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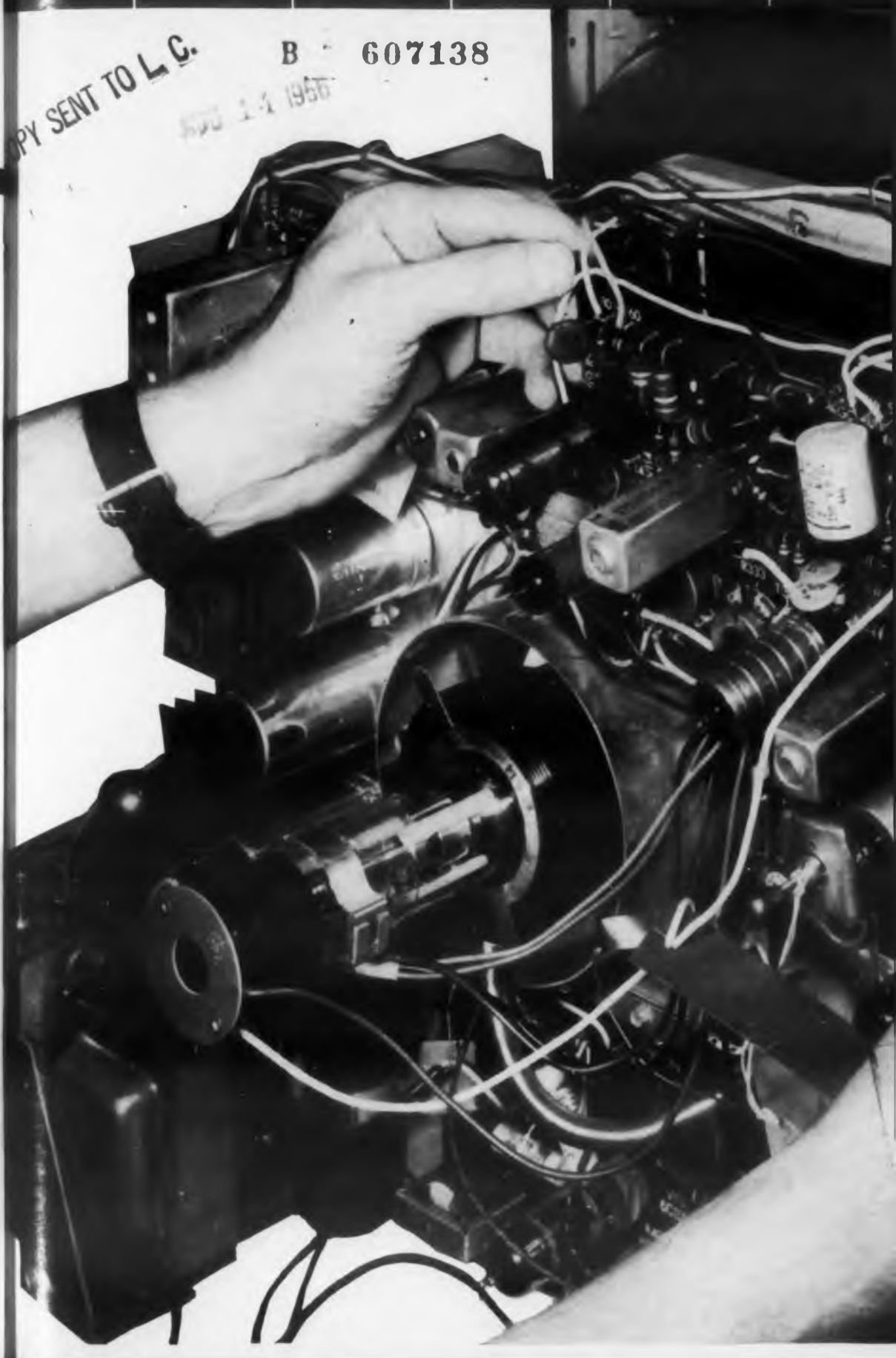

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CIRCLE 2 ON READER-SERVICE CARD FOR MORE INFORMATION

Editorial

Too Much Horsepower?

Engineers need to be fitted to their jobs, obviously. It's just as important as specifying the right tools or suitable electronic equipment for any project.

Unfortunately, there are some among engineering management that tend to evaluate a potential engineer employee only on whether he meets the minimum requirements of the job. Certainly he must be capable of that minimum. But a danger lies in hiring too-high quality talent for the required job.

Management certainly recognizes that a high-powered Ph.D. probably wouldn't be happy as a maintenance technician. Nor would he be too satisfied for very long as a machine shop expediter. These comparisons are too obvious. Other less obvious misfit conditions exist for several reasons.

First, management of an engineering department may have a somewhat overinflated opinion of the quality of the talent they think is required to develop their products. All too often they haven't taken the time to appraise themselves in that light, and therefore, may not know exactly what the requirements are. Even if they discover exceptional quality talent isn't necessary, they may hesitate to admit it.

Secondly, there is always the temptation to hire the most you can get for the money.

As a result, a 100-horsepower engineer on a 50-horsepower job will soon become unhappy. Subconsciously, he harbors a feeling that he can do much more than is required. But he feels restrained by the inherent limitations of the tasks assigned to him. In short order he leaves to find a position where he can utilize most of his talents and training and progress as rapidly as he wishes.

Careful evaluation of an engineer's background versus the job to be done is the responsibility of both the employer and the engineer himself. Good judgement will pay off for all concerned.

Electronic News

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

60-ft Steerable Antenna

To better study the characteristics of scatter propagation, Bell Telephone Laboratories have erected one of the world's largest precision microwave antennas at Holmdel, N. J.

The antenna, which is sixty feet in diameter, is accurately steerable. Built of aluminum, the solid surface is a paraboloid accurate to about 3/16 of an inch. The paraboloid alone weighs 5-1/2 tons and it, together with its supporting and steering structure, is designed to withstand 100 mile-per-hour winds.

Intended for use at frequencies of 460 and 4000 mc, the antenna was also tested at 9400 mc. Using calibrated pyramidal horns as standards, the gain was found to be 37.0 $\pm$0.1 db at 460 mc, 54.6 $\pm$0.2 db at 3890 mc, and 61.1 $\pm$0.5 db at 9400 mc. Half-power beam widths at these frequencies were 2.45, 0.3, and 0.14, respectively, very close to the computed values. Over-all performance, not only in gain and beam width but also in cleanness of the radiation patterns and in minor lobe structure, was excellent even at the highest frequency.

Million Bits Per Inch

An inch-square "honeycomb" developed by a General Electric scientist at Schenectady, N. Y., will store up nearly a million bits of information.

The heart of the tube is a thin sheet of glass in which small holes have been etched and then filled with metal. In practice, information is written onto one side of the honeycomb by a scanning electron-beam. A "reading gun" picks up the information from the opposite side. Early laboratory models have permitted storage for several minutes. It is expected that the time can be extended.

Since the holes in the honeycomb are spaced 500 to the inch, each square inch has 250,000 individual storage cells—and each cell will recognize at least 10 different levels of intensity from the writing gun. Logarithmic calculations increase to more than 800,000 the number of bits of information that can be stored at one time. (250,000 times log to the base 2 of 10.) Possible applications for the new storage tube, in addition to computers, include television cameras and "scan converters" in which radar information is collected and then displayed on an ordinary television screen.

The device, the invention of Dr. Harold R. Day, is believed to be the first mosaic scheme developed with sufficient resolution and ruggedness to be suitable for most applications.

Problems of "leaking" and "smearing" have been solved. The glass honeycomb acts as an insulator between the plugs and the surfaces layers—and between the plugs themselves.

The storage element of this "reading and writing" tube is in the thin hand-held mesh. Although they are not visible in the photograph, there are 250,000 holes in each square inch of the mesh, each filled with a recessed metal plug. The tiny honeycomb is electronically magnified on the television screen in the background. Nearly a million "bits" of information can be stored on one square inch of the thin glass which is expected to have wide use in "smaller computers with bigger memories."

Telescoping Antenna Mast

A completely new type of telescoping mast was introduced recently by Andrew Corp., 363 E. 75th St., Chicago, Ill. The mast is available in 30-, 50-, and 100-ft hydraulic or pneumatic models.

The mast is ideal for mobile radio, broadcast or microwave survey work, TV broadcast remote pickup and for emergency communications. The patented valve system incorporated into each model provides coordinated sequence of sectional elevation for quick and easy guying. The 100-ft mast may be raised to full extended height in 15 minutes. The 30-ft car-top model nests 18-in. above roof-top and is operated from the vehicle's electrical system. Pictured is the self-contained 100-ft portable model, complete with trailer.

Completely Electronic Savings Bank System

The first completely automatic electronic savings bank system ever built will be installed in the Howard Savings Institution of Newark, N.J.

CIRCLE 4 ON READER-SERVICE CARD

The system uses the techniques developed by the Teleregister Corp., 445 Fairfield Ave., Stamford, Conn., employing magnetic storage or memory drums and tapes to control accounts, print pass books, display uncleared check conditions, and "lock up" in the event of overdraft.

The principal advantage of this system is that the teller can have access to central inventory showing the status of any account, at any time, instantaneously, on demand. It is estimated that this will result in a 30% reduction in the teller's time required to perform a transaction, providing more rapid service to customers.

Sales Of TV Sets Go Down

TV sales are in a minor slump, according to a recent article in the N.Y. Times. Citing RETMA figures, the article reported black-and-white TV factory sales off 31,000 units in the week ending May 4th from the preceding week's 96,000.

Emerson Radio & Phonograph, seeing overproduction since Jan. 1, cut 500 employees "temporarily" to level off inventory. RCA reported sales "softened" more than expected after a record first quarter, but indicated no production slashes or layoffs. In Chicago, retail color TV sales were down, despite WNBQ's heavy schedule of color programming. From Washington, RETMA reported a rise in TV set production to 119,352 units for the week ended May 11th, compared with 111,667 a week earlier.

GE Increases Prices On Phenolic Molding Compounds

A price increase for phenolic molding compounds and shell resins was recently announced by General Electric Co.'s Chemical Materials Dept.

According to Dept. General Manager S. L. Brous, the new prices range from 1-1/2¢ per pound on volume purchases of standard, general-purpose molding compound, to 3¢ per pound on certain specialty molding compounds. Included in the increase is a 2¢ per pound rise in the price of shell molding resins.

CIRCLE 5 ON READER-SERVICE CARD ➤

Fairchild Receives $90 Million in New Orders

Fairchild Engine and Airplane Corp., Hagers own Md., has received approximately $90 million in new orders. The new major contracts include orders for the Fairchild C-123 assault transport; the Fairchild F-27, commercial turboprop transport; large Boeing B-52 component subcontracts; a new lightweight, higher performance jet engine for the Air Force; additional quantities of the J-44 jet engines; missile and radar equipment; and Stratos.

More Training in Atomics Urged

An increased number of students must be offered training in atomics at technical institutes to provide the required personnel to design, construct, operate and maintain this nation's nuclear reactors, Walter H. Neiman, Assistant Director of Training, RCA Institutes, said here today.

Speaking before a Conference of the American Society for Engineering Education at Iowa State College, Mr. Neiman declared that technical institutes have to expand their facilities for qualified science and engineering students who cannot be accommodated by our colleges. "Technical institutes may not be able to purchase atomic reactors, cyclotrons, syncrotrons, cosmotrons, or bevatrons," he said. "They can, however, instruct the theory and operation of these devices. There is a sufficient number and variety of equipment and experiments which can be used by technical institutes to train students in the field of science."

Ruggedized TV Camera

Model PD-152 TV camera has operated successfully under flight conditions with forces exceeding 15 g's in each of its three axes. Developed by Precision Laboratory, Inc., Pleasantville, N. Y., the camera is capable of withstanding humidity levels of 100% with extremely high wind velocities. Noise levels as high as 175 db and altitudes over 70,000 feet will not affect picture detail.

Eight Public Schools to be in Closed Circuit TV Net

Plans for installing the nation's first large scale closed-circuit television institutional program throughout an entire public school system has been announced by the Washington County, Md. Board of Education. The program will be instituted when school opens in September, with more than 6000 pupils in two high schools and six elementary schools receiving an important part of their daily instructions by television.

All necessary equipments for the school installations will be contributed by the nation's leading electronic manufacturers through RETMA. Funds to provide for the training of personnel and for supervising the program will be granted by the Fund for the Advancement of Education, an independent agency of the Ford Foundation.

Another closed circuit TV demonstration was recently conducted in the Philadelphia area at the Upper Darby High School through the cooperation of the Upper Darby Board of Education, the Jerrold Electronics Corp., and General Precision Lab., Inc. Jerrold installed a master antenna system which made it possible to show both the program originating within the building and commercial programs from three local stations. The antenna will receive either uhf or vhf signals.

Fruit and Nut Handler

An electric counting and control device, has been developed for the fruit and nut handling industries. Initial reports show a labor cost saving of 99 per cent. Two of these systems now at work totally automate production at two major citrus packing plants in California. A single operator now does the work of 38 at the electronically controlled packing bins; a second savings, the loss of great amounts of fruit due to the necessity to overpack, has also been corrected.

The units, developed by Walkirt Co., Inglewood, Calif., automatically start movement of fruit into box. Dials can be pre-set to any three digit number. When exact total is reached, the counter automatically stops fruit loading equipment, then starts conveyor belt which moves out the filled box. The electronic unit then automatically sets a new box into position for filling to prescribed number of fruit as determined by the pre-set dial. The system will shortly be used to pack nuts.

Correction

Weight for the R4100 series rotary actuators, manufactured by Airborne Accessories Corp., Hillside 5, N. J., was erroneously reported in our June 1 issue. The weight is actually 10 oz.

Industry Copes With Shortage of Electronic Engineers

One of the first attempts by American industry to cope with the shortage of electronic engineers by training skilled craftsmen to take over some of their tasks is described in a recent issue of the *Industrial Bulletin*, monthly magazine of the New York State Labor Dept. The article deals with the creation of a new apprenticeable trade called "electronic laboratory technician."

The program for the trade will aim at training men to build the electronic control box that regulates work and output on the automatic production line.

According to the *Industrial Bulletin*, up until now, companies in the electronics industry have been using full-fledged electronic engineers to do this type of work. The program was registered by the Edward Laboratories Co., Wapping Falls, N. Y., who design and manufacture electronic equipment used to test machine tool functions on automatic machines.

Silicon Becomes Cheaper

The price of pure silicon, was reduced $30 a pound last month by the Du Pont Co.

The reduction brings the price to $350 a pound. Four years ago silicon sold for $430 a pound. Difficulty in getting high purity will hold prices up and current modest drops are due to expanded manufacturing facilities.

RETMA "Medal of Honor" Awarded Paul V. Galvin

At the annual meeting of 700 RETMA members in June, Paul V. Galvin, president of Motorola, Inc., was presented with the 1956 Medal of Honor, the industry's highest award given an individual for outstanding service.

In making the presentation, RETMA president H. Leslie Hoffman said, "Paul Galvin's record in RETMA reads like a ship's log. He has been a director for 22 years, a vice-president three years, and a president for three terms. He has served on every important committee, and as a chairman

of most. His greatest contribution as a RETMA leader probably came during World War II when he had a leading role in mobilizing the infant electronics industry for national defense.

TV Sets Swamp New York Market

The New York market is swamped with TV sets dumped by manufacturers and others. The biggest dump was reported to be that of CBS-Columbia receivers, and dealers were said to be selling these for prices as low as $81 for a 17" table model and $95 for a 21" table model.

The inventory which changed hands as the result of the recent sale of the Capehart-Farnsworth Division by I.T. & T. went exclusively to Macy's, which is selling the sets for prices ranging up from $119 for a 21" table model.

Other inventories unloaded over the past few months include RCA, Philco, DuMont, and Emerson.

May Better Than April for Radio-TV

TV set sales in May were below the May 1955 level. However, a substantial increase was recorded by RETMA for radio set sales during that period. Both radio and TV sales were above the April level.

During the first five months of 1956, retail sales of television sets amounted to 2,428,888 compared with 2,772,648 receivers sold during the corresponding period a year earlier. Radio set sales during the first five months of this year, excluding auto sets, totaled 2,551,272 compared with 2,007,631 radios sold during the same period last year, RETMA said.

GE of Mexico To Produce $9.60 Radio Set

A contract for the manufacture of 250,000 radio receiver sets at a total cost of 27,000,000 pesos (2.16 million dollars) has been signed by GE of Mexico for delivery to the Radio Programas de Mexico. As part of the Mexican firm's 15th anniversary observance, the radios will be distributed throughout Mexico at a retail price of $9.60 each. The first 50,000 sets will be ready for distribution about Sept. 1st.

CIRCLE 9 ON READER-SERVICE CARD ➤

Radar Locates Tanker Planes

A high powered airborne radar beacon enables long range aircraft of the Strategic Air Command to locate each other and pinpoint the exact position of tanker planes. Signals can be triggered automatically by the interrogating radar of fuel-hungry Air Force planes to locate an individual tanker aircraft.

In air-to-air operations, the beacon is installed in designated rendezvous aircraft. Other aircraft wishing to "home" on the beacon dispatch interrogating radar pulses to trigger the beacon. In response to the proper interrogation signal, the beacon in the rendezvous aircraft transmits a coded reply. The operator of the interrogating radar is thereby able to identify the beacon-equipped aircraft, as well as to determine its exact range and bearing.

The new equipment was developed jointly by Wright Air Development Center and the Sperry Gyroscope Co. It has been successfully tested by the Air Force during the last two years.

Inchworm Motor Moves Linearly in Microinches

Intended as a successor to lead screws in feed mechanisms, this linear actuator gives close dimensional control—0.0000005- to 0.0001-in. The first large scale application is in the machine tool field and precision centerless grinders in particular.

The linear motor, developed by Airborne Instrument Laboratories in Mineola, N. Y., makes use of the magnetostriction effect. Expansions and contractions of the armature of the motor due to magnetic field change are converted to forward and backward motions by a pair of clamps. Direction can be reversed with no backlash.

Inchworm motor unit replaces conventional feed-mechanism. The motor repeatedly gives accuracy of ±5 millionths of an inch under machine load conditions requiring a break-loose force of 300 lbs and a sliding force of about 200 lbs.

Biggest Little Electronic Tube

Biggest little electronic tube in the world—that's the General Electric Co.'s description of the 80-ft water tower built at the new tube factory the company has under construction at Owensboro, Ky. This 200,000-gallon water tower was built to the proportions of a 6BK7. The tank is 84,000,000 times larger, by volume. Floodlights will make it visible to motorists on nearby Chicago-Florida Highway 231.

Solid Electrolytic Capacitors Won't Freeze

Capacitors using a new semiconducting manganese-dioxide instead of the usual liquid electrolyte will soon be available commercially.

Developed at Bell Telephone Labs., the electrolyte is largely free of aging, freezing or evaporation. Capacitors using the new material are extremely stable with temperature. Their small size is expected to lead to their widespread use in transistorized apparatus.

Anode of the capacitor may be any one of the film forming metals. Tantalum is preferred because of the excellence of its oxide film. It is also available in porous sintered form with a large surface to volume ratio.

Voltage ratings up to 35 v can be readily achieved. A 20 μf unit rated at 35 v occupies only 0.04 cu in. Smaller units can be realized at lower voltages.

Correction

On page 24 of the June 1st issue, Fig. 3 incorrectly shows logarithmic ordinates of 1.0, 10, and 100. These ordinates should be 10, 100, and 1000.

New "Atom Smasher" to Permit Advances in Physics Research

A new type of particle accelerator or "atom smasher" that will permit important advances to be made in fundamental physics research will be installed at Chalk River early in 1958, Atomic Energy of Canada, Ltd. announced.

To be known as the Tandem Accelerator, the 10-million-volt machine will be developed and constructed by High Voltage Engineering Corp. Chalk River physicists will study in continuous detail the nuclear energy level of heavy elements which they know only in patches today. Until the tandem-style Van der Graaf accelerator became feasible, it was possible to study only certain of the light atomic nuclei. It will now be possible to carry out research programs on heavy nuclei with an accuracy and efficiency never before possible.

The new machine consists of two specially designed Van der Graaf generators placed end to end in a horizontal position, giving the accelerator an overall length of 34 ft and a diam of 8 ft. The 35-ton accelerator will be mounted on a rail in an L-shaped building, 150 ft long and 60 ft wide. The building is to be located on a hillside so that the ground on one side will act as the shielding against high energy radiation. Thick concrete walls will shield the other side of the building. A separate building will house controls and service.

Beam of high speed particles produced by the tandem accelerator will be focussed and deflected in a series of powerful electromagnets into an area 25 ft from the accelerator. The machine will be equipped with a unique switching magnet that will make it possible to switch the particle beam into any one of five directions, depending on the type of study under way.

Closed-Circuit TV Aids Work Inside Furnaces

An RCA closed-circuit TV system which enables operators 150 feet away to see and control processing operations inside huge reheating furnaces is speeding and improving steel production at the Weirton Steel Co., Weirton, W. Va. A second TV installation provides operators up to 350 feet away with remote observation and control of steel slabs in transit on roller tables from the roughing to finishing departments.

Involved in the installation are: three ITV cameras, each positioned at the side of a reheating furnace in Weirton's Hot Mill, and connected by closed-circuit to a monitor in the furnace's remote-control booth, 150 feet away and around a corner from the cameras; a fourth ITV camera, mounted so that it scans a 350-foot roller table between the roughers and the finishing mills. The camera enables operators in the control booths of both the roughing train and the approach table of the finishing mill to see and make certain that the steel slabs are properly positioned while in transit between the two operations.

Washington Report

Albert Warren

Washington Trends & Briefs: ***Nickel,*** constantly plagued with scarcity, is now under Govt control as far as defense contractors are concerned . . . ***Pioneer Radio Arlington (Va.),*** Navy's 43-year-old communications benchmark and once the most powerful station in the world, has been silenced—superseded by modern facilities at Annapolis & Cheltenham, Md. . . . ***Tremendous expense*** of SAGE air-defense system is clearly spelled out in Senate report approving the expenditure: $1,086,000,000 in capital costs; $400,000,000 in annual operating costs . . . ***Industry's ideas*** on how to allocate frequencies for scatter communications will be accepted until Jan. 2, 1957, FCC extending deadline from July 1, 1956 at request of RETMA . . . ***Closed-circuit TV*** market could expand greatly, if experiment at Hagerstown, Md. public schools proves successful. The 5-year test, underwritten by Ford Foundation's Fund for Advancement of Education and RETMA, will link all 47 schools in county by cable or microwave. Speaking of the experiment for making maximum use of best teachers, RETMA Pres. Dr. W. R. G. Baker stated: "The industry is going to learn a great deal as to the requirements of the system. We don't know what education needs in the way of equipment. Like any research project, it's impossible to evaluate the end results, impractical to estimate the cost. All we can do is start."

Dangerous Legislation? . . . ***"Serious impact"*** on small manufacturers was foreseen by RETMA counsel Glen McDaniel as he testified against 2 bills (S. 11 & H.R. 1840) before Senate anti-trust and monopoly subcommittee. The bills would prohibit manufacturers from cutting prices to one customer, in order to meet competition, while maintaining prices to other customers. His illustration: "If I am a small manufacturer selling to a distributor who is my customer and a competing manufacturer seeking to strengthen himself in that territory offers a lower price to my customer, under the law as it now exists I could lower my price to that customer to meet the price offered by my competitor, without reducing my price to all my other customers, if I could prove my good faith and all the other elements required by Sec. 2(b) of the Clayton Act. If, however, S. 11 and H.R. 1840 are enacted into law I could not lower my price solely to that customer in order to hold his business because my doing so might lessen competition. If I have to lower all my prices or lose the customer, I am confronted with a hard choice. In many cases I will not feel able to afford the financial risk involved in lowering all my prices. So I choose to lose the customer—a course that is the lesser of 2 evils."

Letters to the Editor

Dear Mr. Grazda:

May I take this opportunity to congratulate you on your excellent publication. It goes far beyond mere utility in bringing new products to the attention of designers. Your many interesting departments, particularly "Features," "Russian Translations," and "Abstracts," have made ELECTRONIC DESIGN required reading for me. My congratulations on your progressive editorial policy.

As I and my colleagues frequently use the back issues for reference, I have managed to maintain a fairly complete file starting with your first issue. However, the October 1955 issue has proven so popular that it has gotten away from me. I am hoping that you have a copy available which you would send me. Thanking you in advance, I am

C. E. Parker
U. S. Naval Air Missile Test Center
Point Mugu, Calif.

Ed—Reader Parker may be buttering us up just to get a new extinct October issue, but we are prone to such flattery and sent along a soiled office copy.

Corrections

Dear Sir:

Thank you very much for the May 15th issue of ELECTRONIC DESIGN and for the check.

An error on the schematic diagram (Fig. 3, p. 42) has been called to my attention by a correspondent. The rotor connection to the bottom wafer switch should be broken and this rotor reconnected to the 113 v terminal of the battery BT_1.

. . . one additional error in the article, and one place where editing or type setting was in error, is equation 4, p. 43. There should have been a plus sign instead of an equal sign in the denominator between the 1 and $4R_L/P$. On p. 45 below equation (3) there should have been a comma or semicolon in the line reading $= 0$ for $\Theta = 1$; $= 0$ for $\Theta = 0$ . . .

O. M. Salati
Assistant Professor of E. E.
University of Pennsylvania

Gentlemen:

Would you please send the derivations (Equation items) relating to the article on Hybrid Parameters for Grounded Emitter Amplifiers with Feedback. The article referred to is by Robert L. Riddle in your volume 4, April 1st issue.

ELECTRONIC DESIGN is probably the most read magazine in our Engineering Department.

Dayle R. Smith
C. C. Ryan Co.
Minneapolis, Minn.

Ed–How important are derivations to *you*? A few months back we made the assumption that you, the practising design engineer, are mostly interested in working equations and that rather than derivations you would prefer the columns of ELECTRONIC DESIGN taken up with material of the "essential-to-know" variety. For that reason we decided to not publish lengthy derivations but to supply them only to those who specifically asked for them. Actually only a fraction of a per cent of those who read an article ask for derivations and we feel our premise not to publish them was sound. However, it is just as much work to mail derivations as it is to publish them and if you think they're nice to have at the exclusion of other data we'll try to abide by your decision. What do you think? Send a letter or post card now.

Dear Sir:

The European picofarad referred to in ELECTRONIC DESIGN, Feb. 15, 1956, page 117, should be 10^{-12}, not 10^{-9}. In the diagram, a blocking capacitor between the triode plate and diode plates of the second tube is missing.

R. O. Deck
652 Second Ave.
San Bruno, Calif.

ED–Reader Deck is right. We erroneously jumped to a conclusion after studying an ambiguous circuit that 10^{-9} was a Russian deviation from European practice. A picofarad is 10^{-12} farads.

Meetings

Aug. 20-21: National Telemetering Conference, Biltmore Hotel, Los Angeles, Calif. Sponsored by the IRE, AIEE, Institute of the Aeronautical Sciences, and the Instrument Society of America. Papers will be presented on novel industrial or military applications of telemetering in remote measurement systems, flight test data, remote guidance systems, remote monitoring, and air traffic control. New component developments such as transducers, multiplexers, data recorders, transmitters and receivers, pickoffs, and telemetering filters will be discussed. For information, write to IRE, 1 E. 79th St., New York, N. Y.

Aug. 20-24: Conference on Scientific and Technical Writing, Philadelphia, Pa. Sponsored by the University of Pennsylvania Institute for Cooperative Research. The conference, open to scientists, engineers, editors, writers, and administrators, will provide advanced study and experience-sharing in the art of making technical literature readable. The fundamental problems involved in the communication of technical information will be analyzed, and current systems for handling these problems will be evaluated. For information and applications, write to Dr. Harry F. Arader, 3400 Walnut St., Philadelphia 4, Pa.

Aug. 21-24: Western Electronics Show and Conference, Los Angeles, Calif. Sponsored by the Los Angeles and San Francisco Sections of the IRE and the West Coast Electronics Manufacturers Association. For information, write to Mrs. Jeanne W. Jarrett, WESCON, 344 N. La Brea Ave., Los Angeles 36, Calif.

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. 24-25: Industrial Electronics Conference, Cleveland, Ohio. Sponsored by the Professional Group on Industrial Electronics, IRE. For information, write to G. P. Bosomworth, Firestone Tire & Rubber Co., Engineering Laboratory, Akron 17, Ohio.

Sept. 26-30: *New York High Fidelity Show,* Trade Show Building, New York, N. Y. Sponsored by the Institute of High Fidelity Manufacturers. The Audio Engineering Society will hold its annual meeting at the show. For information, write to Jack Gilbert Associates, 1186 Broadway, New York 1, 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 Road, Toronto 12, Canada.

Oct. 1-5: *AIEE Fall General Meeting,* Chicago, Ill. 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,* Hotel Willard, Washington, D. C. Theme of the meeting is "Standards—Guides for Tomorrow." Sessions are scheduled on standardization in the chemical industry, standards and the atomic energy field, the future trend of standards in the metals field, and creative engineering and standards. For information, contact the Standards Engineers Society, P.O. Box 281, Camden, N. J.

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. The submission of papers on associated topics is invited. Titles, authors, and a brief abstract of 200 words should be submitted to Fred Moskowitz, 1014 N. Madison St., Rome, N. Y., before July 1. For information, write to R. C. Benoit, Jr., 138 Riverview Parkway N., Rome, N. Y.

Oct. 16-18: Conference on Magnetism and Magnetic Materials, Hotel Statler, Boston, Mass. Sponsored by the AIEE, IRE, American Physical Society, Amercian Institute of Mining and Metallurgical Engineers. Authors should submit titles of proposed papers by June 15 and abstracts by August 1. 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.

Oct. 22-24: AIEE Machine Tool Conference, Sheraton Gibson Hotel, Cincinnati, Ohio. For information, write to AIEE, 33 W. 39th St., New York 18, N. Y.

Oct. 25-26: Second Annual Technical Meeting of the IRE Professional Group on Electron Devices, Shoreham Hotel, Washington, D. C. Titles and abstracts of 100-200 words on papers to be offered for presentation should be submitted to R. L. Pritchard, Research Laboratory, General Electric Co., Schenectady, N. Y., before August 1. For other information, contact Prall Culviner, Sylvania Electric Products, Inc., 1740 Broadway, New York, N. Y.

Oct. 29-30: Third Annual East Coast Conference on Aeronautical and Navigational Electronics, Fifth Regiment Armory, Baltimore, Md. Sponsored by the Baltimore Section and Professional Group on Aeronautical and Navigational Electronics of the IRE. Theme of the conference is "Electronics in the Jet Air Age." For information, write to W. D. Crawford, Publicity Chairman, Westinghouse Electric Corp., Air Arm Div., Friendship International Airport, Baltimore 27, Md.

Nov. 7-9: Conference on Electronic Technology in Medicine and Biology, Governor Clinton Hotel, New York, N. Y. Sponsored by the AIEE, IRE, Instrument Society of America. For information, write to AIEE, 33 W. 39th St., New York, N. Y.

Nov. 26-30: *Third International Automation Exposition*, Trade Show Building, New York, N. Y. Clinic sessions will be offered in electronic computers, process automation, machine tool automation, office automation, automatic materials handling, servomechanisms, electromechanical components, and electronic components. More than a hundred exhibitors will participate in the clinics. For information, write to Richard Rimbach Associates, 845 Ridge Ave., Pittsburgh 22, Pa.

Oct. 29-Nov. 2: *Convention on Ferrites*, London, England. Sponsored by the Institution of Electrical Engineers. Program will include sessions on theory, preparation, and properties of ferrites, microwave application, square loop applications, radio and TV applications, and carrier frequency applications. For further information, write to W. K. Brasher, Secretary, Institution of Electrical Engineers, Savoy Place, London W.C. 2, England.

Dec. 5-7: *Second IRE Instrumentation Conference*, Biltmore Hotel, Atlanta, Ga. Sponsored by the Professional Group on Instrumentation and the Atlanta Section of the IRE. Sessions will be devoted to industrial applications, missile range instrumentation, and the application of solid state devices. Prospective authors are invited to submit abstracts of 200 words or less not later than Sept. 1 to the program chairman, M. D. Prince, Engineering Experiment Station, Georgia Institute of Technology, Atlanta, Ga. For further information, contact the IRE, 1 E. 79th St., New York, N. Y.

Dec. 10-12: *Eastern Joint Computer Conference*, Hotel New Yorker, New York, N. Y. Sponsored by the IRE, AIEE, Association for Computing Machinery. "New Developments in Computers" is the theme of the meeting. In addition to an extensive program of technical papers, the meeting will feature exhibits by many manufacturers in the computing field. For information, contact Al Forman, Room 639, 480 Lexington Ave., New York 17, N. Y.

Jan. 14-15, 1957: *Third National Symposium on Reliability and Quality Control in Electronics*, Hotel Statler, Washington, D. C. Sponsored jointly by the IRE Professional Group on Reliability and Quality Control, the American Society for Quality Control, and RETMA. For information, write to IRE, 1 E. 79th St., New York 21, N. Y.

Tubes for Direct Digital Counting

Philip Cheilik*

Federal Telecommunications Laboratories, Nutley, N. J.

THE INCREASED importance of digital computers and the use of digital techniques in other fields of electronics, such as radar and communications sampling systems, has led to a search for new counting and switching techniques. Until recently it has been necessary to use binary counters and then make binary-to-decimal conversion. The search for simplified methods has led to the development of one-envelope counting tubes, which are usually direct decimal devices. Five of these tubes will be discussed here and are: 1. the Philips tube; 2. the Burroughs beam switching tube; 3. the cold cathode bi-directional glow transfer tube; 4. the cold cathode uni-directional glow transfer tube; and 5. the IBM tube. There are two general types of counting tubes—*the cathode-ray tube*, of which the Philips and Burroughs tubes are examples; and the *glow-transfer tube*, where a cold cathode glow is caused to settle consecutively on various cathodes.

The Philips Tube

The Philips Tube (Fig. 1A), one of the earliest types, is perhaps the most complex. Circuitry required for its operation is quite critical, and it is necessary to use light sensitive elements (i.e., photocells or photodiodes) in order to take off output signals. It is a cathode-ray tube in which the beam is shaped to resemble a narrow ribbon. The beam is deflected in a horizontal plane and has ten stable positions. In each of these positions it passes through one of the ten apertures in a slotted electrode. Some of the beam electrons pass through corresponding slots in the anode and impinge upon the fluorecent material with which the envelope of the tube is lined. This causes a luminous mark to appear and indicates the position of the count.

Referring to circuit Fig. 1B, assume application of a slow rising input waveform to *D*. The beam will tend to move to the left, resulting in the slotted electrode intercepting more of the beam. This causes the anode current to decrease, increasing anode voltage. Since the right deflection plate is connected to the anode, its voltage increases also. The circuit is so arranged that the increased voltage on the signal deflection plate is accompanied by the same change on the other plate, maintaining constant beam position.

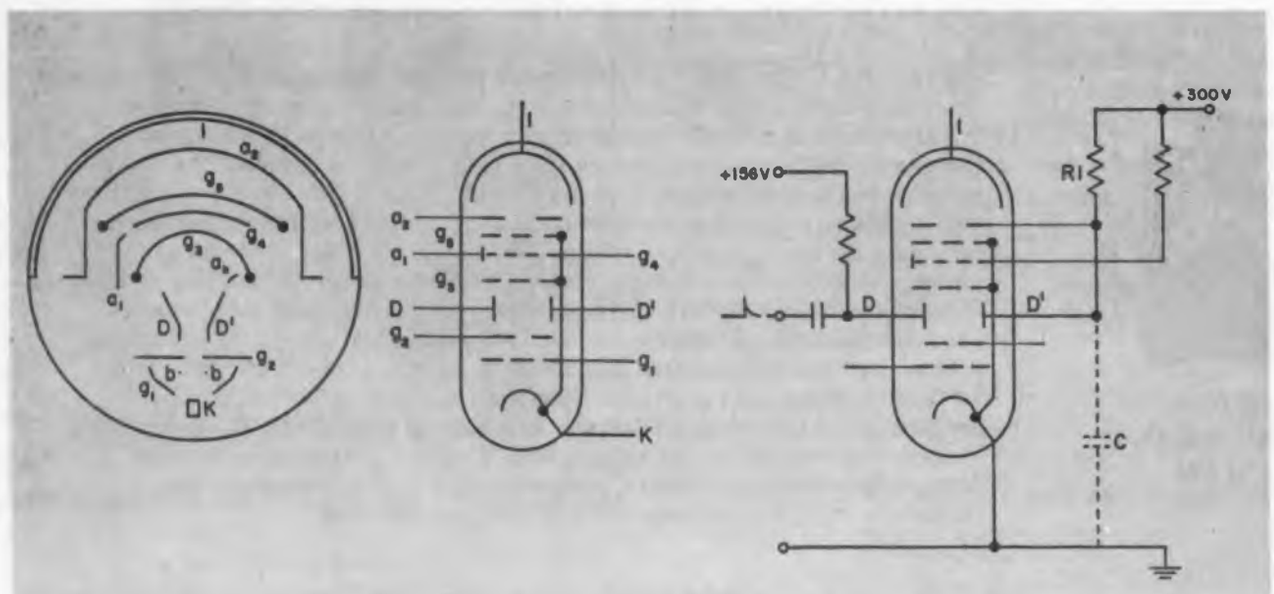
When a positive pulse of the fast rise time shown is applied, the voltage across *R1* cannot decrease instantaneously because of capacitance *C*. Hence, the voltage of *D1* cannot change rapidly. The beam is thus displaced to the left over a distance corresponding to the amplitude of the pulse, which should be exactly the right magnitude to shift the beam to the next slot.

If the pulse is caused to delay slowly, the beam will remain in its new position. On succeeding pulses the beam moves further left. After reaching its extreme left position, the next pulse will shift the beam to the reset anode (*a*). This causes a pulse to appear in an external circuit (not shown), which produces a pulse on the deflection plates so that the tube is reset to the zero position.

The Burroughs Tube

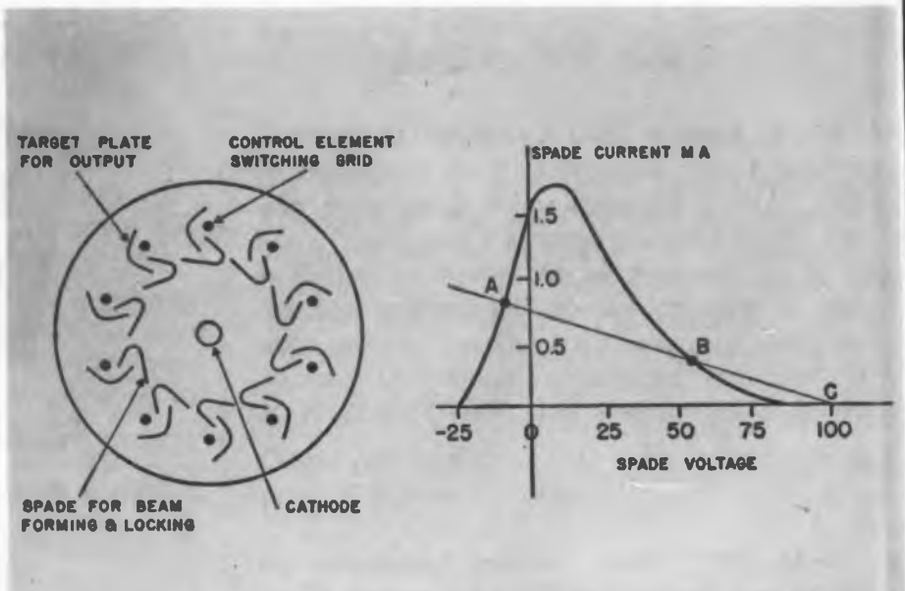
The Burroughs tube is also a cathode-ray type, but uses the beam forming properties of crossed electric and magnetic fields. The magnetic field is supplied by

*Formerly, Electronic Computer Div., Underwood Corp., Long Island City, N.Y.



A. Element configuration B. Circuit

Fig. 1. Philips Tube



A. Configuration B. Spade characteristic

Fig. 2. Burroughs Tube

an external permanent magnet, which is fitted over the tube. The construction of the tube is shown diagrammatically in Fig. 2A. It consists of ten groups of electrodes surrounding a central cathode, each group consisting of: 1. a spade to form and lock the beam; 2. a grid to switch the beam, and 3. a target from which one gets an output.

There are ten stable states to the tube during each of which an output can occur from a different one of the ten targets. There is also an all-clear stable state during which no output occurs on any target. Fig. 2B indicates the stable and unstable states for spade current. When the tube is in the clear position, all the spade voltages are highly positive with respect to the cathode. By lowering the voltage on any one spade, with a suitable series load, it will assume its other stable state (that which is near cathode potential). This causes a beam to form to that spade, by affecting the relationship between the electric and magnetic fields. The associated target will thus give a useful output since most of the beam current does not hit the spade but goes to the target.

A voltage drop on the associated switching grid will cause the beam to be deflected enough so that the next spade draws some current. This causes it to assume its other stable state. As the current to this spade increases, the voltage on the previous spade increases, since it draws less of the beam current. This is a runaway condition and ends with the first spade at high potential stable state and the second spade at low potential stable state. The beam has now shifted to the second spade, so that an output is now obtained from the second target. Since the switching grid affects only a local disturbance in the field, the beam will be affected only if it is in the immediate region of that grid. We can thus connect alternate grids in two groups, all odd and all even grids being connected together. Only a binary device is thus required, such as a flip flop, to cause the tube to count input pulses.

Bi-Directional Glow Tube

The bi-directional glow transfer tube consists of a central anode disc, surrounded by 30 pins (for a ten count tube) in a circular arrangement (Fig. 3). Of the thirty pins, ten are cathodes and twenty are guides. Between successive cathodes there are two guide pins, each going to a separate guide bus. The tube is symmetrical about its center, so that if we start at any cathode (say *K1*) and travel in a peripheral manner, we pass the following sequence of pins: *K1, G1, G2, K2, G1, G2, K3 . . . K1.*

An arc is formed to one of the cathodes at random when the voltage is turned on and when no external signals are applied. To cause the tube to count, a large negative pulse is applied to one of the guides, immediately followed by a negative pulse on the second guide. This will cause the arc to transfer to the next cathode. If the order of pulsing is reversed, the tube will count in the opposite direction.

The mechanism of glow transfer occurs in the following manner: When a negative pulse is applied to guide pin *G1* nearest to cathode *K1*, the voltage difference between anode and *G1* is much greater than that between anode and cathode and the arc will transfer to *G1*. A negative pulse on *G2* following the one on *G1* then causes the arc to transfer to nearest pin *G2*. When the second pulse disappears, both guides will rise to a high positive potential because of the guide currents in the large guide resistors, and the arc will transfer to *K2*, the nearest cathode. This action completes one count.

Uni-directional Glow Tube

The uni-directional glow-transfer tube is a variation of the one just discussed. It is similar in appearance to the bi-directional tube but has three guide pins between successive cathodes (Fig. 4). Negative pulses are applied through a high resistance to the first guide and directly to the second guide. The third guide is connected to ground through a high resistance.

