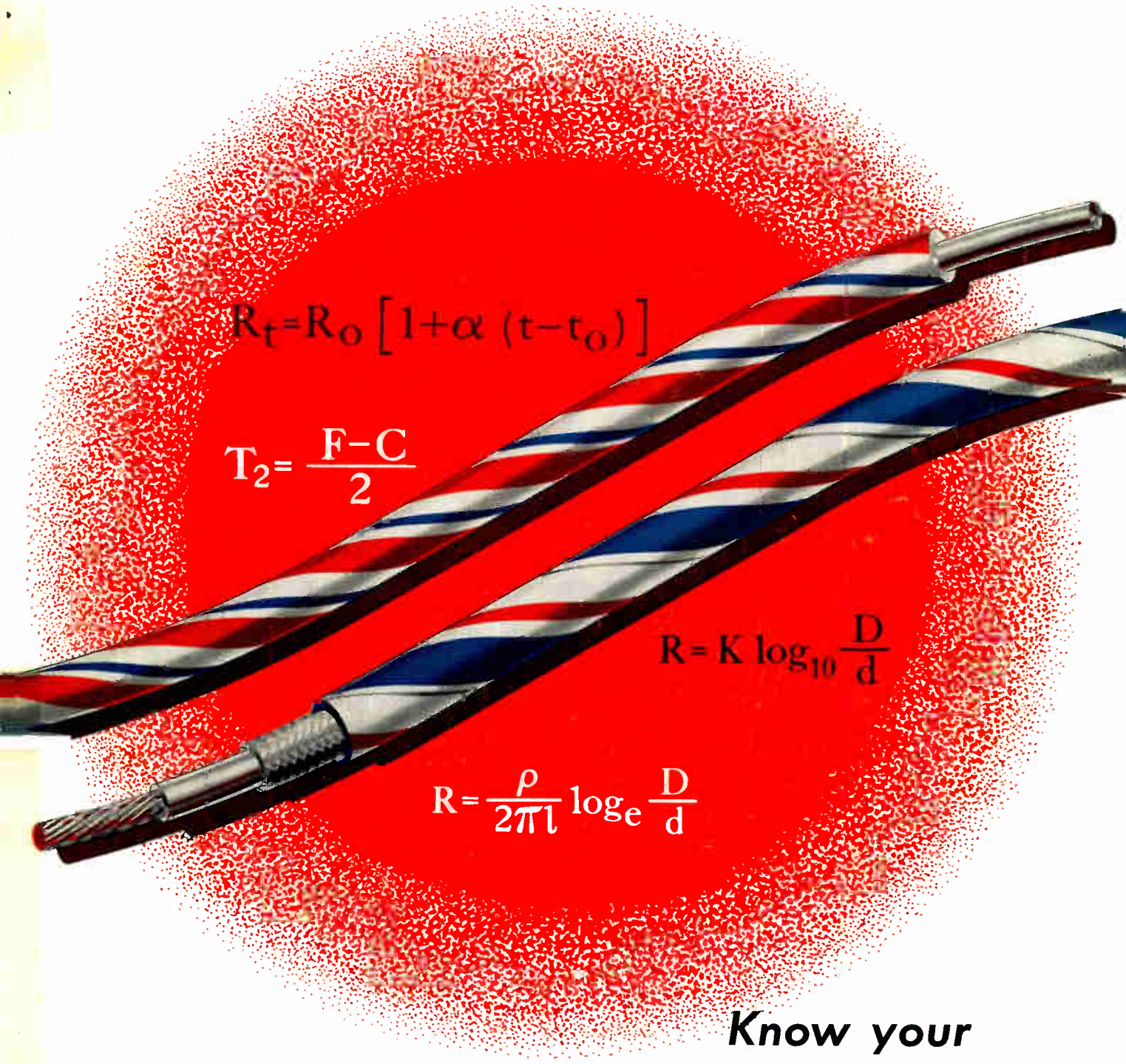
ELECTRONIC INDUSTRIES



Know your
HIGH TEMPERATURE WIRE

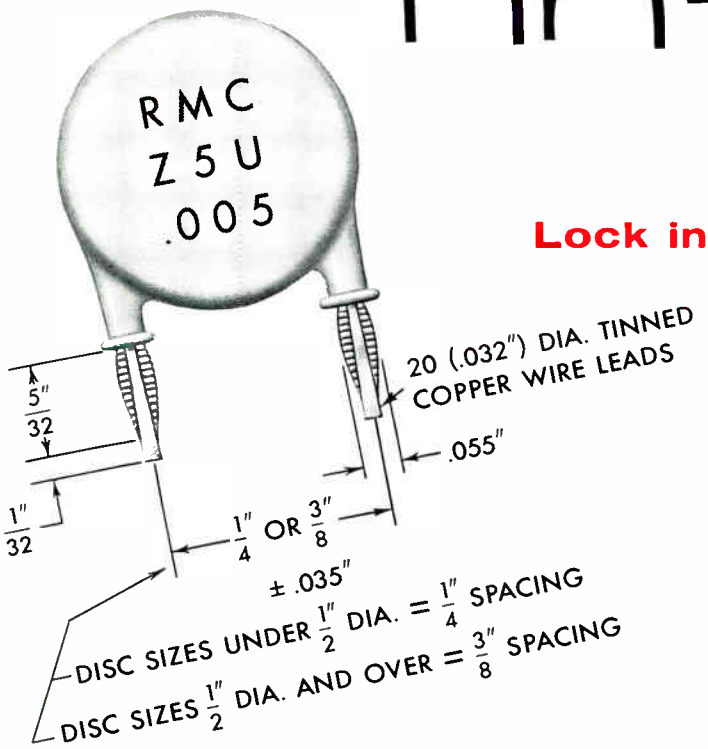
January • 1959
Chilton Publication

Another... RMC FIRST

Fin-Lock®

DISCAPS

Lock into printed circuit boards!



RMC "Fin-Lock" DISCAPS were designed specifically to cut assembly time on all types of equipment utilizing printed circuits.

"Fin-Lock" leads permit either automatic or hand assembly and provide an absolute lock into printed circuit boards. Stand up positioning is assured and crimping of leads is eliminated as is short circuiting in soldering operations.

Designed for holes from .040 to .052, "Fin-Lock" DISCAPS are automatically stopped in holes over .052 by the shoulder design of the "Fin-Lock" lead. "Fin-Lock" leads are available on all RMC DISCAPS of standard voltages, ratings and spacings at no increase over regular prices.

Write today on your company letterhead for complete information.

DISCAP CERAMIC CAPACITORS

RMC

RADIO MATERIALS COMPANY
A DIVISION OF P. R. MALLORY & CO., INC.
GENERAL OFFICE: 3325 N. California Ave., Chicago 18, Ill.
Two RMC Plants Devoted Exclusively to Ceramic Capacitors
FACTORIES AT CHICAGO, ILL. AND ATTICA, IND.

Circle 1 on Inquiry Card, page 117

ELECTRONIC INDUSTRIES

ROBERT E. McKENNA, Publisher • BERNARD F. OSBAHR, Editor

1959 Electronic Preview

This issue marks the beginning of a new year and one that we feel will be even more prosperous than 1958 for all of the readers of the Electronic Industries. All of us on EI join in the wish that it will turn out to be a most happy year as well. On pages 68 to 70 in this issue we again present our annual statistical summary for 1958. Predictions for 1959 from industry sources have been fewer, slower and more difficult to obtain this year. An element of conservation prevails, probably as the result of the recession and cutbacks in 1958. However, a most comprehensive report has just been released by the Electronics Div. of the Business and Defense Services Administration of the U. S. Department of Commerce. It is entitled, "The Electronic Industries Outlook for 1959 and Review of 1958." Here are some of the reports 1959 highlights:

Estimated factory output of electronic equipment and components . . . $7.9 billion (without R & D)

This is defined as:

Consumer radio & TV % related products	$1.5 billion
All other electronic equipment	$3.8 billion
Electron tubes	$0.85 billion
Semiconductor devices	$0.25 billion
Components other than tubes and semicond.	$1.5 billion

These 1959 estimates reflect:

Military electronic equipment — increase 16% over 1958, (Assuming no major changes in present plans and programs.)

Commercial and industrial electronic equipment—up 18 per cent over 1958.

Consumer electronic products—increase 10 per cent over 1958.

Semiconductor devices — up 25 per cent over 1958.

Electronic components other than electron tubes—up 12 per cent.

Other factors of interest are:

1. Electronic industries are now a major segment of U. S. manufacturing economy. In 1957 its output was over 2 per cent of total manufacturers' sales and 4 per cent of durable goods sales. They employed 3.5 per cent of total manufacturing work force—over 6 per cent of durable goods employment. 1958 will be only slightly less than 1957.

2. R&D (military, consumer, industrial) will be more than $1 billion.

3. Electronic components industries employ about 50 per cent of the electronic work force.

4. Since 1939 electronic output has increased 20 times compared to a less than 5 times increase in the gross national product.

By way of summarizing each of the year-end reports of EI editors, in 1959 we expect:

1. Completely transistorized (except for the picture tube of course) battery operated portable TV sets.

2. More "plug-in" type auto sets where the set can double as a portable.

3. Increased hi-fi sales due to gradual growing public interest in stereo. Stereo disc sales will climb. If standards for stereo broadcasting are formulated and adopted, year's end could see meteoric rise in equipment sales.

4. A further increase in foreign imports. Engineering salaries in foreign countries and labor costs are only about 50 per cent that of the U. S. Even with 12½% duty foreign products can be placed on the American market at lower competitive prices.

5. Not much progress in color-TV or in pay TV. Black and white TV sales should rise because of the increasing number of sets that are four or five years old and need replacement. Greatly increased markets for closed circuit TV.

6. More money to be spent for military R&D, less for hardware.

7. The emergence of some new semiconductor materials such as silicon carbide. The use of silicon in semiconductor devices may exceed use of germanium by year's end.

8. Greatly increased pressure on engineering recruitment. Scientific personnel will be harder than ever to get. Companies will be much more selective but will offer much greater security advantages to their selectees.

9. Much more emphasis on the development of devices that will convert heat into electricity, solar converters, electroluminescence, masers and other solid state devices.

10. That we will get a moon missile.

Again, a Happy New Year to all!

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ELECTRONIC INDUSTRIES

Vol. 18, No. 1 January, 1959

MONTHLY NEWS ROUND-UP

NEW PRODUCTS & TECH DATA

DEPARTMENTS

BPA NBP

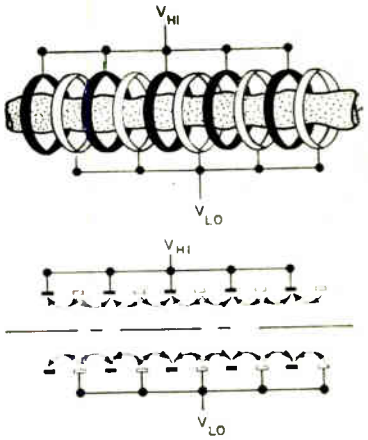
Highlights

Of This Issue

Hi-Temperature Wire!

What To Know About Hi-Temperature Wire! page 53

For engineers who specify wire for hi-temp applications here is a list of pertinent facts about wire. Information includes: types of conductor material, insulation, and methods of applying insulation, with the degrees of protection afforded by each.



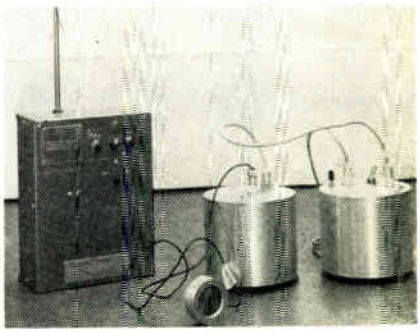
Focussing TW Tubes

Focussing Travelling-Wave Tubes page 58

While magnets do an effective job of confining the beam of the travelling wave tube they do greatly add to the bulk and weight of the packaged tube. Electrostatic focussing eliminates the need for a magnet structure, reducing the weight and also eliminating the problem of alignment of the tube within the magnetic field.

High Accuracy Time Interval Measurements page 62

Equipment is readily available to measure time intervals with an accuracy of 0.1 usec. However these methods are inadequate when we want to measure time intervals to an accuracy of 0.01 usec between events at two widely separated points. This unusually accurate equipment restricts itself to the first two pulses applied to its input, rejecting other signals until reset.



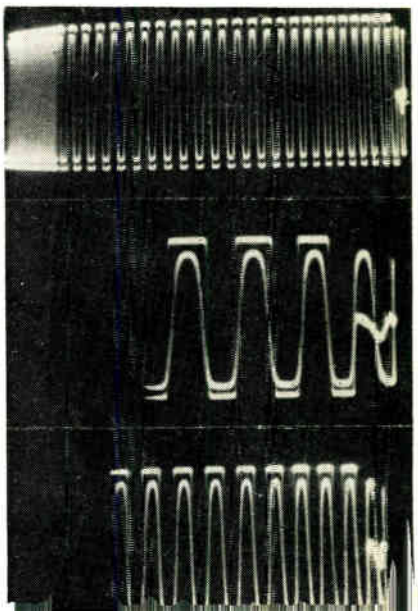
Cardiac Diagnosis

1959 Statistics of the Electronic Industries page 70

An up-to-the-minute report on the various phases of the electronic industries, including late figures on radio and television production; costs of radio-TV servicing; electronic parts distributors; broadcast time sales; distribution of electronic firms across the country and the number of firms active in the various branches of electronic manufacturing.

