on BAKELITE Laminating Varnishes made especially for printed circuits is available by writing Dept. XX-00.

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RCA designs and produces a wide variety of ferrite products including memory cores, matrices, transfluxors, magneto-strictive cores, flyback "C" frames, and deflecting yoke segments.

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RCA manufactures one of the most comprehensive lines of yokes and flybacks for direct-view and projection, color and black-and-white kinescopes; high, low, and intermediate inductances with ferrite cores; ppi, target designator, military-TV, and resolver-type yokes for radar applications; yokes for image orthicons, flying-spot scanners, iconoscopes, monoscopes, and vidicons; auto-type, isolated secondary, and universal-type deflection transformers.

RELAYS

RCA applies manufacturing techniques similar to those used for electron tubes to produce relays for military and commercial applications—6pdt and 4pdt, rotary solenoid, hermetically sealed, miniaturized, high-speed types featuring welded construction; use of "getter" to absorb organic and metallic vapors for prevention of deterioration of contacts and to insure maximum insulation resistances.

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For information or assistance in the selection of RCA Electronic Components best suited to your applications, contact your nearest RCA District Office:

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