The first two guides are normally biased positive with respect to the cathodes. When an input negative pulse arrives, the glow is transferred from the cathode to the nearest *G1*, causing that guide to draw current. This causes its voltage to rise, because of current in its resistor. When the voltage rises high enough, the glow transfers to the second guide because the pulse is still present. When the pulse is removed, the second guide rises to its normal positive bias, causing the glow to move to the nearest non-positive point. This is guide 3. However, since this guide has a high resistance to ground, the voltage in it will rise due to the glow current, and the glow will finally settle on the nearest non-positive point, the next cathode. This completes one count.

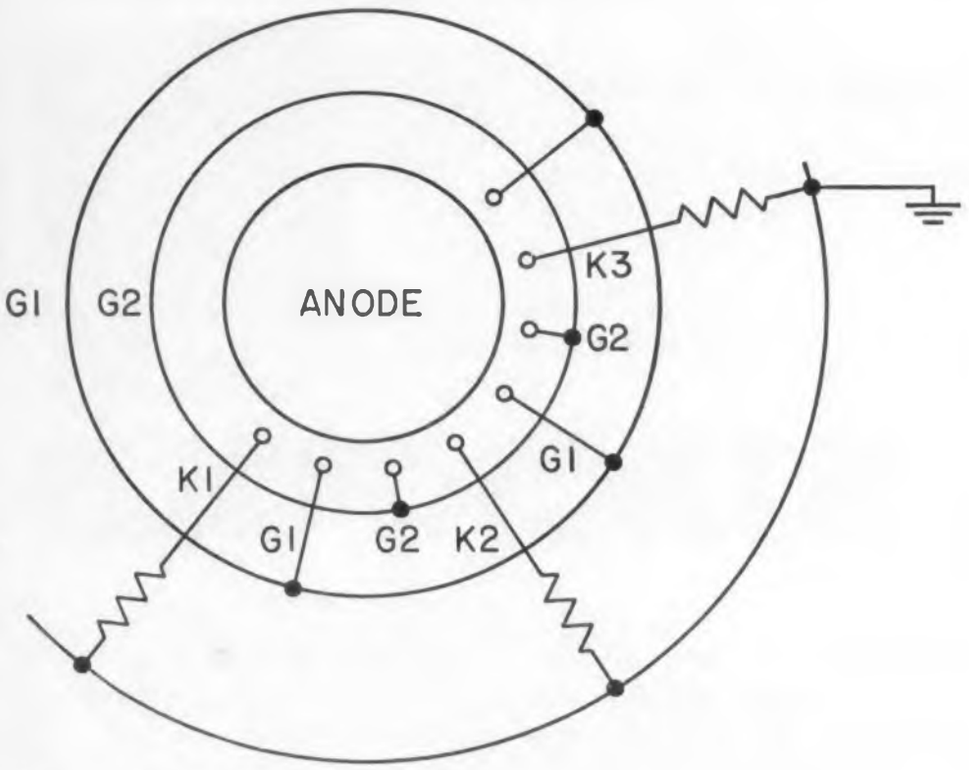


Fig. 3. Basic structure of bi-directional glow-transfer tube

The IBM Tube

The principle of the IBM tube (Fig. 5), is different in that it uses cathodes of two different materials to achieve the transfer of the glow. It also has provision for obtaining the nine complements of any number by inserting an appropriate pulse. Each cathode consists of a hollow cylinder with a whisker or transfer wire attached. All odd cathodes are connected to ground through signal takeoff resistors.Even cathodes are connected to a positive supply.

A glow is formed to one of the odd cathodes since the even ones are at a high positive potential. As the voltage at point *C* is pulsed negative, a glow forms to transfer wire *T2* because it is in the region of the glow to *K1*. This then spreads from *T2* over the surface of attached cathode *K2*. The glow will locate inside the cylinder since the outer surface of the cathode is insulated. The cylinder material has a lower work function than that of the transfer wire so that the voltage between *K2* and the anode will be less than that required to maintain the glow on *T2*. Thus, the glow on *T2* becomes extinguished.

As the voltage at *C* continues to be decreased, the anode voltage will go down. (This is because the glow voltage drop must remain constant). This will cause the glow on *K1* to be extinguished. As the pulse disappears, the voltage at *C* rises. Located in the region of the glow, *T3* will pick it up since the anode voltage has risen an equal amount with *C*. From *T3* it will spread into *K3* and leave *T3*. Also; since C is high, the glow to *K2* extinguishes. This completes one count. There are ten cathodes and ten transfer cath-

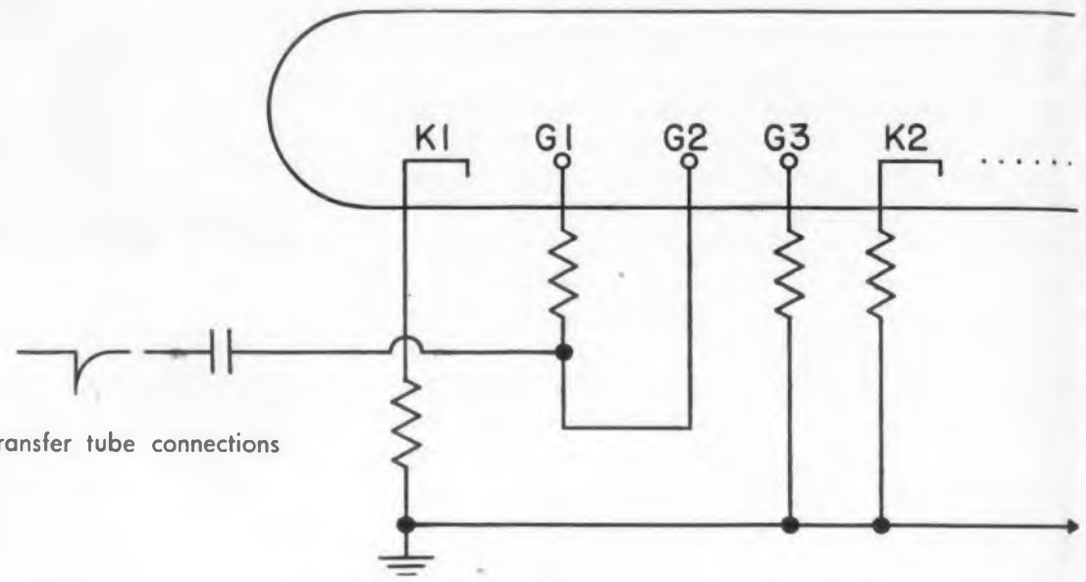


Fig. 4. Uni-directional glow-transfer tube connections

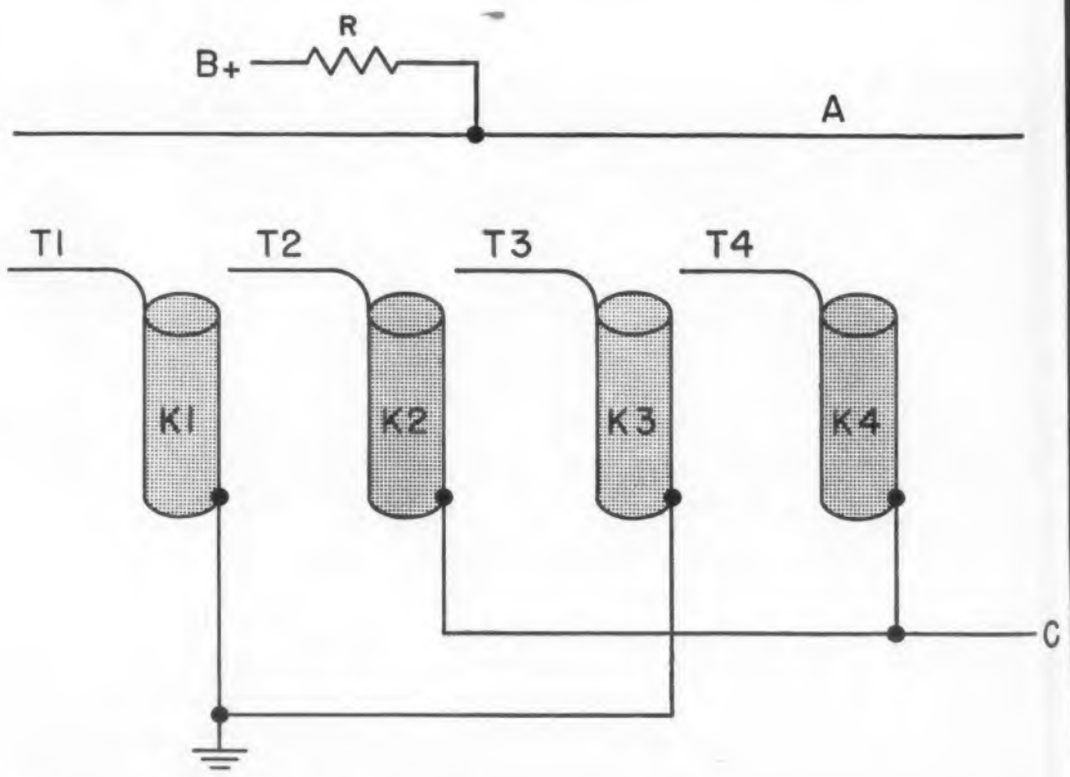


Fig. 5. Cathode configuration for IBM Tube

odes. The internal arrangement of the tube is such that nines complement cathodes are opposite each other. There are ten additional complementing transfer cathodes, two between each nines complement pair so that by applying a pulse, the glow may be transferred to the complement in either direction, giving the nines complement of any number.

Application

The Philips tube seems most suited as a display or indicating device. For instance, it may be used at a remote point to indicate the specific operation being performed at any time during the cycle of an automatic factory process. A number of tubes may be used together to indicate any specific count in an automatic counting process. The number of tubes required is determined by the maximum count. For a count of 999, three tubes are required; for 9999, four tubes, etc.

Both the bi-directional and the uni-directional glow transfer tubes indicate the position of a count, so they also may be used as indicating devices. However, both of these types give output pulses, so they may also be used as control devices. For instance, if it is required to initiate an operation after another process has been repeated ten times, an output can be taken from the tenth cathode to operate the appropriate control circuit. A very important use for these tubes is for switching at any rate up to 5 kc.

A central clock pulse is fed to the input of the tube, and control circuits for the various processes to be initiated are connected to the output cathodes in the correct serial order. If number of processes is less than ten, the output pulse from the last process can be used to reset the tube. If the number of operations is more than ten, a number of tubes can be used.

The IBM tube is a specialized version of a glow transfer tube. Its main application is in accounting machines where it is advantageous to be able to obtain the nines complement of a number. This is useful in arithmetic operations, such as subtraction. The use of this tube in desk type calculators would considerably speed operations which have previously been done by mechanical counters.

The Burroughs tube is the only one of the types discussed which is applicable to any extent in high speed computers. This is because it can count at speeds up to 1 Mc. This tube may be used as a central distributing source for clock pulses, or it can be used as an output frequency divider to facilitate slowing down of output data for typing.

Fields of application of these tubes are ever increasing. In addition to their obvious uses in switching, counting, and indicating, they can be used as safety interlocks to monitor various critical processes. Also, in combination with a central oscillator, they can be used for timing. The use of these tubes has made it possible to develop circuits with a reduction in components.

△ Random Noise Si

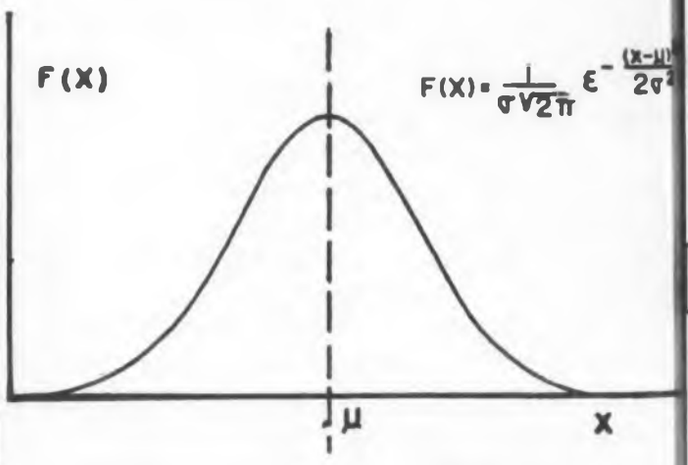
TWO important properties of noise are its frequency spectrum and amplitude probability distribution. These two functions can be authentically duplicated with this new signal generator designed for the study of noise effects on electronic systems.

Amplitude of a random noise signal at any particular instant of time is determined solely by the probability considerations. Certain average properties of the signal can be predicted from past experience over long periods of time. These properties of the random noise signal permit the construction of a noise signal generator based upon probability and statistical methods. Made by Intercontinental Dynamics Corp., 407 Grand Ave., Englewood, N. J., the instrument generates a random signal voltage with Gaussian amplitude probability distribution and a flat "white" power frequency spectrum from 0 to 100 cps.

Basic noise source is a gas tube placed in a transverse magnetic field produced by a small permanent magnet. The magnetic field eliminates undesirable plasma oscillations characteristic of gas tubes and increases noise output of the gas tube generator.

Output is fed into a wideband video-type shaping amplifier. Frequency response of the amplifier is designed to equalize the noise tube characteristics.

Gaussian amplitude distribution is obtained by passing the "white" video amplifier through a band-pass filter, sampling its characteristic and



Gaussian Distribution

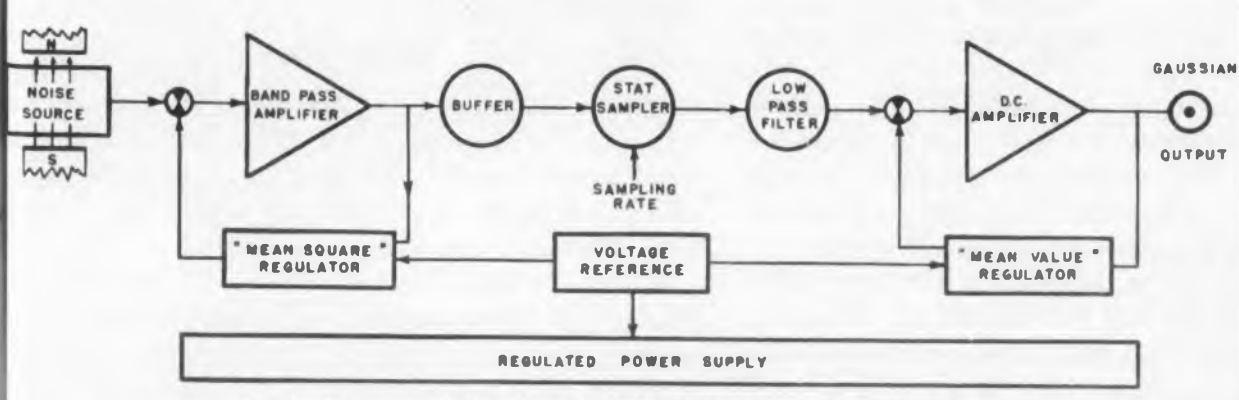
Noise amplitude probability distribution of the G-1000.

Signal Generator

then translating the spectrum with its origin about zero frequency. Low frequency Gaussian probability amplitude distribution thus generated is authentic to better than 2 per cent.

Other characteristics of the unit, designated G-1000, include a frequency response from 0-1000 cps in three steps; drift rate less than 20 mv per hour; white noise produced for all band settings with a power frequency spectrum within 1 db from 0.1000 cps. For more information turn to Reader's Service Card and circle 22.

Wescon Show, Booth Nos. 1331-1332.



Block diagram of the Model G-1000 random noise generator.

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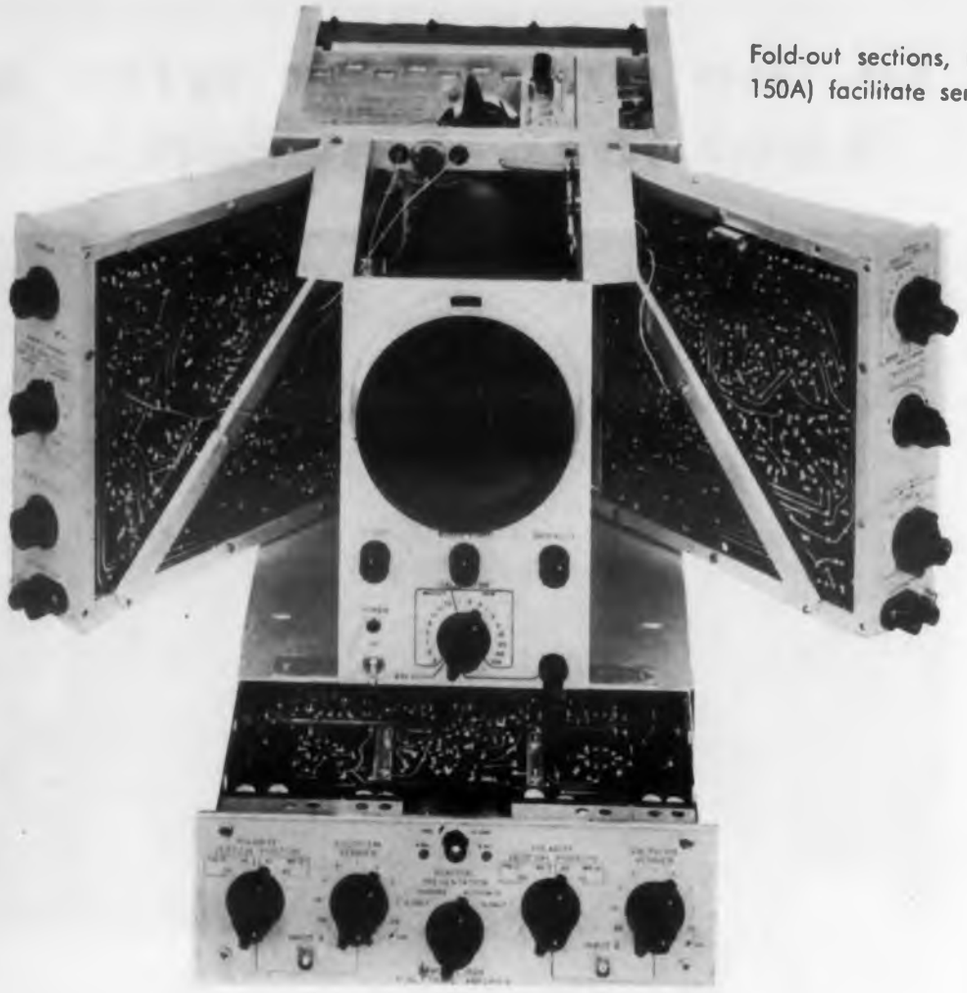


Fold-out sections, (Model 150A) facilitate servicing.

△ All New Oscilloscopes

Feature

Easy-To-Use Usefullness

Design Forum

ENGINEERS will be interested in studying these two all-new oscilloscopes displayed here, if for no other reason than see what kind of devices would be developed by a reputable instrument company first entering the oscilloscope field.

Two units have been announced: a general purpose dc to 300-kc instrument, Model 130A, and a high frequency unit, dc to 10-mc, Model 150A. Careful thought was given to versatility and operating simplicity. The units also feature accessibility for easy maintenance and therefore long term dependability.

Model 130A

Features of the Model 130A make it a true measuring device capable of accurate determination of such quantities as voltage, time and phase shift.

Both the vertical and horizontal amplifiers are identical. This design is of considerable value where phase shift measurements are to be made because very little differential phase shift occurs in the oscilloscope. Generally speaking the scope has no differential phase shift below 100 kc and even at 600 kc the differential phase shift can be held to a few degrees if the horizontal and vertical sensitivity controls are placed at equal settings and minor adjustment made with the sensitivity verniers. This feature lends itself well to an adaptation of the Webb-mask described for phase shift measurement in the January 15, 1956 issue of ELECTRONIC DESIGN.

The frequency response is conservatively rated and the bandwidth actually gives a rise time for the amplifiers of about 1 microsecond. Frequency insensitive attenuators preserve this bandwidth for all sensitivity settings even to the 1-mv/cm range. When the sensivity verniers are in the CAL positions the attenuator calibration is ± 5 per cent.

A high order of dc stability is achieved in the amplifiers through the use of balanced circuitry using twin tube types, low temperature coefficient wire wound resistors, and regulated plate and filament supplies. Tests show this stability to be less than $\pm .15$ mv for violent line voltage variations from 105 to 125-v ac when the amplifiers are on their most sensitive range. Improvement of this is experienced by employing less sensitive ranges.

Balanced inputs on its five most sensitive ranges will accomodate low level transducers which employ balanced outputs.

Accurate measurement of time is possible with a triggered sweep design with a linear sweep generator (Miller-integrator type). In this case a triggered sweep is distinguished from the more common synchronized sweep in that the triggered sweep speed can be accurately set, and it can be triggered at a known point. This coupled with the fact that the sweep times are selected on one calibrated dial ($\pm 5\%$) in 24 steps from 1 μsec/cm to 5 sec/cm makes the Model 130A unique in its price range.

The trigger circuit employs a preset feature which provides automatic internal triggering, and at the same time permits control of the trigger level at which the automatic triggering occurs. In the preset position with the trigger level at zero, and slope in either + or −, the scope will sync as soon as the input signal is applied with no further adjustment.

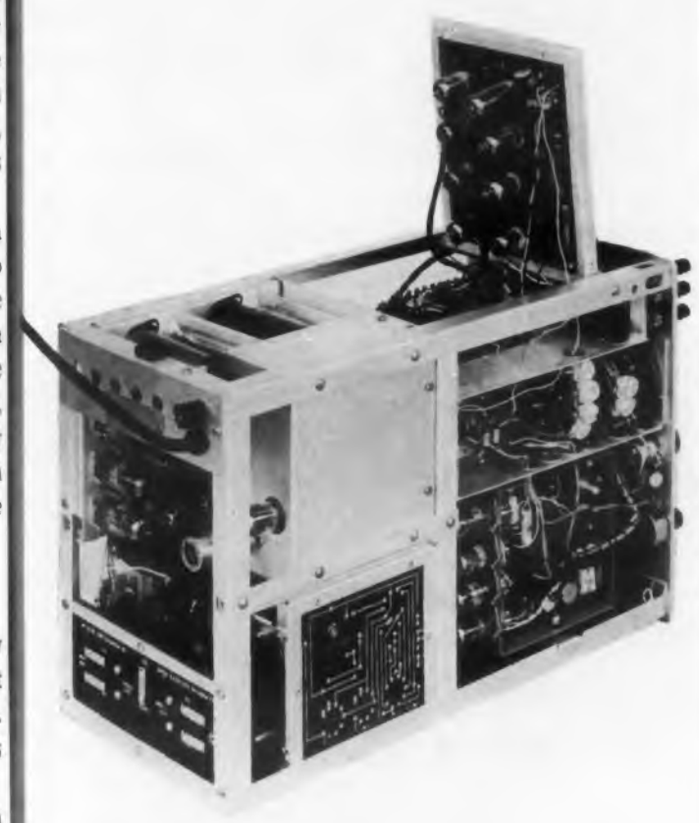
The cathode-ray tube in the Model 130A is a *5AQP* mono-accelerator type with a 5″ flat face to reduce parallactic error. The mono-accelerator type is new and offers several advantages when used in a general purpose oscilloscope. Since deflection of the beam occurs after full acceleration has been achieved, the focus of the beam is nearly the same over any part of the tube face, and spurious illuminations such as bloom or halo effects are eliminated to improve photographic use.

Model 150A

Front panel controls of the dc to mc unit are few and grouped to simplify use. The controls on the left hand panel comprise the horizontal amplifier group. The right hand panel contains the sweep controls while the lower panel contains vertical controls.

The Model 150A has been designed to operate with plug in type vertical amplifiers. At present two of these are available: a dual-channel amplifier and a high gain amplifier. An unusual feature of the dual trace amplifier is that it provides a blanking signal to the CRT

Model 150A High Frequency Oscilloscope Controls are placed in logical areas.



In the Model 130A, bottom etched card containing sweep generator is hinged to provide optimum accessibility for tube change and maintenance.

cathode to eliminate annoying switching traces when it is operating in the chopped position.

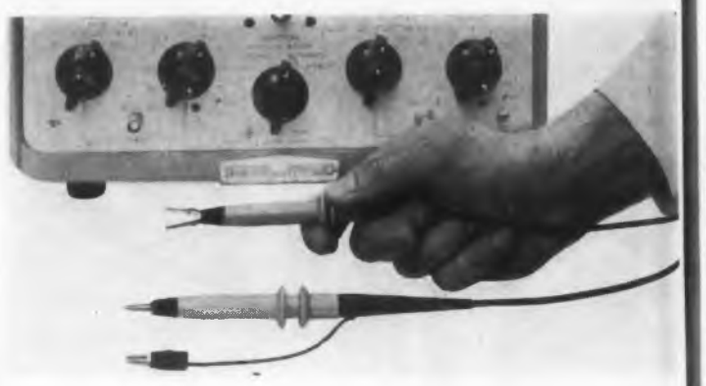
The Model 150A employs a type 5 AMP cathode-ray tube. This tube type is a mono-accelerator having the same advantages mentioned earlier.

The sweep circuit is among the most important of the improved electrical features of the Model 150A. The instrument uses a single 24-position switch to select calibrated sweep times; the dial is direct reading thus decreasing the chance for error which occurs in multiplying several dial readings to obtain sweep time. The sweep time vernier is concentric with the sweep time/cm switch and detents into a position marked CAL when turned fully clockwise. This position takes the vernier out of the circuit. To use the vernier you simply switch it from the detent and adjust the sweep rate around the setting of the sweep time/cm switch. The sawtooth generator is a linear Miller-integrator circuit which provides sweep times from 0.02 μsec/cm to 15 sec/cm.

Any sweep time can be magnified. Magnification is available as X1, X5, X10, X50, and X100. This means that a maximum effective sweep length of 1000 centimeters can be obtained. Whenever a sweep is expanded a reminder lamp glows.

The instrument is equipped with an automatic triggering circuit which employs a single preset position, as described for the Model 130A.

The design of the 10:1 divider probe is unique. It has an input capacity of only 10 μμf which means less loss at higher frequencies than that obtained with other probes available. The probe can be equipped with a variety of tips, but it is supplied with miniature spring loaded alligator jaws. These jaws clamp firmly on circuits under test, and the novel method used to open the jaws makes it possible for the operator to keep his hand away from circuits and thus avoid possible high voltage dangers. The probe can be capacity compensated without the use of tools by loosening the nylon barrel lock and rotating the rear barrel of the probe.



Squeeze-operated alligator jaws on low capacitance divider probe are new in design. Probe is 10:1 voltage divider; 10 megohms with 10 μμf input capacitance. Compensation requiring no tools done by rotating rear guard on probe.

The CRT of both units is easily changed through the front panel of the scope by twisting off the bezel. The bezel locks in place and will support conventional camera equipment without special adapters. The bezel also supports the graticule and the filter which can be changed without effort.

The circuits of both units are contructed on etched cards and sectionalized by function. These features promote ready accessibility of components, tubes, etc. and greatly simplify trouble shooting. These construction features help insure long range reliability of operation.

See instruments at Wescon Show, Booth 1050-1051.

Front view of Model 130A Low Frequency Oscilloscope showing panel controls.

Door on top of Model 150A cabinet gives ready access to sweep output signals, single sweep controls, Z-axis modulation terminals and deflection plates. Fiber lever around CRT base permits simple adjustment of entire CRT to align horizontal trace with graticule.

Saves Money —

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Consider Cold Metal Extrusions—I

Edward S. Cornell, Jr.

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ONE of the great problems confronting the product development engineer and designer is how to select, and when to use, the many and varied new processes that have been generated in the last decade. And, of even greater importance, is the problem of how to design products for use of such processes, to obtain maximum benefits from creative design and to take full advantage of possible economies. Described here is a little-known relatively new process which has great potential when properly applied. It is the cold extrusion of metals, sometimes referred to by design and production engineers as impact extrusion. It is the art of applying pressure which results in the cold flow of metals and is more aptly described as plastic deformation of metal. In many cases the metal is not actually extruded in making the part desired; rather, its shape is merely deformed. It is not the intent of this article to describe fully any particular form of die design or production equipment for making any particular product from extruded or plastic deformed metal, but to point out in a general way what to design for and where to look for information in connection with such processes.

The electronic field is one which can readily employ extrusions because many of the parts used by it are small, require copper or its many alloys, as well as aluminum, for conductivity, some lead and zinc for insulators and in parts for embellishment, or for instituting mechanical action, such as switch parts. In many cases extrusions can take the place of machine processes for screw machine parts, stampings, sand castings, forgings, die castings, and other processes where costs are high or scrap loss is considerable, or where the hot working of such materials as copper offers difficulty due to oxide formation.

Basic design for cold metal extrusion generally calls for the use of a billet or slug approximately equal in specific weight to that of the finished product; therefore, the designer can quickly tell whether his design is economical or not by considering such factors as scrap savings, machine operations, and a general comparison of the final design with products produced by other processes mentioned in this article.

Equipment Required

The equipment generally used in cold extrusion practice is composed of crank type power presses, direct drive and back geared; knuckle and screw presses; drop hammers, preferably air or hydraulically driven; bench power presses; kick presses; hydraulic presses, preferably with high speed and rapid return; and headers, single and multiple position. Bench and floor power presses are probably first choice if for no other reason than that they are readily available in most manufacturing plants. A typical crank type press is shown in Fig. 1.

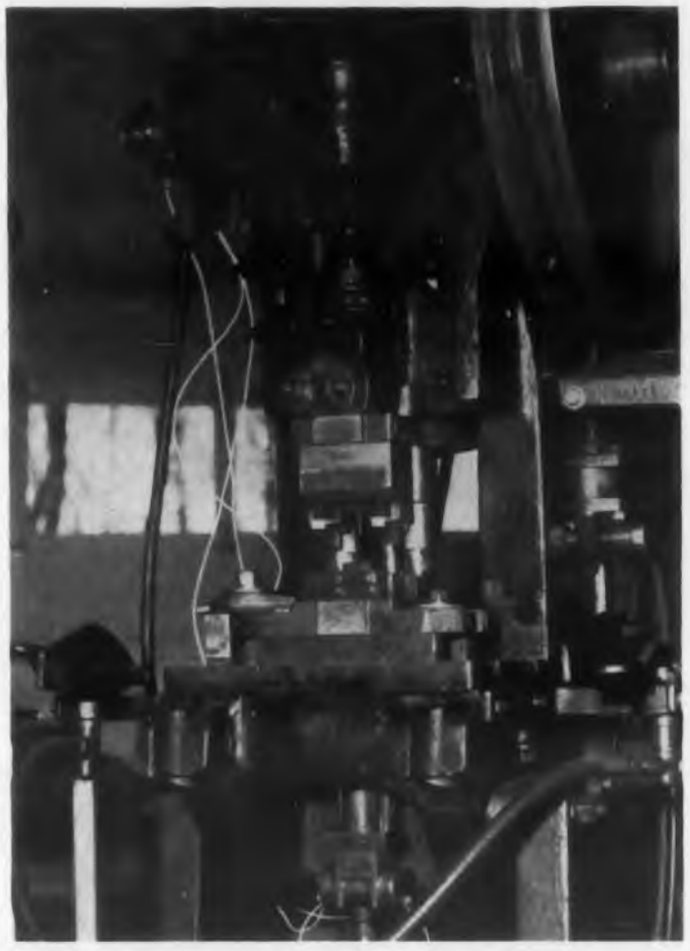


Fig. 1. Crank-type press, set up for cold extrusion of metals.

Headers of various types and kinds are already used for such items as bolts, nuts, screws, and many parts formed from wire. A study of such parts will indicate the possibilities of making other parts which now go into screw machines and other metal working equipment.

Hydraulic presses can be used to advantage, but since speed of impact is necessary in many cases to develop rapid flow, their use must be carefully considered in respect to the part to be made. High speed hydraulic presses are available, however.

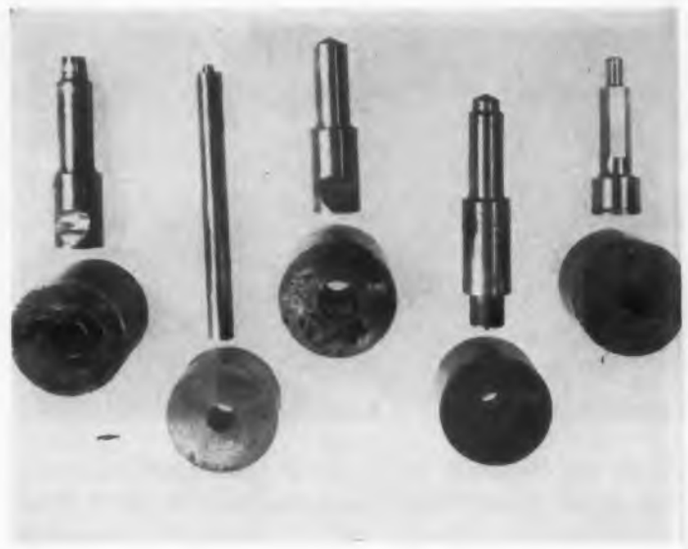


Fig. 2. Some punches and dies made especially to produce metal parts by plastic flow.

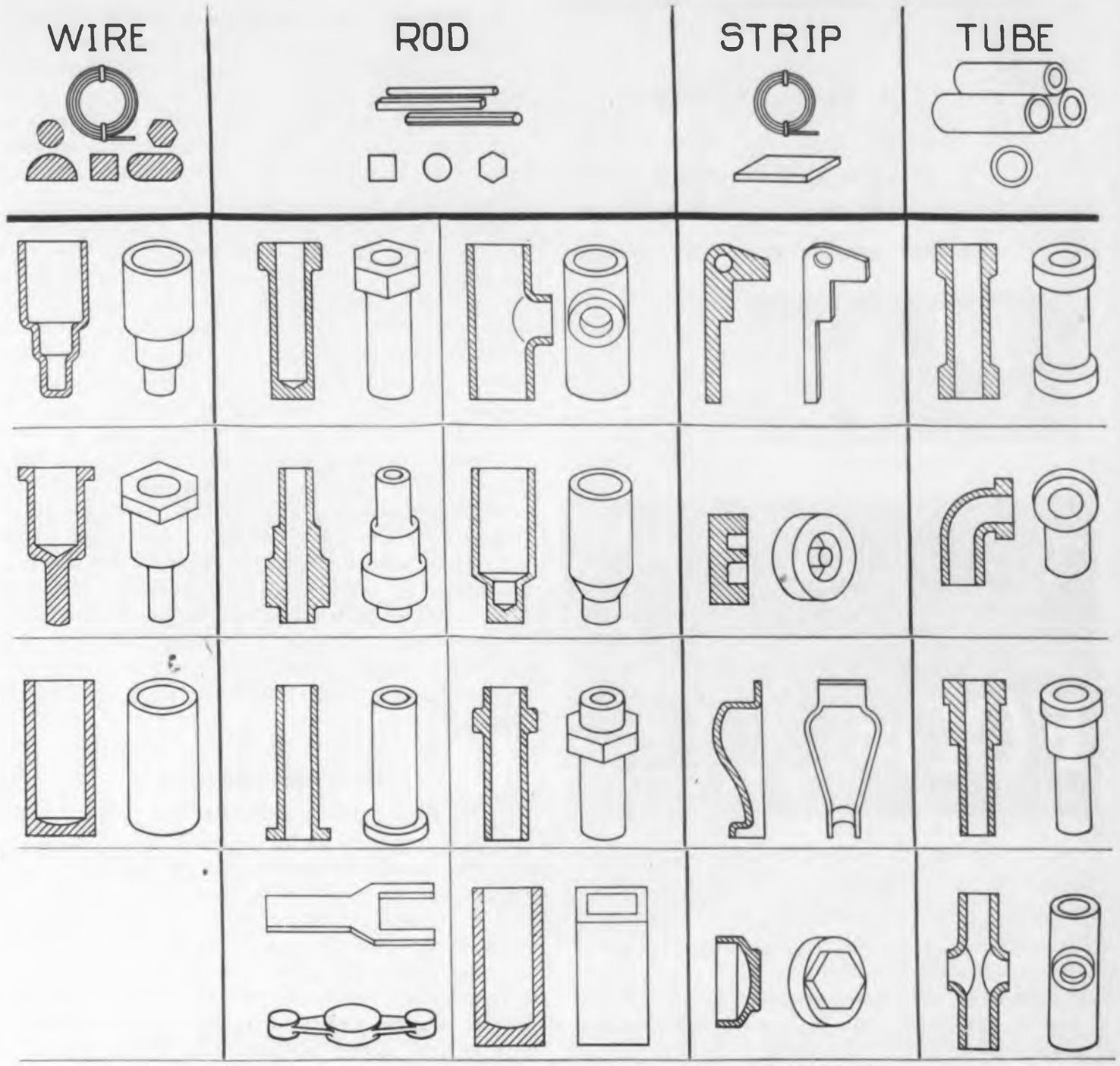


Fig. 3. Examples of shapes that are readily fabricated by metal plastic flow (cold extrusion). A selection of wire, rod, strip, or tube stock should be made, depending upon the final shape desired.

Tools and Materials

The art of making the tools used with pressure producing equipment (those shown in Fig. 2 are typical) for fabricating products by extrusion or plastic deformation is by no means new, as such everyday items as bolts and screws have been made by cold heading, a method of plastic deformation, for many years. The development of alloy steel that will withstand tremendous pressures and shock has, within the last decade, focused attention on the ability to cold flow metals into desirable forms with tools that will withstand the required pressures. This has resulted in processes that are economical and practical if applied to the proper product designs.

With this process, it is desirable to differentiate between the various metals with plastic or malleable attributes such as tin, lead, gold, silver, platinum, copper, brass (selected alloys), and cold rolled steel (selected alloys). They can all be readily formed by cold working into rather intricate shapes when enclosed in dies with correct flow characteristics and when subjected to enough pressure to cause such metals to flow. The advent of shock absorbing steels has quickened research in the field of plastic deformation and has already resulted in an ever widening use of such processes, particularly where product design requires contours that are not readily produced economically by other processes such as hot forging, castings, die castings, or screw machine parts. This applies particularly to screw machine parts of irregular design or where embellishment of design is a requisite; or when a large percentage of scrap causes excessive cost.

Like most new processes, plastic deformation of metals has grown out of the use of available equipment and the modification of tool and die design used in the cold heading, drop forging, die casting, and plastic extrusion processes, etc. The use of nickel in castings resulting in the transition from cast iron to semi-steel for making press frames, which has materially increased their strength and ability to assimilate extreme pressures and resist shock, now permits the use of crank and hydraulic presses as well as headers for making relatively large pieces by cold plastic flow. Likewise, shock resisting alloy steels permit making tools which can take a tremendous amount of pressure without undue risk of breakage and with reasonable die and punch life. These new steels, now offered by practically every steel manufacturer, are readily machined and heat treated and are not expensive. Today such shock steels are looked upon by manufacturers as just as common as carbon tool steels were only a few years ago.

Unfortunately there is a limited source of available information that can be drawn upon by the design engineer in creating new products by plastic deformation for there is but the most sketchy and limited description of these methods in technical books dealing with press working of metals, leading to the belief that these methods are decidedly limited in application and scope.

To better acquaint the product development engineer and designer with the possibilities of extrusion and plastic metal deformation, it is suggested that they explore the present fields of products known to be made on headers, presses, drop forging equipment, die castings, screw machines, plastic molding, and any other processes that use cavity dies or molds. A study of such processes should prove a challenge to their own imagination in working out greater use of these

same techniques in cold plastic deformation. The challenge to creative design and production techniques in this newest field of metal working can only be matched by the startling results that can be achieved in the contour of the product produced and the savings in cost due to elimination of scrap and costly machine operations. Some examples of cold extrusions are shown in Fig. 3.

To obtain maximum results close attention must be paid to the contour characteristics of the dies and punches. To provide proper metal flow, sufficient draft, correct radii, and trapping of metal by undercuts, are only a few of the details requiring study and close attention in both product and tool design. The long list of accomplishments in hot forging, plastic extrusion, hot metal extrusion, cold heading, and sheet metal forming and drawing, if understood in principle can be applied with minor changes in flow characteristics to the design of product and tools for producing products by cold metal flow. Naturally the size, contour, and general characteristics of the product will be limited by the size of punch and die and the amount of pressure required to deform metal to make it. Most of the engineering data required to compute these mechanical and physical elements can be found in engineering handbooks or technical papers and publications dealing with the press working of metals.

Die Design Important

Tool and die design will offer the greatest field for exploratory work for those wishing to use extrusion processes. In addition to the many publications showing the basic principles of tools and dies used in extrusion of metals, forging, stamping, etc (see bibliography), many of the firms furnishing raw materials have handbooks that give basic principles of plastic deformation of metals and give fairly comprehensive data as to various alloys, tempers, etc., on which to base general design fundamentals. Chase Brass & Copper Company; American Brass; Revere, Bridgeport; The Aluminum Company of America; Kaiser; Reynolds; National Lead and many others all publish technical handbooks that are extremely helpful to anyone attempting metal extrusion.

The use of both solid and split dies is common practice. When using split dies, air cylinders capable of counteracting the impact pressures can be used; or wedges, cams, or other mechanical means of keeping the dies closed may be employed. Spring loaded wedges have been found very practical and cheap and can be used in shops where air is not available or where the cost of manufacturing air is excessive. Practically all the manufacturers of tool steels now devote considerable space to data with respect to uses of high impact steels. Their representatives are not only helpful in specifying the proper steel to use to fit specific needs, but their field metallurgists are well informed and can help in respect to die design, as well as pointing out other examples of cold heading or extrusions made by others that can have considerable influence in respect to tool design.

Design Considerations

The extrusion of parts or products can be approached directly from the standpoint of design. In this particular process, design must be altered or shaped to permit the flow of metal in order to produce the part. The use of extrusion methods does not restrict the product designer unduly; on the contrary, it permits him to exercise in many cases greater liberty in respect to contour. In most cases the ability to cause metal to flow permits the incorporation of features which cannot be readily produced by turning operations. As an illustration, a round part turned from rod on a screw machine, lathe, or other turning equipment may offer extreme difficulty in providing a boss somewhere on the body of the part, if it can be provided at all. By extrusion, such configurations can be obtained with ease. Likewise, duplications of many of the resultants from press operations and hot forgings and even die cast parts can be made by cold plastic deformation. Metal can be made to flow and provide many of the contours that other more commonly used processes cannot make, with many additional advantages in strength, conductivity, etc.

Parts illustrated here are all fabricated from the most commonly used raw materials: wire, rod, tube and sheet. There are an unlimited number of material choices depending on the severity of the deformation. In this article only relatively small parts will be considered, however, which do not require excessive pressure, viz: up to 120,000 lbs per sq in., and which are made from materials that come under the general heading of metals with extreme plastic qualities.

Parts from wire. Parts made from wire will generally be found under the category of parts designed for the screw machine, header or lathe, or made on turning equipment in general. Such parts may be readily considered for conversion to extrusion if there is any great amount of scrap loss. The wire used may be copper, brass (high brass without lead in most cases), lead, aluminum, silver, gold, cold rolled steel (limited), and any other of the readily malleable metals. When properly designed, the product should weigh approximately the same as the billet or piece of metal used to make it unless contour refinement decreases or increases this component due to flash.