Cardiac Diagnosis With Strain Gages page 74

The flow rate of respired gases is a particularly important measurement in the diagnosis of pulmonary and cardiac disorders. This compact, portable pneumotachograph recording system makes respiration flow measurements on subjects under almost any field and work conditions which may be encountered.

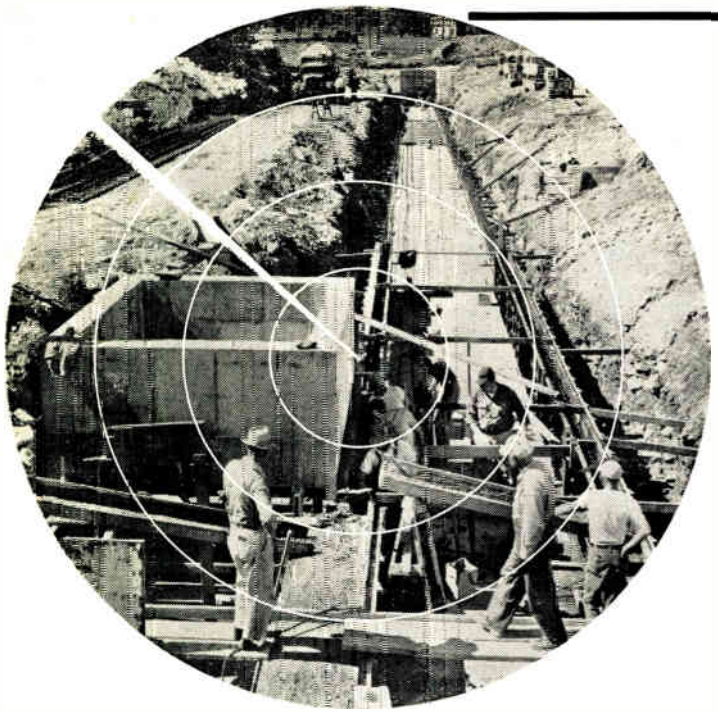


Time Measurements

COMING NEXT MONTH—"INTRODUCTION TO SPACE COMMUNICATION"

Much has been written on the various aspects of space communication. Here is an article that discusses the subject for the first time from the overall system design and performance point of view, based on an analysis of experimental data available and an examination of known techniques. It spells out the problems to be solved and the limitations that engineers must overcome.

RADARSCOPE



DRY LAND "OCEAN"

The exact environment 2-mi. deep in the ocean will be duplicated in this 315 ft. long trough that Bell Labs is constructing in Chester, N. J. to test transoceanic cables. Water will be maintained at 37° F., highly salty, and under 5,000 psi, pressure.

LOOK FOR a round of price increases on TV receivers. Motorola broke the ice last month, announcing increases of $10 to $20 on their line. G.E., Philco and Emerson are all considering price boosts.

THE TV FIELD lists another casualty—Hotpoint. The big appliance manufacturer, a division of GE, is throwing in the sponge after two-and-a-half years of marketing its own brand TV's through Hotpoint distributors. Hotpoint execs explain, "Hotpoint is not in a position to make a major contribution or exert leadership in the field of home entertainment."

THE EXPORT MARKET for telecommunications equipment has increased more than 50% in the past six years. Figures from the Communications Industries Division, Business and Defense Services Administration, U. S. Dept. of Commerce, show an export level of $46,913,632 at the end of 1957, and an expected level of $70 million by 1967. Telephone equipment and supplies are responsible for 75% of the business.

VACUUM TUBES are likely to be with us for much longer than anyone was willing to concede a few years back. Tube sales have confounded everyone by increasing just when the industry was looking for a sharp fall-off.

INDUSTRIAL DISTRIBUTORS have done a fine job selling themselves to some firms, but have done a poor job on many others. A recent survey by the Association of Electronic Parts & Equipment Manufacturers Inc. of 33 of their member firms showed that firms differ widely in the amount of their business transacted through industrial distributors. Twelve companies reported that 76% to 100% of their volume was handled through industrial distributors; four companies placed the volume at 51% to 75%; four companies were in the 26% to 51% bracket; and ten firms showed 10% or less. The other four did not indicate percentages.

OVERSEAS TV boomed on one hand, slowed on the other, in the third quarter of 1958. TV station construction soared; a total of 79 new TV stations went on the air, compared with 57 in the preceding quarter. But TV receiver sales dipped to a total of 1,400,000 sets during the third quarter, compared with increases of 1,700,000 and 2,000,000 in the two previous quarters. The overseas stations now total 639.

THE JETLINERS, like transistors, may be much longer in coming than industry appreciates at this moment. As the first jets go into service on the trans-Atlantic run an impressive array of objections is being thrown up. Fueling costs of the pure jet, it is found, can be painfully exorbitant unless the aircraft can be brought down to the ground quickly at its destination. And there also remains the very pressing financial problem of how to dispose of the old DC-7's and Constellations to make way for the jets.

BETTER RADOMES

New equipment at Stanford Research Institute determines the electrical characteristics of novel, high-strength radome walls. A narrow strip of the radome can simulate a large, flat radome panel.

THE OUTLOOK FOR '59 seems everywhere optimistic. A survey of businessmen across the country found them almost without exception looking to at least modest gains in sales for '59 and pointing to real "boom" years in the early 1960's. Many of the executives found even something good to say about the "recession" year of 1958, pointing to the increased efficiency derived from the cost-cutting, modernization, tighter scheduling and inventory control, and new product development programs brought about by the recession scare.

THE EIA made another plea to the Government for a comprehensive study of the military and civilian uses of the frequency spectrum. The plea was made to the newly formed Special Advisory Committee on Telecommunications, set up last month by the Office of Civil and Defense Mobilization to review the role of the Federal Government in the management of U. S. telecommunications.

EUROPEAN ELECTRONIC FIRMS can compete most favorably on the American market in the field of measurements, says Richard Foxwell, managing director of Wayne Kerr Ltd., British manufacturer of precision test equipment. The test instrument field, he points out, is essentially one of small firms, demanding a high level of craftsmanship, and putting little emphasis on mass production. Under these conditions the British-European electronic firm will function to best advantage. And with the need for increasingly more accurate and sensitive equipment the foreign electronic engineers should be able to make a sizable contribution to the American industry.

FASTER SPEECH TRANSMISSION will be made possible by speech bandwidth compression techniques. S. J. Campanella, Melpar Inc. groups the methods that may be used into four categories: Time or Frequency Compression; Continuous Analysis-Synthesis; Discrete Sound Analysis-Synthesis; and Sound Group analysis-synthesis. Bandwidth compressions of up to 1:20 are possible and binary channel capacity of 5,000 to 10,000 bits-per-second.

NEW METHOD of converting chemical energy directly into electrical power is in advanced development at Lockheed Missile Systems division laboratories. The new "fuel cell"—related to the automobile storage battery—has reportedly achieved almost 100% of fuel utilization and energy conversion efficiencies of 70% or better. Basic difference from the lead acid cell is that the electrochemical fuel is stored outside so the components of the cell are not consumed in the electrode reactions. In terms of watt-hours per lb. of total weight—the car battery yields 8—the new fuel cell is designed to produce 100, and the 5-year goal is for a cell yielding 300 watt-hrs./lb. Even a 150-watt-hr./lb. cell could power every type of aircraft or spacecraft.

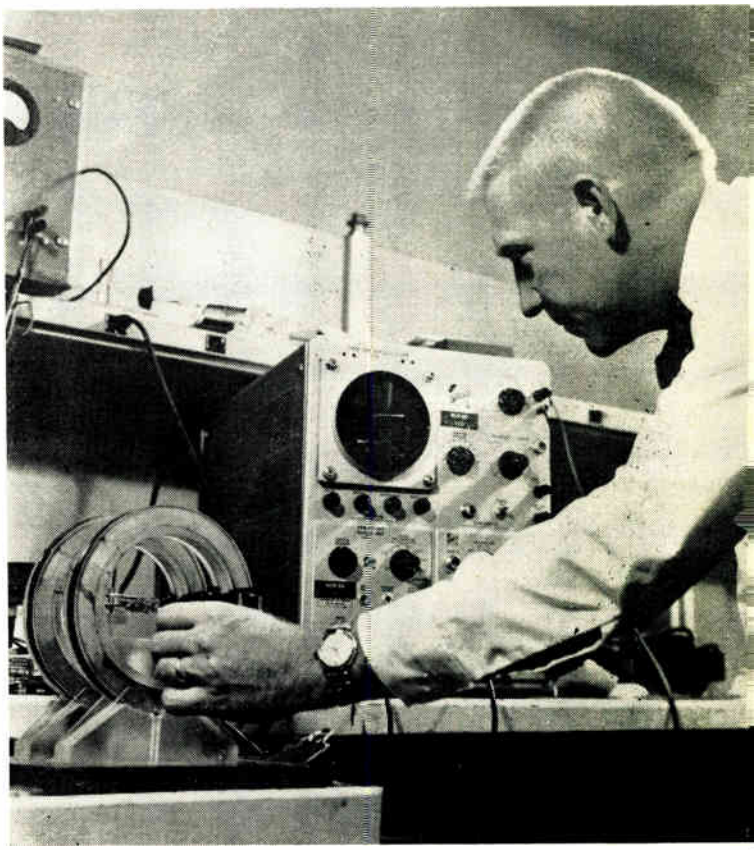
REVERSING THE TREND of the TV industry Zenith announces that they are adding a power transformer to their line of portable TV receivers for 1959.

THE LONG BATTLE between the original CRT manufacturers and the rebuilders took a sharp turn last month with the announcement by RCA that they will now produce two distinct lines of tubes, an all-new line and a line of rebuilts, the latter an economy-priced unit for the replacement market.

NATIONAL SCIENCE FOUNDATION is establishing the Research Information Center and Advisory Service on Information Processing to be operated jointly by the Foundation and the National Bureau of Standards. The new center will bring together research and development data on methods and equipment for the automatic processing of scientific information.

FASTER SWITCHING SPEEDS

Donal A. Meier, research engineer, demonstrates the extremely square hysteresis loop of the new magnetic rod switching device he invented at National Cash Register laboratories. The device, a glass rod with magnetic coating, has switching speeds up to 4 millimicrosecs.



TAKE YOUR CHOICE...
of these two dependable wirewound resistors

MINIATURE

Blue Jacket®

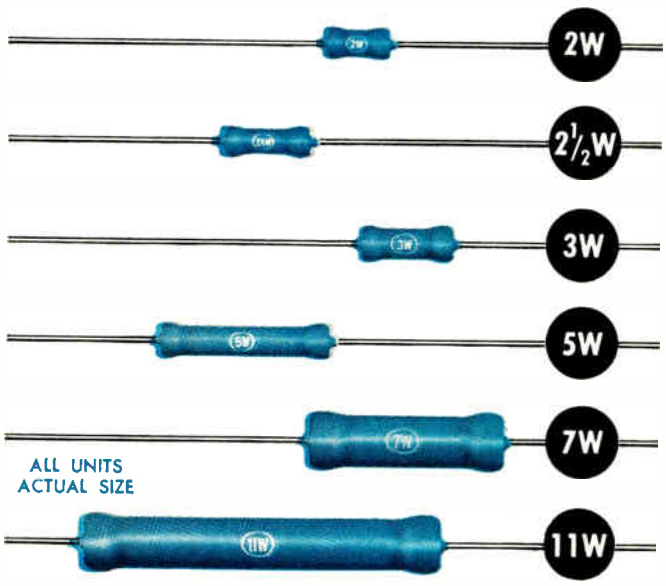
VITREOUS-ENAMEL POWER RESISTORS

Sprague's new improved construction gives even greater reliability and higher wattage ratings to famous Blue Jacket miniature axial lead resistors.

A look at the small *actual sizes* illustrated, emphasizes how ideal they are for use in miniature electronic equipment with either conventional wiring or printed wiring boards.

Get complete data on these dependable minified resistors, **write for Engineering Bulletin 7410.**

TAB-TYPE BLUE JACKETS: For industrial applications, a wide selection of wattage ratings from 5 to 218 watts are available in Sprague's famous Tab-Type Blue Jacket close-tolerance, power-type wirewound resistors. Ideal for use in radio transmitters, electronic and industrial equipment, etc. **For complete data, send for Engineering Bulletin 7400A.**



NEW SMALLER SIZE

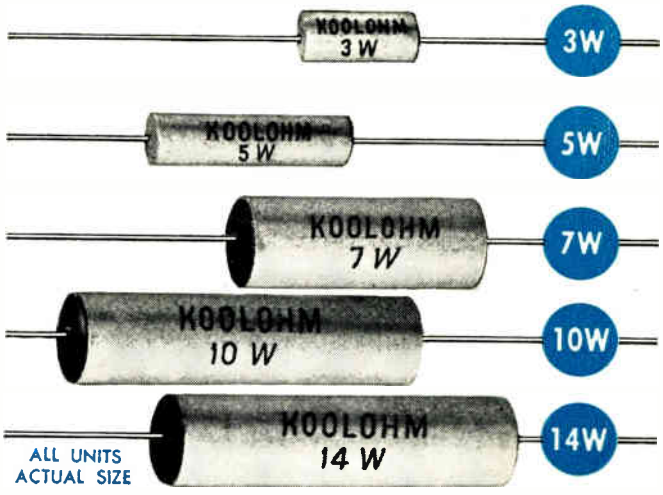
KOOLOHM®

INSULATED-SHELL POWER RESISTORS

New Koolohm construction features include welded leads and winding terminations—Ceron ceramic-insulated resistance wire, wound on special ceramic core—multi-layer non-inductive windings or high resistance value conventional windings—sealed, insulated, non-porous ceramic outer shells—*aged-on-load* to stabilize resistance value.