Parts of approximately 1/4 in. dia and 1/2 in. long or smaller can be made by plastic deformation with relatively light pressures (20,000 lbs to 60,000 lbs per sq in.) provided the configuration of the part is not too complicated and the flow characteristics are properly incorporated in the design. The use of rod can be varied viz, hexagon, round, square, rectangular, etc, depending on the shape of the finished piece. By selecting a contoured rod, extrusion pressures can be minimized and in many cases a simple one shot tool will provide a finished piece.

Many pieces with longitudinal shape can be made

to advantage; and extrusions from the parent billet, made from flat wire, can be successfully formed. These include bosses, lugs, etc.

Parts from tubing. Many shapes that are made from tubing on screw machines can be produced by extrusion from tubular billets. It is not necessary, however, to select tubing in order to provide a hole in the finished part. Holes can be extruded into pieces made from wire and rod. A good rule of thumb is to use tubing in extrusions where the bore is relatively small in respect to the major diameter of the finished piece. Punch life under such circumstances would probably prove costly unless tubing were used.

Parts from sheet. Here we invade directly the field of press working of metal. In most cases we must rely upon a combination of drawing and/or forming, together with plastic deformation of metal to the extent that one can expect to obtain an end result not commonly expected from drawing operations alone. To accomplish this purpose, metal is first congregated in the drawing operations, such as thickening a side wall or bottom or top area of a cup, or perhaps the forming of a thickened area for a flange which requires bosses or perhaps a hex. These latter two operations call for plastic deformation and extensive cold flow of the metal, which can only be obtained by extrusion.

Conductivity. Brass and other low conductivity materials often must be used instead of copper due to the difficulty of machining or hot working copper. The scrap loss in the use of copper turnings is also a costly factor in making such parts. By the cold deformation processes now available, scrap can in many cases be entirely eliminated or cut to a minimum and the speed of production greatly stepped up. Cold working of copper overcomes many of the difficulties encountered in casting and forging copper.

Finish. Generally a highly plainished surface, free from spores, die and tool marks is produced during extrusion. Where subsequent plating is required, little or no preparation of surface to turn out satisfactory finish is, in many instances, necessary.

Strength. The cold working of the materials used in extruded processes results in greatly increasing its tensile strength, wear characteristics, and resistance to shock (in proportion to the amount of cold working). With all materials used in cold plastic extrusions, the grain size (not only at start of the operation but at various stages of the operation) is important. Material suppliers should be consulted until the design engineer understands how the cold extrusion processes work hardens metal many times very close to its ultimate workable limit. An understanding of the slip planes, flow characteristics of metals and of metallurgical structures in general, is essential for the process engineer to bring the design into mass production.

Since one must understand the mechanics of the plastic flow (cold extrusion) process to intelligently design for it, Part II of this article will go into the mechanics and will detail the principles involved.

Subminiature R

REMOTE-control of up to five circuits from one control channel is possible using a miniature resonant reed-type relay. Designed especially for lightweight, miniature control equipment, the unit weighs 0.9 oz and has a volume of 1.1 cu in.

Main function of the relay is to receive one of five tones which causes a resonant reed to vibrate and close an electrical circuit. Reed relay contacts are rated at 5 ma. If more current is to be carried, a secondary relay may be operated by the reed. Essentially, the unit acts as a band-pass filter.

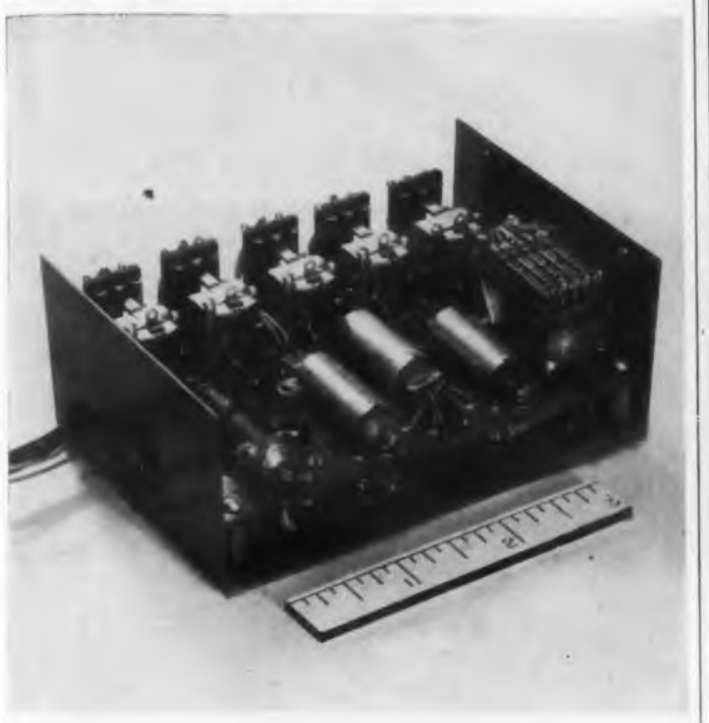
One advantage of the device is that vacuum tubes are not necessary. Less current is required to operate the relay than is necessary to operate the vacuum tubes. Weight, also, is less.

Since the resonant frequencies of the reeds are only four cycles wide, interfering signals must be extremely stable to upset the system. Up to 15 channels may be controlled using the three relays with a frequency range between 250 and 600 cps. Instantaneous control of any two reeds is accomplished through the use of a multivibrator in the transmitter.

Made by W. S. Deans Co., 8539 Albia St., Downey, Calif., the relay features an Alnico 5 magnet to provide magnetic bias. Spring steel reeds are cadmium plated. Coil resistance is 6000 ohms; impedance is 10,000 ohms. Maximum driving voltage is about 15 v rms with a practical minimum of about 3 v rms.

Some of the recommended applications of the device are telemetering, remote circuit switching, remote valve operation, and control of models. For further data on this reed relay, turn to the Reader's Service Card and circle No. 29.

Reed Relay



Resonant reed relay installed in a miniature radio control unit. Five auxiliary relays along the rear of the unit handle currents over the rating of the reed-relay contacts.

Adjustment of the screws on the channel selector wheel permit the selector to skip unused channels.

Self-Servicing T

DESIGN and layout of the chassis and component parts of this TV receiver are aimed toward ease of servicing and adjustment. Several features contribute toward speedy fault locating, especially in the customer's home.

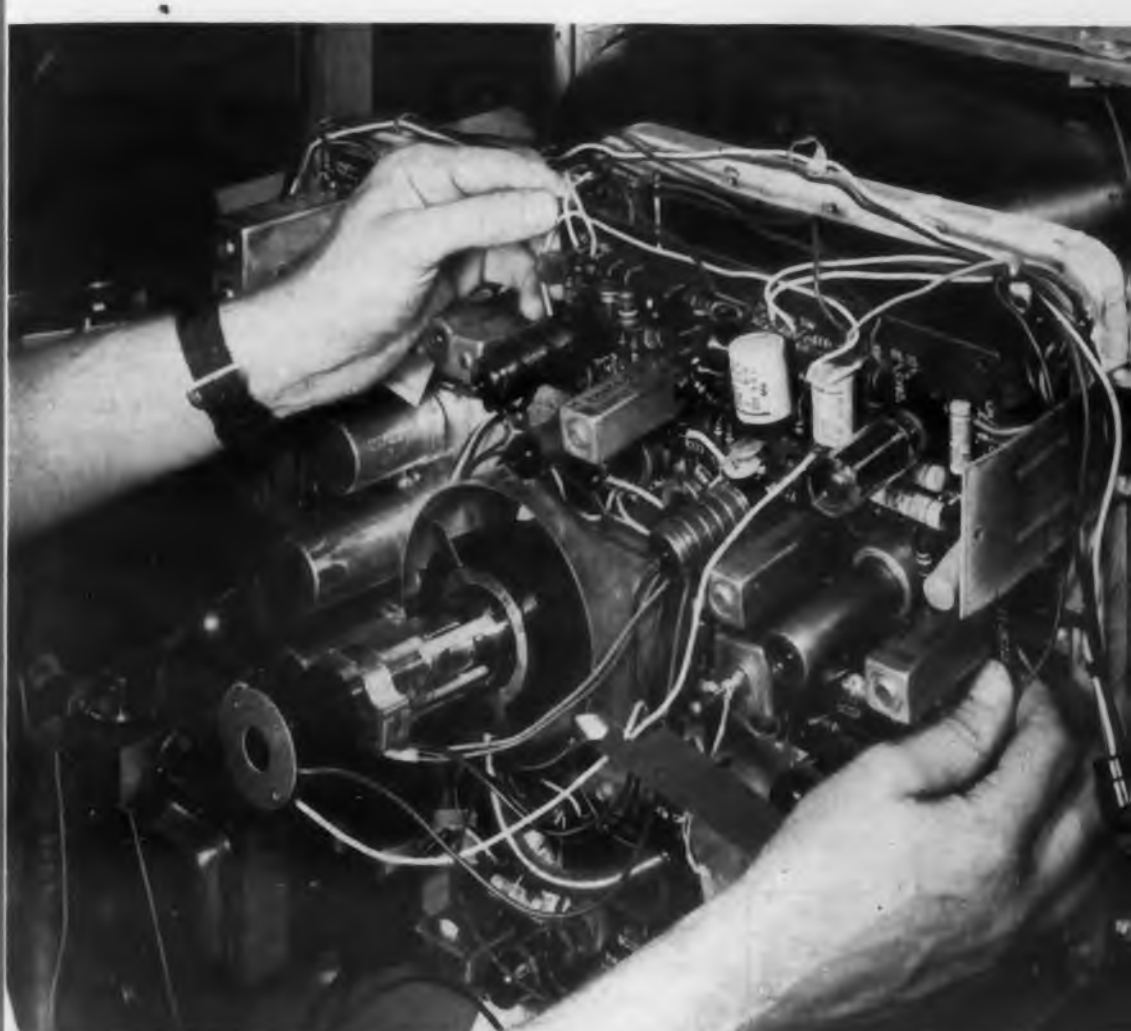
First of the features in these Crosley receivers is the vertical positioning of the chassis. Built around the neck of the picture tube, the chassis makes all important points easily accessible merely by removing the back of the chassis.

Four printed circuit panels make up the main circuit portions of the receiver. Labels are provided to identify parts of the circuit. In some cases, rapid checking is possible by simply touching the terminals in question with a screwdriver. For example, if a filament circuit is suspected, it may be quickly checked by placing a momentary short across the terminals.

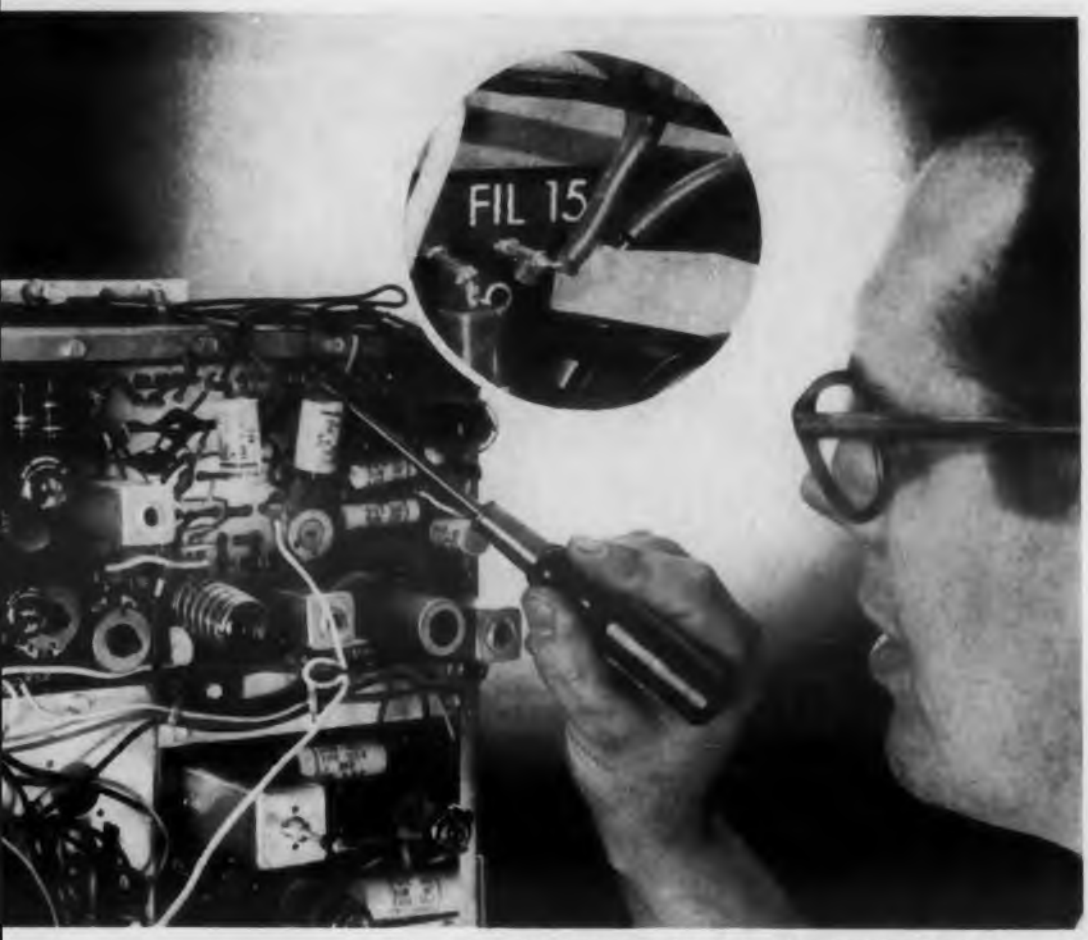
Translucent properties of printed circuit boards are also used to advantage. By placing a light behind the board, the servicemen sees a "map," making it easy for him to trace the circuit.

Made by Crosley and Bendix Home Appliances Div. of Avco Mfg. Corp., these television receivers can be serviced in the home without a great deal of service equipment. Ninety-five per cent of the parts can be replaced from the back, including tubes.

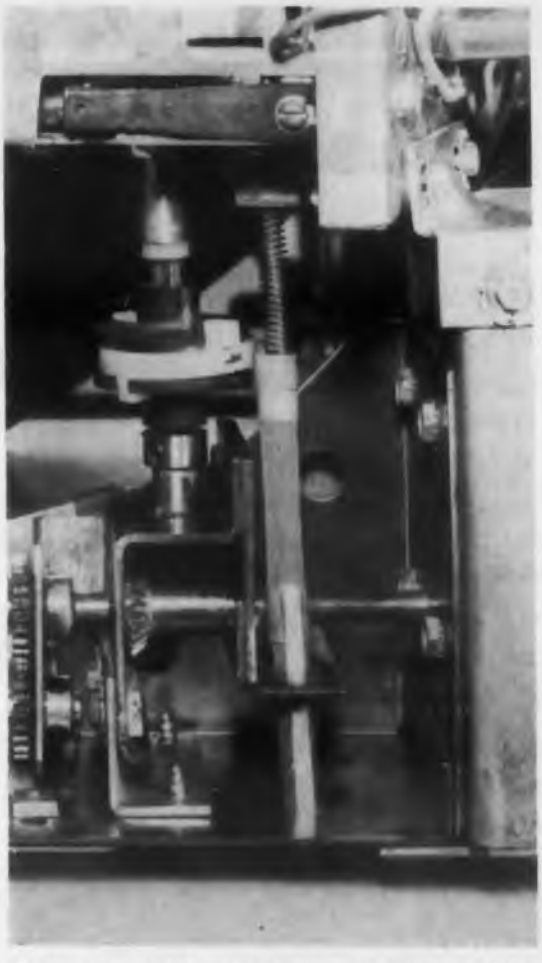
TV Receiver



Four easily removable printed-circuit panels are mounted vertically around the picture tube in this TV set.



All major circuit test points are clearly identified for rapid checking. Most servicing may be done in the customer's home.



Built-in screwdriver, shown vertically, enables the serviceman to adjust slugs.

Traveling W

Charles Ammerman
Haller, Raymond & Brown, Inc.
State College, Pa.

INPUT and output impedances of traveling-wave tubes are important to designers of equipment using them. This article deals with the influence of tube operating conditions, load or source impedance, and frequency on input and output impedances.

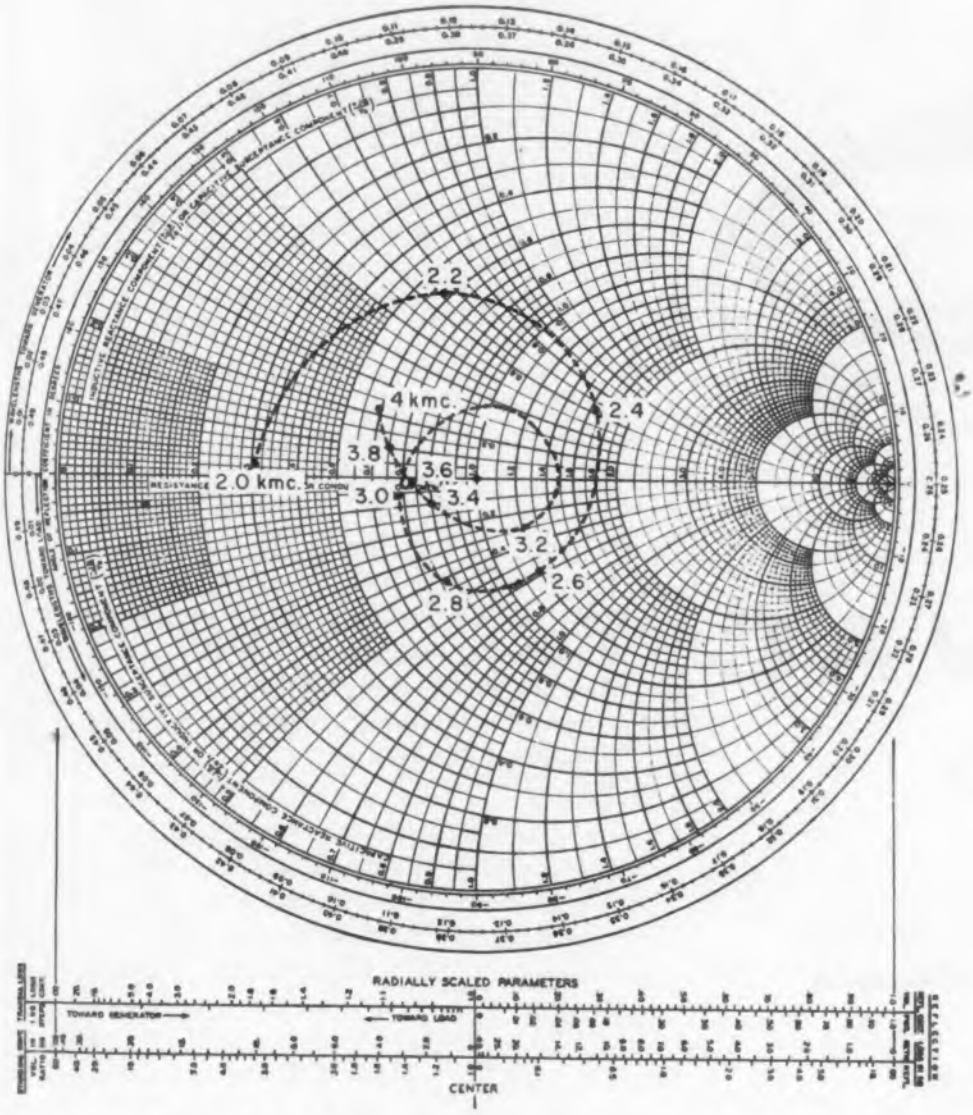
Theoretically, the characteristic impedance for forward waves can be proven to be very nearly equal to the characteristic impedance in the absence of electron flow. In a backward wave, there is no cumulative interaction with the electron stream, thus the characteristic impedance should differ even less.

This theory leads to the expectation that the input and output impedance, being dependent on the characteristic impedance of the helix, should vary only negligibly with the tube operating conditions. Tests on a type S-166A and T-168A (Penta Laboratories Inc.) have shown that no observable change in impedance occurs when the tube is switched on or off.

With regard to impedance as a function of termination, it should be noted that traveling-wave tubes are made with large amounts of attenuation introduced into the helix structure. Consequently, the impedance change caused by mismatch should be rather minor. This is evident from data taken on the T-168A in the accompanying table. Similar results were noted when measuring output impedance for various values of input source impedance. These variations are negligible, and may be due to operator random error.

The variation of impedance with frequency is more real. However, the helix structure is essentially broadband. If care is taken in making a broadband coupling, the standing wave ratio could be expected to be rather small. Measurements of output impedance of type S-166A, plotted on the Smith Chart, reveals a VSWR of less than two over the majority of the range. Input impedance is similar. Dotted lines are estimates of the locus between measured points. Generally, compared to many items encountered in VHF circuitry, the traveling-wave tube has remarkably good impedance properties.

Wave Tube Impedance



Output impedance of type S-166A traveling wave tube over the range 2 to 4 KMC.

Impedance Change Caused by Mismatch of Termination of a Type T-168A Traveling Wave-Tube

Output Termination	Slotted Line Data			
	500 Mc		1000 Mc	
	VSWR	x/λ*	VSWR	x/λ*
Open Circuit	1.90	.0587	3.8	.0163
Short Circuit	1.90	.0550	3.8	.0167
50 ohms	1.90		3.8	.0177

* x/λ is fractional displacement of voltage minimum referred to a shorter line.

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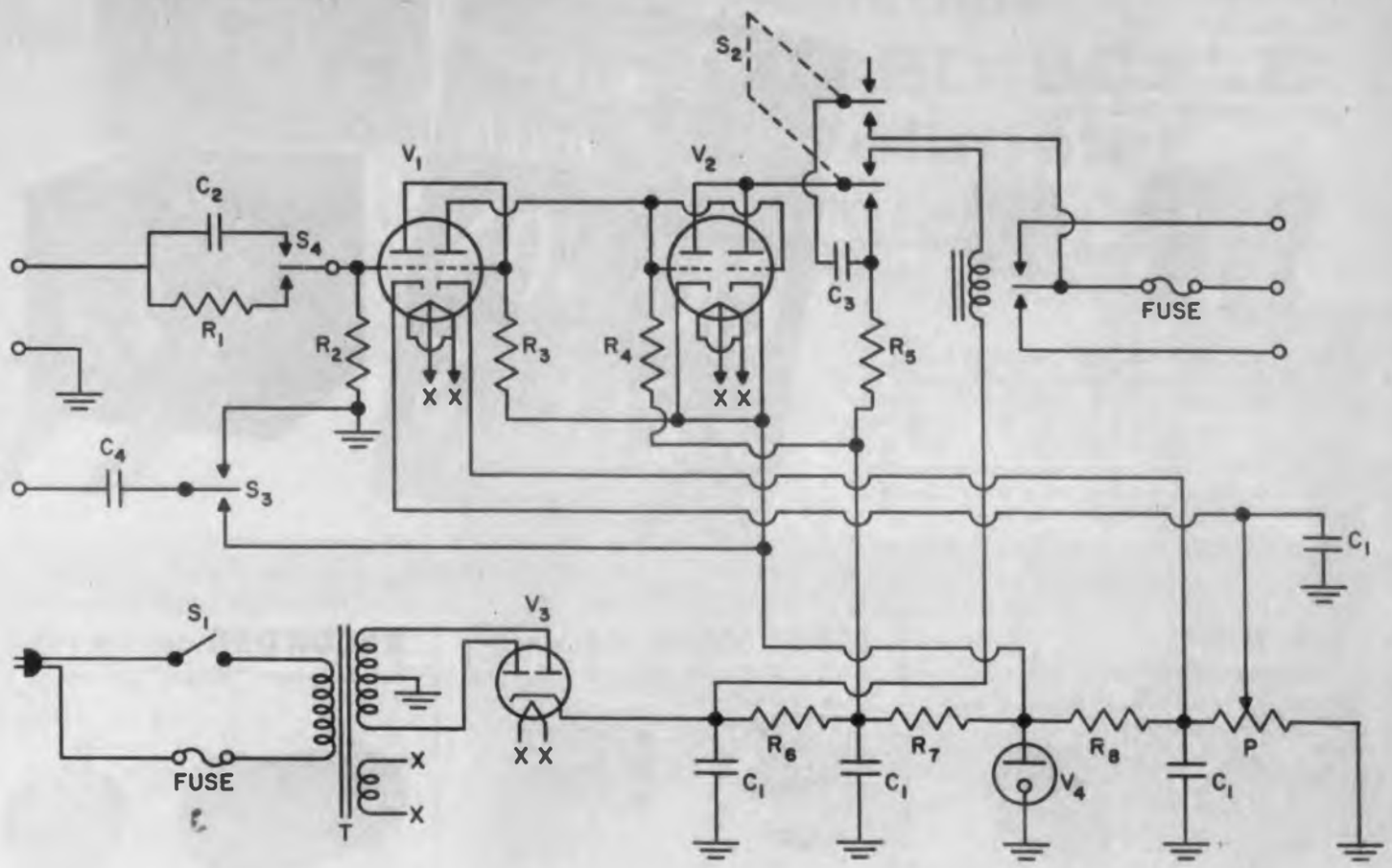
Sweep-operated Relay

TRANSIENT studies can be performed with a minimum of effort by initiating the transient at a convenient part of the oscilloscope trace. Transients and disturbances may be portrayed by means of a device requiring a minimum of setup time.

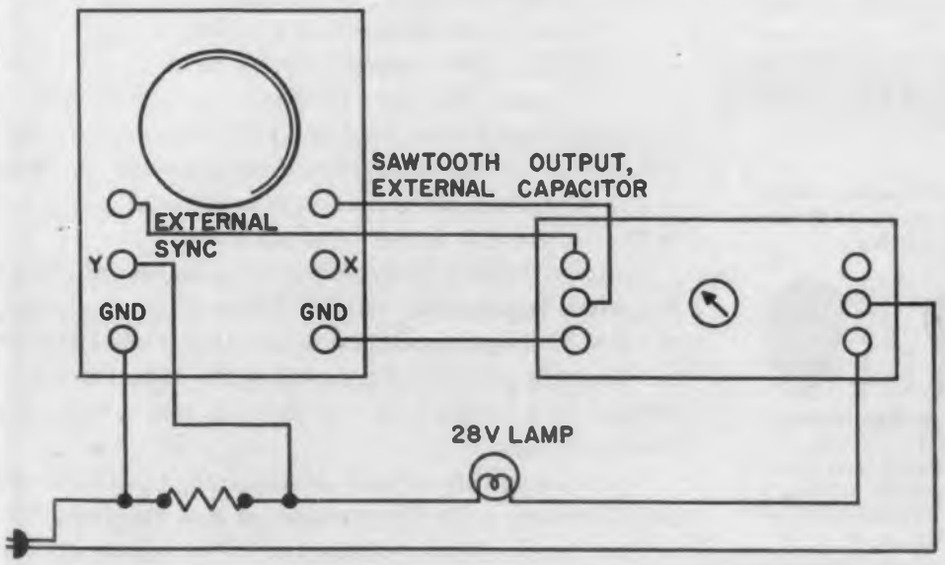
Consisting basically of a dc amplifier that operates a relay, the device compares the sawtooth voltage from the oscilloscope against an adjustable reference voltage. Input is fed to the first section of the first double triode. The cathode of this tube is kept at a positive voltage which can be adjusted by the knob marked "Time Delay." Then, the first section of the second double triode is cut off until the voltage fed into the tube exceeds the bias voltage as set by the time delay. After setting the oscilloscope to repetitive sweep, the unit will initiate the transient at a preset portion of the sweep cycle without critical timing on the part of the operator.

Among the uses recommended for the device by its maker, Englehardt Engineering Co., 38 Burritt Ave., South Norwalk, Conn., include studies of inductive and capacitive circuit elements. Recovery time of voltage regulated systems, time constants of magnetic amplifiers, and operating time of electromechanical devices can be studied easily. For more data on the relay, turn to Reader's Service Card and circle No. 35.

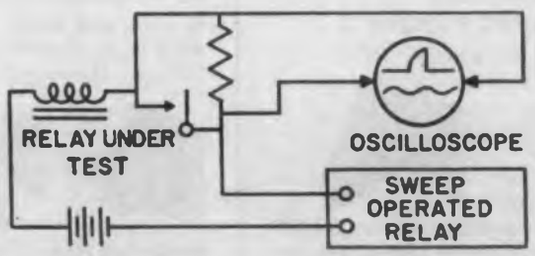
Photo of the sweep-operated relay used to simplify transient studies.



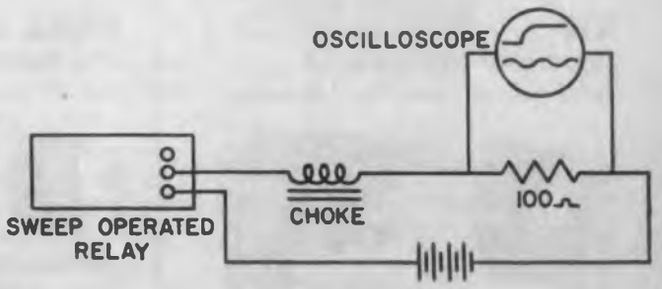
Schematic of the sweep-operated relay.



Circuit used to check inrush characteristics of 28 v aircraft lamp. Oscilloscope pattern is shown below.



Test setup for checking performance of a relay. Upper trace on oscilloscope, below, shows the instant closing of the circuit, the exponential rise of the current through the relay coil, and the closing of the contacts. Lower trace is the timing wave.



Current flow through a choke can be seen with the circuit. Oscilloscope trace shows the exponential current rise. Lower trace is a timing wave.

Supersonic Sound Operates TV Set

SUPERSONIC sound in the range of 40 kc is radiated from this new remote tuning unit to operate various controls of a television receiver. No tubes, batteries or electrical connections are required.

Called the "Space Command," this Zenith control unit consists of four tuning forks. Actuated mechanically by keys, the tuning forks radiate sound to turn the set on and off, mute the sound, and change channels. The hand-held unit will operate the receiver up to 50 ft away.

Four control keys actuate the tuning forks at the following frequencies:

37.75 kc—turn set on and off
38.75 kc—mute or restore sound
40.25 kc—turn channel selector left
41.25 kc—turn channel selector right

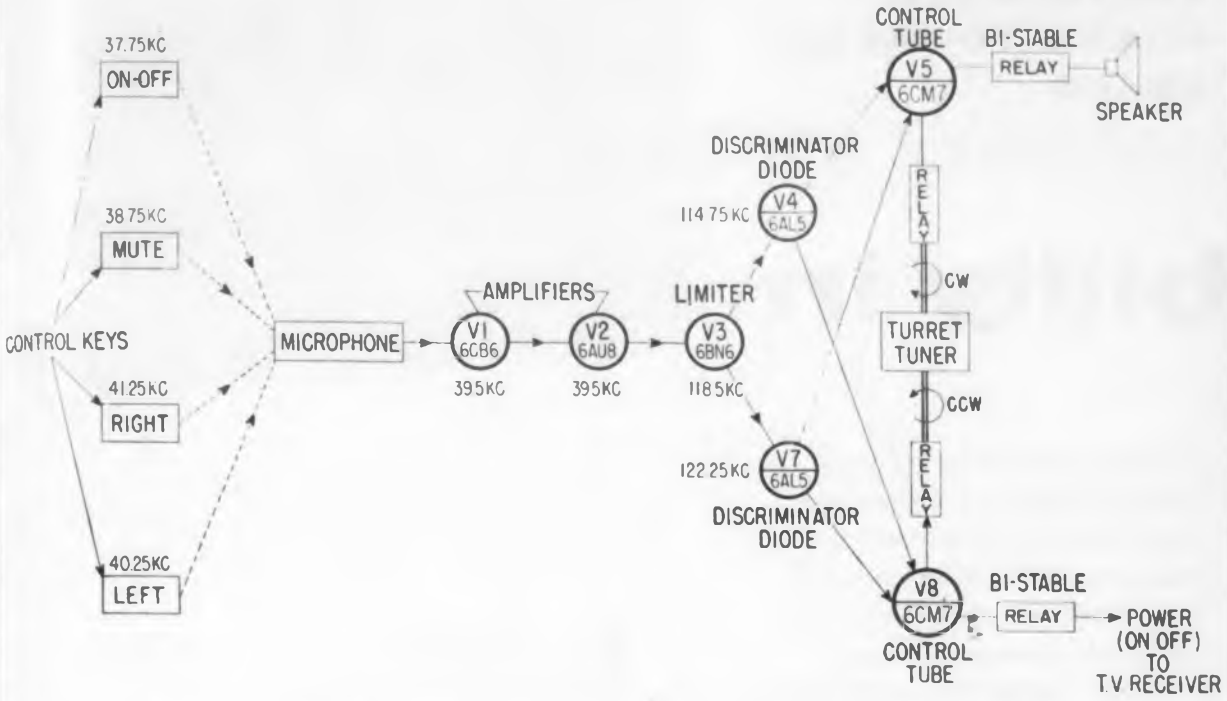
To operate the unit properly, its grill must be pointed toward the receiver. This directs the sound waves toward the microphone mounted on the front of the set. Range of operation is considerably reduced if the control unit is not properly aimed.

Coupled to the microphone is a high-gain 39.5-kc amplifier. Input tube is *6CB6* followed by one section of a *6AU8*. The second section of *6AU8* is used to triple the frequency to 118.5 kc. Limiting the signal is accomplished by a *6BN6*, then the signal is fed to two *6AL5* discriminators.

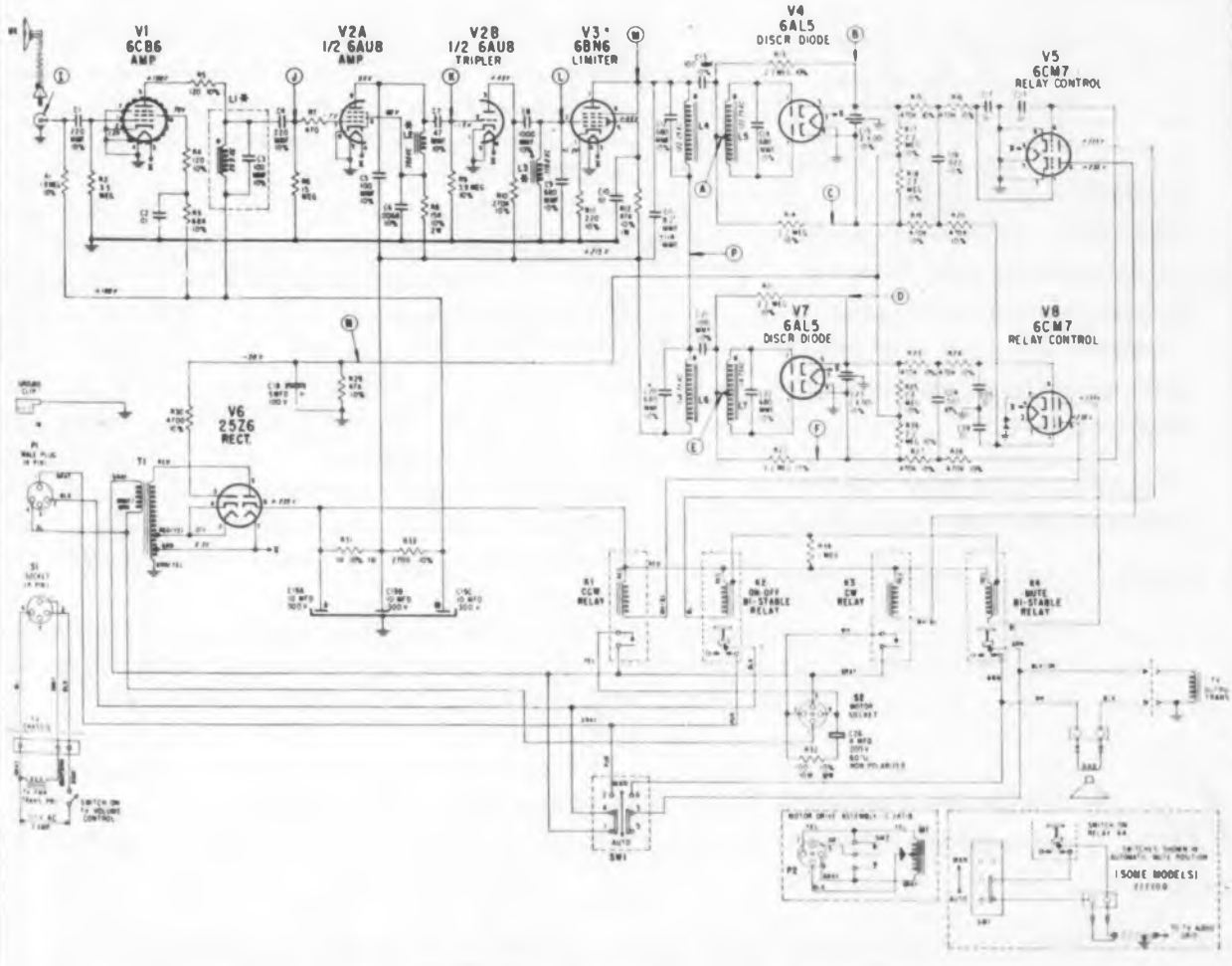
Up to here, the control chassis circuits provide the amplification, noise discrimination and frequency detection. Only signals within the 40 kc range operate the device.

Integrator circuits couple the discriminator output to two *6CM7* relay control tubes. Rectified output of the discriminators overcomes bias on the control tubes. Control relays are operated by plate current in the usual manner. Each control tube accommodates two functions as shown on the block diagram.

A 117-v ac induction motor drives the turret assembly. An internal brake operates automatically when the motor is de-energized to prevent over-travel. Special tabs are provided on the turret to permit the drive to skip unused channels. A switch is provided to disengage the control chassis and motor drive circuits.



Block diagram of the Zenith remote control system in which supersonic sound operates the television receiver.



Schematic of the control chassis of the supersonic sound operated remote control unit.

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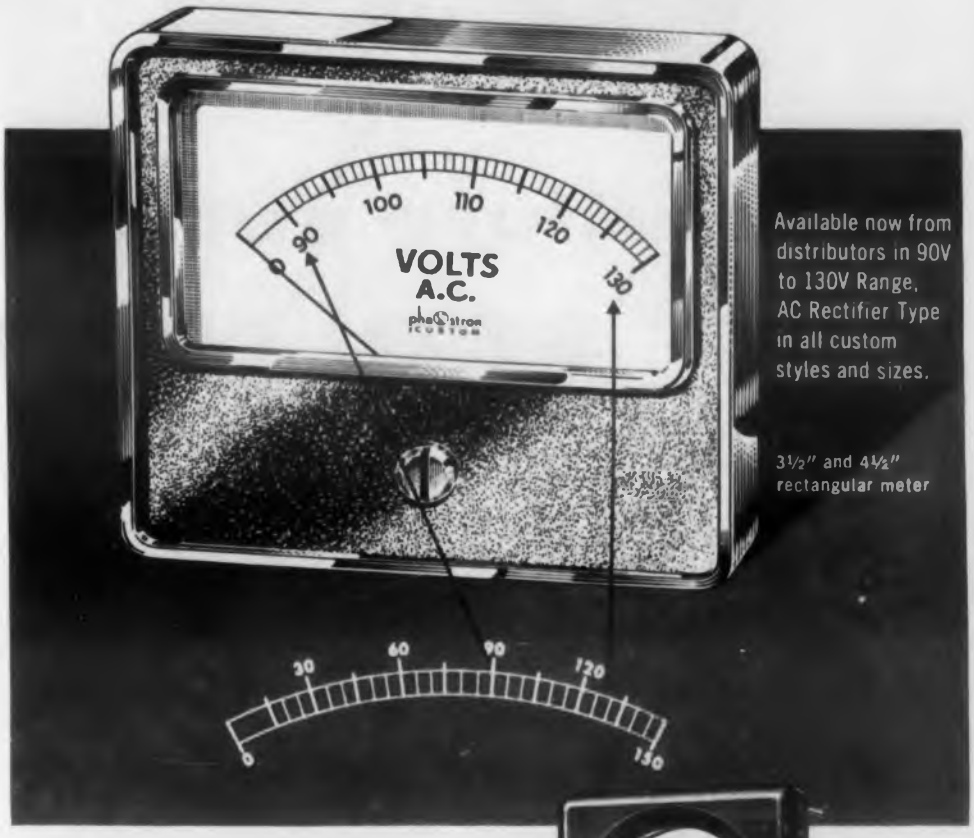

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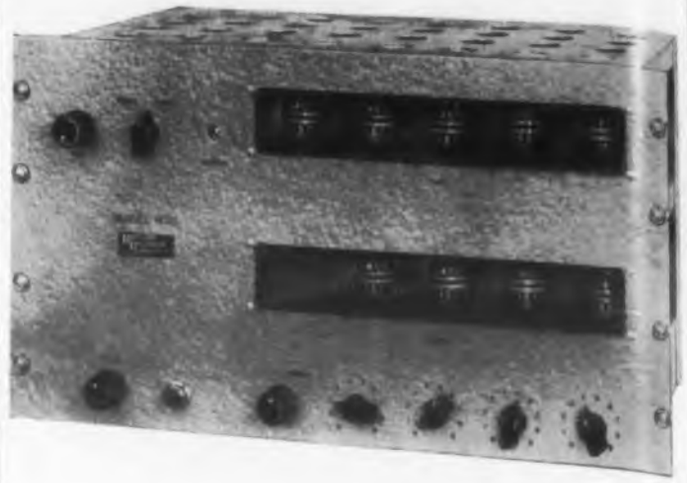
PHAOSTRON INSTRUMENT & ELECTRONIC CO., 151 PASADENA AVE., SOUTH PASADENA, CALIF.

CIRCLE 37 ON READER-SERVICE CARD FOR MORE INFORMATION



FIVE place accuracy in the low frequency range of 1 cps to 20 kc is possible with this precision preset wave timer. Initial frequency measurements are made with the unit set as a conventional events-per-unit-time meter. This measured value is then set in on the preset counter and the instrument operated as a preset wave timer. With this setting, the timing unit will read a value near 1 sec. A four-decade preset counter and a five-decade precision timing unit are used.

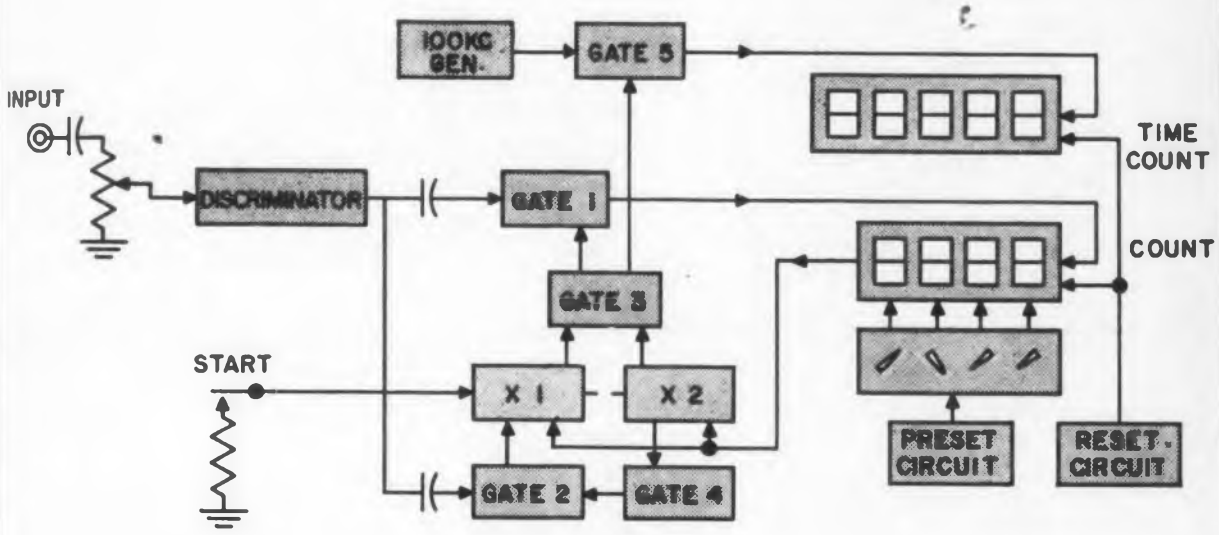
By changing the preset count to bring the time readings to an even value, such as 1 sec (00000), 0.1 sec (10000), or 0.01 sec, (01000), variations from this nominal value can be rapidly noted.

The input frequency, in the unit developed by Ransom Research, Box 382, San Pedro, Calif., is fed through an amplifier to a trigger circuit which selects the zero crossing of each cycle. This in turn generates pulses for the input scheduling circuit. The scheduling circuit is arranged to count off two cycles, start the count exactly on a crossing, count the preselected number on the preset decades, and stop the timer exactly on a zero crossing.

For example, a 400 cps signal can be measured to within plus or minus 10 μsec, or 5 places, instead of three places with the usual plus or minus one count.

Frequency range is 1 cps to 20 kc, square wave, (1 millisec rise time) or approx. 20 cps to 20 kc, sine wave. Preset count capacity is up to 9999 and precision timer range is 10 μsec with increments up to 1 sec. Timing accuracy is ± μsec, input sensitivity is 2 min. For more information turn to the Reader's Service Card and circle 39.

Precise Low Frequency Counter



How It Works

The input signal is applied to the discriminator. After setting the desired preset value, the start key is operated. The flip flops *X1* and *X2* advance from normal position to the 1st position. Gate *4* then opens the input Gate *2* to the flip flops *X1* and *X2*. Input pulses feed into the first flip flop *X1* which puts a count out to the second flip flop *X2*, until a coincidence occurs in Gate *3*. This event means an input wave has passed a zero crossing.

Coincidence in Gate *3* causes Gate *1* and Gate *5* to open simultaneously so that timing commences exactly on a zero crossing irrespective of the time of occurrence of the start signal.

Upon reaching the preset count, the four decade preset counter puts out a pulse simultaneously to the flip flop *X1* and *X2* which set up coincidence conditions in Gate *3* to detect the same zero crossing of the last wave counted. With coincidence occurring, Gates *1* and *5* close, stopping and counting and timing.

If measuring 400 cps, for example, timing starts at a zero crossing of the first wave, ends at the same point on the 400th wave. If exactly on frequency, the reading on the timing decade counter is "00000" or one second to five places, or within 10 microsec. By measuring 40 cycles, readings will be "10000" or 0.10000 sec. Variations from nominal or drift can be quickly noted by successive measurements. Drift effect on readings is minimized as sampling time is 1 sec or less.

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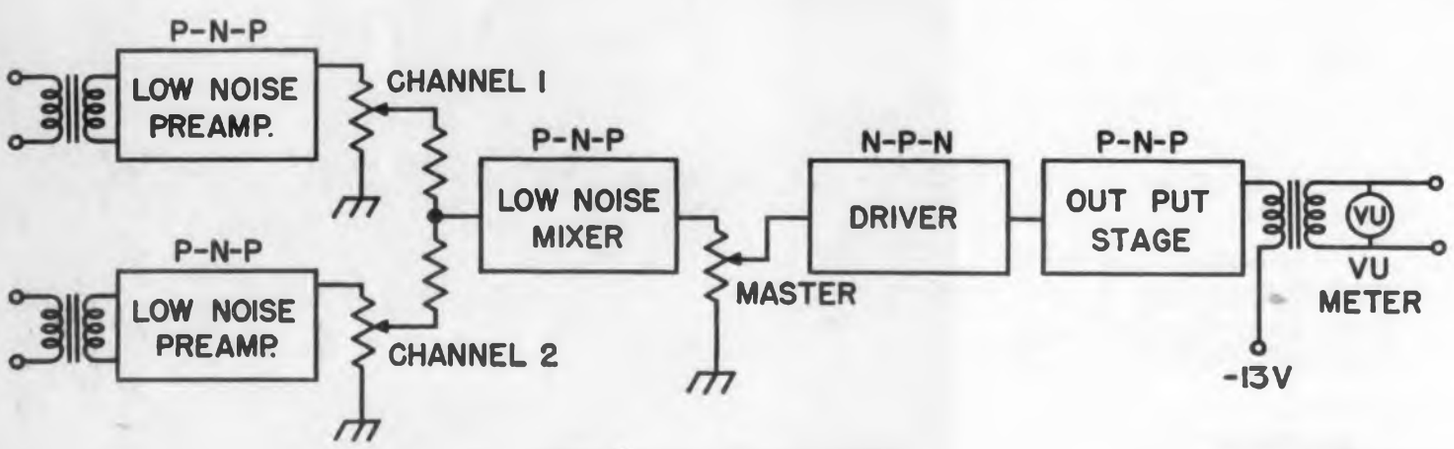
CIRCLE 40 ON READER-SERVICE CARD FOR MORE INFORMATION

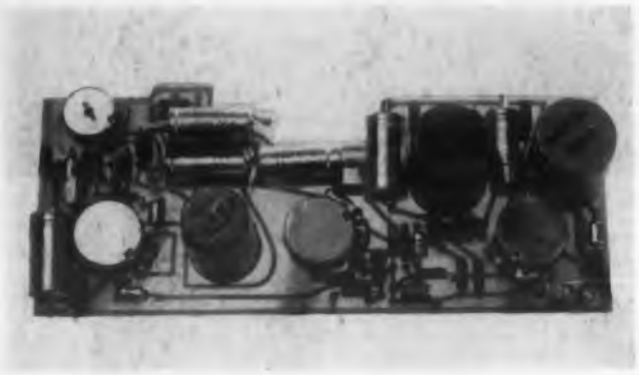
Transistor Mixer-Amplifier

Editor's Note: Predictions are repeatedly made that transistors will replace vacuum tubes in portable equipment. Many of these predictions have been slow to come about. Just recently though, we learned about a transistorized mixer amplifier—a really portable unit for remote broadcasting and recording. It is our thought that a description of this unit might stimulate our readers to review other applications that might greatly benefit by using transistors.

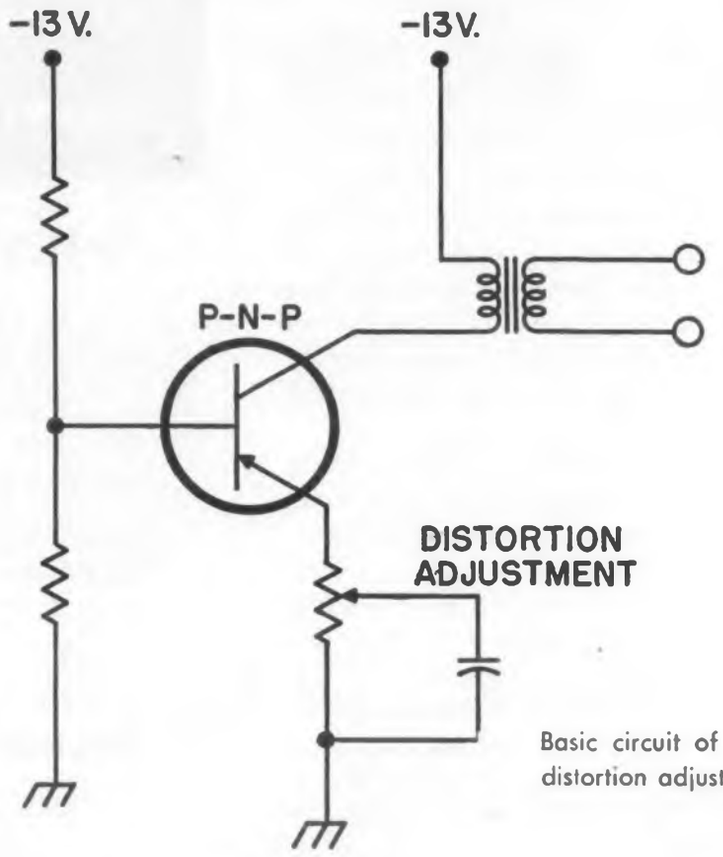
TRANSISTOR circuitry made it possible to reduce the size of this "portable" mixer 95% and weight 90%. The unit in its leather carrying case is comparable to shape-wise transistorized portable radios. By using mercury batteries, in excess of 100 hours of operating life is possible. Spring-loaded battery holders permit rapid replace-



Block diagram of mixer-amplifier

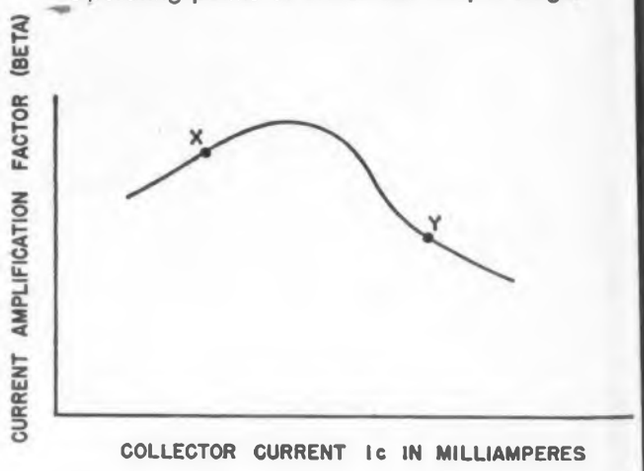


Inside view of mixer-amplifier. Note mercury batteries on back of open cover plate.



Basic circuit of output stage shows distortion adjustment.

Operating points of driver and output stage.



Transistorized mixer-amplifier set up for operation. Unit measures 7-1/2" long, 2-1/4" high, and is 3-1/4" deep. It weighs 3 lbs in a carrying case with shoulder strap.

ment. Because of its extreme portability, the unit is ideal for remote-pickup recordings, outside public address systems, and "on-the-spot" interviews.

Called the Model JG2, the unit developed by Baird Associates, 33 University Road, Cambridge, Mass., consists of two, low-noise preamplifier stages, one low-noise mixer stage, one amplifier stage, and one output stage. P-n-p junction transistors are used in all stages except the amplifier or driver stage. In the driver stage, use of n-p-n stabilizes overall gain with temperature. The high gain of the unit (greater than 85db) permits the use of low-gain microphones. The use of transistors throughout makes the unit, of course, free from microphonics.

A 1-mw average, 10-mw peak output level produced by the transistorized mixer amplifier eliminates the need for shielded cable connections. Signal-to-noise ratio of the amplifier is 60 db for a —60 dbm microphone input. Peak distortion of 2.5% and average distortion of less than 1% are achieved. Non-linear compensation in the driver and output stages is provided by the use of special feedback circuitry. The basic circuit of the ouput stage is illustrated. Dc stabilization of the operating point of the output stage further reduces distortion. Frequency response is within 3 db from 100 to 10,000 cy.

Choice of 50- or 250-ohm input impedance, balanced or unbalanced, is provided. Standard 600-ohm output impedance, also balanced or unbalanced, of the Model JG2 permits direct coupling to telephone lines, tape recorders, and other devices and systems. Other features include a VU meter for visual monitoring and a phone jack for monitoring with headphones. The VU meter also serves as a self-contained battery tester. Patching jacks are supplied to allow connection of 2 mixer amplifiers together to obtain 4-channel operation. Controls include individual channel gain controls for the two channels of the amplifier, master gain control, power switch, and VU meter-battery test button.

Manual Co

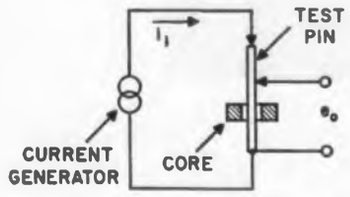
ANALYZING the induced voltage response of miniature ferrite and metallic-tape magnetic cores is facilitated with this newly developed test jig which automatically makes primary and secondary connections through the core. Sliding contacts also connect proper drive sources and sensing circuits to the core under test. The device is useful in both laboratory and production line testing.

Elimination of mechanized complexity and electrical noise is achieved through the use of an autotransformer circuit, a simplified version of which is shown. Noise and other factors, however, were encountered in the development of the unit by Rese Engineering Inc., 731 Arch St., Philadelphia 6, Pa. By adding a noise cancelling transformer and a calibration circuit, the present circuit resulted.

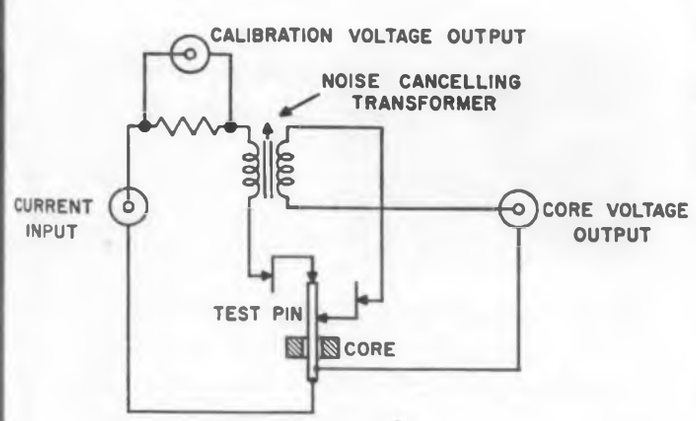
In operation, a current pulse is passed through a one-turn transformer wound on a variable position ferrite core and through the test pin exciting the core under test. The secondary winding of the autotransformer links a turn on the noise cancelling transformer in opposite phase to the winding carrying the input signal. Voltage response of the core to the pulse is observed on an oscilloscope connected to the output.

For more data on the tester, turn to Reader's Service Card and circle No. 43.

Core Tester



Simple autotransformer type circuit for testing magnetic cores.



Schematic of manual magnetic core tester including a noise-cancelling transformer and calibration circuit.

New Products

Products marked with a star are those being exhibited for the first time at the Radio Engineering Show, and include the company's booth number.

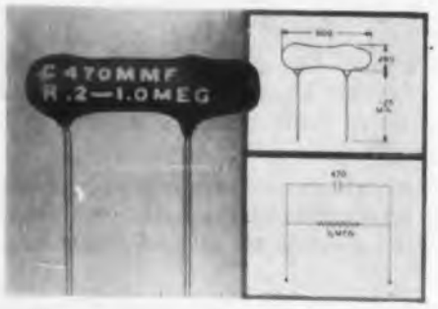
Subminiature Mag-Amp Supplies
For Missile Use

These subminiature, highly-regulated magnetic amplifier type dc power supplies are rugged and stable enough for missile use. Units are available in many sizes and ratings from 5 v for strain gage and transducer operation, to 550-v regulated plate voltage supplies. Designed for maximum reliability, these units contain no vacuum tubes or transistors.

Arnoux Corp., Dept. ED-5, Box 34628, Los Angeles 34, Calif.

CIRCLE 45 ON READER-SERVICE CARD FOR MORE INFORMATION

Resistor-Capacitor
Is Single Unit



This single unit resistor-capacitor, the "Tube-R-Cap," requires only the space of a tubular capacitor. The combination is a standard size CC32 tubular ceramic capacitor that also incorporates, on the same body, a ceramic base resistor in parallel. It is designed to permit greater performance and cost saving in applications where space is at a premium. The unit has many electronic applications and is described as especially valuable for antenna line applications.

Maximum length is 0.900 in. with an approximate diameter of 0.280 in. It is rated as 470 mmfd; GMV-1500 v ac test per UL specifications; resistance 1/2 megohm nominal, 1/2 w. The body is of ceramic impervious to moisture, unaffected by heat, vibration, or common acids. A double coating of Durez phenolic provides insulation.

Centralab, Div. of Globe-Union Inc., Dept. ED, 900 E. Keefe Ave., Milwaukee 1, Wis.

CIRCLE 46 ON READER-SERVICE CARD FOR MORE INFORMATION

Picture Tubes
Reduced in Length

In the illustration, a typical short-length aluminized 90 deg TV picture tube (top) is compared with a conventional aluminized tube (bottom). The tubes pictured are of the 21-in. diagonal size. The new tubes are 2 in. shorter in length in the 21 in. size, while relative savings in length are made in 24-, 17-, and 14-in. types.

These tubes feature a compact, single-unit, straight electron gun. The need for an ion trap has been completely eliminated, and the requirement for beam centering magnets has been reduced. The new tube types permit shallower cabinet design.

Allen B. Du Mont Laboratories, Inc., Dept. ED, 750 Bloomfield Ave., Clifton, N.J.

CIRCLE 47 ON READER-SERVICE CARD FOR MORE INFORMATION

Transitor Tester
A Self-Calibrating Unit

A general purpose transistor tester for laboratory, field, and industrial use, this unit measures and reads small signal beta, collector, leakage current, and collector resistance on a 21-in. meter. These parameters may be measured on all npn, pnp, surface barrier, grown, or diffused junction transistors.

The tester is self-calibrating, and the transistor under test is operated in a temperature stabilized circuit—insuring that each unit is tested under identical biasing conditions. The instrument employs three transistors, one as a stable local oscillator having a nominal frequency of 1000 cps, the other two as a special purpose, low level, synchronous detector. The unit is powered by one battery with very low current drain.

Sonex, Inc., Dept. ED, Upper Darby, Pa.

CIRCLE 48 ON READER-SERVICE CARD FOR MORE INFORMATION

Phototransistor
Is Sensitive to Light Position

The germanium p-n-p alloyed junction three-lead phototransistor, GT-66, is a miniature, light-sensitive photocell intended for use in circuits employing ac amplification for modulated light. It may also be used as a two-lead device with dc (unmodulated) light. Even though it is a miniature, it is capable of performance at a level sufficient to operate a relay.

Applications include: automobile headlight dimmers, tape and punch card reading, optical sound play-back, liquid level control, TV receiver automatic brilliance control, safety devices, and many others. It is also sensitive to relative position of the light source, making it useful in positioning controls.

General Transistor Corp., Dept. ED, Richmond, N.Y.

CIRCLE 49 ON READER-SERVICE CARD FOR MORE INFORMATION

Ribbon Cable Assemblies
Use Teflon Construction

These ribbon cable assemblies, known as "Tempbraid," are available up to 1-3/4 in. width, with Teflon insulated conductors ranging in size from 12 to 32 AWG. "Tempbraid" was especially designed to combine from two to 20 conductors or pairs of parallel conductors, totaling a maximum width of 1-3/4 in. in a single ribbon assembly. This flat type construction provides savings in space, time, and conductor footage. It will take a 90 deg bend. Connections are simplified because of almost unlimited color codings.

"Tempbraid" 100% Teflon construction offers: low loss factor, low dielectric constant, high volume resistivity, non-flammable, low coefficient of friction unaffected by moisture, inert to all known commercial solvents, and working temperature range of −250 to +500 F.

Hitemp Wires, Inc., Dept. ED, Mineola, N.Y.

CIRCLE 50 ON READER-SERVICE CARD FOR MORE INFORMATION

Expansible Compounds

For Insulating and Reinforcing Voids

Two new thermosetting, self-curing polyisocyanate foams are designed for insulating and reinforcing voids between structural members. Designated as Scotchfoam brand expansible compound Type A and Type 1, these two foams are especially adapted to filling cavities where light weight, structural strength, stiffening, vibration dampening, and durability are desirable factors.

Both compounds are a 2-part liquid formulation which can be foamed-in-place to produce a rigid cellular material that will not break loose, settle or sag. Application to desired areas may be made by pouring or spraying. Scotchfoam 1 has a volume expansion of approx 20 to 1.

Design advantages include: low weight factor; adhesion to many types of surfaces without the need for supplementary adhesives or mechanical fasteners; curing without heating; freedom from fire hazard during application; and applicability to irregular surfaces without necessity of cutting and fitting operations.

Adhesives and Coatings Div., Minnesota Mining and Mfg. Co., Dept. ED, 423 Piquette Ave., Detroit 2, Mich.

CIRCLE 51 ON READER-SERVICE CARD

0.0005″ Teflon Tape

Supplied In Continuous Rolls

The 0.0005″ tape provides far greater Teflon coverage at lower cost and finds wide use in capacitors, transformers, and for both wrapped and sintered wires and cables. The thinner tape gives adequate dielectric strength with less Teflon area. It is easier to handle in wrapping operations than thicker tapes, especially on small diameter wires.

Of particular importance, the 0.0005″ tape is supplied in continuous rolls having an absolute minimum of splices. Widths from 1/2″ to 12″ are wrapped to 6″ OD on 1-1/8″ diam spools.

Enflo Corp., Dept. ED, Rt. 38, Airport Circle, Pennsauken, N.J.

CIRCLE 52 ON READER-SERVICE CARD

CIRCLE 53 ON READER-SERVICE CARD ➤

Time Domain Filter System

Uses Cross-Correlation Technique

This time domain system, named the magneFILTER, is particularly useful in seismic exploration where the separation of desired signals from noise background is of vital importance.

The magneFILTER is a specialized analog computer using the cross correlation technique. The trace to be filtered is compared at each instant of time against a filter transient which has been computed from the amplitude and phase conditions desired of a particular filter. The sum of the products of samples from both traces and the transient at any instant of time becomes a running correlation between the two.

With the magneFILTER, it is possible to simulate any of the general filters, plus a wide variety of other linear or non-linear filters which may be useful in experimental investigations. Or, with filter phase and amplitude characteristics individually adjustable, any critical data can be repeatedly examined for optimum filtering as an aid to final interpretation.

Houston Technical Laboratories, Subsidiary of Texas Instruments, Inc., Dept. ED, 2424 Branard, Houston 6, Texas.

CIRCLE 56 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Connectors

BNC and Printed Circuit Types

This firm offers miniature BNC type connectors designed for use with miniature coaxial cable. The compact components include cable plugs and jacks, and receptacles. A plug (left) and a panel jack are illustrated. Outstanding features are quick, "pressure correct" connect and disconnect, and complete moisture and dustproof sealing. An added feature of the plugs and jacks is complete sealing against moisture leakage into the connector through capillary action between the shield and cable insulating core.

Printed circuit connectors are also available in standard and special types. Standards include 10, 15, and 22 contacts.

H. H. Buggie, Inc., Dept. ED, Box 817, Toledo 1, Ohio.

Wescon Show, Booth 104.

CIRCLE 57 ON READER-SERVICE CARD FOR MORE INFORMATION

DC Power Supplies
Are Transistor Regulated

A line of fixed voltage, semiconductor transistor regulated, dc power supplies has been added to this firm's line of "Transpac" miniaturized power packs. The new units provide a rugged reliable stable source of dc power for reference applications, transistorized equipment, guided missile service, computer units, and all types of miniature and standard size electronic devices. Features include high conversion efficiency, low heat dissipation, small size, lightweight, no warmup time, nonmicrophonic operation, and fast transient response. These units are potted in hermetically sealed transformer type housings but include replaceable transistor features.

Units are designed for either plug-in operation or permanent solder connection. Models are available for either 60- or 400-cps operation and for voltage ranges of 5, 10, 20, 30, 40, 50, 100, 150, 200, and 300 v at current ratings up to 200 ma. Line and load regulation are better than 0.5%. Ripple is less than 0.05%. Size of typical units is 2-1/2 x 3 x 4 in. (60 cps type) and 2-1/4 x 2-3/4 x 3-3/4 in. (400 cps type).

Electronic Research Associates, Inc., 67 E. Centre St., Nutley 10, N.J.

CIRCLE 59 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Thermocouple Vacuum Gage
Calibrates 1-1000 Microns

The Model TC-43-3, is designed for use with the VTP-6343 Thermocouple Gage Tube. A light-weight, compact, portable instrument, its accuracy is such that it is valuable as an instrument for advanced engineering.

The TC-43-3 is a complete vacuum measuring unit when attached to a VTP-6343. Front panel controls include an indicating meter calibrated both in dc millivolts and microns pressure of dry air. The unit takes 110 v 56-60 cps 15 ma. It measures 5-1/4 x 4-1/4 x 5-1/4 in. and weighs 3 lb. It operates over air to high vacuum. Calibration (in microns) is 1-1000 microns dry air.

Vacuum Tube Products Co., Inc., Dept. ED, 506 S. Cleveland St., Oceanside, Calif.

Wescon Show, Booth 205.

CIRCLE 60 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Supply
In Subminiature Package

This subminiature power supply is designed to provide B+ and filament voltages to various types of airborne equipment. A unique transformer and the use of silicon rectifiers insure high temperature operation in a 1 x 3 x 9 in. package weighing only 2 lb 4 oz.

Operating from 115 v ac to 400-cps input, the power supply provides 160 v dc at a nominal 100 ma, and 6.3 v ac at 5 amp. Although unregulated, this unit has an inherent regulation factor of 7-1/2 per cent from zero to full load. Units may be interconnected to provide increased voltage or current capabilities. The construction permits use without vibration isolation in all but extreme cases.

Instrument and Electronic Div., Land-Air, Inc., Dept. ED, Oakland Airport, Oakland, Calif.

CIRCLE 64 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Analog to Digital Converter
Counts At a Speed of 400 Steps/Sec

This is a new automatic instrument for precise high-speed measurement and digital recording of outputs from low voltage transducers in both aircraft and ground operations.

Model 311 measures d-c voltages with resolution of 12½ μv by means of a digital scanning technique. Unknown voltage is compared with standard reference voltage through the use of 12 digital scanning units; a thirteenth indicates polarity. All scanning units are modular and interchangeable.

The instrument counts at a speed of 400 steps/sec and gives 20 measurements/sec. At the end of each measurement the converter provides a relay closure that triggers the recorder. An accessory coded readout also can be connected to the converter to display each measurement visually up to a full scale of 999 digits. A "Scan Mode" switch, located on the front panel, selects form of readout—visually or automatic. It is designed to operate in temperates from —55° to 75° C.

Non-Linear Systems Inc., Dept. ED, Del Mar Airport, Del Mar, Calif.

Wescon Show, Booth No. 941.

CIRCLE 65 ON READER-SERVICE CARD FOR MORE INFORMATION

△ A-C Relay

From 6 to 115 v, AC or DC

The HG-2SM-3R retains all the characteristics of the type HG-2SM-dc relay, but will operate at frequencies from dc up to and including 10,000 cps. Operating voltages are from 6 to 115 v, ac or dc.

Measuring only 1-1/2″ in length by 41/64″ diam and capable of operation up to 140°C, this unit surpasses all paragraphs of MIL-R-5757C. Contact ratings are 3 amp resistive and 1 amp inductive @ 28 v dc or 115 v ac.

HI-G Inc., Dept. ED, Bradley Field, Windsor Locks, Conn.

Wescon Show, Booth No. 233.

CIRCLE 67 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Rack-Type X-Y Recorder

Is 0.25% Accurate

The Model 4 "Autograf" X-Y Recorder occupies 19-1/4 in. of standard rack space. It accommodates either 11 x 16-1/2 or 8-1/2 x 11 in. standard graph paper on an illuminated translucent table equipped with a self-contained vacuum hold-down system. Illumination of the table facilitates alignment of the paper and comparison of curves when desired.

Smooth, stepless range controls, selected by detent switches, permit fitting of arbitrary voltages to any desired portion of the recording area in addition to full range zero set and one scale length of zero suppression on each axis. Three step input filters on each axis permit smooth plotting of unfiltered signals.

Recording speed is 1/2 sec for full scale travel, Y axis; 1 sec on X axis. Voltage ranges are 5 mv full scale to 100 v on Y axis; 7.5 mv full scale to 150 v on X axis. Other ranges are available on request. Input resistance is 200,000 ohms per volt up to 10-v range; 2 megohms on all higher ranges. Accuracy is better than 0.25% of full scale; resetability is better than 0.1% of full scale. Power is 115 v 60 cps 100 w. Other voltages and frequencies are availabl-

F. L. Moseley Co., Dept. ED, 409 N. Fair Oaks Ave., Pasadena, Calif.

Wescon Show, Booth 1148-1149.

CIRCLE 68 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 69 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Rotary Switch

Carries up to 15 amp

The type 32-CM Rotary Switch is 1-3/4 in. diam x 1-11/16 in. deep. It is available with three poles on a single deck and may be ordered with as many as nine positions per pole with shorting type action, or five positions per pole with non-shorting type action.

Solid silver alloy contacts, rotors, and slip rings are used throughout. The unit also employs a gold-plated turret. Rotor and stator material is XXXP phenolic in accordance with MIL-P-3115B. Other construction materials can be furnished upon request.

The switch can carry up to 15 amp and break 1 amp non-inductive. It is also available in multi-deck construction. If more than one deck is desired, the unit then becomes square, with each deck 1-3/4 in. square.

The Daven Co., Dept. ED, Mt. Pleasant Ave., Livingston, N. J.

Wescon Show, Booth 756.

CIRCLE 72 ON READER-SERVICE CARD FOR MORE INFORMATION

Automatic Fault Detector

Indicates Faults of 6 Circuits

This new fault finder monitors control circuits continuously and indicates faults instantly in any of the six monitored circuits. It requires no warm-up time, is electrically isolated from monitored circuits, and utilizes printed circuits and standard electronic components for minimum maintenance.

As long as each monitored circuit is trouble-free, its signal lamp remains lighted. But if a fault occurs, even momentarily, the lamp is extinguished and remains so until the fault finder is manually reset. This reset feature assures the detection of momentary faults and also makes the unit a fail-safe device.

Its key component is a cold-cathode gas-filled tube which blocks the current flow until its starting anode is interrupted. Circuitry is such that current flows to the indicator lamp so long as this main anode circuit is not interrupted.

Westinghouse Electric Corp., Dept. ED, P.O. Box 2099, Pittsburgh 30, Pa.

CIRCLE 73 ON READER-SERVICE CARD FOR MORE INFORMATION

Voltage Delay Line

Of Magnetostrictive Type

Applications for this delay line, Model 103, include high access rate temporary storage for computers, replacing drum-type storage; time or frequency determining elements of passive nature; digital circuitry and registers. It is a magnetostrictive unit. Infinite time-delay settings are provided by individual pickup coils positioned and locked in place along the slotted and calibrated microsecond delay scale. The Model 103, first of several models to follow, has a 40-μsec range and four adjustable pickup coils.

Extra pickups, even to a maximum of 20, can be added without noticeable reduction of output due to loading. The limitation in number of pickups is solely a mechanical one. Closest juxtaposition of pickups is about 1μsec. Other models provide time delays from 1μsec to several millisec. Impedance level can be designed to requirements of associated apparatus. Input and output connections are made through coaxial-lead terminals on panel.

The magnetostrictive delay line operates on the property of nickel and other substances to shorten in length when placed in magnetic field. Constriction is equivalent to a shock wave which propagates along the magnetostrictive medium with a time delay equivalent to 5.25 μsec per inch of path length. Pickup coils are placed at any position along the path to receive pulses.

Deltime, Inc., Dept. ED, 608 Fayette Ave., Mamaroneck, N.Y.

CIRCLE 75 ON READER-SERVICE CARD FOR MORE INFORMATION

Frequency Meter

For Broadcast Monitoring

Model 5571 permits direct digital frequency readings from 1cy to 40Mc. It also functions as a frequency ratio meter, 0-1Mc period meter, microsecond to 10-million second time interval meter, 0-2Mc events-per-unit-time meter, and a high speed straightforward counter.

Berkeley Div. of Beckman Instruments, Inc., Dept. ED, 2200 Wright Ave., Richmond 3, Calif.

CIRCLE 76 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Miniature VR Tube

Constant Operating Voltage

Type 6627/OB2WA, is a miniature, two electrode, inert gas-filled cold cathode tube for use as a voltage regulator. It maintains practically constant operating voltage over a current range of 5 to 30 milliamperes and gives extremely small voltage drift throughout the life of the tube. Type 6627/OB2WA is specially designed to maintain stable operating voltages, even in applications where tubes operate continuously under conditions which raise bulb temperature up to 150 C. Improved characteristics for shock, vibration and dark breakdown voltage are other features offered by this new miniature voltage regulator.

Chatham Electronics, Div. Gera Corp., Dept. ED, Livingston, N. J. *Wescon Show, Booth No. 408.*

CIRCLE 80 ON READER-SERVICE CARD

△ Doping Alloys

For Semi-Conductors

High purity metals and alloys, carefully compounded of high purity indium, gallium, aluminum, silver, lead, tin, arsenic and antimony in combinations and proportions to customer specification, are now available from this company.

These alloys can be supplied to extremely close tolerances in the form of pellets, discs, and spheres.

Northwest Lead Co., Dept. ED, 660 Market St., San Francisco, California. *Wescon Show, Booth No. 1617.*

CIRCLE 81 ON READER-SERVICE CARD

△ Casting Resins

Three New Types

Newest in the series of Epocast electrical insulating resins are: Epocast 10G, lower cost epoxy potting material; Epocast 15, semi-rigid, low strain system; and Epocast 16, low-loss system, K = 2.5.

Furane Plastics, 4516 Brazil St., Los Angeles 39, Calif. *Wescon Show, Booth No. 1211.*

CIRCLE 82 ON READER-SERVICE CARD

CIRCLE 79 ON READER-SERVICE CARD

Hook-Up Wires

Insulated With Teflon

"Permacode" hook-up wires combine high temperature operating characteristics with permanent and positive identification. These new wires, insulated with extruded du Pont Teflon suitable for continuous operation up to 210°C, are available in fifteen solid colors and any combination of 2, 3, or 4 colors.

The insulating material comes in both solid and striped colors and provides inherently permanent coding, a significant advance in striping technique. Permacode wires are available in nominal 0.010" or 0.015" wall thicknesses, and are constructed to meet requirements of military specification MIL-W-16878/A, types E and EE.

Revere Corp. of America, Dept. ED, Wallingford, Conn.

CIRCLE 83 ON READER-SERVICE CARD

Teflon Tubing

Has Thin Wall

The high dielectric strength and superior physical properties of POLYPENCO Teflon tubing have provided efficient insulation in the small size tubing required in telemetering equipment used in military and civilian aircraft and missile research and development programs.

The thin wall tubing has a minimum dielectric strength of 750 v/mil, a low dielectric constant of 2.0 and a high surface resistivity above 10^{12} ohms. It has a service temperature range of —320°F to 555°F. The tubing has zero water absorption, is unaffected by moisture, and is also highly resistant to vibration and flexural fatigue. This combination of electrical and physical properties permits miniaturization without fear of dielectric failure.

POLYPENCO Teflon spaghetti tubing is available in AWG wire sizes #8 through #26, in ten colors for coding this type of component assembly. It is chemically inert, fungus resistant, sunlight resistant and non-flammable.

The Polymer Corp. of Pennsylvania, Dept. ED, 125 N. 4th St., Reading, Pa.

CIRCLE 84 ON READER-SERVICE CARD

CIRCLE 85 ON READER-SERVICE CARD ➤

DU PONT

ELECTRONIC DESIGN NEWS

PROPERTY AND APPLICATION DATA ON THESE VERSATILE ENGINEERING MATERIALS: "ZYTEL," "ALATHON," "TEFLON," "LUCITE."

Unique properties of Du Pont TEFLON® help solve electronic design problems

Terminals of Du Pont TEFLON® feature high dielectric strength

The toughness, high dielectric strength and heat resistance of TEFLON make it particularly suited for applications such as these terminals manufactured by Cambridge Thermionic Corporation, Cambridge, Massachusetts. Utilizing in a unique manner the toughness of

TEFLON, the terminals exhibit excellent resistance to shock and vibration over a wide temperature range.

TEFLON has many electronic design possibilities. Its power factor remains extremely low over the entire spectrum. Volume resistivity is very great even after prolonged immersion. Surface resistivity remains high even under exposure to saturated water vapor. TEFLON does not "track" on exposure to arc. Dielectric strength is high over a considerable temperature range.

To obtain complete property and application data, mail coupon.

An engineer at Eitel-McCullough, Inc., holds sleeve of TEFLON molded by Chase Sales Company, Hayward, California, for use in klystron pictured above.

Capacitors encased in TEFLON are designed especially for sustained high-temperature operation in aircraft, airborne computers and other high-ambient-temperature applications where high insulation resistance must be maintained. *(Manufactured by Film Capacitors, Inc., New York, N. Y.)*

The physical, chemical and electrical properties of Du Pont TEFLON tetrafluoroethylene resin make it applicable to a wide variety of uses in the electronic field. It is especially useful in applications involving miniaturization, high-frequency, high-voltage, high-temperature requirements; and exposure to corrosive action.

TEFLON readily provides continuous service at 260°C., exceeding requirements of Class H materials. Of exceptional thermal stability, TEFLON can be used at extreme service temperatures, ranging from a high of 500°F. to a low of —450°F. The power factor of TEFLON is less than 0.0003 over the measured spectrum (60 cycles to 10^8 cycles). Water absorption (ASTM D570-42) is only 0.005%.

A sleeve of Du Pont TEFLON is used by Eitel-McCullough, Inc., of San Bruno, California, in apparatus to measure the radio frequency power output of high-power UHF microwave amplifier klystrons. The sleeve of TEFLON is mounted in a metal pipe through which the electromagnetic energy output from the klystron travels. The TEFLON acts as a window through which the energy passes into water circulating within the cone-shaped sleeve. Here the energy is dissipated. By measuring rate of flow, and temperature change of the water, tube output can be determined.

If you wish complete property and application data on TEFLON to evaluate for your own use, clip and mail the coupon below.

NEED MORE INFORMATION?

CLIP THE COUPON for additional data on the properties and applications of this Du Pont engineering material.

E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department
Room 418 Du Pont Building, Wilmington 98, Delaware.
In Canada: Du Pont Company of Canada Limited, P.O. Box 660, Montreal, Quebec

Please send me complete property and application data on Du Pont TEFLON. ☐

I am interested in evaluating this material for

_____

_____

*Name*_____

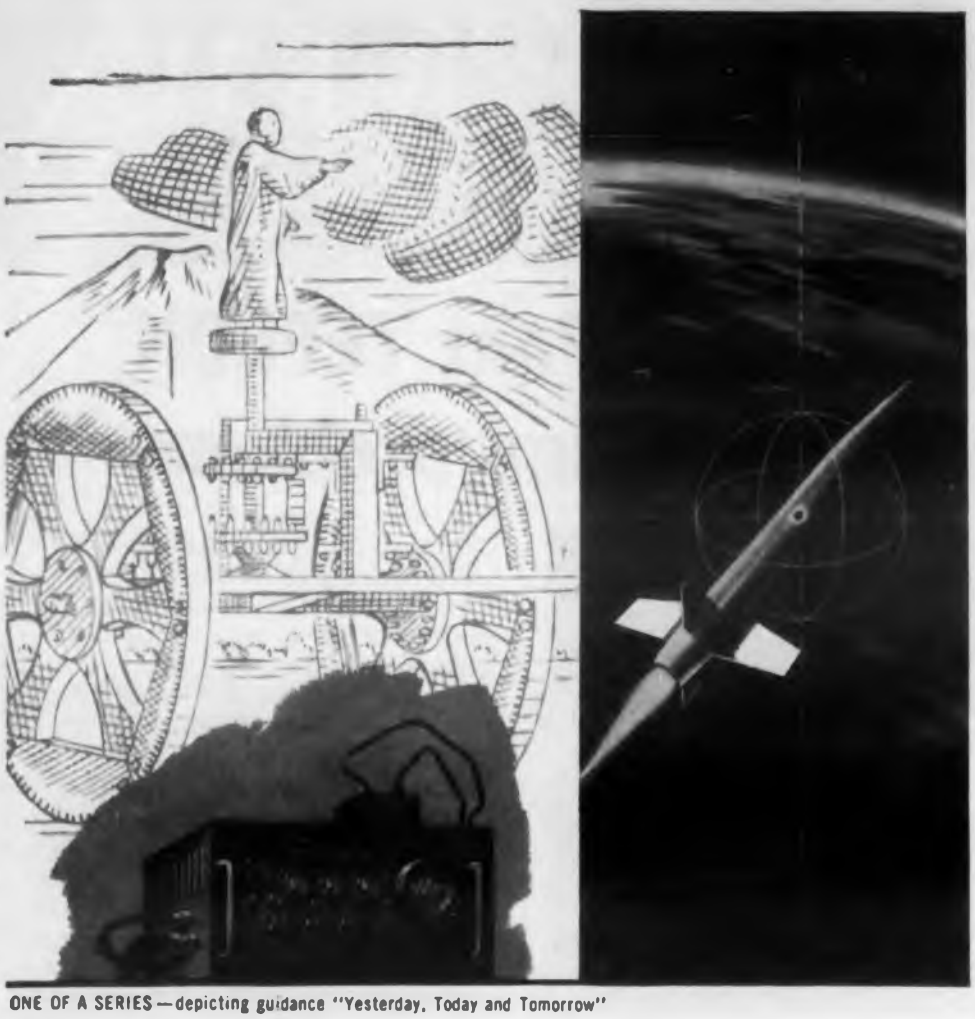
*Firm Name*_____

*Position*_____

*Type of Business*_____

*Street Address*_____

*City*_____ *State*_____



ONE OF A SERIES—depicting guidance "Yesterday, Today and Tomorrow"

navigation is a problem

From the ancient Chinese comes one of the earliest known directional devices. Not the magnetic compass of legend, but a mechanical compass with differential gears for maintaining a constant south-pointing position. It was used by Yellow Emperor Hunag Ti about 2634 B. C. to guide his armies across the vast steppes leading to the sunny, fertile lands of the south.

Many forms of navigation have been developed since, each system requiring greater scientific knowledge. One of today's systems is inertial guidance, a complex integration of electronics and servo mechanisms utilizing the best that present technology can provide.

At Bell, problems in navigation or guidance have been answered in many ways . . . missile guidance systems . . . a recovery system used in several missiles . . . and a landing system for aircraft in all types of weather.

Bell offers an unparalled opportunity to the progressive engineers who desire assignments that demand creative thinking. Engineers with a B. S. or advanced degree in :

DEVELOPMENT ENGINEERING
ELECTRONIC ENGINEERING
SERVO ENGINEERING
DESIGN ENGINEERING

please contact

Manager Engineering Personnel

BELL Aircraft CORPORATION

P. O. Box 1 Buffalo 5, N. Y.

Servo Motor—Generator

In Size 11

This size 11 Servo Motor–Generator features all stainless steel construction, small size, and light weight. It measures 1.062 in. diam x 2-1/8 in. long and weighs 6 oz. Operating temperature range is —54 to +125C. It is especially offered for application in airborne servo systems.

The servo motor will deliver 0.60 oz-in. torque at stall, and its no-load speed is 5600 rpm. Models are available with both low and high impedance windings, and a center tap is provided for parallel operation in push-pull circuits. Generator output is 1/2 v per 1000 rpm, and 19 mv at 0 rpm. Both motor and generator are rated for 115-v 400-cps input, and the combination will draw 6 w.