You can depend upon them to carry maximum rated load for any given physical size.

Send for Engineering Bulletin 7300 for complete technical data.



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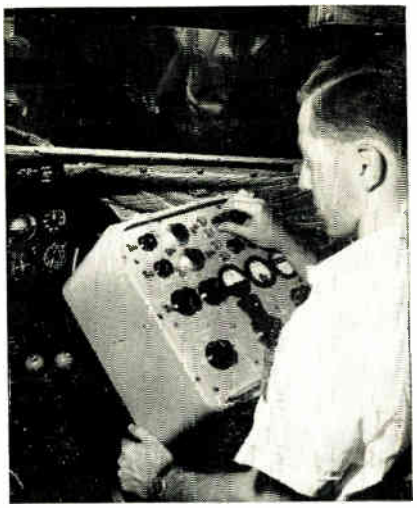
As We Go To Press...

Electronics Simulates Earth's Rotation

Fast, accurate, and less expensive calibrations of airborne compasses can be made using an electronic system recently developed by Sperry Gyroscope Co. for the Air Force.

The system rotates the equivalent of the earth's magnetic field around the aircraft, and at the same time, cancels out the effects of local magnetic influences. Formerly, it was necessary to rotate the entire aircraft around a "compass rose", a precisely surveyed compass face over 100 ft. in diameter painted on the ground, while crewmen painstakingly checked and corrected the compass error.



The equivalent of the earth's magnetic field is rotated around the plane with this knob.

The plasma jet deposits tungsten in a plastic state on this spinning mandrel

Plasma Jet Shapes High Temp Materials

Electronic parts made of high melting point materials, heretofore difficult to make, are being fabricated with a unique plasma jet torch which produces controlled temperatures as high as 30,000°K.

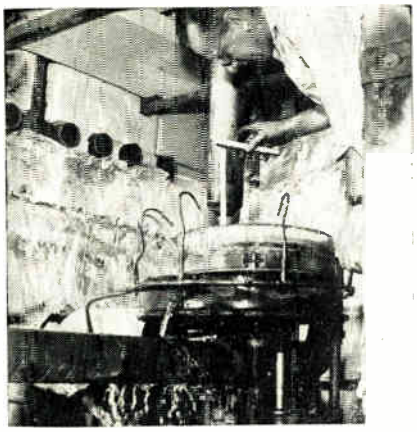
The plasma jet, a stream of intensely hot ionized gas, has been used as a research tool for some time, but it has not been commercially practical because the super-hot jet consumed any container. In this torch, the arc column never touches the wall of the nozzle. A layer of non-ionized gas, moving at speeds up to 10,000 mph and carrying the material to be coated or built into shapes, insulates the arc stream from the nozzle wall.

Power concentration vs power consumption is significant. For example; 50 kw delivered through a ⅛ in dia. nozzle produces a concentration of 3 megawatts per sq. in.

The torch, developed by Linde Co., Division of Union Carbide Corp., is being used to make parts for large vacuum tubes such as tungsten heaters, grid bars, grid cages, targets, and cathode cups. The torch can also be used to apply coatings of crystalline and amorphous boron to nickel base parts used in electron suppression. Coatings of nickel containing barium and strontium carbonates have been applied to molybdenum cathode cups to serve as low temperature electron emitters.

Coatings made with the torch have excellent bond to most base materials including: reinforced plastics, graphites, and carbon.

High power arc torch requires water cooling. Engineer is measuring anode-cathode air gap.



200 Missile Projects Since World War II

The U. S. missile program since World War II has included close to 200 missiles of all types, according to a compilation by the Association of Missile & Rocket Industries.

AMRI's new "Key to U. S. Missiles" lists 160 missiles so far revealed by name. In addition, 32 projects and un-named missiles are known to exist, plus many projects not yet made public for security reasons.

The 160 known items include 46 Army missiles, 55 Navy, 58 Air Force, and 1 of unknown auspices. Of the total, at least 17 have been discontinued. Complete information is lacking on 56 others for security and other reasons.

The survey classes the remaining 87 missiles by their range, as follows:

1. 6 ICBMs, 5,000 mi. range and over: Atlas, Minuteman, Snark, TCBM, Titan, Vanguard.
2. 4 IRBMs, 1,500 to 5,000 mi.: Jupiter, Polaris, Thor, Triton.
3. 8 long range, 100 to 1,500 mi.; Bomarc I & II, Mace, Matador, Pershing, Redstone, Regulus I & II.
4. 18 medium range, 20 to 100 mi., such as Eagle, Falcon series, Firepower, Nike series, and Subroc.
5. 15 short range, 20 mi. and under, such as Bulldog, Diamondback, and Terrier.

The listing also includes 16 drone types and 20 missiles used for experimental and research purposes.

Corning Unveils New Capacitor, and Plant

A new fusion-sealed glass capacitor, designed to give continued peak performance under moist or corrosive conditions, has been developed by Corning Glass Works. The capacitor was announced at opening of Corning's new 142,000 sq. ft. plant in Bradford, Pa.

The CYF capacitor, currently in pilot production, employs two new features:

1) A new sealing technique provides a strong, air-tight glass-metal seal where the lead joins the body of the capacitor.

2) A fusion seal around the perimeter of the capacitor makes it

(*Continued on page* 8)

ELECTRONIC SHORTS

▶ Private industry in 1956 spent about $2-billion for applied research and development on aircraft and missile products; 30% of the total expended for all industrial research and development, according to the National Science Foundation. The aircraft industry was responsible for 81% of the funds ($1.6-billion). The electrical industry was second, with expenditures of $147 million, or 7% of the aircraft products total.

▶ Signing of a contract with Federal Electric Corp. for the installation and testing of ground VORTAC stations signalled the acceleration of a program by the CAA to provide more air navigation facilities. Under the contract, Federal Electric Corp. will provide up to 40 teams of engineers and technicians on call from CAA Regional Offices to install and test the VORTAC equipment as the equipment is delivered to the sites around the country.

▶ Pilots and navigators will no longer require light-proof hoods over their radar sets. A new radar unit makes sharp images on the viewing scope even in bright daylight. Developed by Bendix-Pacific, a division of Bendix Aviation Corp., the new set's brightness is compared to that of home TV screens.

▶ Danger to patients from overexposure to X-rays will be reduced and brighter images made possible as the result of recent discoveries by Prof. Georges Destriau, Westinghouse consultant and a member of the faculty of the University of Paris. By replacing the screen of the ordinary fluoroscope with an electroenhancement screen, brighter images can be achieved. Further, the patient can be removed, and the image made to reappear.

▶ The Air Force has selected Sundance Air Force Station, Wyo., as the site for the installation and test of a factory-assembled, modular nuclear power plant for use in remote military installations. The Sundance site was selected over many similar sites as being the most desirable from the standpoint of electrical and heating loads, site characteristics, accessibility, and other related factors. The Sundance Air Force Station, a new Air Defense Command Aircraft Control and Warning (AC&W) site, has been authorized for construction which is forecast to begin in 1959.

▶ The first attempt to launch a satellite over the Pacific Missile Range will be made in the early part of 1959 from Vandenberg AFB, Cal., the Department of Defense announced. This launching will be part of a series—designated PROJECT DISCOVERER—to be carried out by the Air Force under the direction of the Defense Department's Advanced Research Projects Agency.

▶ The Department of Defense and the National Aeronautics and Space Administration (NASA) announced details of agreements regarding transfer of the Jet Propulsion Laboratory (JPL) from the Department of the Army to NASA and utilization by the NASA of certain Army resources in achieving the Nation's goals in the realm of space. Dr. Wernher von Braun and his associates will remain with the Army at Huntsville, Ala.

▶ Being built at Northrop Div., Northrop Aircraft, Inc., is a second member of the N-156 family, a counterair fighter, developed for use of free allied nations. The N-156 fighter is designed for speeds in excess of Mach 2, and will carry the latest, ultrasonic air-to-air guided missiles and air-to-ground bombs. It is under consideration by various allied governments.

▶ One of the most elaborate mobile TV units ever put together, GE's new 18-ton $250,000 aluminum trailer has been turned over to Army Pictorial Center, Long Island City, N. Y. after being shown off in Washington to military & other govt. officials. The 3-camera setup was bought by Army "to determine the degree of importance of color TV in military applications," according to Lt. Col. Hollis Dakin, TV chief of Pictorial Center. GE suggests that it may be used for "covering maneuvers, missile launchings, atomic problems and medical training programs."

▶ An improved Cuban market for U. S. TVs & radios may be expected in near future, reports the Commerce Dept. It estimated 95% of TV and 70% of radio imports are from U. S., balance from West Germany, Netherlands, Japan. Report states that "trade sources do not anticipate Cuban market in foreseeable future will justify establishment of TV and radio production facilities on the island."

As We Go To Press . . .

Corning Capacitor, Plant

(*Continued from page* 7)

impervious to moisture.

The CYF is guaranteed to show no significant change in capacitance or increase in dielectric loss after more than 1,000 hours in high humidity atmosphere.

Sample capacitors have already withstood more than 200 hours in a boiling, saline solution, and the test is continuing.

The CYF-10 has a capacitance range to 240 mmfd and a DC working voltage up to 500 at 125°C. It meets all requirements of MIL-C-11272A.

The new, modern, electronics plant in Bradford produces glass resistors, capacitors and other electronic parts.

In area it provides more than three times as much space as was formerly available in the company's six leased locations in Bradford.

Electronic Packaging Changes Seen for '59

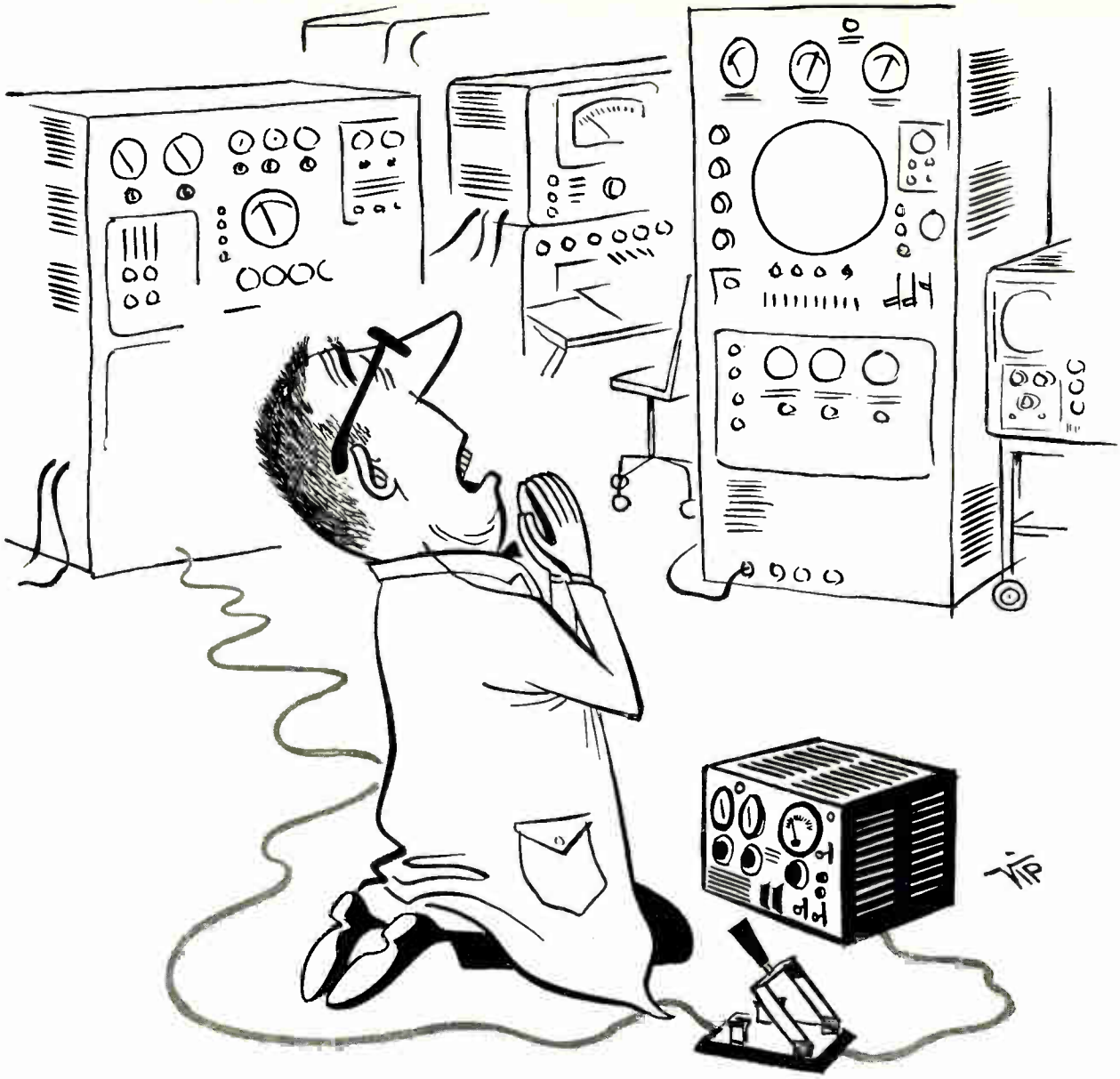
Product protection and point-of-sale-impact, while maintaining a competitive price, are major packaging concerns of manufacturers in the electronics field, according to the Better Packaging Advisory Council.