The combination does not have temperature stabilization, but the effects of temperature on output and phase shift are: output decreases 1/4% per C increase in temperature, phase shift 1 deg leading with 8C increase in temperature. Other motor-generator datar are: rotor inertia, 1.1 gc-cm^2; time constant, 0.0152 sec; max power output, 0.95 w; torque at max power output, 0.3 oz-in.; duty, continuous at stall. Generator input current is 0.050 amp; phase shift is within 10 deg of references; and output impedance (stall) is 1000 ohm.

Kearfott Co., Inc., Dept. ED, 1378 Main Ave., Clifton, N.J.

CIRCLE 88 ON READER-SERVICE CARD FOR MORE INFORMATION

Germanium Diodes

Glass-Sealed, Bonded-Junction

A new series of glass-sealed, bonded-junction germanium diodes, types 1N497 through 1N502 feature high forward conductance, high back resistance and a variety of peak reverse voltages.

These diodes combine low forward impedance and reverse current of junction devices with the fast forward and reverse pulse recovery of point-contact types. Their wide range of peak reverse voltages and low capacitance make them suitable for varied applications such as computers, magnetic amplifiers, modulators, demodulators, and low-power rectifiers.

CBS-Hytron, Semiconductor Div., Dept. ED, Lowell, Mass.

CIRCLE 89 ON READER-SERVICE CARD FOR MORE INFORMATION

Galvanometers

Frequency From 1 To 570 cy

These are rapidly oscillating moving coil galvonometers, equipped with a concave reflecting mirror, 7-mm diam, focal distance 75 mm. Flat mirrors or mirrors with other focal distance are also obtainable.

A wide variety of models are available with inherent frequency from 1 cy to 570 cy and with sensitivities from 0.0036 μa/mm to 252 μa/mm, at 1 m distance. Optimum degree of damping is achieved either by an appropriate external resistance or by adjusting the galvanometer itself (silicon oil damped). Zero point setting is achieved by an 8″ long flexible shaft.

EPIC, Inc., Dept. ED, 154 Nassau St., New York 38, N.Y.

CIRCLE 93 ON READER-SERVICE CARD FOR MORE INFORMATION

Variable Transformers

Can Be Remotely Operated

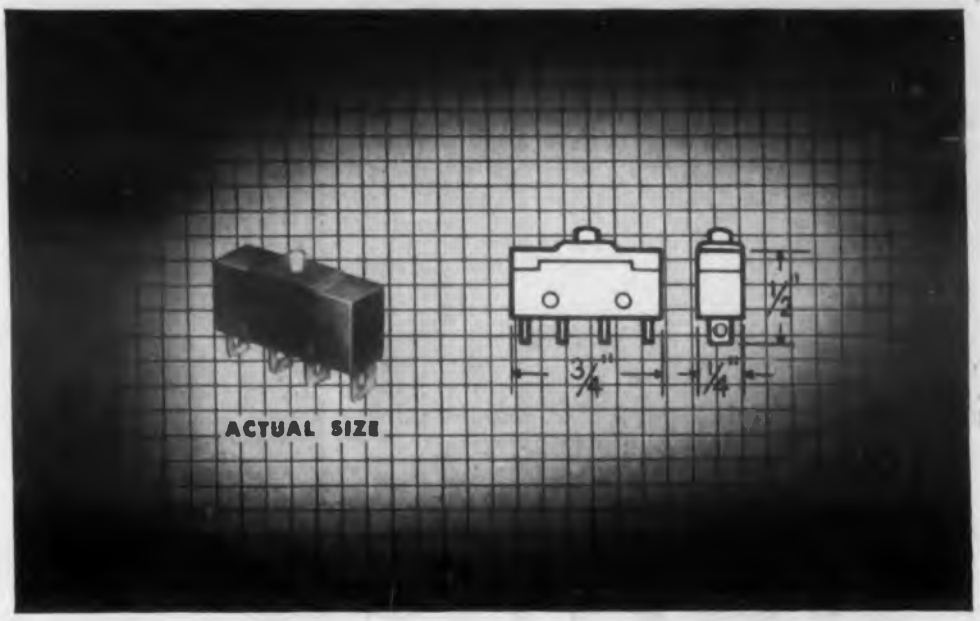
A line of nine basic models of motorized "Adjust - A - Volt" Variable Transformers is offered by this firm. Available in single or up to six ganged assemblies, they are designed for applications where it is desirable to operate variable transformers remotely by a pushbutton or switch.

The units are available in the same electrical specifications as the standard "Adjust-A-Volt" types 500B, 520B, 1500B, 1520B, 3000B, and 3020B, with a range from 0.35 kva to 28 kva at 115 v or 230 v. All units are equipped with clockwise and counterclockwise limit switches. Provisions are made for conduit connections. Standard meters for 115 v 60-cps operation are used. Lower voltage and/or 50-cps motor units are available. Four standard speeds of 6, 13, 26, and 45 sec for full range travel are available on each model.

Standard Electrical Products Co., Dept. ED, 2240 E. Third St., Dayton 3, Ohio.

CIRCLE 94 ON READER-SERVICE CARD FOR MORE INFORMATION

HIGH CAPACITY
in very small size!



NEW Acro Subminiature Snap-Switch

- **HIGH ELECTRICAL RATING**—10 Amps at 115 volts or 230 volts A.C. or 28 volts D.C.
- **EXTREME TEMPERATURE RANGE**—from +350°F to −100°F
- **LONG MECHANICAL LIFE**—many millions of cycles, continuous duty
- **DOUBLE CIRCUIT TERMINAL ARRANGEMENT**

The big feature about this little switch is its high rating. It has *four times* the capacity of most switches in this size. And temperature extremes pose no problem. The Acro subminiature switch will operate within a range of from +350° to −100°F. Long life is assured through use of the rugged Acro rolling spring principle, up to 10 million cycles continuous duty.

High rated Acro subminiature switches are your answer to the problem of controlling big loads in confined areas. And on lesser loads their excess current-carrying capacity is a good safety factor. Four terminal construction permits wiring double circuits where required. The entire unit is housed in a plastic case and can be adapted to any present type actuator. Write for literature.

ACRO
MANUFACTURING COMPANY

SWITCH DIVISION
Columbus 16, Ohio
Plants at Columbus and Hillsboro
REPRESENTATIVES IN PRINCIPAL CITIES

CIRCLE 95 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Digital Read-Out Design

Facilitates Bulb Replacement

The company's line of true, digital, in-line readouts have been improved by the development of a connector which makes bulb changing easier. Formerly, leads were soldered directly to the bulb base. When a bulb burned out, it was necessary to remove the lead, replace the bulb, and resolder the lead.

Now, the lead is soldered to the connector, not the bulb base. To replace a burned-out bulb requires only to remove the connector, replace the bulb and replace the connector. The connectors are spring-loaded to insure good contact with the bulb base. Connectors are available for both regular (1" characters) and miniature (1/2" characters).

The readouts consist of engraved, lucite plates, arranged in depth and held in a precision-machined holder. A new, improved design reduces cross-lighting effects and provides unambiguous readings. Regular 1" high characters can be easily read from 30 feet away. Speed of response is limited only by the response of the bulb.

Electro Instruments, Inc., Dept. ED, 3794 Rosecrans Ave., San Diego 10, Calif.

Wescon Show, Booth No. 341.

CIRCLE 98 ON READER-SERVICE CARD FOR MORE INFORMATION

Thermal Ignitron

Has Thermostat Mounting Plate

This ignitron, designated as the NL-1022, is exactly equivalent to the NL-5822 with the addition of the thermostat mounting plate. It embodies the same copper cooling coil construction used in other thermal ignitrons. This construction gives increased thermal mass, more efficient cooling, and self-flushing water system to prevent sediment deposits.

NL-1022 is rated at 1500 amp max peak current at 1200 max peak inverse and forward volts, or 1200 max peak amp at 1500 max peak inverse or forward volts. Maximum averaging time is 6.25 sec.

National Electronics, Inc., Dept. ED, Geneva, Ill.

CIRCLE 99 ON READER-SERVICE CARD FOR MORE INFORMATION

Analog-to-Digital Converter

For Long Distance Transmission

The purpose of this converter is for accurate long - distance transmission of data representing voltage, current and power. By converting data from analog to digital form, it is not subject to varying line conditions and resultant inaccuracies of readings.

The converter is a photo scanner which converts an analog meter indication into digital form for series or parallel long-distance transmission. It uses a conventional pointer-type meter without modification of the movement or loading of the output shaft.

The basic elements of the meter-reader are: 1) a photocell and light source assembly; 2) a pointer path length mirror; 3) a small motor; 4) a code disc; 5) a sensitive relay; and 6) a group of digit storage relays, one for each digit of the code disc.

Bendix-Aviation Corp., Pacific Div., Dept. ED, 11600 Sherman Way, N. Hollywood, Calif.

CIRCLE 101 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Potentiometer

With Resolution to 0.008%

The Model LA-09 Ten-Turn Potentiometer is designed especially to meet critical demands for reliability in military electronics equipment. A 7/8-in. diam unit, it is built with a rugged all-metal external construction, metal-to-metal stops, stainless-steel ball bearings, and glass-sealed terminals positively seated to the metal housing for optimum strength.

Resolution as close as 0.008% is the result of winding a large number of turns of resistance wire on a mandrel 17% longer than in previously available units. Linearity is held as close as 0.05%. All connections are welded. Taps are welded to a single turn of resistance wire to a tolerance of ±2%.

Components Div., Litton Industries, Dept. ED, 5873 Rodeo Rd., Los Angeles 16, Calif.

Wescon Show, Booth 1256-1257.

CIRCLE 102 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW PRODUCTS . . . BROADER ENGINEERING HORIZONS FROM SORENSEN

MR3215 5-32VDC AT 0-15 AMPS
new, tubeless, magnetic amplifier

WIDE RANGE REGULATED DC POWER SUPPLY

for versatile, trouble-free performance in countless design & test applications

Different outside . . . and *inside!* The latest design in magnetic amplifier regulation. A silicon diode is used as reference element and a transistor amplifier provides the control current for the magnetic amplifier. Wide range, continuously adjustable voltage at high current. Regulation ±0.5% against line or load, ripple 1% RMS. Versatile, dependable, rugged, economical.

Send today for complete specifications, performance data and quotations.

Sorensen

SORENSEN & COMPANY, INC. • 375 FAIRFIELD AVENUE • STAMFORD, CONNECTICUT
CIRCLE 105 ON READER-SERVICE CARD FOR MORE INFORMATION

Frequency Calibrator
for VHF-UHF

The Model 121 Frequency Calibrator is a crystal controlled unit which acts as a secondary frequency standard supplying a source of simultaneous uninterrupted CW signals spaced every 50, 100, and 200 Mc over the frequency range of 50-11,000 Mc. An accuracy of better than ±0.005% is obtained over the ambient temperature range of –20 to 40 C when operated from an ac power source of 103.5-126.5 rms at a frequency range of 50-440 cps.

The output power of the rf signal is not less than –70 dbm at any frequency and is approximately –10 dbm at 200 Mc. An output level control changes the output from maximum to zero level. The instrument is useful for laboratory and field test. It is the commercial equivalent of the AN/USM-45 used by the military.

Nominal operating requirements are 115 v 50-440 cps 25 w. Overall dimensions are approximately 7 x 7-1/2 x 9 in.

Control Electronics Co., Inc., Dept. ED, 1925 New York Ave., Huntington Station, N.Y.

CIRCLE 106 ON READER-SERVICE CARD FOR MORE INFORMATION

1-1/2 in. Diam Meter
Has Scale Length of 2-1/2 in.

The MM-1 "Medalist" Panel Meter is interchangeable with standard 1-1/2 in. JAN types. It is available in all standard ranges and with self-contained accessories. Basic mechanism is the Marion "Coaxial" MEP2-D. Simplified installation is accomplished by means of a threaded ring mount.

The meter is designed to provide readability equal to or better than conventional 2-1/2 in. round instruments, plus the characteristic appearance of the "Medalist" design. Large numerals and a long pointer contribute to the high readability. A "Plexiglas" acrylic plastic case, which affords shadow-free scale illumination from all angles, is available in numerous standard and special colors.

Marion Electrical Instrument Co., Dept. ED, Grenier Field, Manchester, N.H.

CIRCLE 107 ON READER-SERVICE CARD FOR MORE INFORMATION

Industrial Oscilloscope

Usable Response Up To 500 kc

The new oscilloscope features usable response up to 500 kc and is "flat" within 3 db at from 0 to 300 kc. It translates electrical phenomena into visual displays, making it possible to examine, qualitatively and quantitatively, the characteristics of the electrical circuit under test. Built-in calibration voltage enables the user to measure the amplitude of voltage while it is being observed.

Other features include: a flat face cathode-ray tube to minimize distortion; high grade transformers to assure rugged durability; and a minimum of component parts, facilitating service and maintenance.

The oscilloscope was designed to meet the varied requirements in the electronic, aircraft, guided missile, research, chemical, and educational fields.

Hycon Mfg. Co., Dept. ED, Pasadena, Calif.

CIRCLE 111 ON READER-SERVICE CARD FOR MORE INFORMATION

Indicating Instruments

Accurate to 0.25% Full Scale

This firm offers a line of high-accuracy portable indicating instruments which are lower in price and require less power from measured circuits than the previous Type P-3 instruments being replaced. The Type AP-12 (ac-dc) portable standards have an accuracy of 0.25% full scale, and the matching Type AP-11 (ac-dc) portable instruments for general testing are accurate to 0.5% of full scale. An AP-12 wattmeter is illustrated.

Better scale readability is provided in all ac ratings to permit more accurate readings over wider portions of the 5.5-in. scale. All instruments have two spring-mounted pivot bearings which virtually eliminate pivot blunting and cracked jewel bearings. Errors caused by stray magnetic fields are minimized in all instruments by means of improved magnetic shielding. The molded "Textolite" case is not marred by oils or other chemicals, and scratches are easily buffed out.

The instruments weigh 5 lb net, and dimensions are 7-3/4 x 7-7/8 x 3-1/4 in. A leather carrying case is available.

General Electric Co., Dept. ED, Schenectady 5, N.Y.

CIRCLE 112 ON READER-SERVICE CARD FOR MORE INFORMATION

WHY SPARK GAP TUBES ARE IMPORTANT–

and how Bendix Red Bank can help you with spark gap problems!

Bendix Red Bank "Spark Gap" Tubes are specially designed to do two big jobs in electronic circuits.

First, to act as a *"triggering" switch*—as on jet ignition systems. Here, Bendix* Spark Gaps pass high currents with relatively low voltage drop and have the advantage of being able to handle high voltages in small space. Further, these tubes can be made insensitive to ambient temperature variations and are not normally affected by pressure, altitude, or humidity changes.

The second function of Bendix Spark Gaps is as a *protective element*—guarding radar equipment against voltage overload, to name one example. Here, Bendix Spark Gaps keep high voltage surges from getting through to damage circuit components.

Our design and manufacturing experience with spark gap tubes is extremely broad. If our extensive line of these tubes . . . ranging from 750V to 50KV in DC breakdown voltages . . . does not already contain a type to fit your needs, we are in a position to design one to handle the job with the exact degree of efficiency that you require.

To find out more about what we can do to help you with your spark gap problems, get in touch with RED BANK DIVISION, BENDIX AVIATION CORPORATION, EATONTOWN, NEW JERSEY.

* TRADEMARK

West Coast Sales and Service:
117 E. Providencia Ave., Burbank, Calif.
Export Sales and Service:
Bendix International Division,
205 East 42nd St., New York 17, N. Y.
Canadian Affiliate:
Aviation Electric, Ltd., P. O. Box 6102,
Montreal, Quebec.

Red Bank DIVISION — Bendix AVIATION CORPORATION

CIRCLE 113 ON READER-SERVICE CARD FOR MORE INFORMATION

UNION

Miniature Relays *in Stock for quick shipment*

Need relays in a hurry? Call Union Switch & Signal. You can get any of the standard UNION DC or AC Miniature Relays shipped from stock. These are available with (1) Plug-in mount, (2) Single screw mount, (3) Center of gravity flange mount, (4) Double screw mount, (5) Top flange mount, (6) Clamp mount, (7) Bottom flange mount, (8) Flange mount.

OUTSTANDING FEATURES

GOLD ALLOY OR PALLADIUM CONTACTS are cleaned by a special process to assure a degree of contact reliability unsurpassed in this field. Gold alloy contacts are especially fitted for dry-circuitry use.

COIL RESISTANCES UP TO 9,500 OHMS for a wide variety of applications.

HIGH VIBRATION AND SHOCK RESISTANCE available with vibration resistance up to 2,000 cycles at 30 G's and shock in excess of 50 G's.

HIGH LIFE EXPECTANCY. Tested through 1,000,000 operations.

UNION Miniature Relays are precision made—assembly is quality controlled. All meet or exceed the requirements of MIL-R-5757. Write for a copy of Bulletin 1010.

75 Years 1881 1956

OF EQUIPMENT AND SYSTEMS ENGINEERING . . . . .

UNION SWITCH & SIGNAL

DIVISION OF WESTINGHOUSE AIR BRAKE COMPANY

PITTSBURGH 18, PENNSYLVANIA

CIRCLE 115 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Magnetic Core Tester

Provides Reliable Testing

Designed expressly for testing tape wound bobbin cores, the Magnetic Core Tester, BCT 301, provides precise control over the frequency, pattern, amplitude, and rise time of the core driving signal, and allows extremely accurate measurement of the switching time of the core as well as the amplitude of the output voltage.

Mounted on a single six-foot relay rack, the BCT 301 consists of a core counting jig, a pattern generator, current drivers, calibrator and power supplies.

Two current drivers convert the voltage pulse from the pattern generator into the positive and negative constant current pulses used for driving the cores. Front panel controls provide for variable current amplitude from 0 to 1 amp; variable rise time from 0.2 μsec to 1 μsec; variable pulse duration from 1 μsec to 10 μsec.

Burroughs Electronic Instruments Div., Dept. ED, 1209 Vine St., Philadelphia, Pa.
Wescon Show, Booth 1607.

CIRCLE 116 ON READER-SERVICE CARD FOR MORE INFORMATION

Non-Metallic Spur Gears

4 Fine Pitch Sizes

Type AB precision non-metallic spur gears are available from stock in both nylon (FM-10001) and linen phenolic (MIL-P-15035 Type FB1) material and 4 fine pitch sizes 48, 64, 72 and 96 pitch. Bores are available in 1/8, 3/16, and 1/4" bore. These gears are cut to AGMA Precision 1 tolerances.

PIC Design Corp., Dept. ED, 160 Atlantic Ave., Lynbrook, L.I., N. Y.

CIRCLE 117 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Welding Unit

For Spot and Seam Welds

The VIW-1 unit, while initially developed for seam welding use, may also be used as a power unit for general spot welding applications when used in conjunction with the VTA-9 bench model welding head. This combination finds application where difficult materials, such as molybdenum, tungsten, beryllium copper, or stainless steel, must be joined, as well as other materials where material thickness is less than 0.001 in. and oxide-free welds are required.

The VIW-1 is a completely self-contained unit consisting of a welding transformer together with a fractional cycle timer and an adjustable speed repeat timer, all housed in a 12-1/4 x 15 x 22 in. metal cabinet. In addition, a ground cable and a seam welding handpiece are provided so that no further components are necessary to perform either spot or seam welding operations. The standard unit is provided for operation from either a 220-v single phase or a 208-v leg of a three-phase 50- or 60-cps, grounded or ungrounded, power line.

Vacuum Tube Products Co., Inc., Dept. ED, 506 S. Cleveland St. Oceanside, Calif.
Wescon Show, Booth 205.

CIRCLE 121 ON READER-SERVICE CARD FOR MORE INFORMATION

Precision Potentiometer

For Servo and Telemetering Applications

This rugged, precision potentiometer is especially adapted to flight test, servo feedback and telemetering applications. Housed in a cast aluminum case, this rotary sector pot is designed to withstand up to 40 lb side load on the shaft while operating. It is also gasket and o-ring sealed against immersion to 15 psi.

Other specifications are: dual element, 4800 ohms each element; dual wipers each element and pickoff; up to 2-w dissipation per element; 110° active travel 5° overtravel each end; resolution 1/17°.

Minco Engineering and Mfg., Dept. ED, 801 8th Street, S. E., Minneapolis 14, Minn.

CIRCLE 122 ON READER-SERVICE CARD FOR MORE INFORMATION

Stupakoff
METAL-BONDED
ALUMINA TERMINALS

Right—Sample of a Stupakoff Alumina Terminal in test rig, torsion-tested to destruction. The failure occurred in the ceramic, not in the bond.

Left is similar terminal before testing.

Amazing bond-strength, and unequalled high-temperature ceramic-to-metal adherence are two outstanding characteristics of Stupakoff Alumina Terminals. Available in six standard stock sizes and many special designs, these terminals provide assurance of stronger, tighter, soft-soldered assemblies. The alumina body is a Stupakoff development, processed under rigidly controlled conditions.

The new Stupakoff metal-bond technique (patent applied for) should not be confused with the ordinary silver metallizing process. This is not a plating, but an intimate bonding of ceramic and metal. Its effectiveness is proved by the photograph at the left, showing the results of a typical torsion test. Ultimate failure of the terminal occurred in the ceramic and not in the bond.

Because the bond remains hermetically tight, well beyond the temperature limits of soft solder, assembly processes are simplified and more dependable.

Write for full information and prices on Stupakoff Metal-Bonded High Alumina Terminals.

Stupakoff
DIVISION OF

Write Dept. ED
LATROBE, PENNSYLVANIA

The CARBORUNDUM Company

CIRCLE 123 ON READER-SERVICE CARD FOR MORE INFORMATION

'dag' Colloidal Graphite improves CRT performance

For many years, **'dag'** Colloidal Graphite dispersions have been vital to the manufacture of various types of cathode ray tubes. Now an interesting new **'dag'** Interior Coating with superior electronic and electrical characteristics has been developed for easy, economical application. A smooth, non-reflective, conductive film, free of organic contaminants, is deposited on the inside walls of CRTs. By grounding stray electrons, secondary emission is retarded and ray-focusing improved. Even in aluminized tubes, **'dag'** Colloidal Graphite furnishes "assured conductivity" at the neck and button.

Where an opaque, conductive shield is needed for outside surfaces, **'dag'** Exterior Coating provides a convenient, fast-drying tenacious lacquer coating.

A valuable bulletin, showing other ways in which **'dag'** colloidal dispersions help in the manufacture of electrical and electronic equipment, is yours free on request. Ask for Bulletin K-8.

'dag' is a registered trademark of Acheson Industries, Inc.

ACHESON COLLOIDS COMPANY

PORT HURON, MICHIGAN

. . . also Acheson Colloids Ltd., London, England

ACHESON COLLOIDAL DISPERSIONS:

Graphite • Molybdenum Disulfide • Zinc Oxide • Mica and other solids

CIRCLE 125 ON READER-SERVICE CARD FOR MORE INFORMATION

Point Indicator

Reduces Layout Time

The "Miracle Point Indicator" reduces computing and layout time in joining, shaping, drilling, and milling. It is a combination angle finding, center locating, and leveling device, consisting of a mercury-balanced level and degree-calibrated dial enclosed and mounted on a magnetized V-base.

The indicator automatically determines angles and center points which ordinarily would require minutes or even hours of measuring, scribing, computing, and layout. By placing the indicator base against a surface, such as a board to be leveled, or metal stock to be shaped, the instrument will read off the exact angle at which the work is being held. It is accurate to within 3 min.

Two Alnico-V magnets in the base hold the indicator in contact with metallic objects. To find the center of an object, such as a section of bar stock to be drilled, the indicator is placed astride it, and turned until the dial reads zero. The V-base junction then indicates the exact center. A center punch runs through the instrument to aid in marking hole locations. Similarly, points can be located at any angle on material to be worked: the indicator is placed on the object and turned until the dial reads the desired angle. The center punch then indicates the correct point location.

Racine Instrument Co., Dept. ED, 500 College Ave., Racine, Wis.

CIRCLE 126 ON READER-SERVICE CARD FOR MORE INFORMATION

RF Power Supply

Provides 7.5-12 kv Output

The Model 7512 is an rf type power supply with a voltage output of approximately 7.5-12 kv, and 1 ma of current may be drawn throughout the voltage range. To obtain an output of 7.5 kv at 1 ma, low voltage input requirements at 300 v dc at 500 ma. By varying the dc input, the output voltage can be increased. Maximum input voltage of 425 v at 100 ma will give an output of 12 kv at 1 ma.

Spellman Television Co., Dept. ED, 3029 Webster Ave., Bronx, N.Y.

CIRCLE 127 ON READER-SERVICE CARD FOR MORE INFORMATION

Light Pulser and Modulator
For DC to Video Range

Light pulses in the microsecond range and modulated light beams at variable frequencies from dc through the video region are easily obtained with high speed light pulsing and modulation apparatus offered by this firm. Applications include use in such areas as sound-on-film, video-on-film, polarimetry, densitometry, photography, photometry, interferometry, and measurement of semiconductor parameters.

Baird Associates-Atomic Instrument Co., Dept. ED, 33 University Rd., Cambridge 38, Mass.

CIRCLE 130 ON READER-SERVICE CARD

Gold-Plated Terminals
For Coaxial Cables

This manufacturer now offers gold-plated terminals which add mechanical strength to the center conductor of their line of microminiature coaxial cables.

Gold-plated terminals are available for either solid or stranded conductors where cable dielectric has the following maximum diameters: 0.050 in., 0.070 in., or 0.110 in.

Microdot, Inc., Dept. ED, 1826 Fremont Ave., South Pasadena, Calif. *Wescon Show, Booth No. 1327.*

CIRCLE 131 ON READER-SERVICE CARD

Descriptive Data Sheets
For 400 New Equipments

Data sheets on about 400 new equipments will be added to the approximately 1100 equipments now covered in the 4-volume set, "Electronics Test Equipment Descriptive Data Sheets." This is a new service of interest to persons working with electronic test equipment. A wealth of information is included on each data sheet and especially valuable are the indices and the cross references by functional classification and designation.

Carl L. Frederick and Associates, Dept. ED, 4630 Montgomery Ave., Bethesda 14, Md.

CIRCLE 132 ON READER-SERVICE CARD

CIRCLE 133 ON READER-SERVICE CARD ➤

Grade L-6 (Body 306) Steatite Ceramics

Small and large parts held to extremely close tolerances by Centralab

Can be extruded or molded

Can be worked the same as metal—ground, drilled, threaded or tapped

Can be metallized with fired-on-silver

- High dimensional stability.
- Modulus of rupture, 20,000 psi.
- Water absorption less than 0.1%.
- Safe operating temperatures at continuous heat, 1500° F.
- Freedom from cold flow.
- Abrasion-resistant.
- Hardness greater than 7.5 Moh's scale.
- Loss factor only .00395 at 1 megacycle per second.
- Dissipation factor les than .002.
- Dielectric constant of 5.27 at 1 megacycle per second.
- Chemically inert.
- Freedom from carbonization.

See Centralab's new products in Booth 1225 at the WESCON Show

Refer to Centralab's Ceramic Buyer's Guide in Sweet's Product Design File — or write for your personal copy. Ask for Bulletin 42-221.

Centralab ®Trademark

X-2456

A DIVISION OF GLOBE-UNION INC.

960H East Keefe Avenue • Milwaukee 1, Wisconsin
In Canada, 804 Mt. Pleasant Road, Toronto, Ontario

CIRCLE 134 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Waveguide Isolator

Max Forward Attenuation 1.5 db

This new ferrite waveguide isolator which operates on the Faraday principle provides complete broad band coverage of all X-band frequencies from 8.2 to 12.4 kMc. The instrument, Model X365A provides almost flat response over the entire X-band, making unnecessary the use of many, narrow-band isolators for work in this range. The X365A insures maximum forward attenuation of 1.5 db and at least 25 db reverse attenuation. SWR is 1.2 and maximum power dissipation is 5 w.

Hewlett-Packard Co., Dept. ED, 275 Page Mill Rd., Palo Alto, Calif.

Wescon Show, Booth No. 1050.

CIRCLE 135 ON READER-SERVICE CARD FOR MORE INFORMATION

Phase Meter

For the AF Range

The Model 120 Phase Meter provides an accurate measurement of phase between two signals in the audio frequency range. The measurement is presented automatically as a direct reading. An accuracy of ±1 deg is obtained over the frequency range of 20-20,000 cps. A reduced accuracy is obtained over an extended frequency range to beyond 100 kc.

Sinusoidal and nonsinusoidal signals are accepted; any type of waveform is acceptable which does not cross the zero axis more than once in a given direction per cycle. The phase reading is given directly on a large 4-1/2-in. meter which has two scales. The first scale reads 0 to 360 deg, and the second scale reads 0 to 30 deg with divisions marked in half-degree steps. A sector switch is provided to cancel out all but the last 30 deg of any phase shift so that full precision may be given to any reading on the 0 to 30 deg scale.

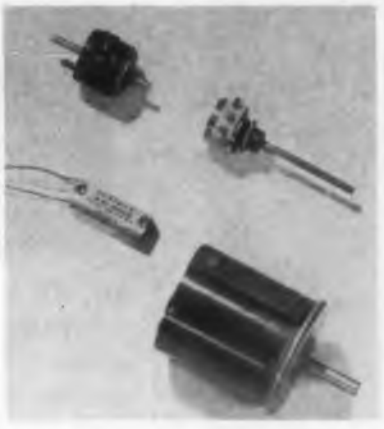
An output is available which is suitable for use with recording equipment and which provides 0 to 10 v corresponding to a phase shift of 0 to 360 deg. Power requirements are 115v ac ±10% 50-1000 cps.

Control Electronics Co., Inc., Dept. ED, 1925 New York Ave., Huntington Station, N.Y.

CIRCLE 136 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Potentiometers

For Operation to 225 C



A complete line of high temperature precision potentiometers and components with operating temperatures from −55 to +150 C, or +225 C, is available from this firm. The line includes wire-wound potentiometers in both single and multi-turn types which are rated for continuous duty at 125°C at 3/4 w to over 4 w, with 0.1 w or more at 150 C, depending on size and type. These units are available in 7/8 in., 1-3/4 in., and 2 in. diam linear and functional types, and both 10-turn and 3-turn 1-13/16 in. diam units. A 10-turn 7/8 in. unit will be available shortly.

In addition to wire wound units, "FilmPots" and trimmer "FilmPots" with "Nobl-Ohm" precious metal alloy film resistance elements are available. The rotary types are offered in 3/4 in., 7/8 in., and 1-1/8 in. diam. These are rated at 225 C for the 3/4 in. unit and 150 C for the larger units. The trimmer "FilmPots" are rated to 175 C. These units have a load life at high temperature up to and in excess of 500 hr and a rotational life at high temperatures up to 500,000 cycles or its equivalent for multi-turn units, depending upon specific resistance requirements. They are designed to meet the general environmental specifications of MIL-E-5272A and to exceed the temperature requirements. Representative units are illustrated.

Fairchild Controls Corp., Components Div., Dept. ED, 225 Park Ave., Hicksville, L.I., N.Y.
Wescon Show, Booth No. 1206-1207.

CIRCLE 140 ON READER-SERVICE CARD FOR MORE INFORMATION

Lever Switch

With Safety Lock

This telephone-type lever switch has a safety locking device to prevent accidental operation. The locking device snaps into place when the lever is moved to either operated position or neutral. The lever must then be pushed inward to release the lock before it can be moved out of position.

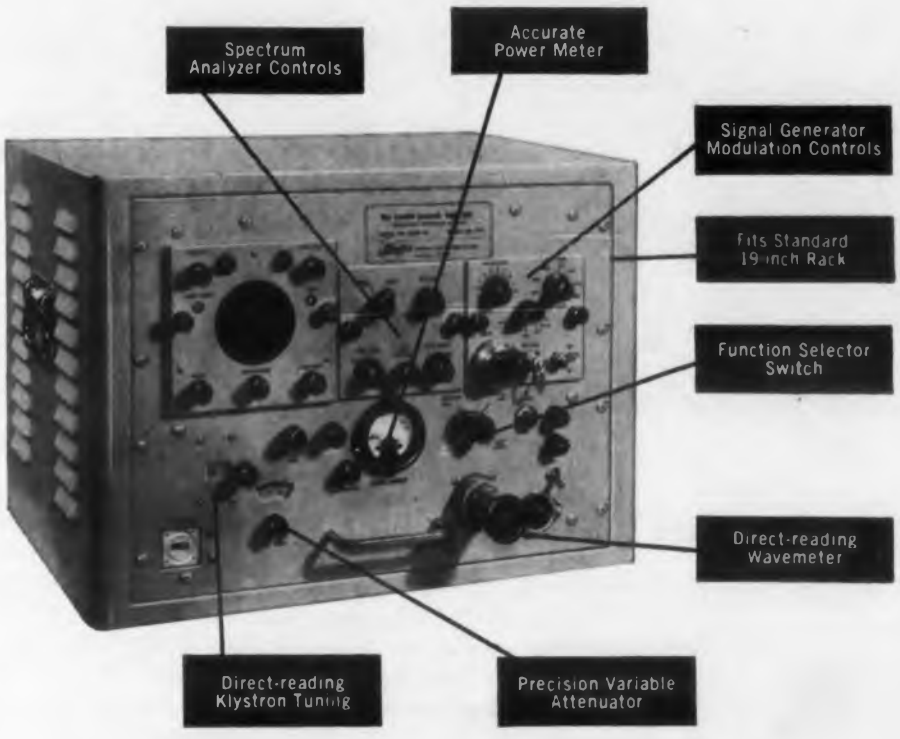
Donald P. Mossman, Inc., Dept. ED, Brewster, N.Y.

CIRCLE 141 ON READER-SERVICE CARD FOR MORE INFORMATION

Kearfott RADAR TEST SET*

Completely checks both transmitter and receiver operations in the field or on the production line

*Available for Ku, C, or X-Band Frequencies



KEARFOTT UNIVERSAL RADAR TEST SETS

A complete radar testing facility – includes Spectrum Analyzer, accurate Power Monitor, direct-reading Frequency Meter, versatile Signal Generators complete with variable pulse, saw tooth and square wave modulation. New improved design reduces testing time with increased accuracy. Operates on 60, 400 or 1200 cycles power.

Write for complete information on these versatile R.F. Test Sets. Available for Ku, C or X-Band Frequencies.

Wescon Booth No. 1416

See Kearfott for PRECISION NAVIGATION INSTRUMENTS and Servo Systems Components.

Custom Microwave Components to your blueprints or ours. Send today for information on Kearfott Microwave Equipment.

Kearfott COMPANY, INC.
LITTLE FALLS, NEW JERSEY
WESTERN DIVISION
253 VINEDO AVE., PASADENA, CALIF.
A SUBSIDIARY OF GPL

SALES OFFICES

EASTERN OFFICE	MIDWEST OFFICE	SOUTH CENTRAL OFFICE
1378 Main Ave.	188 W. Randolph St.	6115 Denton Drive
Clifton, N. J.	Chicago, Ill.	Dallas, Texas

CIRCLE 142 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Potentiometer

Has 0.01% Linearity

The Model MD-20 is a 10-turn 2 in. diam ultra precision potentiometer providing independent linearity as close as 0.01% or better. High stability combined with extra rugged construction assures highest accuracy even under severe environmental conditions.

The resistance coil is externally wound on a non-hygroscopic ceramic core which is chemically inert, dimensionally stable, and has a very low coefficient of expansion. Rugged metal-to-metal traveling nut stops withstand static torque of 50 in-oz. The wiper arm is independent of the stops, and, to minimize wear, only the wiper touches the resistance element. The cover is precision machined aluminum. Electrical angle is 3600 deg with 90 deg overtravel at each end.

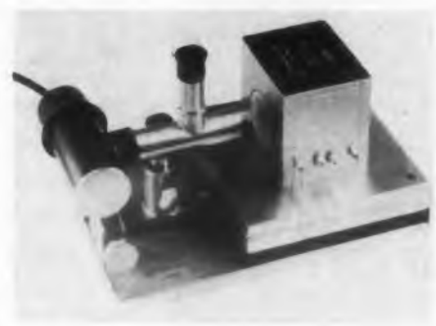
All taps are welded to a single turn of wire. Resistance values of 1 K to 100 K can be supplied, with other values to customer order. The MD-20 is also available in a compact 20-turn version.

Components Div., Litton Industries, Dept. ED, 5873 Rodeo Rd., Los Angeles, 16, Calif.
Wescon Show, Booth 1256-1257.

CIRCLE 145 ON READER-SERVICE CARD FOR MORE INFORMATION

Interferometer

Measures to 4×10^{-6} in.



This interferometer will reliably measure absolute displacements down to 4×10^{-6} in. Completely self-contained, it is known as the "Glennite" AT-16. It operates on the Fabry-Perot Principle and employs the fringe disappearance technique. It is especially applicable to the calibration of crystal type vibrators, particularly those of the piezoelectric type, to insure proper calibration and accurate frequency response of accelerometers.

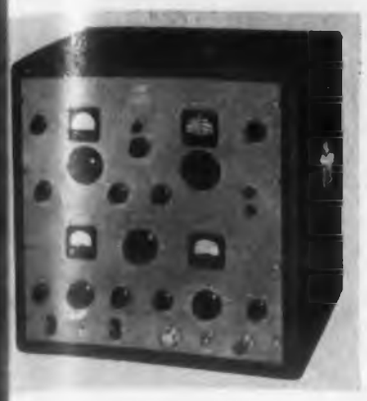
The unit measures displacements having frequencies in the range of 500-25,000 cps with an accuracy of approximately 6 per cent and requires only a mirror mounted on the vibrating structure.

Gulton Mfg. Corp., Dept. ED, Metuchen, N.J.

CIRCLE 146 ON READER-SERVICE CARD FOR MORE INFORMATION

Signal Generator

For Alignment and Test



The Model 160 Single-Sideband Signal Generator is for alignment and test of single and doube-sideband receiving equipment. Providing continuous tuning from audio frequencies to 50 Mc, together with several crystal - controlled outputs, this generator features a low distortion modulation source for all available single and double-sideband modulation systems.

Crosby Laboratories, Inc., Dept. ED, Box 233, Robbins Lane, Hicksville, L.I., N.Y.

CIRCLE 148 ON READER-SERVICE CARD FOR MORE INFORMATION

Ring Dynamometer

Operates Over Wide Range

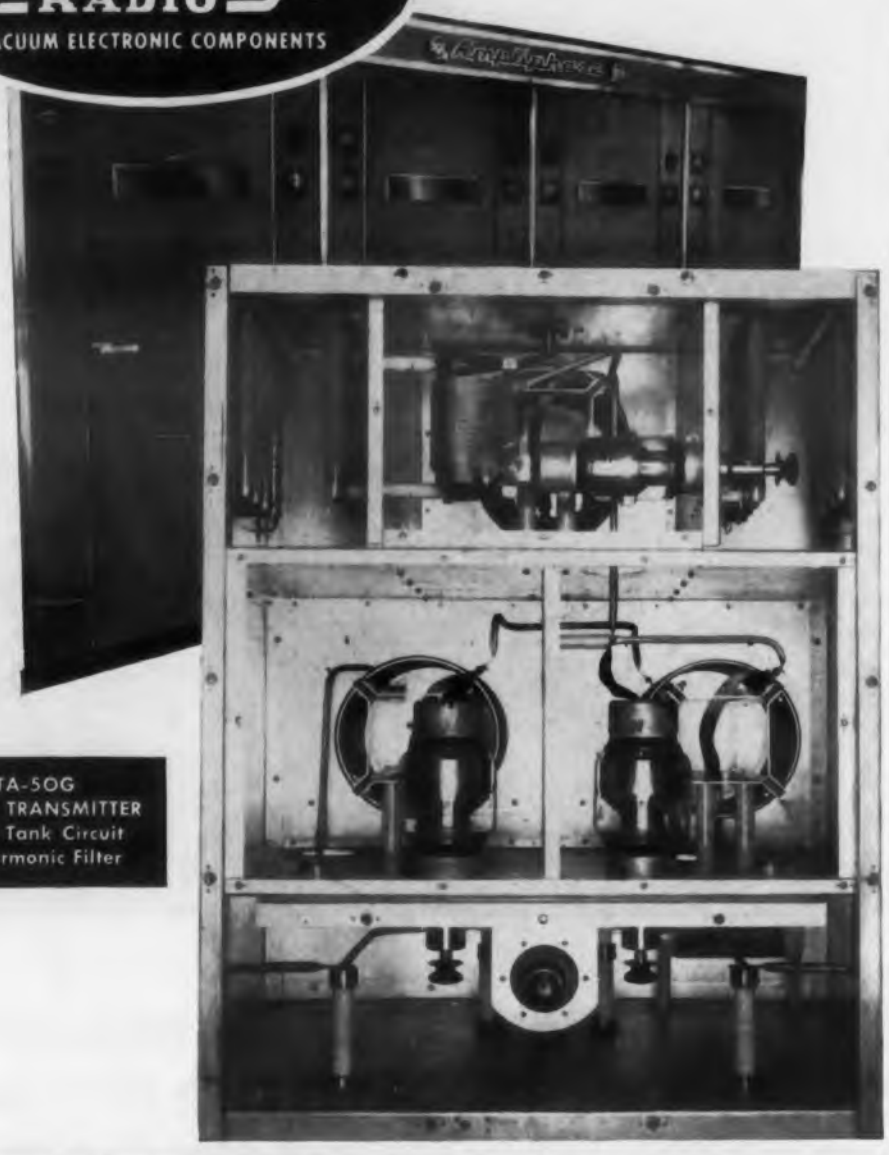
The Type TDC-4 is a compact, easily operated, proving ring dynamometer. A force-sensitive transducer for detecting static or dynamic forces, it contains a linear variable differential transformer and is designed to permit the remote detection of forces beyond the scope of ordinary mechanical, indicator-type proving rings. Because the unit is electrical, response is instantaneous and precise, thus making it possible to control, measure, and record with great accuracy a wide range of weights and tensile or compressive forces. A convenient mechanical zero adjust is provided.

The dynamometer can be obtained in ranges from 0 to ±50 lb, up to 0 to ±10,000 lb. The output variation is completely stepless. Approximate full range output is 0.250 v with 6.3 v 60 cps input. Departure from linearity is less than ±1.0% of full range outut. Other specifications include: ambient temperature range —65 to 220 F; hysteresis less than 0.5%; weight between 0.50 lb for the 50 lb size and 2.5 lb for the 10,000 lb size. The dynamometer is well suited for use with all types of Schaevitz recorders and indicators.

Schaevitz Engineering, Dept. ED, P. O. Box 505, Camden 1, N.J.

CIRCLE 149 ON READER-SERVICE CARD FOR MORE INFORMATION

Jennings RADIO
VACUUM ELECTRONIC COMPONENTS



RCA BTA-50G
50 KW TRANSMITTER
Output Tank Circuit
and Harmonic Filter

JENNINGS VACUUM CAPACITORS SIMPLIFY TRANSMITTER DESIGN

RCA like other transmitter manufacturers both in the United States and in Europe makes full use of Jennings Vacuum Capacitor in order to simplify transmitter design and increase circuit efficiency. Seventeen vacuum capacitors are used in the 50 kw broadcast transmitter shown above to help create a superior product for a competitive market.

The reason that vacuum capacitors are standard components in most modern high powered transmitters is because they are smaller, have wider capacity ranges, and are more efficient than other types of high voltage variable capacitors. The vacuum dielectric in these capacitors is such excellent insulation that for a given voltage rating a very small physical size is possible. Because they are small they have wider capacity ranges with much lower minimum capacities. This small size also reduces inductive losses while their all-copper construction reduces resistive losses making it possible to design more efficient circuits.

We would like to send you our catalog summary with its large selection of vacuum components to help simplify your transmitter designs.

JENNINGS RADIO MANUFACTURING CORP. · 970 McLAUGHLIN AVE. P.O. BOX 1278 · SAN JOSE 8, CALIF.

CIRCLE 152 ON READER-SERVICE CARD FOR MORE INFORMATION

Signal Converter

Handles 400-cps Transducers

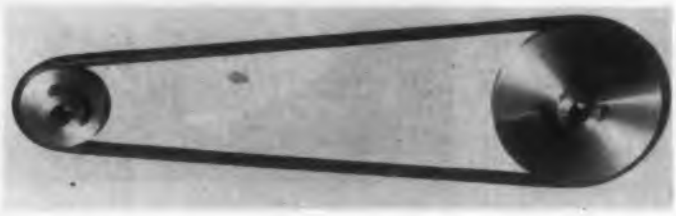
This three channel instrument is for the measurement of aircraft and laboratory physical parameters. The system accepts signals from 400-cps transducers and drives conventional magnetic galvanometer recording devices. Frequency and voltage regulated power is supplied to the transducers from unregulated power, and a large demodulated signal output with 0.5 per cent linearity is available without amplification.

Dynalysis Development Laboratories, Inc., Dept. ED, 11941 Wilshire Blvd., Los Angeles 25, Calif.

CIRCLE 153 ON READER-SERVICE CARD FOR MORE INFORMATION

Pulleys and Belts

For Precision Applications



These precision stainless steel pulleys are available from stock in three basic shaft sizes of 1/8, 3/16, and 1/4 in., and in outside diameters from 1/2 to 2 in. Type "AF" neoprene rubber belts or cotton braided belts are also available from stock.

PIC Design Corp., Dept. ED, 160 Atlantic Ave., Lynbrook, L.I., N.Y.

CIRCLE 154 ON READER-SERVICE CARD FOR MORE INFORMATION

Thermocouple Vacuum Gauge Control

Small Size and Light Weight

VTP-TC-43-3, a new miniaturized thermocouple vacuum gauge control, combines small size (5-1/4" x 4-1/4" x 5-1/4") and light weight (3 lb) with a high degree of accuracy and ruggedness. A simple single meter with push-type switch provides readings for both heater current and thermocouple output. It operates air to high vacuum. Easily calibrated 1-1000 microns dry air.

Vacuum Tube Products Co., Inc., Dept. ED, 506 S. Cleveland St., Oceanside, Calif.

CIRCLE 155 ON READER-SERVICE CARD FOR MORE INFORMATION

Silicon Rectifiers

Meet Military Requirements

These rectifiers, RETMA type designated 1N537 and 1N538, were developed under a United States Air Force contract and meet stringent military requirements. Occupying a total volume of only 0.03 cu in and weighing 0.07 oz, they have axial leads (pigtails for easy assembly).

They are suitable for computer power supplies for many applications such as guided missiles, blocking applications, magnetic amplifiers, other low leakage applications, and a wide variety of high temperature electronic equipment power supplies.

Both of the rectifiers are rated at a maximum dc output current of 250 ma at 150 C. However, they may be designed into circuits for outputs of up to 750 ma where lower temperature conditions are encountered. A prime feature is that high current loads can be carried without the use of any heat sink whatsoever.

The 1N537 is rated at a maximum peak inverse voltage of 100 v, while the 1N538 is rated at 200 v. Maximum surge current for both rectifiers is 10 amp. Full cycle average forward voltage drop is a maximum of 1/2 v for both devices. Both are hermetically sealed in metal cases, having glass-to-metal seals.

Semiconductor Products, General Electric Co., Dept. ED, Electronics Park, Syracuse, N.Y.

CIRCLE 158 ON READER-SERVICE CARD FOR MORE INFORMATION

TV Tuner

Has Low Noise Figure

The "Neutrode" tuner provides more than 32-db gain and less than 7-db noise, channels 2 through 6; and more than 28-db gain with less than 8-db noise, channels 7 through 13. These figures are for the tuner as a whole, of which the neutralized triod is a prime stage.

By employing printed circuitry, the tuner has improved wiring, uniformity, and performance, and lower inspection costs. It is easy to maintain.

Standard Coil Products Co., Inc., Dept. ED, 2085 N. Hawthorne, Ave., Melrose Park, Ill.

CIRCLE 159 ON READER-SERVICE CARD FOR MORE INFORMATION

FOR TODAY'S ELECTRICAL-ELECTRONIC MULTI-CONDUCTOR CABLE REQUIREMENTS

To meet the needs of the electrical and electronic industries, William Brand announces a new and expanded line of Turbo Brand plastic insulated multi-conductor cable. Precisely made to your specification, these cables can be furnished with or without shielding, with exact positioning within the cable of the individual coaxials, twisted pairs, triples or any of the many other standard or more complex components that go into today's rigidly engineered interconnecting cables.

Quotations promptly rendered upon receipt of your specifications. Write today!

WILLIAM BRAND & COMPANY, INC.
Willimantic 2, Connecticut

TURBO BRAND

Quality Electrical & Electronic Wire & Insulating Materials Since 1920.

CIRCLE 160 ON READER-SERVICE CARD FOR MORE INFORMATION

Storage Oscilloscope
Offers Infinite Persistence

The "Memo-scope 102" is a self-contained storage oscilloscope with infinite information persistence. All stored waveforms are presented at equal and constant brightness until intentionally erased. This feature is especially useful for the display of single transients, or for comparing a number of waveforms simultaneously without photographing. For permanent records, waveforms can be viewed and analyzed at leisure, photographing only the wanted pictures.

The unit is primarily designed to operate with any standard electrostatic-deflection oscilloscope. It may also be operated using front-panel connections to the vertical and horizontal amplifiers. It provides electronically regulated dc voltages, including 3-kv and 5-kv high voltage supplies. Stored information is erased either by a pushbutton or by an applied pulse. A special, direct-coupled, unblanking circuit allows the writing beam to be unblanked to a uniform intensity across the screen by means of an externally provided gate signal.

Preamplifiers and sweep circuits for converting the "Memo-scope" into a complete storage oscilloscope with sensitive dc amplifiers and wide-range triggered linear sweeps are also available.

Advanced Electronics Mfg. Corp., Dept. ED, 2025 Pontius Ave., Los Angeles 25, Calif.

CIRCLE 163 ON READER-SERVICE CARD FOR MORE INFORMATION

DC Multimeter
Rated 20,000 Ohms/Volt

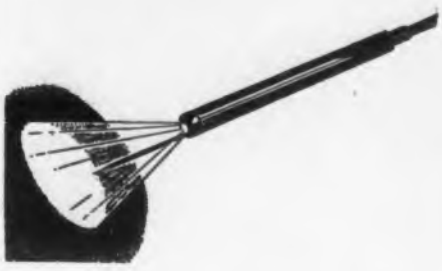
This VOM, Model 110, is a new 20,000-ohm/volt dc multimeter, compact enough to fit into the pocket or a tube caddy. It provides a wide variety of ranges including six dc and ac voltage ranges, five dc current ranges, three resistance ranges, and six decibel ranges. Flexible voltage measurements are possible due to extra low (1.5 v full scale) and extra high (3000 v full scale) voltage ranges. Complete current ranges up 600 ma and broad decibel ranges from −20 to +70 db are also available. A full-view 3-1/2-in. meter with long scales affords high readability.

Precision Apparatus Co., Inc., Dept. ED, Glendale 27, L. I., N. Y.

CIRCLE 164 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Illuminated Probe

Makes Tests Easier



The "Probe-lite" combines both a probe and a source of illumination in one simple device no larger than the probe alone. The device eliminates the necessity of holding an extra flashlight, usually in an awkward position, and in effect gives the user the benefit of an extra hand. Operation is simple. The tip of the cord set is inserted in jack of the "Probe-lite" and a brilliant, pre-focused light is available.

The unit has an extra long, slender probe tip to provide easy access in difficult areas. It uses a standard pre-focused globe and a Penlite battery.

Phaostron Instrument and Electronic Co., Dept. ED, 151 Pasadena Ave., S. Pasadena, Calif.
Wescon Show, Booth 1167-1168.

CIRCLE 168 ON READER-SERVICE CARD FOR MORE INFORMATION

Frequency Converter

Has 0.25 Per Cent Voltage Regulation

The Model 400A is a low-cost, lightweight frequency converter delivering 100 va of 400 cps power. For general use in electronics, aviation, laboratory, and other applications, it occupies little more than 1 cu ft in either bench or rack-mounted designs. It has no moving parts. Voltage regulation, no load to full load, is 0.25 per cent; frequency regulation is better than ±1 cps; total harmonic distortion is better than 3 per cent; and all three performance characteristics are independent of power factor.

Input is 50-400 cps, 117 v ±10 per cent, 37 w. The output frequency is continuously variable from 380-420 cps, and the output amplitude is continuously variable from 90-130 v. Use of external condensers increases variable frequency range to 200-1700 cps. The frequency of oscillation is completely determined by the resonant frequency of a tuned circuit. Amplitude of oscillation is limited by non-linear elements in a bridge circuit.

Tel-Instrument Electronics Corp., Dept. ED, Garden St., Carlstadt, N. J.

CIRCLE 169 ON READER-SERVICE CARD FOR MORE INFORMATION

FANSTEEL

High-Temp Selenium RECTIFIERS

...for ambient temperatures to 150°C

All standard cell sizes, circuit arrangements and protective finishes

Optimum output . . .
Minimum size . . .
Maximum dependability!

Write for Bulletin 6.400, 6.401

FANSTEEL METALLURGICAL CORPORATION
North Chicago, Illinois, U.S.A.

DEPENDABLE RECTIFIERS SINCE 1924

CIRCLE 170 ON READER-SERVICE CARD FOR MORE INFORMATION

DECADE RESISTANCES & VOLTAGE DIVIDERS

delivered from stock

Accuracy: 10 ohms and above: ±0.1%
1 ohm: ±0.25%
0.1 ohm: ±1%
0.01 ohm: ±5%

Temp. Coeff.: ±0.002% per degree C.

Maximum Load: ½-watt per step

Frequency Limit: Non-inductive to 20KC

DECADE RESISTANCE BOXES

Type	Dials	Ohm Steps	Total Resistance—Ohms	Price
817	3	0.01	11.1	$60.00
818	3	0.1	111	51.00
820	3	1	1,110	56.00
821	3	10	11,100	60.00
822	3	100	111,000	63.00
823	3	1,000	1,110,000	77.00
824	3	10,000	11,100,000	120.00
817-A	4	0.01	111.1	75.00
819	4	0.1	1,111	71.00
825	4	1	11,110	77.00
826	4	10	111,100	79.00
827	4	100	1,111,000	92.00
828	4	1,000	11,110,000	139.00
8285	5	0.1	11,111	94.00
829	5	1	111,110	101.00
830	5	10	1,111,100	113.00
831	5	100	11,111,000	155.00
817-C	6	0.01	11,111.1	105.00
8315	6	0.1	111,111	109.00
832	6	1	1,111,110	121.00
833	6	10	11,111,100	169.00

UNMOUNTED DECADE RESISTANCES

Type	Dials	Ohm Steps	Total Resistance—Ohms	Price
435	1	0.1	1	$12.00
436	1	1	10	13.25
437	1	10	100	13.25
438	1	100	1,000	15.00
439	1	1,000	10,000	16.00
440	1	10,000	100,000	18.50
441	1	100,000	1,000,000	32.50
442	1	1,000,000	10,000,000	60.00

DECADE VOLTAGE DIVIDERS (Potentiometers)

Type	Dials	Ohm Steps	Total Resistance—Ohms	Price
845	3	1	1,000	98.00
837	4	0.1	1,000	126.00
835	4	1	10,000	132.00
836	4	10	100,000	146.00

SHALLCROSS MANUFACTURING COMPANY

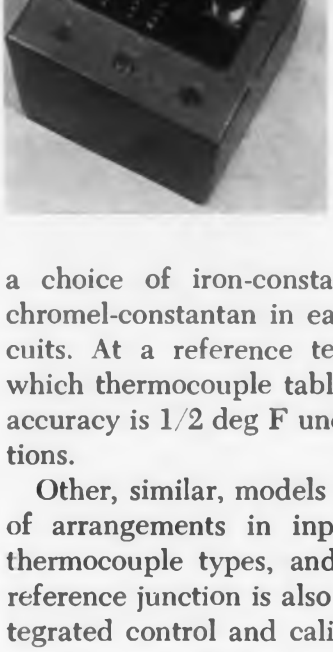
526 Pusey Ave., Collingdale, Pa.

Shallcross

CIRCLE 172 ON READER-SERVICE CARD FOR MORE INFORMATION

Reference Junction

For Thermocouple Circuits



Model RJ-1 Thermocouple Reference Junction provides a thermostatically controlled temperature reference for thermocouple circuits, eliminating the necessity for cold-junction compensation and ice-bath maintenance. There are 24 thermocouples in the unit, with a choice of iron-constantan, chromel-alumel, or chromel-constantan in each of 12 independent circuits. At a reference temperature of 150 F, for which thermocouple tables are available, the rated accuracy is 1/2 deg F under normal ambient conditions.

Other, similar, models are offered with a variety of arrangements in input and output coupling, thermocouple types, and number of circuits. The reference junction is also available as part of an integrated control and calibration system for oscillographic recording. It weighs 15 lb, measures 8x10x10 in., and operates from 115 v.

Pace Engineering Co., Dept. ED, 6914 Beck Ave., North Hollywood, Calif.

CIRCLE 173 ON READER-SERVICE CARD FOR MORE INFORMATION

Potentiometer

For Printed Circuits

The PC-5 Wire Wound Potentiometer mounts directly on printed circuit boards by its own round leads, eliminating the use of screws and lugs. In addition, it features environmental-resistant construction, light weight, and small size (1-1/2 in. diam x 1-1/4 in. high). It is well suited to airborne as well as other compact equipment. The cylindrical shape is easily adaptable to automatic installation techniques.

Characteristics include a terminal linearity of ±3 per cent; resistance range of 10-35,000 ohms; dissipation of 2 w; rotation (electrical and mechanical) of 325 deg; and noncorrosive, non-nutrient, sealed construction.

George-Held, Inc., Dept. ED, 1020 N. La Brea, Los Angeles 38, Calif.

CIRCLE 174 ON READER-SERVICE CARD FOR MORE INFORMATION

Supply-Demodulator
For Flight Tests

The regulated Power Supply–Demodulator Unit, Model DV-1, is for use with gyros in flight test applications where 115-v 400-cps single-phase primary power is available. A small unit, it is 6-1/16 x 7-3/16 x 12-3/4 in. long and weighs only 13 lb. It has been designed for use with one to three Doelcam Model K Rate Measuring Gyroscopes to comprise a complete rate measuring system.

The DV-1 properly energizes the motor and pickoff of each gyro and converts the ac output signal of each pickoff to dc for use with oscillograph galvanometers. Inasmuch as a change in speed of the gyro motor due to input-voltage frequency variation would directly affect overall gyro sensitivity, compensation has been incorporated to vary the excitation current to the gyro pickoff in order to maintain constant system sensitivity.

Doelcam, Div. of Minneapolis Honeywell Regulator Co., Dept. ED, 1400 Soldiers Field Rd., Boston 35, Mass.

CIRCLE 178 ON READER-SERVICE CARD FOR MORE INFORMATION

Electronic Potentiometer
Transmits Pneumatic Signal

The "Dynamaster" Pneumatic Transmitter is available in either potentiometer or bridge circuits and will measure any variable which can be translated into an electrical quantity. It then converts the measurement into a universal 3-15-psi pneumatic signal for transmission to a remote pneumatic indicator or recorder, or automatic controller.

With this unit, it is possible to present measurements such as speed, viscosity, pH, resistance, smoke density, current and voltage, frequency and conductivity, etc., on the new miniature pneumatic receivers, along with more conventional measurements of flow, pressure, and temperature. It is available either "blind" or with an indicating scale for at-the-scene measurements.

The Bristol Co., Dept. ED, Waterbury 20, Conn.

CIRCLE 179 ON READER-SERVICE CARD FOR MORE INFORMATION

WHY...

has this time delay relay aroused such interest?

- May be ENERGIZED CONTINUOUSLY . . . does not require auxiliary lock-in circuits . . . a load carrier in itself
- SNAP-ACTION contact speed . . . up to DOUBLE-POLE, DOUBLE-THROW switching.
- SIMPLE HERMETICALLY-SEALED time element . . . long life stability. Not subject to aging or fatigue.
- LOW COST as a unit; even lower considering simplified installation.
- The NAME . . . *Silic-O-Netic* Time Delay Relay . . . MEANING: SILICone controlled, magNETIC flux variation.
- It's NEW . . . the Type "A" *Silic-O-Netic* Relay is a vastly improved model.

STRAIGHT FACTS

Time Delays . . . from 1/4 to 120 seconds

Small size . . . Overall dimensions $2\frac{1}{16}$" x 2" x $1\frac{9}{16}$" . . . Weight 3 ozs.

Operation . . . Hydraulic magnetic principle providing positive contact operation, good contact pressure

Contact capacity . . . 3 amp. at 120 volts, AC (Non inductive load) . . . DPDT

Write for Bulletin T-5002

HEINEMANN

ELECTRIC COMPANY
156 Plum St., Trenton 2, N. J.

CIRCLE 180 ON READER-SERVICE CARD FOR MORE INFORMATION

MORE FOR YOUR INSTRUMENT DOLLAR!

New SHASTA Model 301A Wide-Range Oscillator

NEW

Shasta

WIDE-RANGE OSCILLATOR

FOR DESIGN & TEST USE

FEATURES

- ★ **Internal impedance less than 55 ohms**
- ★ **10 cps to 1 mc range**
- ★ **± 1 db over entire range**
- ★ **Drives 600 ohm load @ 10 v. over entire range**
- ★ **Distortion less than 1%, hum level less than 0.1%**
- ★ **Drift less than ± 2%**

DESCRIPTION— SHASTA's Model 301A fills the need for a compact, rugged and reliable general-purpose wide-range oscillator for laboratory or production test use. Simple, dependable circuitry provides top stability, low distortion. Its wide frequency range and low-impedance 160-milliwatt power output meets a wide range of test requirements. Built-in electronically-regulated power supply reduces waveform distortion, improves frequency stability, and minimizes effects of line voltage variations.

BRIEF SPECIFICATIONS

Frequency Range: 10 cps to 1 mc, 5 steps
Max. Amplitude Variation: ± 1 db, 10 cps to 1 mc
Power Output: Max. 10 v. into 600 ohm load
Distortion: Less than 1%
Min. Load Imp.: 600 ohms
Hum Level: Less than 0.1% of rated max. output
Dimensions, Weight: 9¾"H x 8"W x 9"D; 14 lbs.
Price: $140.00 f.o.b. factory.

ACCESSIBILITY is "tops," thanks to SHASTA's exclusive chassis design!

SHASTA "designed for the user" instruments offer more usable features per dollar. Write today for Technical Bulletin 301A; please address Dept. SE-8

S-19

OTHER SHASTA QUALITY INSTRUMENTS— Expanded Scale Frequency Meters and Voltmeters • Oscillators • AC Voltmeters • Power Supplies • Wide Band Amplifiers • Bridges • WWV Receivers • Decade Inductors

Shasta *division*

BECKMAN INSTRUMENTS INC.

Phone: LAndscape 6-7730 • Richmond 3, Calif.

See us at Wescon Show Booth #746

CIRCLE 182 ON READER-SERVICE CARD FOR MORE INFORMATION

Parabolic Antenna

For Tropospheric Scatter

This 28-ft parabolic antenna is for tropospheric scatter transmission. Antenna feeds have been designed for use in the 450-2700 Mc range.

Utilizing an aluminum mesh reflecting surface and back-up support, a 65-lb wind load rating is provided. The antenna achieves excellent structural stability through the use of "K" frame construction, using all aluminum members. A design feature permits the raising and lowering of the antenna feed to facilitate installation and maintenance.

To eliminate transportation problems and minimize damage normally attendant to the shipment of large crate items, this antenna is shipped in 12 sections each of the reflecting surface and "K" frame members and then enclosed into two easy-to-handle shipping boxes.

Prodelin, Inc., Dept. ED, 307 Bergen Ave., Kearny, N. J.

CIRCLE 183 ON READER-SERVICE CARD FOR MORE INFORMATION

△ New 3-in. Oscilloscope

Measures 5-1/4 x 11 x 19 in.

This 3-in. oscilloscope, the 627R, is only 5-1/4 in. high x 11 in. deep x 19 in. wide, to mount in standard relay racks. It responds from dc to 300 kc and is flat from dc to 150 kc. Horizontal and vertical amplifiers are identical and balanced. All operating controls are grouped for maximum efficiency and flexible performance. The 3-in. CRT is flat-faced, and it is a tight-tolerance type with recurrent or triggered sweep. It expands eight times tube diameter.

Also available is a new 5-in. oscilloscope, the 632, for color TV testing. This new scope features a wide bandpass, flat at burst frequency of 3.58 mc. Sweep range is 20 cps to 100 kc.

Hycon Electronics, Inc., Dept. ED, Pasadena, Calif.

Wescon Show, Booth 241-2.

CIRCLE 184 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Swaging Tools

For Terminal Lugs

An improved line of swaging tools for use with swaging machines in the application of USECO terminal lugs is offered by this firm. The tools are made from 4130 aircraft quality chrome-moly steel, flame hardened and polished for accuracy and long life. A large stock of swaging tools and machines is maintained for immediate delivery.

Swaging tools weigh 4 oz and are ordered by the part number of the terminal for which the tool is to be used. Swaging machines weigh 18 lb. They are rack and pinion type machines that develop pressure on a 4 to 1 ratio. They are constructed of machined gears to insure speed and ease of operation and long life.

U. S. Engineering Co., Dept. ED, 521 Commercial St., Glendale 3, Calif.
Wescon Show, Booth 239.

CIRCLE 188 ON READER-SERVICE CARD FOR MORE INFORMATION

Test Instruments

For Color TV

The Model CB-2 Color Bar Generator (shown at top in illustration) has the correct luminance, chrominance, and phase angle as specified by the NTSC, and it displays six colors (plus black and white) simultaneously. The DG-1 White Dot Generator (bottom) produces small, square dots as well as cross-hatch, horizontal bars, and vertical bars; this unit produces exceptionally stable patterns due to the fact that the frequencies are derived from count-down circuits from a master 315-kc oscillator.

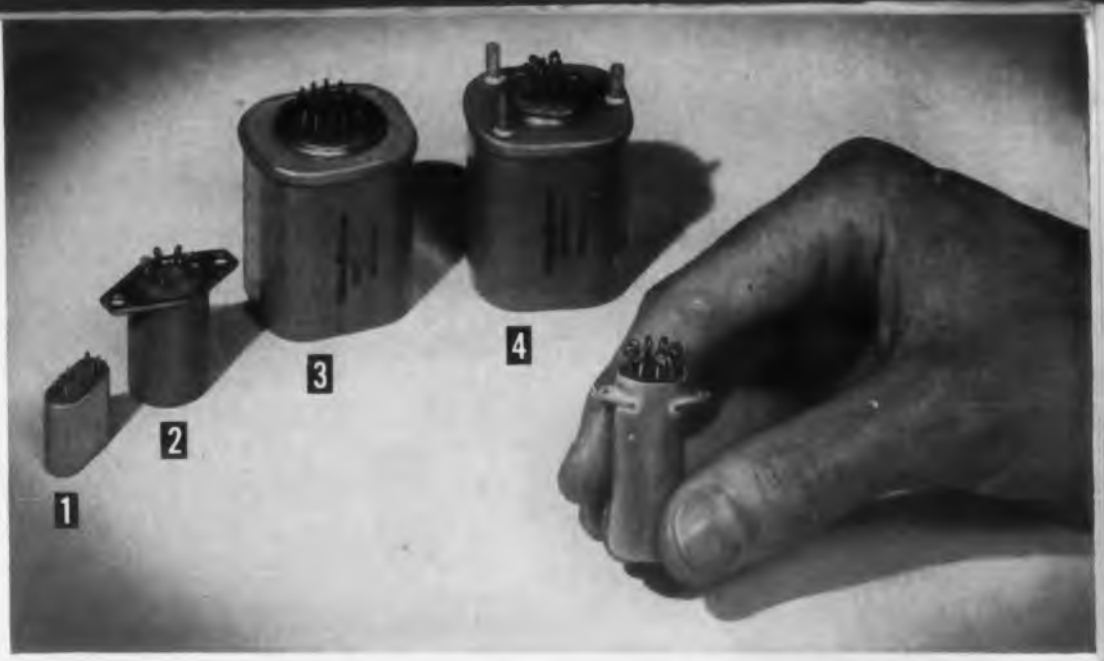
Features of this firm's sweep generators include: frequency coverage of 0-1400 Mc; sweep widths up to 85 per cent of center frequency; output voltage of 1 v into 50 ohms at fundamental frequency; leakage sufficiently low to permit measurements at maximum receiver gain; low maintenance; and flatness within 5 per cent over sweep width.

The power source is 115 v 60 cps ac; 50 cy is also standard on request.

Telonic Industries, Dept. ED, Beach Grove, Ind.

CIRCLE 189 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 190 ON READER-SERVICE CARD ▶



NOW—G.E. adds 2PDT sub-miniature to small sealed relay line

Now—to give you still more flexibility in applying General Electric hermetically sealed relays to your electronic systems—G-E engineers have developed the new 2PDT sub-miniature. Like other ratings in the G-E sealed-relay line, this new unit combines small size with unusual reliability under severe temperature, shock, and vibration conditions—making it ideal for air, sea, as well as ground applications. **Description:** .651 in. in diameter, 1.6 in. long; weighs one ounce. Unaffected by vibrations of 10 to 55 cps at .12 in. maximum excursion or 55 to 500 cps at 15Gs acceleration. Withstands shock tests in excess of 50Gs. Operates in ambients of 125 C. Available in a wide variety of coil ratings.

4 MORE G-E SEALED RELAYS YOU CAN USE

1 Micro-miniature relay: Weighs only .35 oz, measures .34 in. by .78 in. by .84 in. Rated 2 amp resistive at 28 v DC or 115 v AC. Also available in current-sensitive models. Standard relays withstand ambient temperatures of 125 C, and 20Gs acceleration at 50 to 500 cps.

2 Sub-miniature SPDT relay: This rugged relay weighs only .9 oz and occupies less than .8 cu. in. of space. Available for d-c or 400-cycle a-c operation. Contacts are rated 2 amp at 28 volts DC or 115 volts AC.

3 High-speed 4PDT relay: Is especially designed for use where operation as fast as 500 microseconds is required. Weighing only 5 oz and measuring $1\frac{7}{16}$ in. by $1\frac{21}{32}$ in. by $2\frac{3}{32}$ in., it is ideal for such applications as ground-based radar, multiplexing of electronic signals, and computer circuits.

4 Miniature relay: Over 300,100,000 operations without a miss is the record of a typical model of this relay. After the 200 millionth operation there was less than 3 mils wear between the armature tail piece and the contact lifter. Available in 2-, 3-, or 4-pole double throw and 6-pole normally open forms. Rated 5 amp at 28 volts DC at 85 C.

MAIL TODAY FOR G-E RELAY DATA

General Electric Co., Sect. E792-4, Schenectady 5, N. Y.

- ☐ NEW 2PDT Sub-miniature—Bulletin GEA-6412
- ☐ Micro-miniature—Bulletin GEA-6346
- ☐ SPDT Sub-miniature—Bulletin GEA-6211
- ☐ High-speed 4PDT Miniature—Bulletin GEA-6212
- ☐ Miniature—Bulletin GEA-6213
- ☐ HAVE G-E SALES ENGINEER CALL

NAME..... TITLE.....

COMPANY.....

ADDRESS.....

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

GENERAL ELECTRIC

Miniature Connector

For Printed Circuits

This is a miniature connector for printed circuit application. The connectors have 0.040 diam pins with 0.312 spacing and are for 1/16″ thick printed circuit boards.

Also available are printed circuit connectors having 0.200, 0.300 and 0.400 pin spacing. The pins can be furnished with 0.030, 0.040 and 0.050 for 1/32, 1/16 and 3/32″ thickness boards.

Nugent Electronics Co., Dept. ED, 621 E. 8th St., New Albany, Ind.

CIRCLE 193 ON READER-SERVICE CARD FOR MORE INFORMATION

Digital Recorder

Works at High Speeds

An automatically-sequenced, high speed, digital recorder, the Model 3151 provides a simple and economical means for simultaneous recording of "on" or "off" voltage phenomena appearing on as many as 45 channels at sampling rates as high as 2500/sec. Typical applications include monitoring of operations and data in large-scale digital computers and other data-processing systems. Records are made in the form of black marks for "on" channels (positive voltage input of 1 v or more and no marks for "off" channels (no signal input) on electro-sensitive "Teledeltos" recording paper.

Recording paper speed is in excess of 150 ips, providing approximately 1/16-in. spacing for the 2.5-kc sampling rate. Standard 4 in. wide paper rolls contain 400 ft of recording paper, providing more than 3.5 million record locations on a single roll. A three-sequence digital interval generator is used to program paper drive functions. Each sequence is adjustable from 1 to 99,999 millisec in 1-millisec steps. The interval generator may be used with an external time base, such as the clock track of a computer data-handling system, for recording only selected portions of data.

Potter Instrument Co., Dept. ED, 115 Cutter Mill Rd., Great Neck, N. Y.

CIRCLE 194 ON READER-SERVICE CARD FOR MORE INFORMATION

Thyratron Control

Uses Inert Circuit Elements

This simplified, fast response, grid control circuit produces a steep wave front grid firing potential which can be varied in phase from 0 to 180 deg. It is for such applications as high power, fast response servos, regulated power supplies with variable frequency inputs, motor controls, etc. Units are supplied in matched sets for full wave or three phase applications. Where extremely small levels of control power are available, a unit can be driven by a transistor.

Ortho Filter Corp., Dept. ED, 196 Albion Ave., Paterson 2, N.J.

CIRCLE 197 ON READER-SERVICE CARD FOR MORE INFORMATION

Electromechanical Switches

Offered in Wide Variety

Several types of electromechanical switches originally designed and built for service in telephone systems, are now being made available for industrial applications. The switches include two general types: automatic stepping switches, and key switches for manual operation.

Principal among the stepping switches is the XY Universal Switch (illustrated) used in thousands of dial telephone exchanges in this country and abroad. This switch is a two-motion, 100-point step-by-step switch that operates over 10 points in a primary direction, and 10 points in a secondary direction. It can be used for searching through 100 four-wire circuits to find a particular circuit, for selecting a particular circuits from among 100 circuits, or for performing consecutive operations in 100 separate circuits.

Similar but smaller is the XY Deca Switch, providing 10-point selection among 10 four-wire circuits.

Among the key switches are a wide variety of cam key, indicating, plunger, push, and twist button types, with locking and interlocking features if desired. Suitable mountings for single or multiple key arrangements of any type also are available.

Telephone Div., Stromberg-Carlson Co., Dept. ED, Rochester 3, N.Y.

CIRCLE 198 ON READER-SERVICE CARD FOR MORE INFORMATION

Precision Resistors

Tolerances to 1/50%

Ideal for printed circuitry or for use in limited space applications, Precise-Ohm AW and BW resistors measure only 1/2″ diam and approx 1/2″ long. Type AW is rated at 1/4 w; type BW is rated at 1/2 w. Tolerances of 1%, 1/2%, 1/4%, and 1/10% are standard; however, tolerances of 1/20% and 1/50% may be obtained on special order.

Both types are non-inductively wound, equipped with No. 20 tinned annealed copper or high copper-content alloy pigtail wire leads. In applications requiring matched resistors, such as in analog computers or bridge networks, these types may be matched to 1/50%.

Precision, Inc. Dept. ED, 730 Lyndale Ave., Minneapolis, Minn.

CIRCLE 203 ON READER-SERVICE CARD FOR MORE INFORMATION

Microwave Signal Generator

Covers 4200 to 11,000 Mc

The MSG-34 covers S, C, and X Band frequencies — 4200 to 11,000 Mc—with a power output of I mw. It is equipped with Uni-Dial construction which provides complete integration and simple operation. Large, direct-reading dials indicate frequency and attenuation.

Other features of the instrument are: provision for external modulation by multiple pulses; automatically tracked power monitor; and non-contacting oscillator choke.

The modulator, utilizing printed circuit techniques, permits internal pulse and square wave modulation from 10 to 10,000 pps at pulse widths of from 0.2 to 10 μsec.

Polarad Electronics Corp., Dept. ED, 43-20 34th St., Long Island City 1, N. Y.

CIRCLE 204 ON READER-SERVICE CARD FOR MORE INFORMATION

Q-Meter Jig

For Low-Impedance Measurements

The Model 10-B series jig for low impedance measurements facilitates measurements of inductance and Q of small coils, large capacitors, transistor parameters, transmission line characteristics, resonant by-pass capacitors, vhf and uhf tuner parameters, r-f impedance of electrolytic capacitors, antenna impedance, and other low impedance components.

Radio Instrument Laboratories, Dept. ED, 12-05 Sumner Place, Fair Lawn, N. J.

CIRCLE 210 ON READER-SERVICE CARD FOR MORE INFORMATION

Tantalum Capacitors

In Wide Range of Ratings

High ratings are available in the type TNT subminiature tantalum electrolytic capacitors. These metal-encased capacitors, only 0.145 in diam x 3/8 in. long, fit readily into miniaturized transistor circuits. Five different ratings are available: 80 mfd at 3 v: 50 mfd at 6 v; 25 mfd at 15 v; 15 mfd at 30 v; and 8 mfd at 50 v.

P. R. Mallory & Co., Inc., Dept. ED, Indianapolis 6, Ind.

CIRCLE 211 ON READER-SERVICE CARD FOR MORE INFORMATION

Panel Mount Hygrometer

Accurate To Within 4%

Panel mount hygrometer Model 102 is a precise humidity indicator suitable for all industries. This instrument can be easily mounted in a panel, and the humidity sensing element can be remotely located. Designed for humidity chambers and process control panels, it is accurate to within 4%, and no calibration is necessary because of a negligible temperature coefficient.

EL-Tronics, Inc., Dept. ED, 1420 Walnut St., Philadelphia, Pa.

CIRCLE 212 ON READER-SERVICE CARD FOR MORE INFORMATION

In-Line Readout Indicators

All Numbers In One Plane

Three new in-line readout indicators have been designed for electronic counting instruments, featuring all numbers in one plane. Known as the 5910 Series, the three models were designed with large, easy-to-read numbers to reduce operator fatigue and provide greater accuracy through fewer reading errors.

Each of the indicators retain their readings while the counter accumulates new data. This will permit a sharp reduction in instrument display time, speed up measurements, and make possible more samples per unit time than before.

Each digit of the Series 5910 uses a novel arrangement of seven lighted bars to form any number from zero to nine. Numbers on all three indicators, varying in size from 4 to 6 digits, can be easily read from any angle and from across a room.

Each digit consists of a plug-in module formed by a printed circuit board, 2 tubes, 4 printed circuit relays and a printed display panel. Using palladium contacts, the relays are guaranteed for 50 million operations. Any relay can be changed without damaging the printed circuit board.

Berkeley Div., of Beckman Instruments, Inc., Dept. ED, 2200 Wright Ave., Richmond 3, Calif.

CIRCLE 216 ON READER-SERVICE CARD FOR MORE INFORMATION

Klystron

34.0 to 35.6 kMc

The VA-97 is a rugged, reflex klystron suitable for use as the local oscillator tube for airborne radar and similar applications. In the VA-97 reflex klystron, the integral external tuning cavity design has been carried up to a frequency range of 34.0 to 35.6 kMc.

This design combines high environmental performance with excellent electrical performance. It is tough and reliable and is rated for use at any altitude without pressurization. At only 400 v beam voltage, it provides adequate power and electronic tuning for radar local oscillator service. The VA-97 features a slow-motion tuner free from mechanical backlash.

Varian Associates, Dept. ED, 611 Hansen Way, Palo Alto, Calif.

CIRCLE 217 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Supplies

For Programming Applications

These newly developed power supply units are intended for applications requiring remote control and/or programming according to commands from an operator or control system—such as in tube-test programming, automatic production testing, and other automated processes.

Also useful for general applications, all three models feature main and vernier controls, auxiliary bias and filament outputs, as well as high regulation over full range and for all load conditions.

Designated Models 231-A, 232-A, and 233-A, all units have an output range of 0-300 v, regulation of 0.1 v, and ripple of only 1 mv. Current outputs for the various models are 0-100 ma, 0-200 ma, and 0-300 ma.

Electronic Measurements Co., Inc., Dept. ED, Lewis St., Eatontown, N. J.

CIRCLE 223 ON READER-SERVICE CARD FOR MORE INFORMATION

Twin Triode

For Computer Use

The 6829, a 9-pin miniature medium-mu twin triode is the first in a line of 5-star high reliability computer tubes, designed for service in the severe environments in which airborne and mobile military computing equipment must operate.

The 6829 has an altitude rating of 60,000 feet and withstands impact acceleration of 450 g and vibrational acceleration of 2.5 g. Max plate voltage is 275 v and plate dissipation of each plate is 2.2 w. In typical computer applications with 100 plate volts and zero grid volts, each section draws approx 17 ma plate current.

When operated with a cathode bias resistor of 220 ohms and with 150 plate volts, each section has an amplification factor of 47, plate resistance of 7000 ohms and transconductance of 6700 μmhos. Plate current cutoff is achieved with 4.8 grid volts when 150 plate volts are applied.

General Electric Co., Tube Dept., Schenectady 5, New York.

CIRCLE 224 ON READER-SERVICE CARD FOR MORE INFORMATION

Communications Receiver

Measures Reradiation of TV Receivers

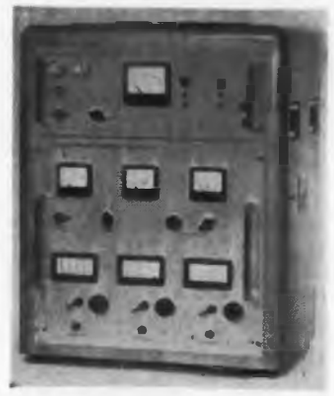
The new SP-600-VLF communications receiver meets the requirements set forth by the FCC Docket No. 9288 on reradiation of radio receivers as it affects TV set manufacturers. Operating over an extremely low frequency range, 10 kc to 540 kc, the SP-600-VLF is ideally suited to measurement of low frequency radiations common to TV flyback circuits, and other sources of spurious emissions.

Hammerlund Mfg. Co., Inc., Dept. ED, 460 W. 34th St., New York 1, N. Y.

CIRCLE 228 ON READER-SERVICE CARD FOR MORE INFORMATION

Frequency Measuring System

Has 10 cps to 600 Mc Range



Testing of precision quartz crystals and filters, magnetostrictive filters, and a variety of other highly selective components or circuits, such as oscillatory circuits, can be accomplished quickly and precisely by means of this frequency measuring system. Known as the Type FT-XZB Decade Frequency Measuring System, is also valuable for pre-setting of communications receivers, for monitoring of transmitter frequencies, and for incoming inspection. Non-skilled personnel can use it.

The FT-XZB consist partly of a frequency synthesizer which contains as its frequency standard a 100-kc quartz crystal with an accuracy of 2×10^{-7}. Through the use of precise frequency dividers, the synthesizer provides standard frequencies which may be fixed or continuously varied from 30 cps to 30 Mc.

The FT-XZB, when used with suitable receivers, also permits telemetering of frequencies covering a range of 10 kc to 30 Mc; and frequency recordings over a range of 10 cps to 600 Mc, when used with separate dc recorders.

Instrument Div., Federal Telephone and Radio Co., Dept. ED, 100 Kingsland Rd., Clifton, N.J.

CIRCLE 229 ON READER-SERVICE CARD FOR MORE INFORMATION

Test Chamber

Has —100 to 400 F Range

This completely self-contained, multi-environment test chamber produces temperatures ranging from —100 to 400 F and automatically maintains accuracy during continuous operation within ±2 F. Known as the Model D-102A, it is constructed entirely of steel and has a 12-cu ft stainless steel inner chamber completely sealed to prevent moisture seepage into insulation. Radiation losses are kept to a minimum. The chamber temperature can be dropped to —65 F in 40 min or raised to 400 F in 30 min, starting at room temperature.

Low temperatures are generated by dry ice placed in a special compartment. A motor driven fan circulates air over the ice. Refrigerated air then passes through the working volume in a double convection system. High temperatures, selected by a 3-w switch, are supplied by an electric heating element. Standard design includes a triple-pane, sealed observation window and three instrumentation ports.

Mantec, Ins., Dept. TC, 126 Maryland St., El Segundo, Calif.

CIRCLE 234 ON READER-SERVICE CARD FOR MORE INFORMATION

Cooling Fan

For Electronic Cabinets

The Model 2E610 Electronic Cabinet Cooling Fan is designed for mounting on a standing 19-in. wide rack with a 10-1/2 in. panel height. It is a twin 6-1/2 in. centrifugal blower with each wheel double inlet, resulting in high air delivery and adequate motor cooling. It is equipped with a 1/8-hp double shaft motor and produces 800 cfm under normal operating conditions.

The 2E610 is equipped with a permanent air filter and a 19-in. x 10-1/2-in. stainless steel grille covering the entire front. Modifications are available to specifications.

McLean Engineering Laboratories, Dept. ED, P. O. Box 228, Princeton, N.J.

CIRCLE 235 ON READER-SERVICE CARD FOR MORE INFORMATION

New Literature

Engineering Courses 242

A 44-page brochure has been published entitled "Your Future in the New World of Electronics," which is timely and of specific value to the importance of electronics in the world. Included in this comprehensive illustrated booklet is a 9-page detailed, factual report on "Opportunities in the Radio and Electronic Industry for Technically Educated Men," prepared by the company's president. It discusses the importance of advanced technical training and is of interest to companies who are trying to upgrade technicians to design aides or to junior electronic engineers.
Capitol Radio Engineering Institute, Washington 10, D.C.

Thermostats 243

A 4-page bulletin, No. 8400, is announced covering thermostats, most of which are illustrated with halftone cuts. Temperature ranges, ratings, mountings, terminal arrangements, etc., along with a temperature conversion chart are also included.
Stevens Mfg. Co., Inc., P. O. Box 1007, Mansfield, Ohio.

Navigation System 244

A 20-page, 4-color brochure has been offered describing the company's navigator system. The brochure explains how the system works, describes its component units, the technical system and the advantages for providing greater safety for passengers, aircraft, and economic flight operation. The system gives accurate, reliable and continuous position fixing for helicopters, fixed wing aircraft, ships and land vehicles, and is suited for terminal area traffic control and landing approach procedures.
Bendix Aviation Corp., Pacific Div., 11600 Sherman Way, N. Hollywood, Calif.

Commutation Switch 245

A 6-page booklet has recently been issued illustrating and describing the Model TM55 series commutation switches.

This bulletin describes operating characteristics of the Model TM55 and specifications for 555 ceramoplastic commutator plates.
Mycalex Electronics Corp., 30 Rockefeller Plaza, New York 20, N. Y.