Survey reports that more than 50% of manufacturers are contemplating a change in package design or material for the coming year. This study found that 30% of the companies queried had replaced folding and set-up cartons and boxes, metal cans, or corrugated cartons and boxes, with fibre cans or tubes during the last five years. It also revealed that 50% of fibre can users have been packaging their products this way for from 6 to 20 years, with an additional 20% using these products for over 20 years.

Sustained sales increases were reported in this nationwide survey by 35.3% of the companies, as a result of using fibre can and tube packaging. Of this group, 63.3% said that they experienced gains of from 11% to 100%, and 7% cited sales jumps of *over* 500%. The average sales increase for all companies reporting was 32%.

The survey re-affirmed the significance of savings for every company in influencing a packaging decision, regardless of the industry

(*Continued on page* 10)



Quality Control: *state of the art*

It has been rumored that some engineers rely upon supernatural means to insure proper quality control. When all else fails, there is something to be said for this method. At Hughes Products, however, we try to take a more scientific approach to quality control. That's why Hughes Products systems and components have established such an outstanding record of reliability.

On the following three right-hand pages are specific examples of reliable Hughes components—Quick Recovery Diodes, TONOTRON*Storage Tubes, and MEMO-SCOPE® Oscilloscopes.

In addition to these, other Hughes Products devices with this "built-in" reliability include: Precision Crystal Filters for selective tuning...Rotary Switches...Thermal Relays...MEMOTRON® and TYPOTRON® storage tubes...Diodes, Transistors and Rectifiers with uniform performance...and Industrial Systems which automate a complete and integrated line of machine tools.

*Trademark of H. A. C.

For additional information regarding any component or system please write: Hughes Products, Marketing Dept., International Airport Station, Los Angeles 45, California.

Creating a new world with ELECTRONICS

HUGHES PRODUCTS

SEMICONDUCTOR DEVICES · STORAGE AND MICROWAVE TUBES · CRYSTAL FILTERS · OSCILLOSCOPES · RELAYS · SWITCHES · INDUSTRIAL CONTROL SYSTEMS

Coming Events

A listing of meetings, conferences, shows, etc., occurring during the period January-March that are of special interest to electronic engineers

Jan. 11-13: Annual Convention, National Appliance & Radio TV Dealers Assoc.; Conrad Hilton Hotel & Merchandise Mart, Chicago, Ill.

Jan. 12-14: 5th National Symp. on Reliability & Quality Control, IRE, AIEE, ASQC, & EIA; Bellevue Stratford Hotel, Phila., Pa.

Jan. 13: Meeting, Assoc. of Electronic Parts & Equipment Mfgs., Inc.; Como Inn, Chicago, Ill.

Jan. 19-22: 43rd Physical Society Exhibition of Scientific Instruments, London, England.

Jan. 20: Meeting, The Radio Club of America, Inc.; Benjamin Franklin Auditorium; New York, N. Y.

Jan. 21-23: Southwest Electronic Exhibit; Arizona State Fairgrounds, Phoenix, Ariz.

Jan. 23-24: Nat'l Executive Committee and Board of Governors Meeting, Representatives of Electronic Products Manufacturers, Galveston, Tex.

Jan. 23-25: Michigan State Conference, American Women in Radio & TV; Detroit, Mich.

Jan. 26-28: 12th Annual Symp. on Modern Methods of Analytical Chem., Louisiana State University; Baton Rouge, La.

Jan. 26-29: 27th Annual Meeting, Institute of Aeronautical Sciences; Hotel Astor, New York, N. Y.

Jan. 26-29: Plant Maintenance & Engineering Show; Public Auditorium, Cleveland, Ohio.

Jan. 27-30: 15th Annual Technical Conf., Society of Plastic Engrs.; Hotel Commodore, New York, N. Y.

Jan. 28-29: 5th Annual Midwest Welding Conference, ARF and American Welding Society; Campus, Ill., Inst. of Tech.

Jan. 28-31: Meeting, American Association of Physics Teachers—APS Hotel New Yorker, New York, N. Y.

Feb. 1-6: Winter General Meeting, AIEE-Technical Operations Dept.; Hotel Statler, New York, N. Y.

Feb. 2-4: 7th Regional Tech. Conf. & Trade Show, IRE, University of New Mexico, Albuquerque, N. M.

Feb. 2-7: Committee Week, ASTM; Penn-Sheraton Hotel, Pittsburgh, Pa.

Feb. 3-5: 14th SPI Reinforced Plastics Div. Conf., SPI; Edgewater Beach Hotel, Chicago, Ill.

Feb. 5-8: 1959 San Francisco High Fidelity Music Show, Institute of High Fidelity Manufacturers, Inc.; Cow Palace, San Francisco, Calif.

Feb. 6: Regional Conference, Society of Technical Writers and Editors—Chicago Chapter; Chicago, Ill.

Feb. 12-13: Transistor & Solid State Circuits Conf., IRE, AIEE, & University of Pennsylvania; Univ. of Penna., Phila., Pa.

Feb. 15-19: Annual Meeting-Metallurgical Society Functions, AIME; St. Francis Hotel, San Francisco, Calif.

Feb. 16-19: West Coast Convention, Audio Engineering Society; Los Angeles, Calif.

Feb. 16-23: 1959 Los Angeles High Fidelity Music Show, Institute of High Fidelity Mfg., Inc.; Biltmore Hotel, Los Angeles, Calif.

Feb. 17: Annual Education Seminar, Assoc. of Elect. Parts and Equip. Mfg. Inc.; Tam O'Shanter Country Club, Niles, Ill.

Feb. 17: Meeting, The Radio Club of America; Benjamin Franklin Auditorium, New York, N. Y.

Feb. 19: Conf. on Ammonium Persulphate Etching, Western Assoc. of Circuit Manufacturers; Rodger Young Aud., Los Angeles, Calif.

Feb. 19-21: Winter Meeting, National Society of Professional Engineers; Dinkler-Tutweiler Hotel, Birmingham, Ala.

Feb. 23-26: Symp. on Thermophysical Properties, ASME; Purdue Univ., Lafayette, Ind.

Feb. 24-25: State Presidents Conference, National Association of Broadcasters; Washington, D. C.

Mar. 1-3: Southeastern Regional Conference, Nat'l Assoc. of Music Merchants, Dinkler-Plaza Hotel, Atlanta, Ga.

Mar. 3-5: Western Joint Computer Conf., IRE, AIEE, Assoc. for Computing Machinery; Fairmount Hotel, San Francisco, Calif.

Mar. 5-6: Flight Propulsion Meeting, IAS; Hotel Carter, Cleveland, Ohio.

Mar. 6-7: Meeting, American Physical Society; Univ. of Texas, Austin, Tex.

Mar. 8-11: Gas Turbine Power Conf. and Exhibit, ASME; Netherlands-Hilton Hotel, Cincinnati, Ohio.

Abbreviations:

ACM: Association for Computing Machinery
AIEE: American Inst. of Electrical Engrs.
AIME: American Institute of Mining & Metallurgical Engineers
ASME: American Society for Mechanical Engineers
APS: American Physical Society
ARF: Armour Research Foundation - Illinois Institute of Technology
ARS: American Rocket Society
ASQC: American Society for Quality Control
ASTM: American Society for Testing Material
EIA: Electronics Industries Assoc.
IAS: Institute of Aeronautical Sciences
IRE: Institute of Radio Engineers
SPI: Society of Plastics Industry

As We Go To Press (cont.)

Electronic Packaging

(*Continued from page* 8)

or the market situation. Actually, savings are a greater source of profit than increased sales. For example, if a company's net profit on sales amounts to 10%, a cost reduction of only 10% would be the real equivalent in profits of a 100% sales increase. Cost reduction thus produces more profits than any other operation.

Ernst Weber Elected IRE President for '59

Ernst Weber, president of the Polytechnic Inst. of Brooklyn and president of the Polytechnic Research and Development Corp., has been elected president of the Institute of Radio Engineers for 1959. He succeeds Donald G. Fink, Director of Research of the Philco Corp., as head of this international society of 68,000 radio engineers and scientists.

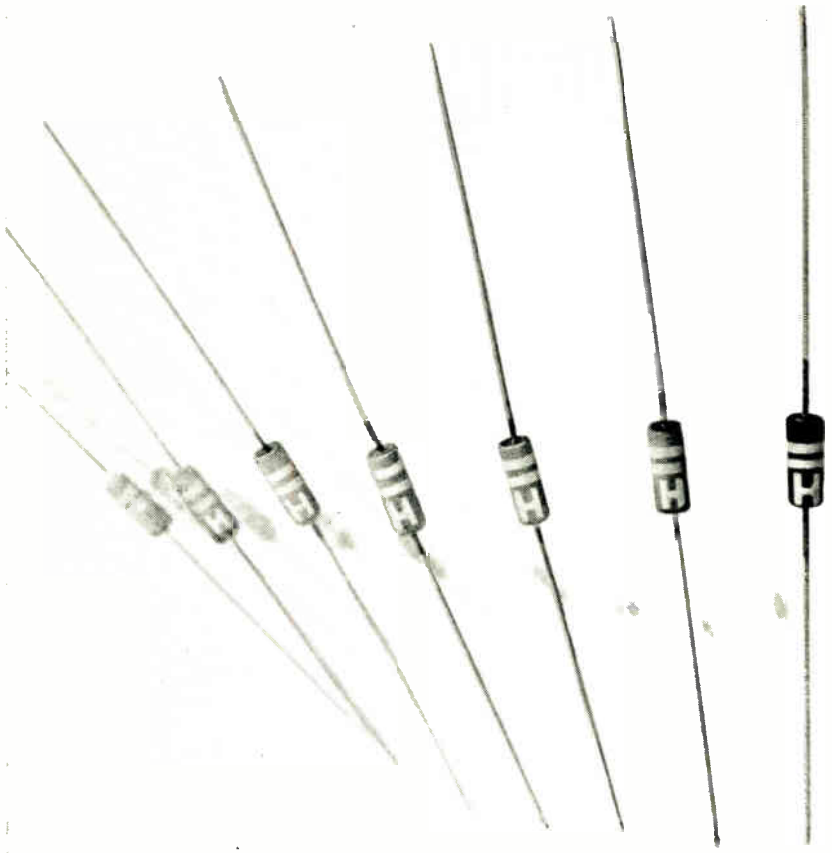
Donald B. Sinclair, vice president and chief engineer of General Radio Co., West Concord, Mass., will succeed Carl-Eric Granqvist, director of Svenska Aktiebolaget Gasaccumulator, Stockholm-Lidingo, Sweden as IRE vice president.

Elected as directors for the 1959-1961 term are Ferdinand Hamburger, Jr., Professor of Electrical Engineering at The Johns Hopkins University, Baltimore, Md. and Bernard M. Oliver, vice president of research and development, Hewlett-Packard Co., Palo Alto, Calif.

Cancer Observation via Ultraviolet TV

Dr. Jerome J. Freed, Institute for Cancer Research, will demonstrate the flying spot ultraviolet microscope at the January 12, 1959, meeting of the Phila. Chapter, IRE Professional Group on Medical Electronics. Ultraviolet light discerns details of cancer cells which visible light cannot. The flying spot technique permits longer study by minimizing the amount of ultraviolet, slowly lethal to the cells.

Interested persons are invited to attend the meeting scheduled for 8:00 PM at the Institute, located at 7701 Burholme Ave., Phila. 11, Pa.



quick recovery!

Reliable Hughes Silicon Junction Diodes

With recovery to 400 K ohms (minimum) in 1 microsecond... Hughes high-speed silicon diodes reliably meet the quick recovery requirements of most germanium types, and in addition, stand up under high voltages at high temperatures. In fact, the breakdown voltages increase with temperature...thereby providing maximum protection when temperatures reach unexpected levels. With this order of reliability, Hughes quick recovery silicon diodes assure dependability under the most severe operating temperatures.

Typical performance levels:

Breakdown voltages at current of 0.1 mA from 30-200 volts.

Ambient operating temp. —80°C to +150°C

Reverse current—as low as 1 μA at —175 volts and 25°C

—as low as 30μA at —175 volts and 100°C

Special high conductance types in the quick recovery series are available in all voltage classes. No matter what your problem, chances are that there is a Hughes diode to meet your need. Write today for a complete data sheet on the Hughes quick recovery silicon diode —or any other Hughes semiconductor device.