Double-Bore Thermowells 246

Data Sheet No. 6561 has been released describing the three main types of double-bore thermowells, which provide two separate bores to permit a test sensing element to be placed in the same thermowell as the primary temperature elements. They reduce the cost of test procedure and enable accurate testing to be undertaken on the temperature detecting elements. The data sheet covers construction features and specifications, applications plus illustrations of the various wells, in addition to variations that are available to meet specific requirements.
Trinity Equipment Corp., 472 Westfield Ave., East, Roselle Park, N. J.

Forged and Rolled Rings 247

A 16-page bulletin has been released describing seamless forged and rolled rings. The illustrated booklet gives details on the company's experience in steel-making-know-how available to potential customers with specific steel-machining problems. The bulletin contains a four-page chart showing, in eighth-inch divisions, weights for rings from one inch to 145 inches overall diameter.
ALCO Products Inc., Box 1065, Schenectady, N. Y.

Servo Mechanism Components 251

A 4-page bulletin has been offered listing the characteristics and specifications of 138 servo mechanism components now in production. The bulletin has been especially prepared to provide an easy guide in the selection of rotating components to meet design requirements. Complete specifications and illustrations are included, in addition to applications for the units.
Norden-Ketay Corp., Precision Components Div., 555 Broadway, New York 12, N. Y.

Microwave Equipment 252

A new, 16-page descriptive brochure has been issued describing the company's microwave communications equipment to different types of industry. The booklet, which contains a large number of photographs and diagrams of the company's microwave installations, describes typical expandable systems for 500 miles, 120 miles, and 90 miles. Specifications for the equipment are also included.
Philco Corp., Govt. & Industrial Div., 4700 Wissahickon Ave., Philadelphia, Pa.

Testing Instruments 253

A new illustrated bulletin has been made available describing electronics testing equipment. The 6-page bulletin, No. 2056, gives concise descriptions and specifications of products in the company's extensive line of testing instruments designed for use by radio, TV and refrigeration technicians.
Simpson Electric Co., 5200 W. Kinzie St., Chicago 44, Ill.

Thermostats 254

A new bulletin has been issued describing the company's line of sealed-in-glass thermostats. A new section has been added that gives design data based on accelerated life and performance tests. Included are tips on the application of thermostats to crystal ovens, information on contact protection and uses with ac and dc loads.
The Instrument Div., Thomas A. Edison, Inc., W. Orange, N. J.

Sound Recording Film 255

A new bulletin has been offered on Audiofilm, for the original magnetic recording of motion picture and TV sound tracks. The folder presents some of the magnetic and performance characteristics of Audiofilm, which is made on standard motion picture film triacetate base.
Audio Devices, Inc., 444 Madison Ave., New York 22, N. Y.

Vulcanized Fibre 262

A 4-page, 2-color bulletin entitled "Engineering Materials To Improve The Design and Performance Of Your Product" describes and illustrates the physical properties and use benefits of two basic engineering materials—vulcanized fibre, and laminated plastic. Illustrated are a few of the many industrial uses of these materials including among others noiseless gears, cams, terminal blocks, and printed circuits. Tables list fibre and grades, specifications, characteristics, and applications.
National Vulcanized Fibre Co., 1056 Beech St., Wilmington 99, Del.

DB Wave Detector 263

A 4-page brochure has recently been issued describing the DB Standing Wave Generator, which can measure all standard microwave and ultramicrowave frequencies, from 5.8 kMc to 90 kMc.

This brochure includes full descriptions, applications, and ordering information.
DeMornay-Bonardi, 780 S. Arroyo Parkway, Pasadena, Calif.

Solvents 264

An 8-page booklet has been issued describing the company's spray clean technique. The technique is used in aircraft and electromechanical instrument fields for cleaning precision ball bearings such as used in gyros, servomechanisms, and other instruments where low torque specifications must be met. The illustrated booklet describes applications methods, the ultimate in chemical cleanliness for the components of such units such as transistors, diodes, vacuum tubes, jewel bearings, pivots, and other precision parts in the electronic and electromechanical fields.
Cobehn Inc., Passaic Ave., Caldwell, N. J.

Torque Manual 265

A second edition torque manual has recently become available. This manual was compiled to aid those persons responsible for torque specifications and applications. The purpose of the booklet is to depict general principles of torque tools and methods of use.
P. A. Sturtevant Co., Addison. Ill.

Pulse Control Systems 270

A 16-page bulletin has been published giving the latest helpful information on how manufacturers and users of tape-wound or ferrite cores can benefit from using pulse control systems to test cores by digital techniques. The illustrated booklet shows how reliable testing procedures are necessary, and states the need for equipment which not only tests how a core will meet specifications within all necessary ranges of tolerance, but also how it will eventually operate in the system for which it is intended. Block and timing diagrams show how the pulse fulfills testing needs.
Burroughs Corp., Electronic Instruments Div., 1209 Vine St., Philadelphia 7, Pa.

Condenser Cans 271

This 19-page catalog helps in selecting Condenser Can requirements. This line of condenser cans with extruded holes will facilitate the rapid assembly of terminal outlets and also improved quality and appearance. Included in catalog are full line drawings of various cans.
Northern Metal Products Co., 9595 W. Grand Ave., Franklin Park, Ill.

Ceramic Capacitors 272

A 20-page catalog (616) has been released describing all standard ceramic capacitors—disc, tubular, slug-types, and special types. The illustrated 3-color catalog consolidates in a complete presentation the extensive variety of C-D ceramic capacitors available to meet any precise applications. These include single and dual capacitance discs, tubulars, printed circuitry and automation discs, high voltage slug types and special design types. The "Tiny Mike" line described therein is excellent in performance standards, quality and cost.
Cornell-Dubilier Electric Corp., S. Plainfield, N. J.

Conductive Organic Coating 273

A data sheet has recently been issued describing the 538-L black, an electrical conducting organic finish resistant to chemicals, and to corrosion. It can be used to provide an electrical conducting path to surfaces which would otherwise be electrical non-conducting. Properties are described in the data sheet.
Alfred Hague & Co., Inc., 227-34th St., Brooklyn, N. Y.

Waveguide Components 282

A 4-page catalog of waveguide components for use in the 26.1-kMc to 39.5-kMc (8-10-mm) band has been issued. Included in this catalog are illustrations and code numbers describing various waveguide components.

Products are manufactured by Hilger & Watts Ltd., London, England and distributed in this country by Jarrell-Ash Co.
Jarrell-Ash Co., 26 Farwell St., Newtonville 60, Mass.

Receptacles 283

Bulletin 44 has been issued describing printed circuit receptacles with "short" and "long" mounting pins for use on panels from 1/16" to 3/16" thick. These new receptacles are available in 50-, 70-, and 93-ohm types in "Screw On" (SO); "Slide-On-Series" (SOS) and both types are available in either straight or right angle styles. This bulletin also includes an illustrated table on printed circuit receptacles.
Microdot, Inc., 1826 Fremont Ave., S. Pasadena, Calif.

Drafting Practices 284

A 50-page booklet has been issued on standard and simplified drafting practices. The first section contains a speech on this subject given before the American Society for Engineering Education. The remainder of the booklet gives details on drafting room practice and simplified drafting.
American Machine & Foundry Co., 261 Madison Ave., N. Y. 16, N. Y.

Retractile Cords 285

An 11-page, 2-color catalog has been issued showing the company's complete line of retractile cords for industry, communication and home application. The catalog includes more than 25 illustrations picturing as many different uses for these springlike cords that extend to approximately six times their retracted length and when released return to their neatly coiled normal size. Comprehensive tables specify sizes, lengths, and applications of interest to electronic engineers.
Koiled Kords Inc., Box K, New Haven 14, Conn.

Leak Detector 290

A 6-page, illustrated brochure is now available describing the leak detector. Bulletin 183 contains the latest technical data on this instrument as well as information on many applications.

Covered in the brochure are methods by which leaks may be detected, particular applications of interest and instrument specifications. Descriptions of accessories available for use with the Leak Detector are also featured in the brochure.

Beckman Instruments, Inc., Fullerton, Calif.

Tubular Capacitors 291

A new 12-page bulletin now available describing mineral oil impregnated metal-clad tubular capacitors, designed for "workhorse" applications in military electronic circuits.

The Kovar glass-to-metal process is used to seal these capacitors, which are highly resistant to oil leakage and moisture penetration. The units are built to MIL-C-25A specifications.

General Electric Co., Schenectady 5, N. Y.

UHF Coaxial Wavemeters 292

A catalog has been published describing the company's line of uhf coaxial wavemeters and several other items of interest to the electrical and electronic industry. In addition, included in this illustrated pamphlet are descriptions of applications and specifications of solder, nameplate edging machines, fly cutters and other items of interest to electronic engineers.

Mico Instrument Co., 80 Trowbridge St., Cambridge 38, N. Y.

Thermistor Tele-Thermometers 293

A data sheet has been published describing the 12-channel dial thermometer with flashlight battery powered circuit and thermistor probes. Included in this bulletin are new types of interchangeable probes, also 6-channel and single-channel models. These instruments are designed to operate in an ambient temperature range of 35 to 150 F. Indicators for wider ambient temperature ranges can be provided on special order.

Arthur S. LaPine & Co., 6001 S. Knox Ave., Chicago 29, Ill.

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MIL-I-11683
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- Frequency range 150 KC to 1000 MC by means of four quick-change tuning heads. At least one RF amplifier with tuned imput is employed for each tuning range.
- Easy frequency scanning by means of single tuning knob.
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- Input VSWR better than 1.2 to 1.
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Regulators 302

An 8-page, 2-color illustrated booklet is now available describing two new RM (Repetitive Manufacture) regulators which replace nine former station ratings. RM regulators give Class I accuracy, as defined by ASA, and are designed to carry increased future loads without change of equipment. On existing feeders, the booklet points out, more load can be carried at lower cost. The RM regulators' narrow bandwidth contributes to increased revenues and fewer voltage complaints.
General Electric Co., Schenectady 5, N. Y.

Test Instruments 303

A 4-page, 2-color catalog has become available describing electronic test instrumentation including expanded scale voltmeters and frequency meters, vacuum tube voltmeters, oscillators, resistance bridges, power supplies, wide band amplifiers, WWV receiver and decade inductor. Catalog also includes features and brief specifications of instruments.
Shasta Div., of Beckman Instruments, Inc., P. O. Box 296, Station A, Richmond, Calif.

Silicone Glass Laminates 304

A new 4-page brochure has been issued on glass cloth laminates bonded with silicone resins. It features "case history" descriptions of a wide range of specific electric and electronic applications. Typical physical and dielectric properties are also detailed. Also included is a list of current manufacturers and fabricators of silicone-glass laminates.
Dow Corning Corp., Midland, Mich.

Tapes and Rubber Products 305

A booklet has been issued entitled "Imagination and the Man" stating how the company's representative, industrial imagination, and know-how are combined to improve products and industrial operations while cutting costs. The illustrated booklet describes the uses of industrial tapes and related products. Their applications to a variety of products and industrial problems are thoroughly detailed. Ways are suggested to solve problems and achieve desired results with a little "imagination."
Johns-Manville, Dutch Brand Div., 7800 S. Woodlawn Ave., Chicago 19, Ill.

Controlled Atmosphere Enclosure 310

Bulletin No. 33-D has been offered describing a controlled atmosphere enclosure which provides 100% dust control. Features include: the positive pressure in the box and the even flow of air towards the outside through the bottom opening prevent unfiltered air from entering; the unit makes bare hand work in a dust-free atmosphere possible.
Controlled Atmosphere Enclosures Corp., 230-11 141st Ave., Springfield Gardens, N.Y.

Aircraft Accessory Systems 311

A 4-page illustrated booklet has been issued describing the company's complete accessory systems for basic aircraft services. The booklet describes, with model numbers and illustrations, pressurization and air conditioning systems, high and low pressure compressors, valves and controls, and a complete group of pneumatic accessories.
Stratos Div., Fairchild Engine & Airplane Corp., Bay Shore, L.I., N.Y.

Radio Interference Equipment 312

A 4-page illustrated folder has been issued describing the model NM-40A WLF (very, very low frequency) radio interference-field intensity measuring equipment. The folder lists various important functions never before achieved by a tunable equipment covering the 30 to 15-kc frequency range. Complete specifications are also included.
Stoddard Aircraft Radio Co., Inc., 6644 Santa Monica Blvd., Hollywood, Calif.

Magnetic Recording Tapes 313

"Sound Talk" bulletin No. 32 has been offered discussing mechanical considerations in the use of thin base magnetic recording tapes. The 4-page bulletin is illustrated with graphs and compares the physical properties of thin base and standard base recording tapes.
Minnesota Mining and Mfg. Co., 900 Fauquier St., St. Paul 6, Minn.

Tantalum Capacitors 314

Bulletin 6.100-1 has been published describing tantalum capacitors. Included in the bulletin are the "PP" series of porous tantalum capacitors, giving specifications, ratings, dimensional drawings and ordering references. Typical temperature characteristics curves are also included.
Fansteel Metallurgical Corp., Rectifier-Capacitor Div., N. Chicago, Ill.

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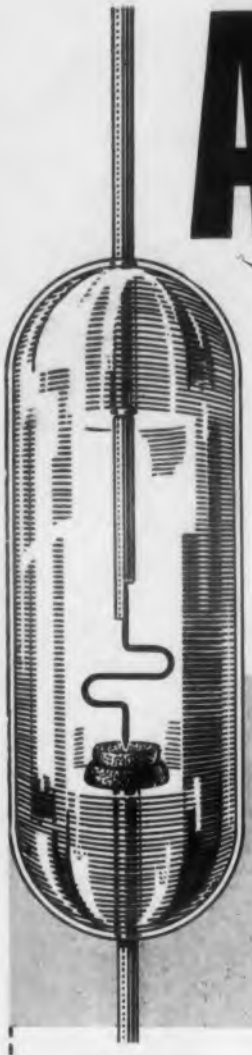

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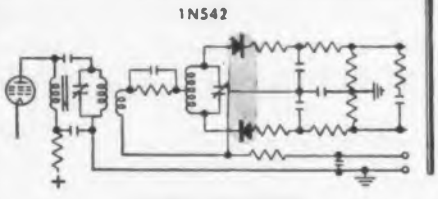
- DC restorer type 1N88G
- AGC and AM detector type 1N541
- matched-pair ratio detector for TV and FM receivers—type 1N542



RATIO DETECTOR

COMPUTER DIODES

- recovery-time and high-temperature tested types
- tight-tolerance, point-contact, high-temperature guaranteed types.

	DIODE TYPE		Recovery Tested	DIODE TYPE
Solder-in	1N480	1N490		1N476 & 1N478
Clip-in	1N119	1N120		1N477 & 1N479
Back Resistance at −20 to −50 volts at 55°C.	400K	200K		Min. and Max. characteristic limits specified at both 25°C. and 60°C. Replace most point-contact types.
Forward Current	5 ma at + 1 volt			

GENERAL PURPOSE and REPLACEMENT DIODES

- 100 volt types
- high back-resistance types
- 1 megohm back types
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including . . .

1N34G	1N54G	1N63GA	1N87GA
1N34GA	1N54GA	1N67A	1N89G
1N38G	1N58G	1N67G*	1N89GA
1N38GA	1N58GA	1N67GA	1N90
1N48G	1N60GA	1N68G*	1N90GA
1N48GA	1N63G	1N68GA	1N116

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230 DUFFY AVENUE, HICKSVILLE, LONG ISLAND, N. Y.

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Patents

Diode Gating Circuit

Patent No. 2,730,632. D. L. Curtis. (Assigned to Hughes Aircraft Co.)

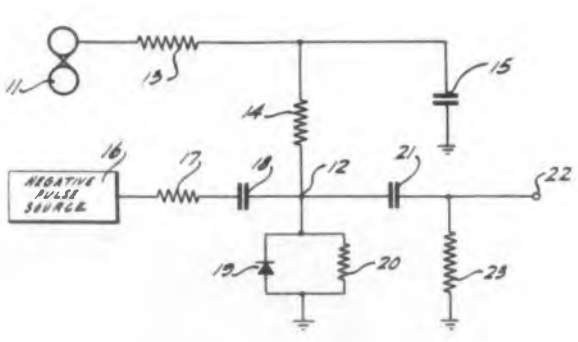
A diode gating circuit such as used in computers have improved reliability if the back resistance of the diode may vary without affecting the output of the circuit. Diodes are subject to a considerable decrease in their back resistance because of age, heat and defective construction of various kinds. These defects may cause a substantial reduction in the magnitude of the output signal or may pass a signal which should have been blocked.

A gating signal generator *11* shown in Fig. 1 is usually of the flip-flop type and has a gating potential in the neighborhood of 90 v and a low voltage level of about 0 volts. The gating pulses are applied to series resistors *13*, *14* and *20*, which are of about equal value so that the potential at junction *12* from the gating pulse is about 30 v. Since this represents about 1/3 of the potential generated by gating generator *11*, the circuit is substantially unaffected by the usual variations in output potential which occcur in the gating pulse generator. Diode *19* is connected in parallel with resistor *20*.

A negative control pulse source *16* applies a pulse of about 30 v through resistor *17*, capacitor *18*, and parallel circuit *19*, *20*. If there is no gating pulse then a negative control signal *16b* in the other drawing is shorted through diode *19* and presents no potential at junction *12*. If, however, negative control signal *16a* occurs at the same time as gating pulse *11a*, the circuit is open and signal *12a* then appears at junction *12*. Should the potential of the negative control signal exceed the gating signal, the potential above the gating pulse will be shorted through the diode. The circuit is therefore unaffected by expected variations in potential of the control signal. A differentiating circuit of capacitor *12* and resistor *23* differentiates the signal to produce an output signal or pulse *22a* at output terminal *22*.

Capacitor *15* connects the junction of resistors *13* and *14* with ground and serves two primary functions. One of these functions is to decouple the negative pulse source from gating pulse source *11* so that the flip-flop generator is unaffected by the negative pulse. The second function is to shunt some of the pulse generator energy to ground so that the rise time and fall time of the potential at junction *12* is delayed. This prevents the gating signal from being differentiated in the differentiating circuit and appear as a spurious output signal.

The low output impedance of negative pulse source *16* also shunts a large portion of the energy from gating pulse generator *11* upon a change from or to the high potential state of the gating pulse generator, and provides a further delay in the rise and fall time of the gating pulse.



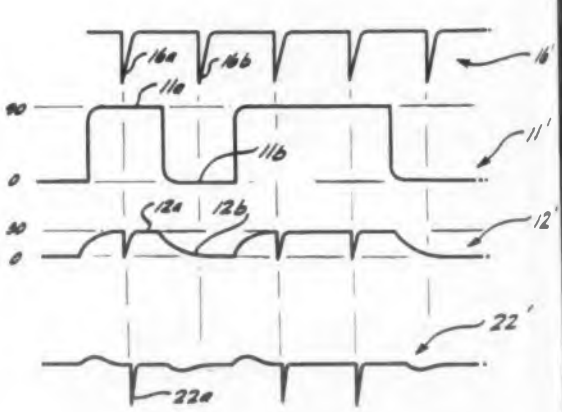


Fig. 1 (above); Fig. 2 (right)

nitron Control

tent No. 2,738,442. Pierre M. G. Toulon. ssigned to Products and Licensing Corp., ew York, N.Y., Nelson Moore and Wilm D. Hall)

A system for controlling the firing of a mber of arc discharge devices with niter elements. A rotating brush triggers ch igniter element through a commutator d thus causes a discharge at a frequency lated to the speed of rotation of the brush.

ischarge Tube Voltage Transformers

atent No. 2,727,987. John H. Coleman. Assigned to Radio Corp. of America)

A voltage transformer is described by eans of which a transformation is secured an applied dc potential or of an aplied ac voltage to a dc potential of different magnitude. The transformer comrises a cathode or electron source and a llector electrode. Between these two ectrodes is located an anode which is rmeable to electrons. The patent particlarly describes a spiral form of anode which a potential is applied.

A constant magnetic field is applied axlly to the electrodes. The load is conected with the collector, which has a egative voltage determined by the energy of the electrons collected on it. A region of step-down voltage is obtained from zero voltage to a voltage comparable to that applied to the anode. A region of step-up voltage is secured at higher voltages.

Electronic Counting or Registering Arrangements

Patent No. 2,739,266. Lionel Clifford Burnett. (Assigned to Ericsson Telephones Ltd., London, England)

A glow counter tube with a number of stable discharge positions which can be used for counting electrical impulses. The device utilizes a common anode and one cathode for each stable discharge position desired. Between each count cathode there are at least two guide cathodes which are utilized to transfer the glow from one count to the next. To increase the count by one the first guide cathode potential is depressed thereby transferring the glow. The second guide cathode potential is then depressed and the first guide potential increased leaving the glow on the second guide electrode.

Finally the second guide potential is raised leaving the glow discharge in a position one count higher than its initial position.

NEW! ½-inch wire-wound

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UP TO 100 K

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Now You Can specify a Waters pot for your miniaturized designs that require 50K and 100K potentiometers. In the reliability-proved construction of the AP-½, these new, higher values give you:

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- ***Ganging — up to four units***
- ***Three mounting styles — plain-bushing, split-bushing, or servo***
- ***Three terminal styles — radial, axial, or wire-lead***
- ***Automation models — for printed circuits***
- ***Encapsulated designs available***

General specifications: Centerless-ground, stainless-steel shaft can be sealed with O-ring; gold-plated, fork-type terminals; 2% standard linearity for 50K and 100K — 5% for lower values; temperature range —55 to +105C, to 125C on order; 2 watts at 80C; anodized aluminum body ½" diameter × ½" long — ⅝" long for 100K; corrosion-resistant-alloy bushing; all electrical connections spot-welded or soldered; furnished with stops or for continuous rotation. *Write for data sheet on these dependable ½" potentiometers.*

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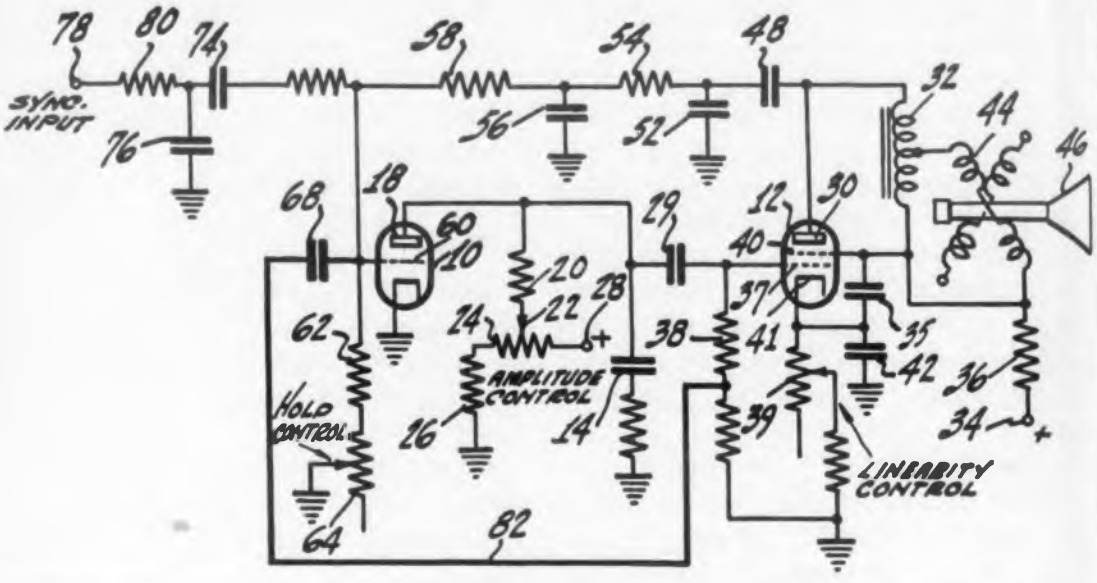
Electronic Oscillator Circuits

Patent No. 2,729,766. B. S. Vilkomerson. (Assigned to Radio Corp. of America)

A multivibrator circuit is the common form of saw-tooth wave generator for controlling the horizontal sweep of the beam of a cathode-ray tube. This form of oscillator is usually used also as the saw-tooth wave generator for controlling the vertical deflection of the beam of a cathode ray tube. In a TV receiver, this type of oscillator is coupled to the deflect on yo of the picture tube. With a r sistan coupled form of multivibrator, a egati going pulse is induced when adjus ment the circuit is made to change its fr quen This pulse will block the operatio of t oscillator for a definite period an is o jectionable.

A multivibrator is shown which is fr of the objection described. The mul vibrator is of the usual type, includi



tube *10* in whose plate circuit is an R-C circuit comprising capacitor *14* and resistance *20*. The plate circuit is coupled to the control grid of tube *12* through capacitor *29*. Anode *30* of tube *12* is coupled to yoke *44* of the cathode-ray tube. A feedback coupling from the anode of tube *12* to the control grid of tube *10* is provided through capacitors *38*, *42* and *56* and resistors *54* and *58*.

If the frequency of the multivibrator should be changed, such as by adjustment of the hold control in the grid circuit of tube *10*, the control grid will go positive and induce a negative voltage in its output which will block tube *12* and the multivibrator. In order to compensate or correct for this transient voltage, the input or control grids of the two tubes are coupled together by connection 82 and capacitor *68*. With this connection, when the control grid of tube *10* goes positive upon adjustment of the frequency, the generated negative blocking voltage is fed back through connection *82* to the control grid of tube *10*, counteracting the positive potential on the grid. In this simple manner the multivibrator is freed from any blocking difficulty which heretofore was experienced in this type of oscillator.

Method of Constructing an Electrical Filter

Patent No. 2,738,466. Bernard Niederman. (Assigned to Motorola, Inc., Chicago, Ill.)

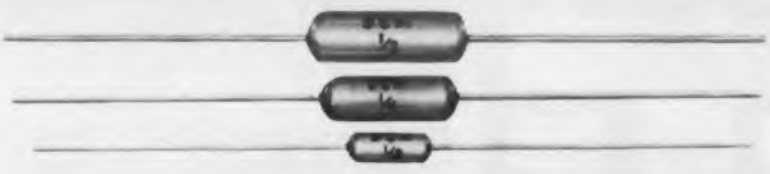
A method of constructing an electrical filter in a series of cup shaped sections which are filled with liquid plastic. Prior to solidification of the plastic, the coil positions are adjusted with respect to the permeable cores such that the filter has the desired electrical characteristics. When the plastic solidifies the coils are rigidly held in the proper position.

High Speed Printing and Perforating Machine

Patent No. 2,737,882. Harold C. Early and Lyman W. Orr. (Assigned to Burroughs Corp., Detroit, Mich.)

An apparatus capable of printing characters on a tape at high speeds. The tape is passed near the printing head in a region containing heat expansible gases. Application of a control signal causes an electrical discharge in this region and the gases expand. The expanding gases then cause the tape to be impelled against the printing head and the selected character is printed.

tomorrow's resistor is here today!



NEW . . . and now available in three sizes, ⅛, ¼, ½ watt

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deposited carbon resistors

Performance to meet, not just today's most exacting requirements, but the needs of the future for higher and still higher limits of reliability! That's what you get in Electra's new doubly-insulated molded resistors. Yes, doubly-insulated . . . to give you extra mechanical protection, longer load life, better electrical insulation, greater resistance to heat and moisture. And look at these truly "miniature" sizes:

	Resistance Range	Length	Diameter	Lead Dia.	Lead Length
DCM ⅛	10 Ohms to 1 Meg.	13/32"	.136"	.026"	1½"
DCM ¼	10 Ohms to 1 Meg.	19/32"	.219"	.026"	1½"
DCM ½	10 Ohms to 2.5 Meg.	3/4"	.25"	.032"	1½"

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- Threshold voltage adjustment
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for every application

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- Adjusting scale factors
- Parameter compensation
- Fixed reference circuits

TIC manufactures in production quantities the most complete line of precision trimmer potentiometers in the industry. Common to all TIC trimmers is the unexcelled TIC quality construction and advanced design. The wide selection of sizes and shapes, in addition to the wide range of power and temperature capabilities, permit selection of units of maximum compatibility with a specific application.

The TIC Trimmer Potentiometer Line includes units from ½ inch to 1 inch in size . . . 50 to 100K ohms in resistance . . . . −55° C to +145° C temperature range . . . power ratings up to 4 watts. Advanced mechanical design provides extremely precise, stable adjustments under all forms of adverse environmental conditions.

TIC was the originator of the high stability subminiature trimmer pots. For example the original metal-film potentiometer, the TIC RFT Metlfilm, represents the outstanding advance high stability trimmer potentiometer design. The RFT contains a resistance element of metallic film that provides infinite resolution for ultra-fine trimming. Compactness of the RFT permits stacking 7 to the square inch. Latest addition to the TIC Trimmer Line is the new low cost RWT which, like the RFT, provides adjustment by use of a 25-turn lead screw.

Complete information on the TIC Trimmer Potentiometer Line is available upon request.

TECHNOLOGY INSTRUMENT CORP.

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Books

Guide To Instrumentation Literature

W. G. Brombacher, Julian F. Smith, and Lyman M. Van der Pyl. National Bureau of Standards, Circular 567, price $1.00.

This circular is intended to assist research investigators, instrument users, and others interested in utilizing the extensive and scattered literature of instrumentation. It was prepared as part of the program of instrumentation, research and development which is sponsored at the National Bureau of Standards by the AEC, the Office of Naval Research, and the Air Research and Development Command.

This compilation consists of an introduction, a source list of instrumentation literature, an author index, and a subject index. Over 1200 references are listed, including abstract journals, bibliographies, 660 books on technology, directories of manufacturers, guides to and indexes of technical literature, periodicals of interest, and guides to dissertations, patents and specifications.

Articles published in periodicals are not referenced, but indexes and abstracts of such articles on a given subject are indicated in the subject index.

Principles of Color Television

Hazeltine Laboratories Staff, Editors—McIlwain and Dean, John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y. Price: $13.00.

This text is prompted by the urgent need for more information to meet the rapid advance of color television. The Hazeltine Corp. has in recent years sponsored a series of general reports covering the various aspects of this field which have laid the foundation for this book.

The presentation includes a broad statement of the fundamental requirements for a successful color television system. A group of short chapters at the start of the book is devoted to the topic involving quantitative handling of color, which is one of the most abstruse phases of the subject as approached by the designer. Following these chapters, the various system requirements are stated and the available means for satisfying them are presented. The transmission standards of the FCC are described in detail; succeeding chapters present the leading principles and features of transmitting and receiving equipment. A glossary of color television terms concludes the text. The presentation assumes a familiarity of engineering theory and techniques of monochrome television, including a fair mathematical background.

Solid State Physics, Vol. II

Editors: Frederick Seitz and David Turnbull, Academic Press Inc., 125 E. 23rd St., New York 10, N. Y. Price: $10.00.

The purpose of the present series is to fulfill the need for compact and authoritative reviews of the important areas of the solid state science field.

Although the growth of solid state physics has not been characterized by any radical changes in basic physical theory, it has extended the theory and the understanding of its implications. Also, the viewpoints in certain closely allied fields, particularly in electronics, metallurgy, crystallography, and the chemistry of solids, have been influenced markedly by development in solid state science.

Because of the expansion of knowledge in this field, physicists are finding that, in order to make significant contributions it is desirable and necessary to concentrate their efforts in narrower fields than formerly. Therefore, this presentation is especially helpful to investigators and students who can readily obtain a balanced view of the whole field. Although many excellent short texts have appeared recently, many scientists have come to recognize the need for an up-to-date treatise on solid state science that reviews comprehensively all of the important facets of the subject.

Amplitude Modulation
Alexander Schure, Ph.D., Ed. D., John F. Rider Publisher, Inc., 480 Canal St., New York 13, N.Y. Price: $1.25.

This text treats the modulation process by which the original signals are changed to radio frequencies. More specifically, the process wherein the amplitude of the carrier wave is varied as a function of the instantaneous value of another wave called the modulating wave.

The material covers both the important basic principles of amplitude modulation and certain of the methods used to accomplish this modulation. The techniques presently in popular use are variations on the basic device of applying the modulating signal to one or more electrodes of a vacuum tube rf amplifier stage. Aside from this common feature, the impedances, currents, and voltages at the various electrodes are considerably different in the various methods of modulation. An individual approach and treatment is given to each case discussed.

The fundamentals of the modulated signal, modulation amplitude considerations, power in the modulated wave, improper modulation, asymmetrical modulation, basic design consideration, and frequency stability and linearity are thoroughly defined. The explanations are essentially non-mathematical.

TV Repair Questions and Answers, Vol. 5
Sidney Play, John F. Rider Publisher, Inc., 480 Canal St., New York 13, N. Y. Price: $2.10.

This final volume is presented to fulfill the need of specific questions and answers a practicing technician has in mind when he trouble-shoots and repairs television receivers.

A broad base of servicing techniques and procedures are given full coverage, while the electronic theory is kept to a minimum.

The text, including servicing of sound sections and low voltage circuits (also filament strings), has been organized so that it can be assimilated as a complete picture on the servicing of these parts. The book can be used as a handy reference source. The first chapter is concerned with general sound servicing techniques. The remaining chapters discuss individual receiver sections.

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Russian Translations

What The Russians are Writing

J. George Adashko

Elektrosviaz' No. 2, 1956

Pulsed Exciter for FM UHF Transmitter, F. V. Kushnir & I. A. Shidlovskii, (4pp; 4 figs). Description of a new pulse-phase exciter for an FM transmitter. The center frequency of the exciter is stabilized by a quartz resonator. The exciter features low non-linear distortion, a low level of internal noise, and does not require tuning or trimming during operation.

The novelty in this circuit, developed by the Leningrad Division of the Scientific-Research Communication Institute, is the use of quartz stabilization in place of automatic frequency control, which usually produces some operating difficulties. Its block diagram is shown in Fig. 1. Here *1* is the phase-modulated pulse generator (to which the modulating voltage is applied); 2 is a multiplier-limiter for sinusoidal FM oscillations; 3 is an amplifier for l-f modulating signal (the output of which goes to the next stage); *4* is the control frequency-detector with amplifier; and 5 the rectifier.

Fig. 2 shows the components of the phase-modulated pulse generator, which consists of a quartz-resonator-stabilized driver oscillator *1*, sawtooth generator *2*, modulating stage 3, and a rectangular-pulse-shaping stage *4* (the modulating voltage is applied to stage 3).

Fig. 3 shows the manner in which the modulation is produced. The sawtooth voltage is applied across capacitor C_1 and to the grid of the tube 1 (modulated stage) where it is limited to exactly half its height (Fig. 4a; the solid line across the triangle is marked "limiting line"). The modulating voltage is applied to the same circuit (via R_1) and changes the limiting level within the period of the sawtooth voltage. Plate current starts flowing approximately simultaneously with the grid current, so that the leading edge of the plate-current pulses shifts with the modulating voltage (Fig. 4b). The next two tubes differentiate and limit these width-modulated pulses into a sequence of phase-modulated pulses (Fig. 4c). The parameters of the integrating circuit R_1C_2 (Fig. 3) are so chosen as to make the modulating voltage applied to the first tube vary in inverse proportion to the frequency.

The linearity of the modulation characteristic depends only on the waveform of the sawtooth voltage, which can be made nearly ideal. The noise level depends on the stability of the sawtooth voltage, which can be made high by stabilizing the plate supply voltage. This results in low distortion (harmonic coefficient less than 0.3% at 1000 cps and less than 1% at the a-f range boundaries) and low noise level (—68 db). Several models of this exciter have been in use for several years and have given reliable and stable service.

Effect of Selective Fading on Facsimile Signals When Various Methods of Modulation Are Used, A. M. Polykovskii, (4pp; 2 figs). A considerable percentage of distortion of facsimile signals, transmitted at short-wave frequencies, is due to selective fading. This is particularly true where the facsimile signals are transmitted via AM radio with FM-modulated subcarrier (abbreviated AM-FM modulation). A brief discussion shows that better results are obtained with FM-FM modulation, in which the facsimile signal frequency-modulates the subcarrier, which in turn frequency-modulates the transmitter carrier, although more complicated equipment is required.

Problems in Measuring Industrial Radio Interference, V. V. Roditi, (5pp; 4 figs.). Short review article discusses the basic parameters of a standard interference meter and the opinions held on this subject in the West and in the USA.

Electric Losses in Shields of Communication Cables, I. I. Grodnev & K. Ia. Sergeichuk, (9pp; 9 figs; 2 tables). Straightforward calculation by integrating product of the radial magnetic and longitudinal electric fields. Experimental tables and curves are also given.

Internal Transient Attenuation of Instruments Used to Measure Transient Attenuation, S. A. Krasik, (6pp; 4 figs; 1 table). Discussion based on network theory, particularly theory of symmetric four-terminal networks.

The Best Code, A. A. Kharkevich, (6pp; 12 figs). The "best" code is defined as one insuring the transmission of maximum amount of data at maximum noise stability. This is true if all communicated data have the same probability. Here the statistics of communication do not enter the discussion. Simple geometric figures are used to determine the optimum code.

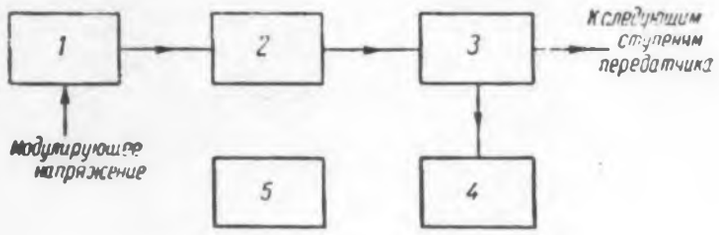

Fig. 1

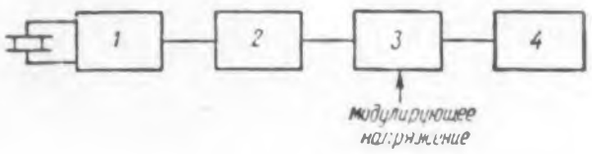

Fig. 2

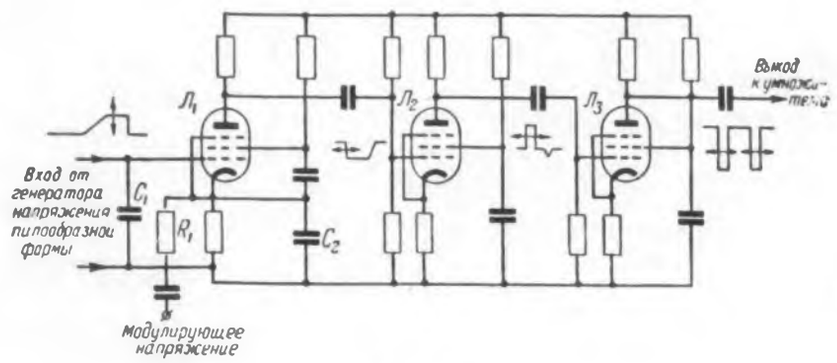

Fig. 3

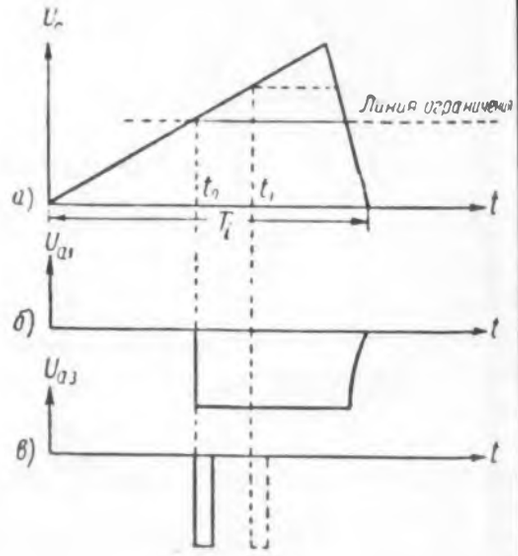

Fig. 4

Frequency-Modulated Oscillator with Reactance Tube, V. P. Minashin, (7pp; 6 figs). Description of a simple FM oscillator producing large frequency deviation, low non-linear distortion, and relatively high voltage level. Fig. 1 shows the equivalent circuit of such an oscillator, where *LC* is the tank circuit and *iX* represents the tube. Fig. 2 shows the actual circuit diagram, Fig. 3 some of the phase relationships, and Figs. 4 and 5 show experimental curves of the frequency deviation and the output level vs. the grid voltage.

Measurements made on this amplifier showed that the non-linear distortion does not exceed 0.15-0.25% at a relative frequency deviation of ±1.5%, as compared with 0.2-0.3% distortion produced in the h-f exciter of an FM broadcast transmitter at a frequency deviation of ±0.16%.

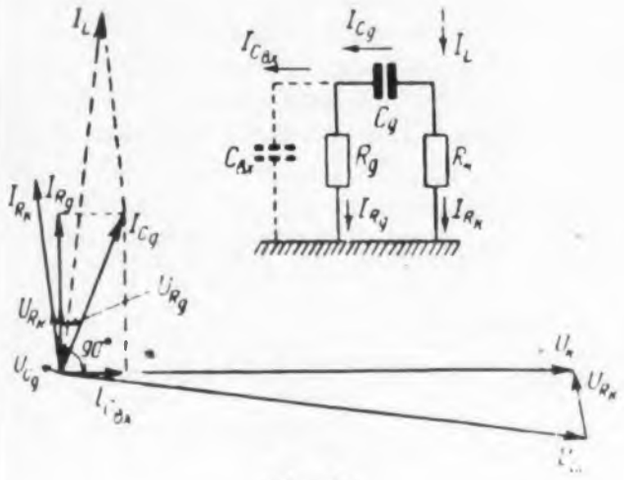

Fig. 3

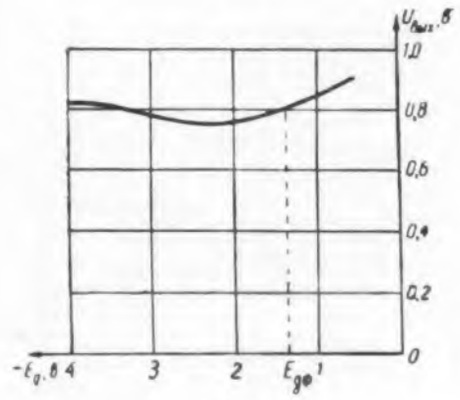

Fig. 5

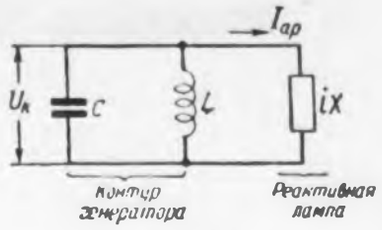

Fig. 1

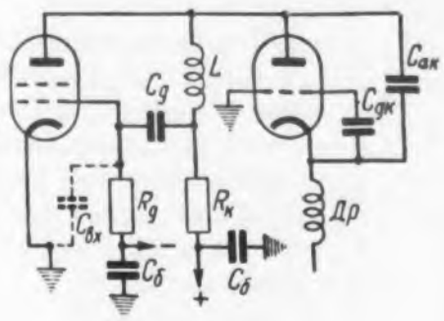

Fig. 2

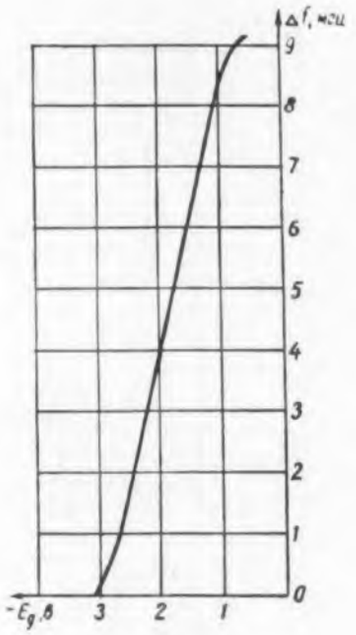

Fig. 4

Distribution of Frequencies and Reception Interference in Radio Relay Lines, A. V. Sokolov, (6pp; 6 figs.) The article discusses the origin of many internal types of interference in multiple-trunk microwave-relay lines. It is shown that no possible distribution of operating station frequencies can eliminate these interferences. However, the noise can be kept down to a value not disturbing the reception by the use of highly selective band-pass filters in the transmission and reception channels. Equations are given for the noise signals caused by various sources.

Asymmetric Suppression of Side Spectra, B. V. Fedortsov, (13pp; 13 figs). Highly mathematical discussion of the waveform distortion of a facsimile signal produced when asymmetric suppression of the side spectra causes non-stationary signals in the system. The article discusses in detail the transmission of isolated image details, the transmission of the black-white boundary, and the transmission of two image details in sequence. Reference is made to Goldman's Frequency Analysis, Modulation, and Noise (translated into Russian in 1951).

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Russian Translations

Dual Channel Si

THE block diagram, Fig. 1, shows a new type of single-sideband radio receiver. The front end, up to the i-f stage, is conventional. The signal is amplified in three i-f stages and applied to the signal grid of a second converter, made necessary by the difficulties in designing quartz filters for 455-kc operation.

Three quartz filters are used, two (wide-band) for side-band separation, and one (narrow-band) to filter out the carrier frequency. Fig. 3 shows the wide-band filter and its frequency characteristics. The narrow-band filter is of the differential type with a center pass-band frequency of 100 kc and an average bandwidth of ±40 cy. Such a narrow filter protects the automatic-frequency-tuning system against the effect of smooth noise, and at the same time produces reliable tuning for all sudden changes

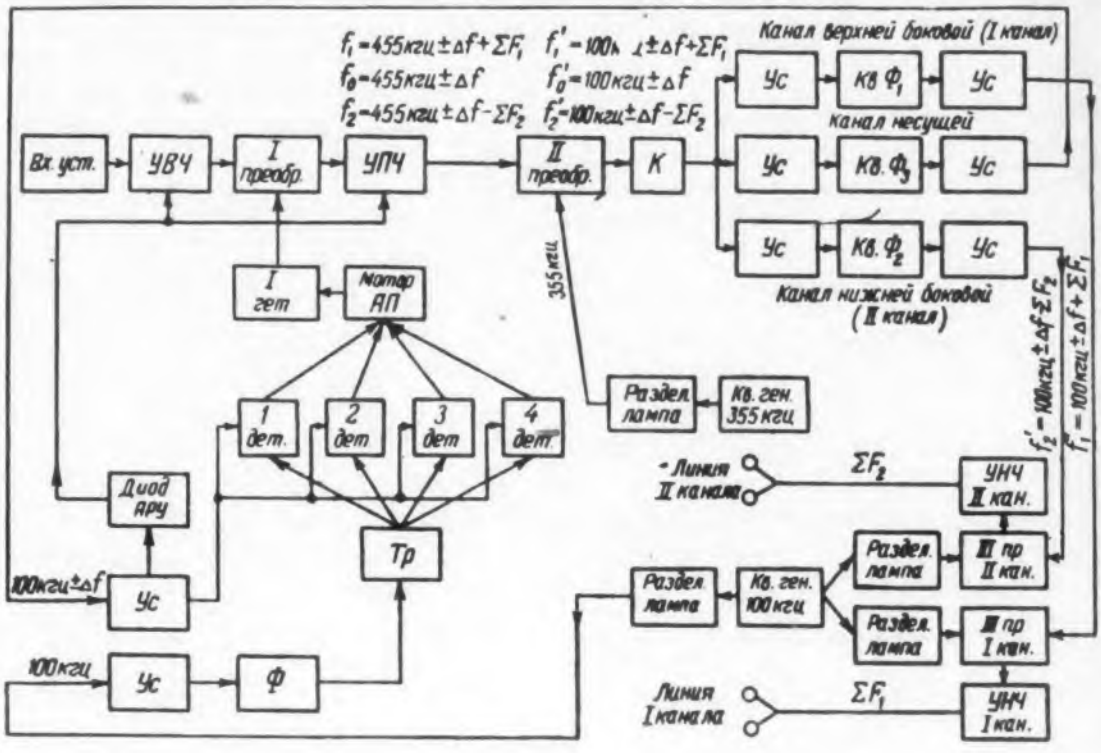

Fig. 1

Fig. 1 legend

1—input equipment
2—h-f amp.
3—first converter
4—i-f amp.
5—second converter
6—dist. amp.
7—amplifier
8—quartz filter
9—upper sideband channel (I)
10—carrier channel
11—lower sideband chan. (II)
12—first heterodyne
13—auto. tun. motor
14, 15, 16, 17—detectors
18—transformer
19—auto. ampl. control diode
20—separation tube
21, 22—channel lines
23—100-kc quartz osc.
24, 27—l-f ampl.
25, 26—third converter
28—355-kc quartz osc.
29—filter

el Single Sideband Receiver

f the frequency of the first heterodyne of he receiver; these jumps usually do not exceed 20 cys.

Fig. 2 shows the automatic tuning and utomatic gain control of the receiver.

The article concludes with an analysis of he non-linear distortion which produces transient talk" in a two-channel receiver. Fig. 4 shows how this distortion can be liminated by shifting the channels relative to the carrier frequency by an amount qual to the width of a single channel. The istortion can also be eliminated by optinum adjustment of the grid voltages of the ubes of the preceding stages. The first ethod makes it very easy to be rid of ransient noise, but requires a wider radio hannel. The second method requires no hannel separation, and is therefore more practical. For a *6K4* tube employed in the last stage of the i-f amplifier, the signal-grid voltage must not exceed 0.25 v, the other parameters being $U_a = 250$ v, $U_{g1} = 100$ v, and $E_{g2} = -2$ v. The signal-grid voltage of the second-frequency-converter tube must not exceed 0.08 v the parameters being $U_a = 250$ v, $U_{g1} = 100$ v, $E_{g2} = E_{g3} = -2$ v.

Operating tests show this dual-channel single sideband receiver to be stable in operation, with the automatic tuning system being quite trouble-free. The high selectivity of this receiver makes it possible to work with the quieter of the two channels at will. Condensed from an article Dual Channel Single Sideband Receiver, by S. A. Tishin. Elektrosviaz' No. 1. Jan. 1956. 9 pages, 4 illustrations.

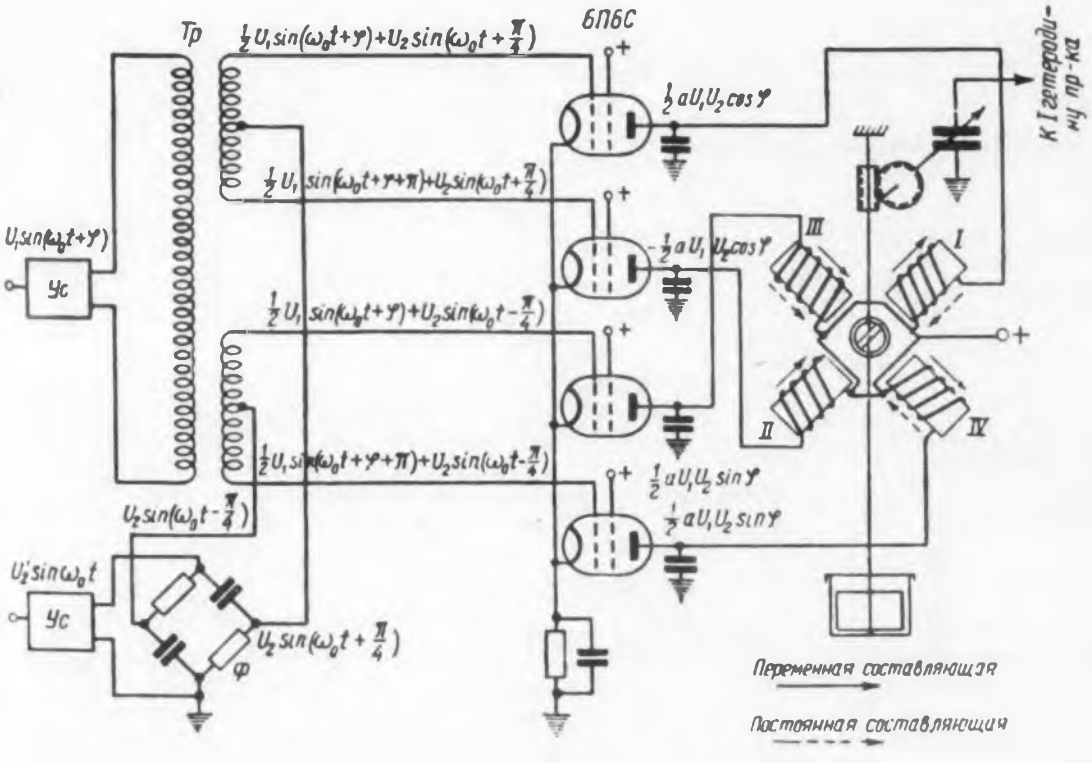

Fig. 2

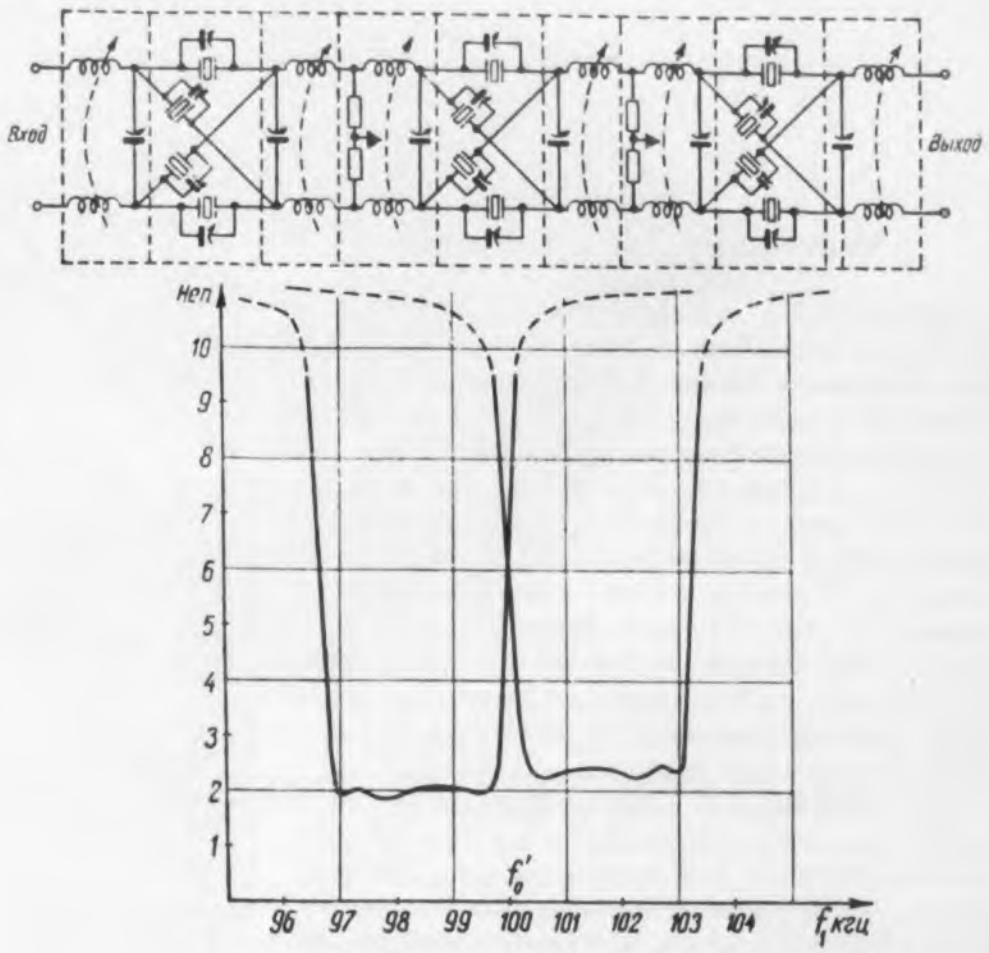
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Fig. 3

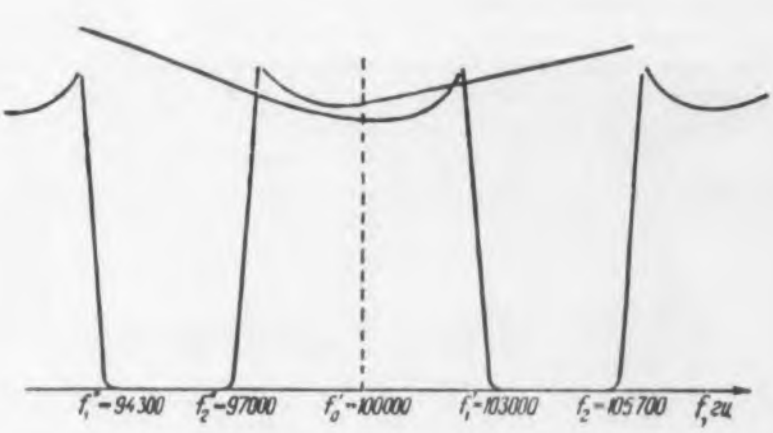
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Fig. 4

Abstract—German

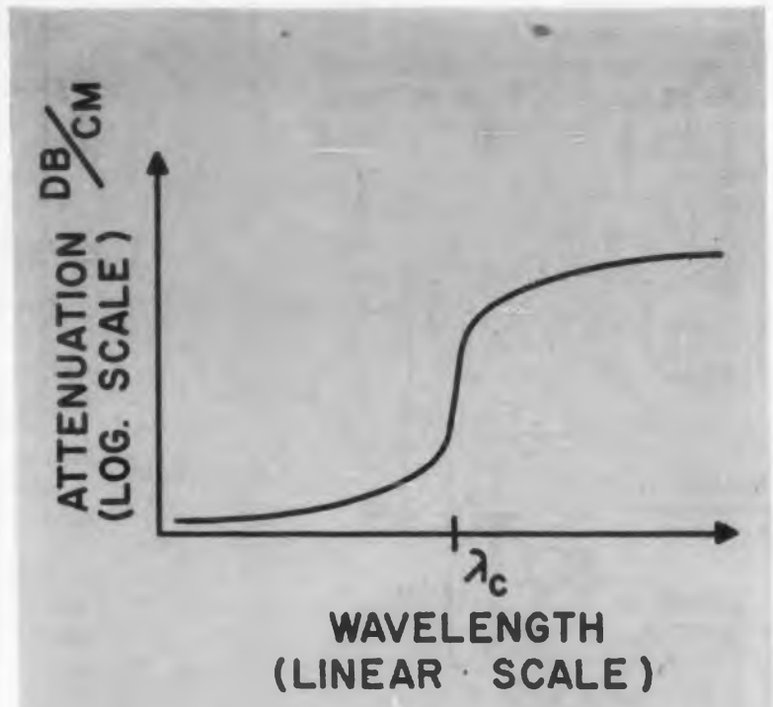
Design Ideas from Germany

Alfred Jorysz

Waveguides as Attenuators

EXISTENCE of a finite wall conductivity produces an S-shape attenuation curve near cut-off, rather than the theoretically infinite increase in attenuation obtained for a perfectly conducting waveguide, Fig. 2. This characteristic may be used to stabilize keystron oscillators, for example. The propagation of electromagnetic waves in circular waveguides of finite wall conductivity is examined below and above the cut-off frequency. Formulae for the complex propagation constant are derived for waveguides in which the skin depth is negligible compared to the wall thickness and the tube radius. Measurements of the attenuation and phase constants near cut-off for the TE_{11} mode show close argeement with theoretical expressions.

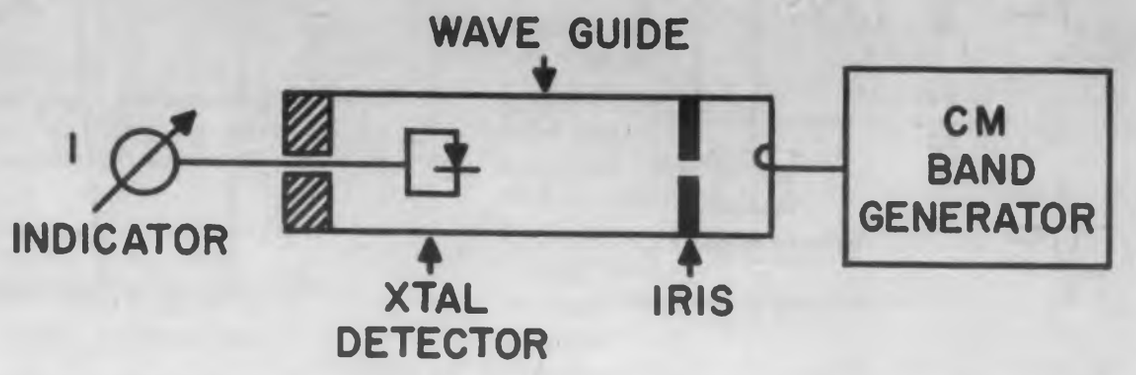
Measurements were made on a brass tube seven meters long, 6 cm in diameter, having a cut-off wavelength of 10.239 cm. The experimental set-up for determination of the attenuation curve is shown in Fig. 1. In a 707 B klystron generator, fine frequency adjustments were obtained by changing the reflector voltage. Good stability for the duration of a measurement series was achieved by use of a regulated power supply. The wave meter was a coaxial resonator with an accuracy of 0.004 cm. The crystal diode used had a quadratic characteristic. Up to about one hundredth of a db per centimeter, the amplitude change of the standing wave maxima was used to determine the attenuation. For higher attenuation values, standing waves become practically negligible and a probe with crystal detector and broad band dipole was introduced. Measurements were made over the same distance at various sections in the wave guide and found to be independent of the location.



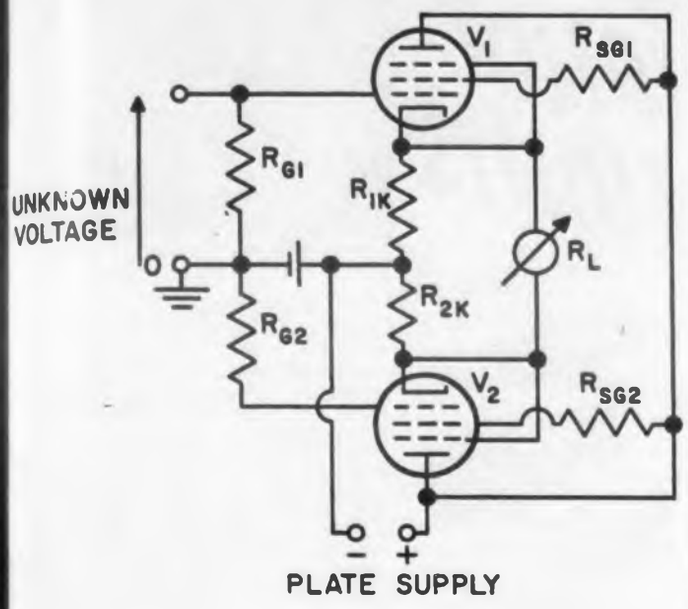
Details of phase velocity measurements and possible ways of improving the accuracy of all results are also mentioned.

The S-type attenuation characteristic may be used to stabilize the frequency of a generator in the centimeter band within the range of about 10^{-8}. This can be accomplished by feeding the output of a reflex klystron through two parallel attenuation channels. One is adjustable and frequency independent, the other is a wave guide exhibiting the above described S-curve. The output of each attenuation channel is fed to a crystal detector. The sum of the detector output currents is adjusted to zero at the cut-off frequency (point of inflection) of the S-curve, by setting the variable attenuator to the correct value. Any change in frequency produces then a change in the total detector current. With the aid of a photocell amplifier, a control voltage can be produced which controls the klystron frequency.

The accuracy of this method may be improved by filling the wave guide with a gas which shows a resonance effect near the cut-off frequency. The considerable change in the dielectric constant of the gas causes a corresponding variation in the cut-off frequency of the wave guide. *Abstracted from an article by W. Schaffeld and H. Bayer, "The behavior of electromagnetic waves in circular wave guides with finite wall conductivity near the cut-off frequency,"* Archiv der elektrischen Uebertragung, *vol. 10, pp. 89-97 March 1956.*



Inverterless Push-Pull DC Amplifier



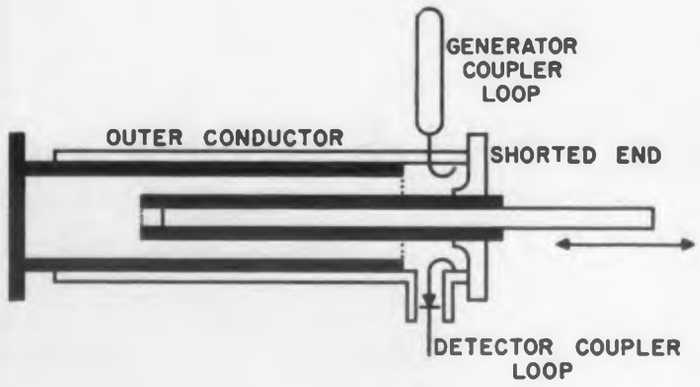
Two unequal tubes in the unique cathode follower push-pull circuit illustrated in Fig. 1, eliminate the need for a phase inverter. This new type push-pull dc amplifier permits the application of unbalanced voltages to its input terminals. The requirements of good linearity, compensation of zero signal current, negligible output noise and low zero drift are fulfilled.

The voltage to be measured is applied to V_1 as shown. The change in the plate current of V_1 changes the drop in the cathode resistor R_{2K} of V_2 via R_L. Since the grid potential of V_2 is fixed, its plate current is controlled by the drop across R_{2K}. Current feedback is provided in each tube by the unbypassed cathode resistor. An additional feedback path exists due to the divider action of R_{2K} and $R_{1K} + R_L$.

In order to fulfill the requirements of zero signal current compensation and a linear transfer characteristic, it is necessary for V_2 to have a higher transconductance than V_1. Equations are set up to determine the values of R_{1K} and R_{2K} if the plate supply voltage, the load resistance R_L and the two tubes are given. The computations are based on an approximation of the $I_p - E_g$ characteristics by parabolic expressions. Proper selection of the operating point is discussed and an outline of the individual steps in the calculation of R_{1K} and R_{2K} is given.

In a practical example, the transconductance ratio of the two tubes is about 7:1 and the cathode resistor of V_2 is found to be approximately 2.5 times the value of R_{1K}. The dc amplifier built with these components shows excellent linearity over an input voltage range from −40 to +40 v. Its sensitivity is roughly 0.5 ma per volt. *Abstracted from an article by E. Schlosser and S. Goetze, "A dc amplifier with unbalanced input," Frequenz, vol. 10, pp. 19-24; January 1956.*

Rod Wavemeters



Rod wavemeter designs are described, which permit frequency measurements from 180 Mc to 80 kMc. Their main advantages are high accuracy, a range as high as 5 octaves and good sensitivity.

Wavemeters with an adjustable short on two-wire systems or coaxial lines are limited in performance because of the imperfections in the shorting contact. Wave guide resonators have a rather limited frequency range and a non-linear calibration curve.

In the rod wavemeter the center conductor of a coaxial line is made adjustable in length. The outer conductor is open at one end and shorted at the opposite end. Resonance occurs at odd multiples of $\lambda/4$. At the point where the inner conductor enters through the shorted end of the outer conductor, coupling loops to both generator and detector are located. An accurate worm and gear drive permits adjustment of the center conductor length l. For an exciting wavelength λ_g,

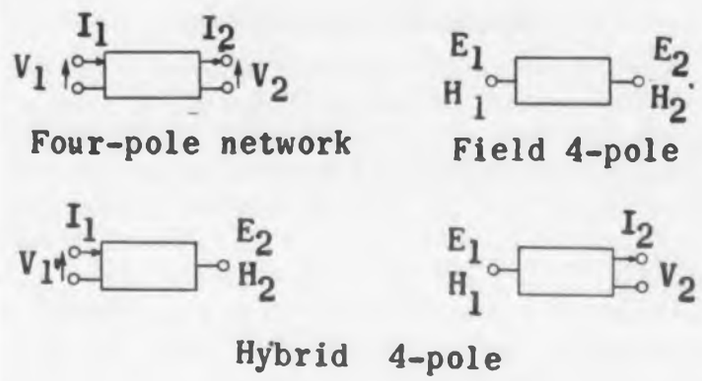
$$l=\frac{2n-1}{4_k}\lambda_g+C, \qquad n, k=1, 2, 3 \ldots$$

n determines the order of the resonance and k the order of the harmonic of λ_g.

One of the problems of this construction is to make the correction factor C frequency independent. Two types of rod wave meters are described. In the less accurate version, of 0.1% accuracy, the dimensions are such that several resonance positions exist, while in the precision uhf units only one resonance is determined with an accuracy of 0.01%.

Details of construction, sources of errors and results of measurements are given for two precision wavemeters and several standard units in the wavelength range from 3.5 mm to 1.65 m. *Abstracted from an article by U. Adelsberger, "The rod wavemeter in the range from 180 to 80,000 mcps, construction and experimental results."* Archiv der elektrischen Uebertragung, *vol. 10, pp. 51-57; February, 1956.*

Field Quadripole



New concepts of "field quadripole" and "hybrid quadripole" are introduced in an interesting analysis, applicable to the solution of transmission problems of electromagnetic waves in coaxial lines and waveguides. These concepts are applied to the calculation of uhf attenuators.

Field quadripole and hybrid quadripole are based on the standard four-pole network in which output voltage and current are related to the input quantities through its characteristic matrix. In the field quadripole a matrix relates the input electric and magnetic fields to the corresponding fields at the output terminals. A hybrid quadripole, on the other hand, may have input voltage and input current, while the output is an electro-magnetic field, characterized by its electric and magnetic components. The opposite type has a field input and conventional voltage-current output.

The particular problem to which the above concepts are applied, involves a circular waveguide which is energized by a concentric line and whose output is coupled to another concentric line. With proper termination of the concentric lines, two waves, one moving forward and one in reverse, exist on each line. In the waveguide, however, there is an infinite numbr of TM waves. For each one of these modes, there exists a transmission channel, consisting of a transmitting hybrid quadripole, an intermediate field fourpole and a receiving hybrid fourpole.

The matrices are computed for these elements and the theory then applied to the problem of a concentric line coupled to an infinite waveguide and to the TM mode piston attenuator treated by A. B. Giordano in the *Proc. of the I.R.E.* in 1950. *Abstracted from an article by A. Sander, "The excitation and propagation of TM waves in a circular waveguide with concentric lines as transmitter and receiver,"* Archiv der elektrischen Uebertragung, *vol. 10, pp. 77-85; February, 1956.*

Abstracts

Government Reports

Systems Engineering

A report prepared for the Navy designed to aid the systems engineer. The author defines the systems engineer as a "man who, when assigned to a project, is capable of coordinating and preparing or carrying out three things—first, an optimum scheme (system survey) showing the interrelation of all factors that will affect the project and sway future action; second, an optimum set of organized ideas (the plan of procedure) pertaining to carrying out the project; third, an optimum physical realization (the product) of the devices necessary to terminate the project." To provide useful material for the systems engineer in any industry, technical considerations are eliminated. Only material common to most systems problems is included in the book. An introduction to systems engineering is given, the factors surrounding a typical systems engineering problem are enumerated, and the systems design process is outlined. The system survey, a preliminary step in the systems engineering process, and the organized project plan are discussed, and a check list is given for each. Ideal and optimum tests are defined. Based on the development cycle, product development is examined from the systems engineering viewpoint, and the subject of systems tests is treated, with a check list given. The report concludes with a discussion of the completion and reinstigation of projects. *PB 111801 Systems Engineering, J. N. Warfield, Ordnance Research Laboratory, The Pennsylvania State University, for the Navy Bureau of Ordnance, Aug. 1955. 30 pages. 75 cents.*

Effects of Low Temperature on Various Materials

Low temperature thermal expansion of 15 miscellaneous substances were measured. Literature data for several other materials of possible interest have been collected. Length changes between 300 and 0°K are reported in tabular form as an aid in the engineering design of cryogenic devices. In addition to the measurements on the low temperature thermal expansion of plastics which have been reported in LADC-1230 (AECU-2161), the expansions of various metallic and non-metallic materials which were of interest to the laboratory were measured. These measurements do not represent work of extreme precision, but were made only to obtain engineering information. *Low Temperature Thermal Expansion of Various Materials. Henry L. Laquer, Los Alamos Scientific Lab. N. Mex. Dec. 9, 1952. Nov. 30, 1955. 58 pages. 40 cents.*

Reliability Bibliography

Material published on the reliability of electronic equipment since 1950 is compiled and listed under appropriate subject headings. List of subjects is (1) Circuit design (2) Components (3) Electron tubes (4) Failure Analysis (5) General (6) Human engineering (7) Maintenance (8) Mechanical design (9) Systems and (10) Testing. Source of the material is given along with an abstract of about 100 words. These references are printed four to a sheet and ruled. They may be cut out to form individual references on 3 x 5 cards. *NEL Reliability Bibliography compiled by W. E. Jorgensen, I. G. Carlson and C. G. Gros. Available to Department of Defense activities and to a limited extent to government contractors upon request to the Commanding Officer and Director, U.S. Navy Electronics Laboratory, San Diego 52, Calif.*

Millimeter Wavelength Components

Naval Research Laboratory has designed a series of waveguide components and test equipment covering the portion of the millimeter wavelength range from 4 mm to about 1 cm. Included are connectors, standing-wave indicators, wavemeters, attentuators, directional couplers, switches, hybrid junctions, adjustable shorts, crystal mounts, power meters, power supplies, terminations, bends, horns, tees, and tapers. *PB 111968 Millimeter Wavelength Components, R. G. Fellers and J. A. Kaiser, Naval Research Laboratory, Mar. 1956. 27 pages. 75 cents.*

Bibliography on Thermal Conductivity

Several methods of measuring the thermal conductivity of metals are available to the investigator. Many of these methods measure the temperature drop when heat flows in one dimension in a solid body. Various techniques which yield absolute or comparative values are described. The Forbes bar and the dynamic methods yield the conductivity by giving a value for the thermal diffusivity. The thermal conductivity can also be estimated from the electrical conductivity in some materials. Thermal conductivity varies with the temperature for any particular material and is related to the specific heat, density and the chemical composition. Information from the literature is consolidated in graphical form to illustrate the effect of the temperature and composition on the thermal conductivity. Many heat resistant materials are included. An extensive bibliography and subject index on thermal conductivity has also been compiled covering the literature through July 1954. *PB 111756. Survey and Bibliography on the Determination of Thermal Conductivity of Metals at Elevated Temperatures. Richard D. Seibel. Watertown Arsenal, Aug. 1954. 65 pages. $1.75.*

Abstract

Relation Between Reliability

EMPLOYING a tube whose performance characteristics are noticeably higher than needed for adequate functioning of the equipment is a matter of serious concern. Basically, the reason why this kind of design may be dangerous is that high performance tubes can only be obtained at the sacrifice of factors which strongly influence reliability from the standpoint of design.

For example, one can take any triode or pentode manufactured and successfully contend that if the control grid is brought closer to the cathode, its wire made smaller, and the separation between turns reduced, the mutual conductance can be increased with little or no increase in plate current. Similarly, he might contend that where heater power consumption is a measure of performance efficiency, one can shrink dimensions in such a way that heater power requirements are decreased with no adverse effect on dynamic and static characteristics. The design engineer will readily agree with these contentions but he can, at the same time, show that microphonism, short circuits when the tube is jarred, variations in characteristics with life, the probable occurrance of grid emission, and a further listing of undesirable features will increase exponentially as a result.

Mutual conductance of ordinary receiving tubes has been increased several hundred per cent over a period of thirty years and reliability has also been tremendously improved. Why, we might ask, cannot the designer and manufacturer exercise their combined talents to make some projected high-performance tube be just as reliable as the one that is almost hot enough for the proposed application? This question has been asked many times, and the answer is, as far as we know, the same as it has always been.

First of all, you can not promise, if you want to stay in business, that you can deliver something that neither you nor anyone else knows how to make.

Second, any idea or new principle that would enable you to make the projected super-hot tube just as reliable as a more conventional one will also, in all probability, be employed to improve existing tubes. A five or ten year old type is always a more reliable one than it was when it was first made for a number of reasons, one of which is that important types are frequently redesigned to incorporate recent advances as long as their popularity continues.

Performance and of Tubes

From the design standpoint, therefore, new high-performance tubes can rarely, if ever, hope to compete on the basis of reliability with older types having more modest ratings.

Taken by types, tubes are somewhat like people. You have to live with them awhile to become fully acquainted with their likes and dislikes; to learn how to get along with them. This is certainly true so far as tube manufacturing is concerned, and presumably is true to some extent in tube application problems. In processing tubes or their parts, and even in the choice of materials—such as the composition of the cathode base alloy or coating—what is good medicine for one type could be poison to another.

While this may be a rather unscientific analogy, we can state categorically that uniformity, overall quality, life, and any other factor contributing to reliability will improve the production experience over a period of years. Specification changes in materials, dimensions, layouts, and processes on important tubes may continue a long time before engineers and production personnel are satisfied that further improvement is not likely to be achieved before the type reaches obsolescence. The net result is that improvements in reliability can never keep up with improvements in performance.

Take for example, the double triode, type, *6J6*, which was introduced just before World War II. It was obvious that the *6J6* could out-perform other tubes and result in savings in volume, power consumption and weight. A demand for this type in large quantities quickly developed, part of this demand being for military applications in field equipment.

Now the remarkable electrical performance of the *6J6* was achieved through the introduction of some rather novel features which proved difficult to control in production. That is, they were difficult until costly experience and further intensive development resulted in a more reliable design. In retrospect, it is fully evident that if introduction of the *6J6* had been withheld until all the bugs had been worked out, we would still be waiting for it. Reliability can be built into a new tube—or a computer or an automobile transmission—only with experience.

Abstracted from "The Relation Between Performance and Reliability of Tubes," George D. O'Neill and Marcus A. Acheson, Sylvania Electric Products Inc. appearing in the Sylvania Technologist, *April 1956, p. 49.*

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.

RETMA Standards—Request for Reaffirmation

In accordance with the RETMA policy of reviewing existing RETMA Standards, the following standards have been submitted for reaffirmation. Although the official comment period may have expired, you are encouraged to comment if you are vitally interested.

REC-111, Chassis Pickup of Vehicular Receivers (S.P. 499)

REC-102A, Drive Pulleys (S.P. 500)

REC-106A, Class A Variable Air Capacitors (S.P. 501)

REC-124, Output Transformers for Radio Broadcast Receivers (S.P. 502)

Electron Tubes

MIL-STD-200C, Military Standard for Electron Tubes, 14 Febuary 1956

This change notice identifies tube types that are standard for Guided Missile applications.

Application Design Notes

ASESA 51-4, Application Design Notes (Electronic Components)

The following new ADN's have been added to this publication:

Part Name	*ADN*	*No. & Date*
Relays, Armature (For Electronic Equipment)	5757	10 May 1956
Coils, Radio Frequency; and Transformers, Intermediate and Radio Frequency	15305	10 April 1956
Meters, Electrical Indicating Panel Type, Ruggedized	10304	31 May 1956

Preferred Parts Lists

ASESA 49-1, Preferred Parts Lists (Electronic Components)

The following preferred parts lists have either been newly issued or revised:

Part Name	*PPL*	*No. & Date*
Meters, Electrical indicating, Panel Type, Ruggedized 2-1/2 Inch	10304-MR	20 April 1956

Meters, Electrical Indicating, Direct Current, 1 Inch	17275-MR	20 April 1956
Rectifiers, Metallic, Selenium	11050-RS	20 April 1956
Capacitors, Fixed Mica-Dielectric	5-CM	20 April 1956
Jacks, Telephone	641-JJ	20 April 1956
Plugs, Telephone	642-PJ	20 April 1956

Brushes

ASA C64. 1-1956, NEMA CB 1-1956, REQUIREMENTS FOR BRUSHES FOR ELECTRICAL MACHINES
Carbon, carbon-graphite, electrographitic, graphite, and metal-graphite brushes used in electrical machines are covered in this joint standard. Definitions and illustrations of brush surfaces, connections and clips, dimensions and tolerances, procedure for describing brushes, and test procedures are contained in this standard. Copies are available from National Electrical Manufacturers Association, 155 East 44 St., New York, N. Y., for $2.00 per copy.

Standards Proposal—Request for Comment

The RETMA Engineering Office, 11 W. 42nd St., New York 36, N. Y., requests industry comments on the following proposed standards. Send for proposal number as indicated. (Although official comment period may have expired, you are encouraged to comment if you are vitally interested.

SP-503, SOLDERABILITY TEST STANDARD
A test for the solderability of lead wires, terminals, and appropriate hardware which are to be joined by a soft-solder operation is defined.

SP-498, THERMOPLASTIC INSULATED AND JACKETED HOOK-UP WIRE
Tinned annealed copper conductors insulated with a concentric wall of a heat-resisting synthetic resin compound, and covered with an extruded thin wall of nylon intended primarily for general radio, electronic, and instrument chassis wiring in circuits up to 600 volts r.m.s. are covered by this proposed standard.

SP-497, STANDARD TEST METHODS FOR ELECTRONIC COMPONENT PARTS: METHODS 4 AND 5, DIELECTRIC TEST AND SALT SPRAY.
The dielectric test is of the type to be used for the purpose of determining the ability of component parts or materials to withstand a potential at sea level or at a specified altitude. The salt-spray test is to be used for the purpose of determining the adequacy of protective coatings or finishes, and has been widely used to evaluate the resistance of metals to corrosion in marine service or in exposed shore locations.

Foreign Standards

The following standards have been received by the ASA library. These standards are available on loan to ASA members, others may order copies through ASA. These standards are available only in the language of the originating country.

GERMANY (DIN 45513,B1. 1-4), FOUR TYPES OF TAPES FOR MAGNETIC RECORDING

GERMANY (DIN 45519,B1. 1,2), TWO METHODS OF MEASURING SOUND TRACKS

BULGARIA (BDS 1510), RADIO RECEIVERS, SUPERHETERODYNE TYPE CLASSIFICATIONS, SPECIFICATIONS

FRANCE (NF C 42-100), GENERAL RULES PERTAINING TO ELECTRIC MEASURING INSTRUMENTS AND ACCESSORIES

FRANCE (NF C 92-210), SAFETY RULES FOR TELEVISION RECEIVERS CONNECTED TO THE MAIN POWER LINE

GERMANY (DIN 43678), BASIC DIAGRAMS FOR SWITCHES AND CIRCUIT BREAKERS

GERMANY (DIN 41231/3), THREE TYPES OF FIXED CAPACITORS, CLASS W2 ANDG2

JAPAN (JIS C 4002), GENERAL RULES ON ELECTRIC MACHINERY AND APPARATUS (Available in English)

JAPAN JIS C 6404/5), ROTARY VARIABLE CARBON RESISTORS, WITH AND WITHOUT SWITCH (Available in English)

JAPAN (JIS C 6421), INTERMEDIATE FREQUENCY TRANSFORMERS FOR BROADCAST RECEIVERS (Available in English)

JAPAN (JIS C 6423), MINIATURE FIXED CERAMIC CAPACITORS (Available in English)

JAPAN (JIS C 6425), VARIABLE AIR CAPACITORS FOR HOME RECEIVERS (Available in English)

JAPAN (JIS C 7005), SMALL SIZE VACUUM TUBE BASE

JAPAN (JIS C 7008/11), FOUR STANDARDS FOR VACUUM TUBE BASES: DESIGNATION, DIMENSIONS, INSPECTION GAGES

THE NETHERLANDS (N 5036), GLOSSARY OF TERMS USED IN ELECTRICAL ENGINEERING, GENERAL

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POLAND (PN E-01002), ELECTRIC WIRING CABLE TERMINOLOGY

POLAND (PN E-01211), GRAPHIC SYMBOLS FOR SWITCHES

UNITED KINGDOM (BS 2311:1955), COLOUR CODES FOR CONNECTIONS IN RADIO AND ALLIED ELECTRONIC EQUIPMENT

UNITED KINGDOM (BS 2689:1956), RECOMMENDED METHODS FOR ESTIMATING THE EFFECT OF DELETERIOUS SUBSTANCES IN FIBROUS ELECTRICAL INSULATING MATERIALS

Specifications listed on these pages are for information only and government contractors should be guided by their contracts. Copies of military specs should be obtained from sources recommended by procuring officers. ASESA bulletins may be obtained from Fort Monmouth, N. J. ASA Standards may be obtained from American Standards Agency, 70 E. 45th St., New York 17, N. Y., unless otherwise noted.

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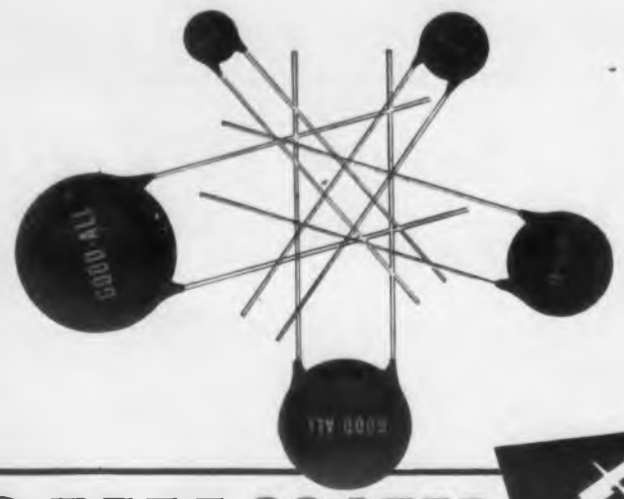

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MAXIMUM DIAMETER

Temperature Coefficient	1/4	5/16	1/2	5/8	3/4
P-100	1-3 mmf	4-9 mmf	10-30 mmf	.....	.....
NPO	2-12	13-22	28-60	61-75 mmf	76-110 mmf
N-33	2-15	16-27	28-60	61-75	76-110
N-80	2-15	16-27	28-60	61-75	76-110
N-150	2-15	16-30	31-60	61-75	76-110
N-220	3-15	16-30	31-75	76-100	101-140
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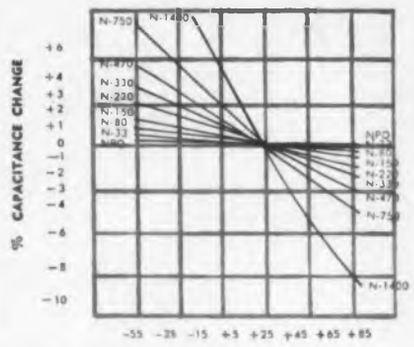
CAPACITANCE CHANGE VS. TEMPERATURE IN °C



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DESIGN

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