Address: HUGHES PRODUCTS, Marketing Department, International Airport Station, Los Angeles 45, Calif.

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How to save 77 years

The boy Galileo sat in the sanctuary of Pisa's great cathedral, observing the movement of a lamp which had been set swinging by a sudden gusty draft. The chain by which it was suspended from the high ceiling was of such a length that the arcs decreased but slowly. Strange thing, though. No matter how far the pendulum swung, its movement consumed the same time. Galileo made a note of that. The year was 1581.

The old man sat at his writing desk, sixty years and a thousand disputes later, writing down a new theory. The regularity of a swinging pendulum might be combined with a spring mechanism to improve the unreliable clocks of that day. So Galileo scribbled on, and did nothing more about it. A number of years after his death Huygens took the notes and invented the pendulum clock. *Seventy-seven years had elapsed since the boy made the observation upon which it was based!*

The creative thinker today still need not have a specific use in mind when, by equation or formula, he branches off from the accepted to the hitherto unknown. The classic invention of this decade, the transistor, evolved in the Bell Telephone Laboratories as scientists sought a deeper understanding of semiconductors. On the other hand, another great invention, the feedback amplifier, came from the acutely creative mind of one Bell engineer faced with a specific problem.

Current Bell Laboratories activities—in such areas as data transmission, radar and submarine cable development—call for the coordinated efforts of all types of thinkers and all types of approaches. One type complements another.

Today, seventy-seven years would not have elapsed between the swinging lamp and the swinging clock pendulum—certainly not at Bell Labs, where ideas, though not rushed, are carefully advanced toward fruitful application in national defense, industry and communications. An important part of this harvest is the efficiency of America's telephone service, unequalled anywhere else in the world.

BELL TELEPHONE LABORATORIES

WORLD CENTER OF COMMUNICATIONS RESEARCH AND DEVELOPMENT

Tonotron* tube  **picture of the Los Angeles Yacht Harbor**

The Hughes TONOTRON tube presents a complete spectrum of grey shades. **Result:** high-fidelity picture reproduction. The illustration above, for example, is an unretouched photo of a typical radar display as viewed on the face of a TONOTRON E.I.A. Type 7033 Tube.

Additional outstanding characteristics of the TONOTRON tube are high brightness (in excess of 1500 foot lamberts with full half tone range) and controllable persistence. The family of TONOTRON tubes is ideally suited for ground mapping, weather radar displays, slow-scan TV, "B" scan radar, oscillography, armament control radar, optical projection systems, and miniature radar indicators.

Other Hughes cathode-ray storage tubes: The MEMOTRON® tube displays successive transient writings until intentionally erased. The TYPOTRON® tube, an exceptionally high-speed character writing tube, displays any combination of 63 letters or symbols until intentionally erased.

For complete technical data please write Hughes Products, Electron Tube Division, International Airport Station, Los Angeles 45, California

*TRADEMARK OF H. A. C.
®REGISTERED TRADEMARK

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ANNOUNCING
NEW MICROWAVE GENERATOR

plug-in units cover:
4,200 to 8,000 mc
6,950 to 11,000 mc

Model PMX is a versatile, portable signal generator with an extremely wide range of modulation capabilities. It is simple to operate, highly stable and accurate, and is designed for quick, easy inspection and servicing.

Interchangeable Plug-In Units (Part of Model PMX):
4,200 to 8,000 mc — Tuning Unit G 48
6,950 to 11,000 mc — Tuning Unit G 711

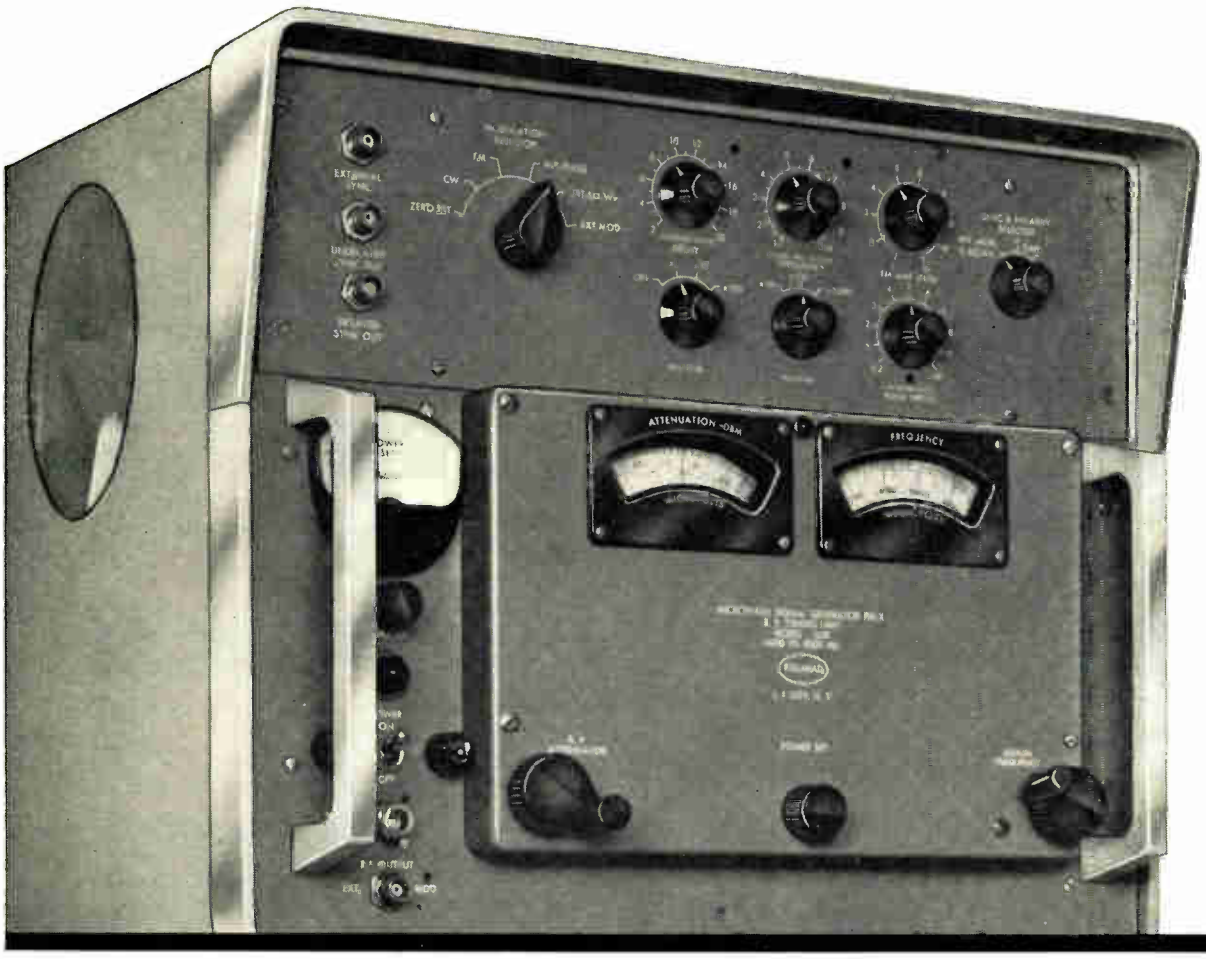
Calibrated Power Output: 0 dbm (1 milliwatt) to —127 dbm.

Modulation Capabilities: Internal or external pulse, square wave or FM.

Internal Pulse: Width, adjustable 0.2 to 10 microseconds. Repetition rate, 10 to 10,000 pps. Delay, 2 to 2,000 microseconds. Rise and decay, 0.1 microsecond.

Internal FM: Linear sawtooth output, 5 mc frequency deviation. Capable of internal or external, pulse or sine wave synchronization.

Output Synchronization Pulses: Positive polarity, delayed and undelayed.



MODEL PMX

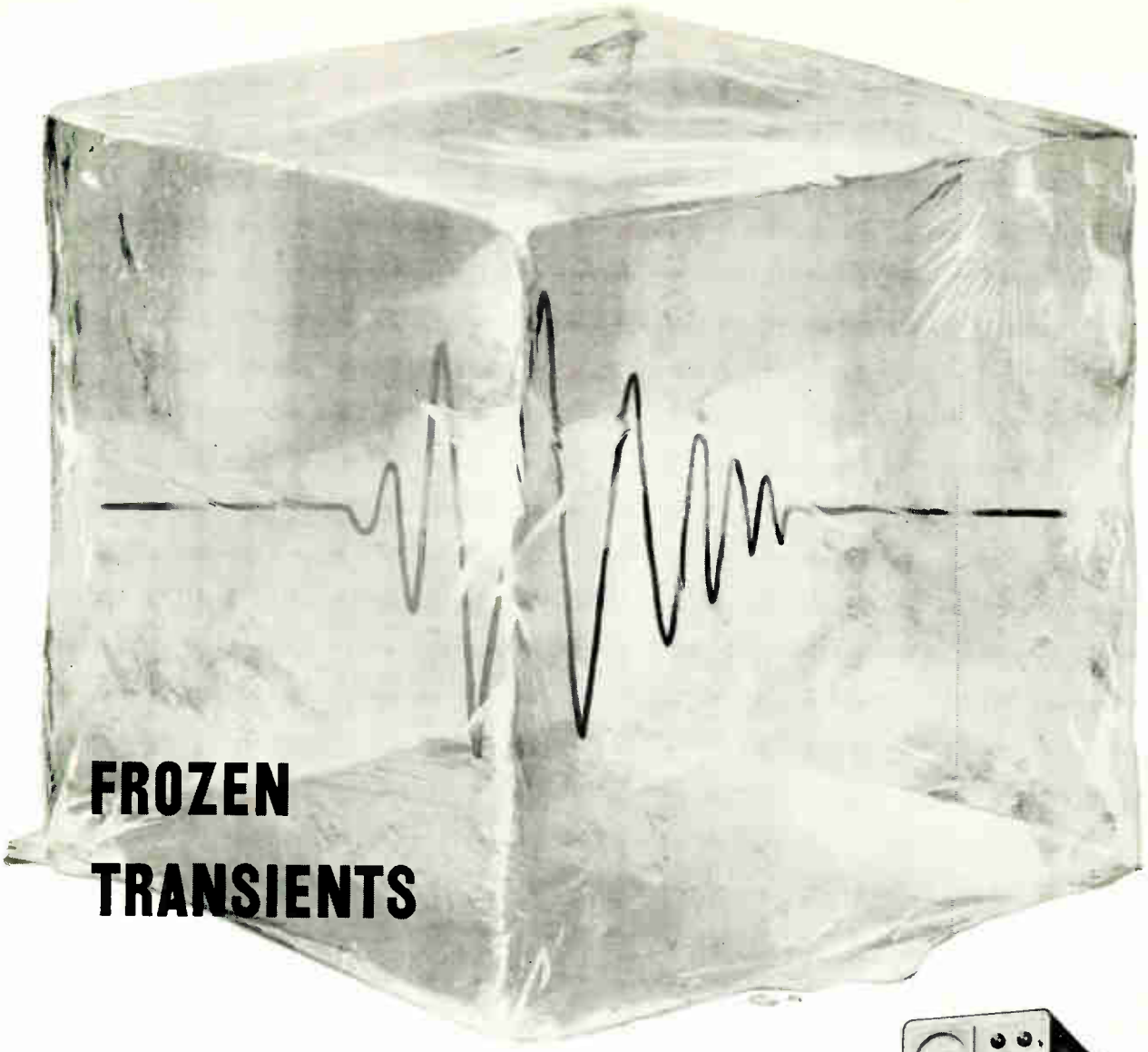
FREE LIFETIME SERVICE ON ALL POLARAD INSTRUMENTS

Write for specifications. Ask your nearest representative (in the Yellow Pages) for a copy of "Notes on Microwave Measurements."

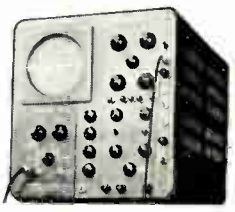
POLARAD ELECTRONICS CORPORATION

43-20 34th Street • Long Island City, N.Y.

Representatives in principal cities



with the Hughes MEMO-SCOPE® Oscilloscope



Trial and error methods necessary to capture elusive transients on conventional scopes waste time, film, and precious research dollars. Never again need this happen. With the Hughes MEMO-SCOPE® oscilloscope you may instantly "freeze" wave forms with brilliant clarity for careful study, comparison and analysis.

The Hughes MEMO-SCOPE® oscilloscope retains these frozen transients until intentionally erased. Selected transient information may be triggered externally or internally. Successive wave forms may be written above, below or directly over the original information.

SWEEP SPEED FOR STORAGE: 10 microseconds to 10 seconds per division (0.33").

FREQUENCY RESPONSE: DC to 250 KC down 3 db.

SENSITIVITY: 10 millivolts to 50 volts per division or with optional high sensitivity preamplifier 1 millivolt to 50 volts per division.

APPLICATIONS: Trouble shooting data reduction equipment . . . switch and relay contact study . . . ballistics and explosives research . . . ultrasonic flaw detection . . . physical testing — shock — stress — strain.

A Hughes representative will gladly demonstrate the MEMO-SCOPE® *oscilloscope in your company. Simply address your request to: Hughes Products, Marketing Dept.—*MEMO-SCOPE®
International Airport Station, Los Angeles 45, California

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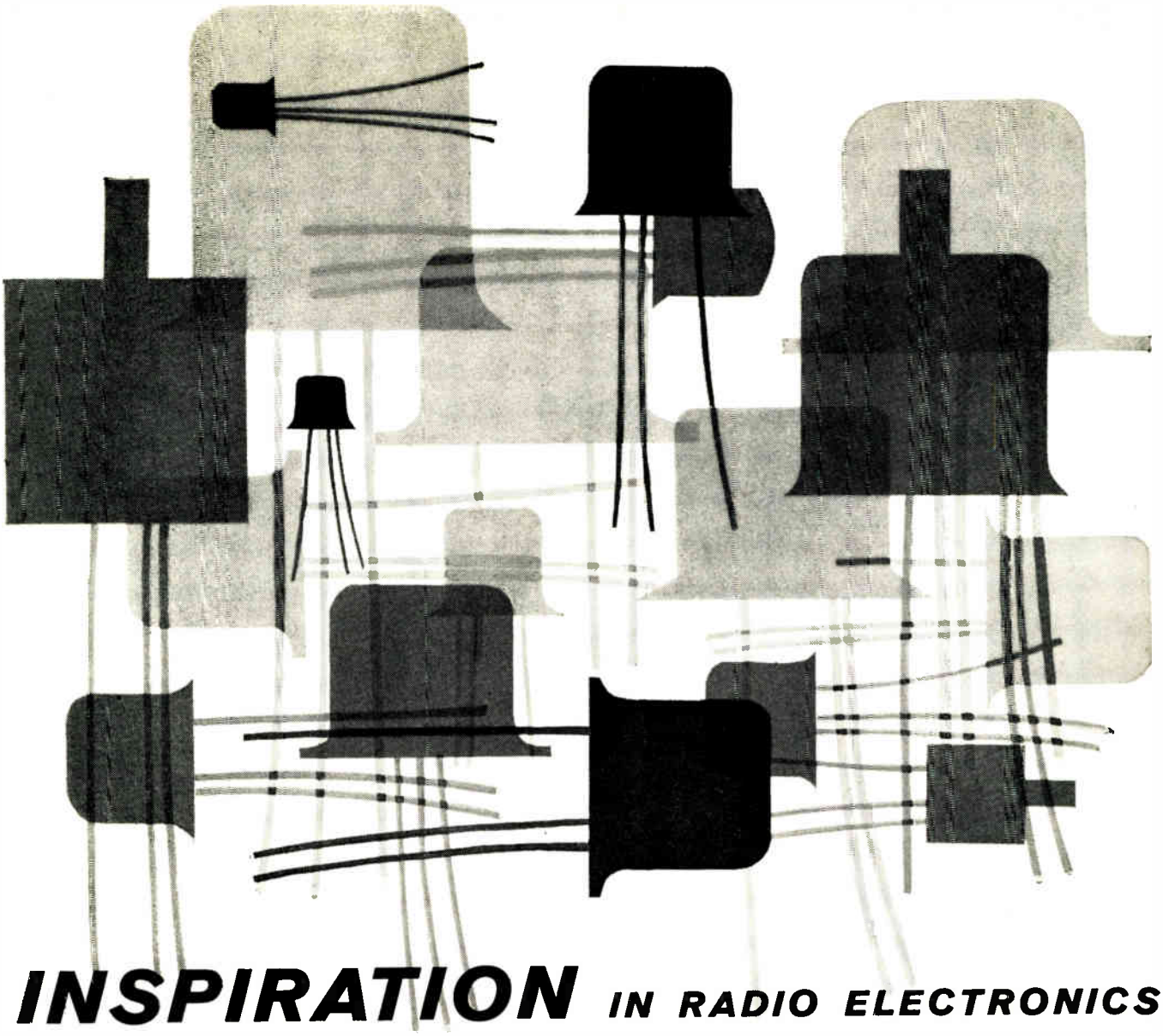


INSPIRATION IN RADIO ELECTRONICS

Think big has always been the order of the day in radio electronics. Galvani, Marconi and you either have changed or can change the world with a thought or an idea unheard of before. Seeing all that's new at the 1959 IRE SHOW can spark your new idea—can be your inspiration. Big in number of manufacturers and suppliers exhibiting, big in number of top radio electronics experts, big in number of important developments on display—that summarizes this year's CONVENTION and SHOW. Don't miss this once-a-year opportunity for man-to-man talk with the thinkers, planners and doers in your field of specialty.

THE IRE NATIONAL CONVENTION
Waldorf-Astoria Hotel
AND THE RADIO ENGINEERING SHOW
Coliseum, New York City

MARCH 23·24 25·26

REMEMBERS THE MAN

THE INSTITUTE OF RADIO ENGINEERS
1 EAST 79th STREET, NEW YORK 21, N. Y.

Circle 12 on Inquiry Card, page 117

Circle 13 on Inquiry Card, page 117

Electron Tube News
—from SYLVANIA

SYLVANIA CREATES A

New Profile of Dependability

IN GOLD BRAND TUBES

RADIOGRAPH PROFILE shows the superior uniformity of Gold Brand Tubes

Exclusive design, production and identification techniques add extra reliability and efficiency to Gold Brand Tube performance

The perfect uniformity of its physical profile is symbolic of the new level of reliability in Sylvania Gold Brand Tubes. It represents the results of exclusive design and production techniques developed and refined at one of the world's most advanced tube facilities, The Sylvania Gold Brand Plant in Burlington, Iowa.

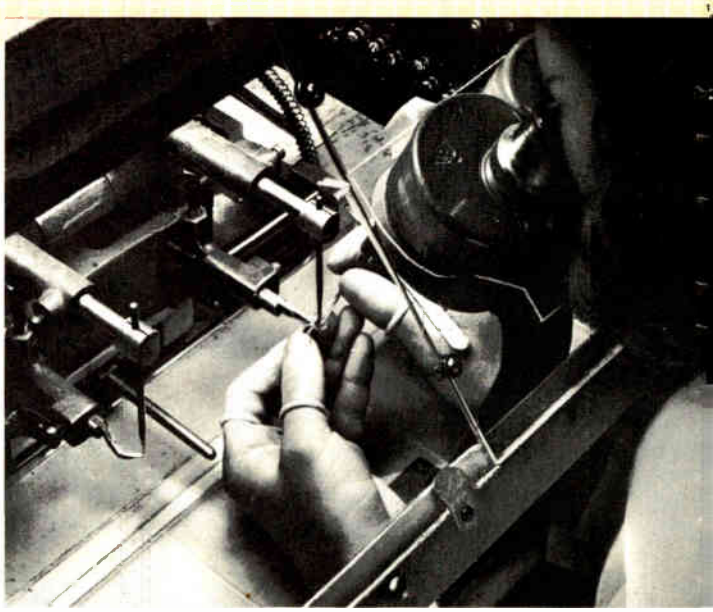
The unmatched reliability of the Gold Brand "New Concept Bulb" is evident in latest test data. Hourly thermal shock tests (100°C to 0°C) indicate less than 2/10% tip failure during the past two years. This record is due to Sylvania-developed automation equipment, such as the "New Concept" tubulated bulb machines, and to tight quality controls maintained throughout the entire Gold Brand manufacturing process.

The Production Lot Letters etched on its envelope are another indication of the extra dependability of Sylvania Gold Brand Tubes. They are the key to a profile of lot production and test data that offers the user more precise application information and provides for better quality control.

THE EXCLUSIVE LOT LETTERS on each Sylvania Gold Brand Tube identify a complete file of production and test characteristics for individual tube lots

SYLVANIA CREATES A NEW PROFILE OF

SYLVANIA'S ORIGINAL folded coil heater design is processed in this ultra-clean room to prevent contamination



ALL TUBE MOUNTS are precision-welded under stereo microscope

New heater design increases tube efficiency

Sylvania has increased the efficiency profile of Gold Brand Tubes by an exclusive heater design, automatic cathode tabbing and by extra control over the environment in which cathode and heater operations are performed.

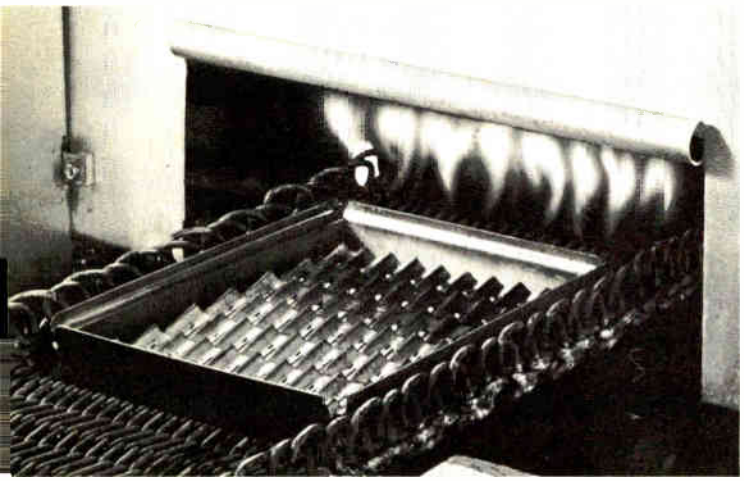
The Sylvania-pioneered folded coil heater used in Gold Brand Tubes permits use of heavier wire for extra ruggedness, permits use of heavier insulation, and allows the cathode to run at higher temperatures for added efficiency at lower heater voltages. The U shaped coil used in double section tubes requires but two welds instead of four, giving extra reliability.

All coating and tabbing operations for heaters and cathodes are performed in a specially air conditioned and filtered room within Sylvania's Gold Brand air-conditioned plant in Burlington, Iowa. Greater cleanliness is achieved to eliminate possible impurity contamination.

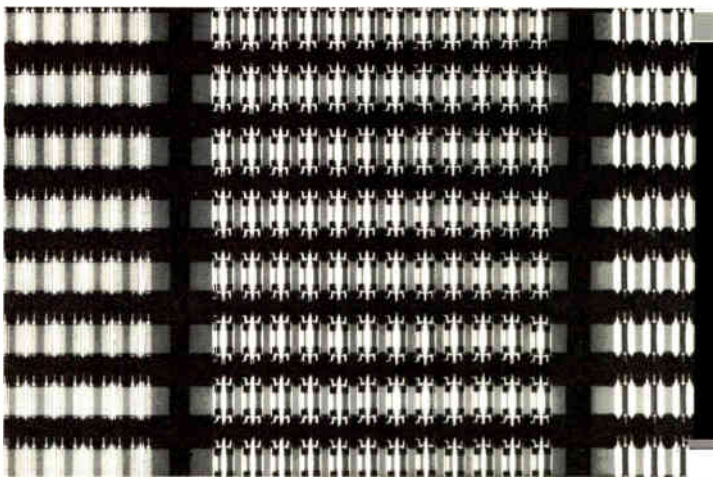
Microscopic welding adds ruggedness

All fine welding operations such as heater welds for Gold Brand Tubes are made under stereoscopic microscope to assure weld perfection.

Specially developed weld energy sources such as phase control, slope control and stored energy units are utilized. Weld pressure and current are constantly controlled through Sylvania-patented measuring devices to obtain the strongest and most reliable welds.



EXCLUSIVE FLAME SHIELD firing of grids and parts removes microscopic lint particles



RADIOGRAPH PROFILES of Gold Brand mounts insure against hidden defects

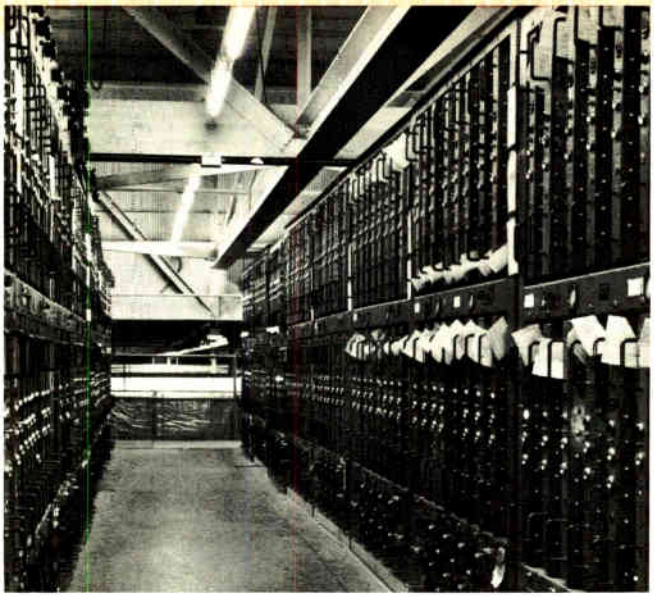
Exclusive flame shield process improves tube performance

All Gold Brand grids and parts undergo Sylvania's exclusive flame shield firing just prior to processing in a high-temperature reducing atmosphere. Contaminations such as lints, oxides and gases are eliminated. The flame shield removes microscopic lint particles.

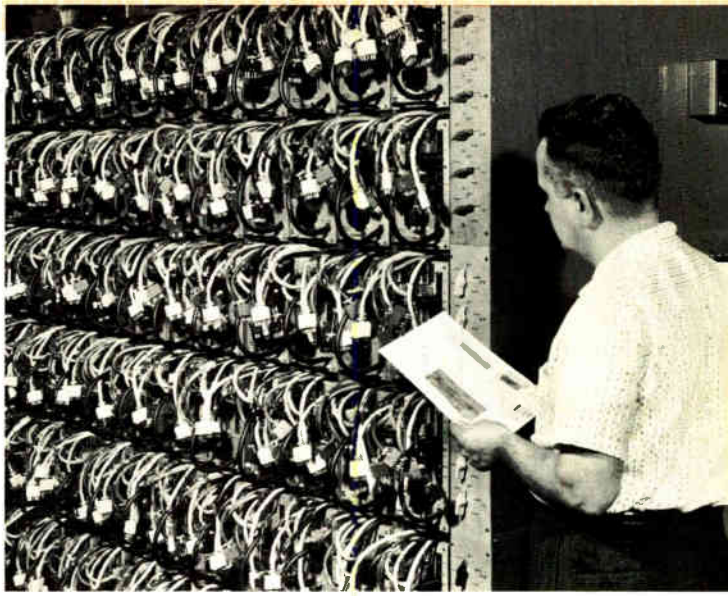
X-ray reveals mount reliability

Even though every mount for Gold Brand Tubes undergoes 100% microscopic inspection, Sylvania carries quality control a step further by using X-ray as a process control on all Gold Brand mounts. X-ray is also used as a 100% inspection tool where appropriate throughout the entire manufacturing process.

DEPENDABILITY IN GOLD BRAND TUBES

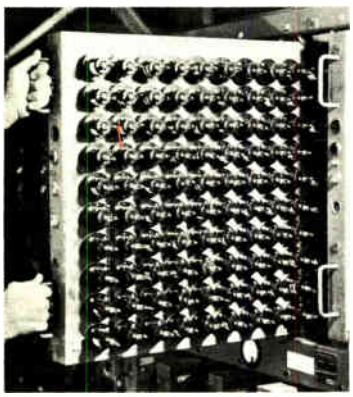


OVER 1.5 MILLION TUBES a month receive burn-in stabilization on specially designed stabilization equipment



ALL SYLVANIA GOLD BRAND TUBES receive thermal and electrochemical aging on Sylvania designed equipment

Advanced testing techniques insure top Gold Brand performance



Through continual improvement of its processing and testing methods, Sylvania Gold Brand Tubes are setting new performance records.

All Gold Brand Tubes receive thorough burn-in to insure optimum stability of electrical characteristics both initially and throughout life. Sylvania burn-in facilities are among the industry's largest. Up to 2 million tubes are stabilized each month!

Every Gold Brand Tube also receives highly refined thermal and electrochemical aging on Sylvania designed automatic equipment. Specialized Cyclic processing is used for optimum pulse emission levels and reduced hum levels.

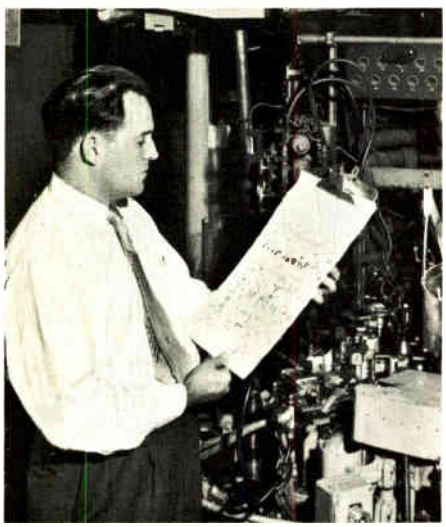
In addition to heater cycle life tests, environmental tests and thermal shock tests, every Gold Brand Tube goes through a final electrical test for pulse emission, AF noise, mutual conductance at rated and reduced EF, static characteristics, shorts, and continuity. Gold Brand Tubes are also subjected to 100% microscopic inspection.

Better vacuums achieved for Gold Brand Tubes

More efficient vacuums have been achieved for Gold Brand Tubes through the use of improved exhausting and gettering techniques. Evacuation is performed on automatic equipment with tubes individually evacuated on oil diffusion pumps.

Control charts are maintained over all phases of sealex operation including vacuum measurements on individual heads to improve vacuums. An emission activation control chart is also maintained to reflect control of emission related items.

After sealing, pure barium getters are post flashed to insure maximum gas elimination. Specially designed RF induction heating installations are used so that other tube elements are not affected.



EVACUATION AND SEALING are rigidly controlled automatically

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No Postage Stamp Necessary If Mailed in the United States

BUSINESS REPLY CARD

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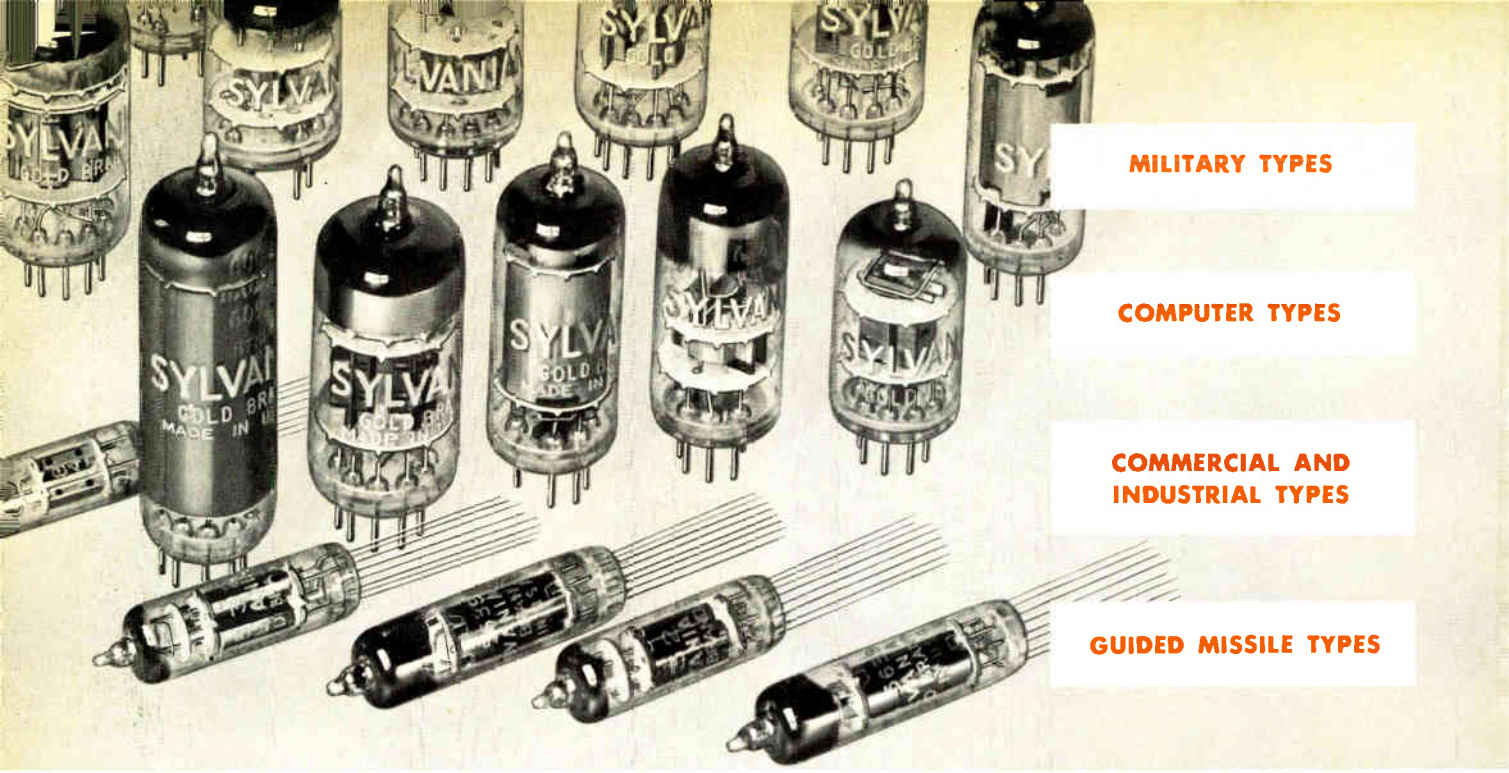
SYLVANIA ELECTRIC PRODUCTS INC.
1100 Main St.
Buffalo 9, N.Y.



SYLVANIA GOLD BRAND LINE is comprised of Military Types, Guided Missile Types, Commercial and Industrial Types and Computer Types

The Sylvania Gold Brand Line—premium tubes designed for specific applications

There are over 100 types of Sylvania Gold Brand Reliable Tubes ranging in size from subminiature to miniature and larger. They include types specifically designed to cover electronic circuits in four main application areas: Military Applications, Guided Missile Applications, Commercial and Industrial Applications and Computer Applications.

Sylvania Gold Brand Military Types, originally used in proximity fuzes, are now designed for application in a wide range of ground, sea and air equipment. Nearly 20 of the types are currently used in the control system of the F-106 fighter.

Sylvania Gold Brand Guided Missile Types are specifically designed to meet the tough requirements of military missiles and rockets. Today some 14 Sylvania Gold Brand originals are used in the Falcon missile alone.

Sylvania Gold Brand Commercial and Industrial Types are used in commercial airline equipment, mobile communications equipment and in industrial control equipment.

Gold Brand Reliable Computer Types, designed to meet the special requirements of data processing equipment, are used in many of the major computers on the market today. When dependability counts, specify Sylvania Gold Brand Tubes.

SYLVANIA

SYLVANIA ELECTRIC PRODUCTS INC.
1740 Broadway, New York 19, N. Y.
In Canada: Sylvania Electric (Canada) Ltd.
P. O. Box 1190, Station "O," Montreal 9.

LIGHTING · TELEVISION · RADIO · ELECTRONICS · PHOTOGRAPHY · ATOMIC ENERGY · CHEMISTRY-METALLURGY

Please send additional information on the items checked below:

- ☐ Gold Brand Military Types
- ☐ Gold Brand Commercial & Industrial Types
- ☐ Gold Brand Guided Missile Types
- ☐ Gold Brand Computer Types

Name_____

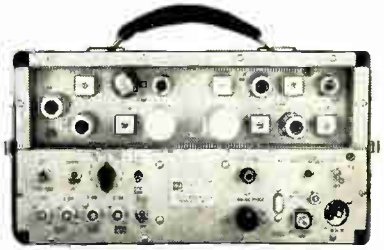
Address_____

Company_____

Use this handy business reply card to request additional information on these important new Sylvania developments

1003-C VIDEO TRANSMISSION TEST SIGNAL GENERATOR

Produces multi-frequency burst, staircase, modulated stairstep, white window, composite sync. Variable duty cycle. Regulated power supply.



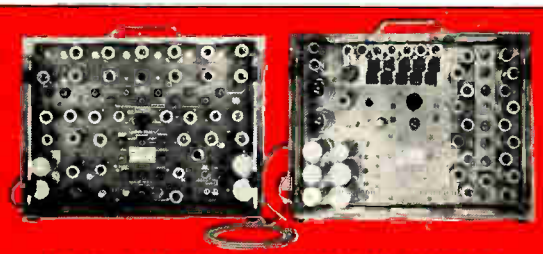
1004-B VIDEO TRANSMISSION TEST SIGNAL RECEIVER

Very rapid and accurate measurements of differential phase and differential gain characteristics of video facilities. Responds to standard stairstep test signal modulated with 3.58 mc.

VIDEO TRANSMISSION TEST EQUIPMENT

In Daily Use by Major Networks, Stations, and Long Lines Carriers

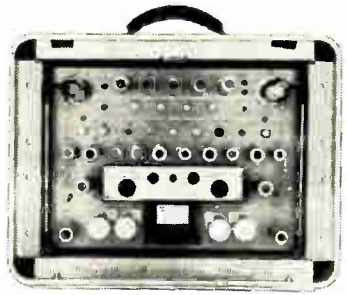
ALL UNITS AVAILABLE IN CARRYING CASE OR 12¼" STANDARD RACK MOUNTING



1005-A VIDEO TRANSMISSION TEST SET

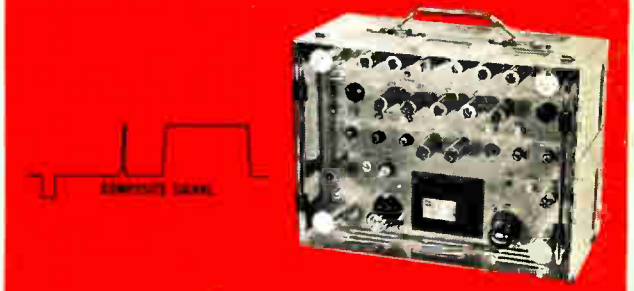
1005-A1 — Produces composite television waveforms suitable for measuring amplitude vs. frequency, differential gain vs. amplitude, dynamic linearity, differential phase vs. amplitude, high frequency transient response, low frequency transient response, low frequency phase or streaking, smears, mismatches, and other video characteristics.

1005-A2 — Supplies composite EIA Sync, blanking, horizontal and vertical drive signals and regulated B + power for itself and 1005-A1. Features magnetic core binary counters.



1008-A VERTICAL INTERVAL KEYER

Permits test and control signals to be transmitted simultaneously with program material, between frames of TV picture. Any test signal (multiburst, stairstep, color bar, etc.) may be added to the composite program signal. Test signals are always present for checking transmission conditions without impairing picture quality. The home viewer is not aware of their presence.



1073-CR SIN^2—SQUARE WAVE GENERATOR

Provides new waveform for testing TV or other pulse unit or system for amplitude and phase characteristics. Sin²—Square Wave pulse is equivalent to TV camera signal and is more sensitive than a Square Wave in indicating ringing. Video test signal adjustable for 1.0 volts or 1.4 volts peak to peak. Now in use by major TV networks and long lines carriers.

AT THE FRONTIERS OF ELECTRONICS
COLOR TV · INDUSTRIAL INSTRUMENTATION · TELEMETRY

TELECHROME MANUFACTURING CORP

Full Specifications & Details Available on Request

TELECHROME MANUFACTURING CORP.

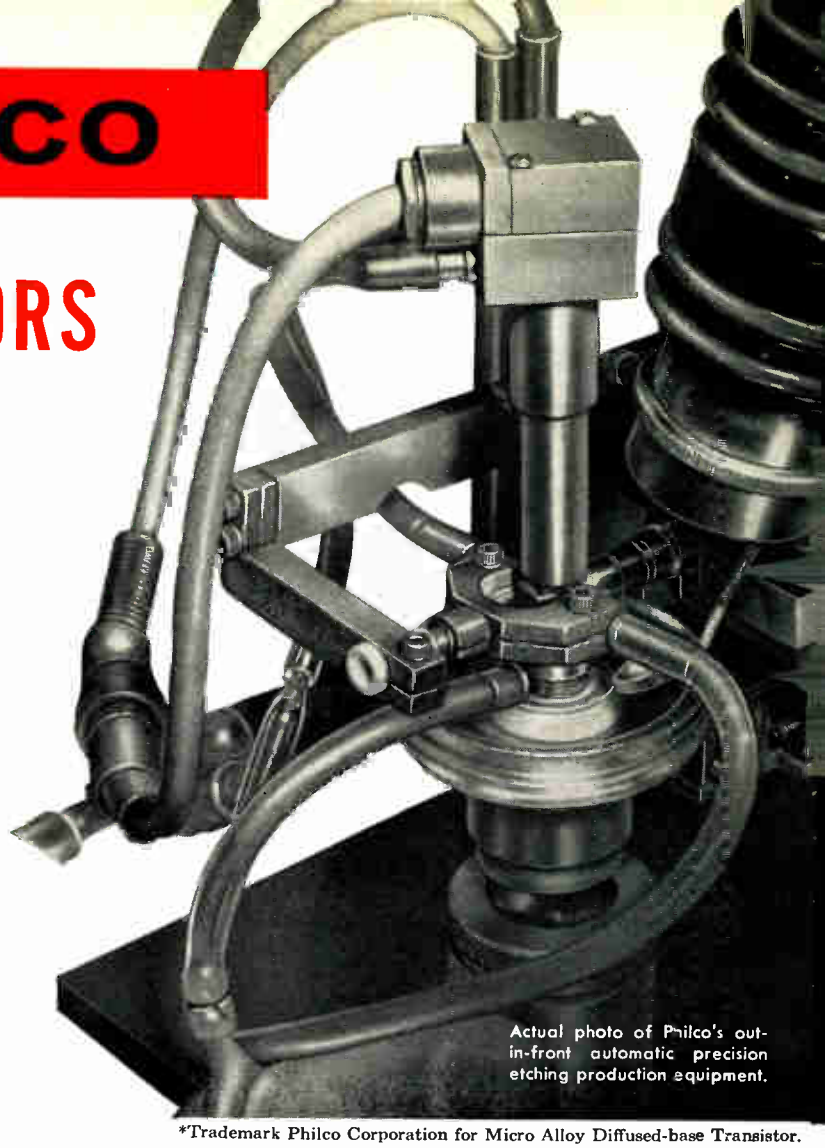
28 RANICK DRIVE AMITYVILLE, N. Y. Cable Address: COLORTV—TWX: AMITYVILLE NY2314

Midwest Engineering Division—106 W. St. Charles Rd., Lombard, Ill., MAyfair 7-6026 Western Engineering Division—13635 Victory Blvd., Van Nuys, Calif., State 2-7479

First from **PHILCO**

MADT* TRANSISTORS CONTROLLED IN DESIGN AND MANUFACTURE...

to meet your exact circuit requirements ...NOT SELECTED!



Actual photo of Philco's out-in-front automatic precision etching production equipment.

*Trademark Philco Corporation for Micro Alloy Diffused-base Transistor.

New VHF-UHF Transistors available in unlimited quantities – at realistic prices!

NOW, TRANSISTOR CENTER, U. S. A., offers a new family of MADT (field flow) transistors in unlimited quantities. Here are precision transistors which greatly expand the design potentials of high-gain, high frequency amplifiers; high speed computers; high-gain, wideband video amplifiers; and other critical high frequency circuitry.

Due to Philco's exclusive electrochemical manufacturing process, MADT's are *controlled* not *selected*. The electrodes are precisely placed in the graded field to produce the exact characteristics you require. MADT's are available immediately in unlimited quantities. Quantities 1 to 99 available "off-the-shelf" from your local franchised Philco Industrial Transistor Distributor.

MADT FAMILY APPLICATIONS DATA

TYPE*	f_{max}	Power Gain	Oscillator Efficiency	Class of Use
2N499	320 mc	10 db at 100 mc		amplifier to 125 mc
2N500			45% at 200 mc	Oscillotor to 350 mc
2N501	Ultra high-speea switch typical t_r = 9 mμsec; (18 max.); t_s = 9 mμsec; (12 max.); t_f = 7 mμsec; (10 max.) in circuit with current gain of 10 and voltage turnoff.			
2N502†	800 mc	11 db ot 200 mc		amplifier to 250 mc
2N503†	420 mc	12.5 db at 100 mc		amplifier to 175 mc
2N504	50 mc (min.)	46 db at 455		high gain IF amplifier
2N588	250 mc	14 db at 50 mc		Oscillator and amplifier to 80 mc

*Available in voltage ratings up to 35 V and dissipation ratings to 50 mw at 45°C.
†In JETEC TO-9 Case (Widely known as JETEC 30 Case).

Make Philco your prime source of information for high frequency transistor applications.

Write to Lansdale Tube Company, Division of Philco Corporation. Lansdale, Pa., Dept. EI 159

PHILCO® CORPORATION

LANSDALE TUBE COMPANY DIVISION

LANSDALE, PENNSYLVANIA

TRANSISTOR CENTER U.S.A.

Circle 14 on Inquiry Card, page 117

Facts and Figures Round-Up January, 1959

ELECTRONIC INDUSTRIES TOTALS

E. I. C. MAJOR PRODUCT NUMBER	PRODUCT NAME	TOTAL NUMBER OF COMPANIES
1	Amplifiers, Audio	378
2	Amplifiers, RF—IF	179
3	Amplifiers, Special Purpose	553
4	Amplifiers, Television	73
5	Analyzers	205
6	Antennas, Commercial	285
7	Antennas, Home	122
8	Antenna Accessories	306
9	Aviation Auxiliary Electronic Equipment	605
10	Batteries, Chargers and Accessories	144
11	Cabinets, Racks, Panels and Accessories	326
12	Capacitors, Fixed	145
13	Capacitors, Variable	68
14	Chassis Accessories	333
15	Chemicals, Coatings and Related Products	322
16	Chokes	239
17	Coils	446
18	Communication Systems	333
19	Computers	446
20	Connectors and Terminals	376
21	Control Equipment, Communications	169
22	Control Equipment, Industrial	682
23	Crystals, Accessories and Cores	201
24	Detectors	232
25	Dials and Front Panel Accessories	236
26	Filters	360
27	Gages	150
28	Hardware	567
29	Headphones	36
30	Indicators	435
31	Industrial Electronic Equipment	398
32	Insulation Materials and Compounds	317
33	Insulators	247
34	Kits	147
35	Lighting Equipment and Accessories	188
36	Magnetics	260
37	Meas. and Test Eqp.—Bridges	149
38	Meas. and Test Eqp.—Counters	223
39	Meas. and Test Eqp.—Decade Boxes	62
40	Meas. and Test Eqp.—Generators	225
41	Meas. and Test Eqp.—Monitors	95
42	Meas. and Test Eqp.—Oscillators	186
43	Meas. and Test Eqp.—Oscillographs	72
44	Meas. and Test Equip.—Special Purpose	615
45	Meas. and Test Equip.—Standards	113
46	Medical Electronic Equipment	163
47	Materials, Raw	412
48	Meters, Audio	106
49	Meters, Electrical Measurement	259
50	Meters—RF	122
51	Meters, Special Purpose	239
52	Microphones	80
53	Microphone Accessories	55
54	Microwave Components	254
55	Military Equipment	421
56	Military Systems Engineering	371
57	Missiles	401
58	Mobile Communications Equipment	153
59	Mobile Communications Accessories	187
60	Motion Picture Equipment	60
61	Motion Picture Equipment Accessories	116
62	Motion Picture Film	11
63	Motors and Generators	242
64	Navigation Systems	190
65	Nuclear Products	200
66	Photoelectric Equipment	120
67	Power Supplies and Converters	554
68	Printed Circuits	339
69	Production Machinery and Equipment	372
70	Radar Devices	191
71	Receivers, Communication	216
72	Receivers, Home	112
73	Receivers—Nav. and Spl. Purpose Nav.	108
74	Recorders, Audio	88
75	Recorders—Special Purpose	211
76	Recording Accessories	118
77	Rectifiers	146
78	Relays	279
79	Resistors and Volume Controls	218
80	Seals	158
81	Semiconductors	69
82	Services, Broadcast	75
83	Services, Industrial	579
84	Sound Reproducing Equipment, Disc.	134
85	Sound Reproducing Equip., Magnetic	91
86	Sound Sys., Inter-Com. and Hear. Aids	203
87	Speakers	65
88	Speaker Accessories	96
89	Studio Equip., Color and Bl.-and-Wh.	120
90	Studio Accessories	85
91	Switches	490
92	Testers	361
93	Tools, Hand	139
94	Transformers	415
95	Transmitters	235
96	Transmitter Accessories	112
97	Tubes	156
98	Tube Parts	186
99	Tuners	117
100	Ultrasonics	77
101	Wire and Cable	380

Summary of Companies Reporting Employment Figure of . . .

19 or less	20-49	50-99	100-249	250-499	500-999	Over 1000	*Companies Reporting No Employment Figures*
969	847	690	768	439	266	304	259

Personal Income ...	$298,254,624,000	Vehicle Registration	66,671,069	Truck Fleets	34,209
Population	171,994,400	Metal Work. Prod. Workers	6,463,701	Public Warehouses	3,768
Private Employment.	34,964,326	Metal Working Plants	26,675	Univ. and Colleges.....	2,347

Summary of U. S. electronic manufacturing by major product categories. This page has been reproduced from the Electronic Industries Marketing Guide and is in essence a summation of data printed out from 35,000 cards in EI's market research IBM deck. Each major EIC product number is associated with approximately 25 specific products. Related non-electronic statistics are from other Chilton Company magazines that total 17.

ARCTIC MISSILE WARNING SYSTEM

As winter darkness moves into the Arctic construction of America's Ballistic Missile. Early Warning System (BMEWS) is progressing on schedule. These concrete foundations for detection radar reflectors are covered with tarpaulins to protect them from the cold

Snapshots of the Electronic Industries

ULTRASONIC WELDING

"Sonoweld" ultrasonic welder has a special welding fixture and microscope on movable base to weld .002" dia. gold alloy wire to silicon. Aeroprojects Inc. is the mfr.

ELECTRONIC MUSIC

Avant-garde composer Edgard Varese (T) and Hano Kogel, Bogen-Presto, make adjustments on tape of Varese's "Poeme Electronique," an unusual combination of sounds generated by electronic instruments

SPACE RIDER

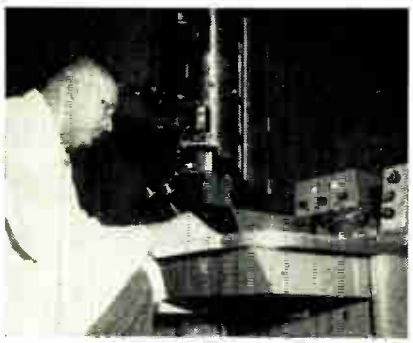
At GE a radio beacon (left) is screwed onto its antenna in spherical data capsule. With additional units the assembly will be completely potted to withstand the 40,000 g. force when it strikes water

FIRE CONTROL COMPUTER

Printed circuit board (right) is inserted into fire control computer being manufactured by GE for the USS Observation Island at GE's Pittsfield, Mass. plant.

DIFFRACTION CHAMBER

RCA specialist (below) demonstrates the new Electron Diffraction Chamber designed for use with Electron Microscopes for metallurgical study

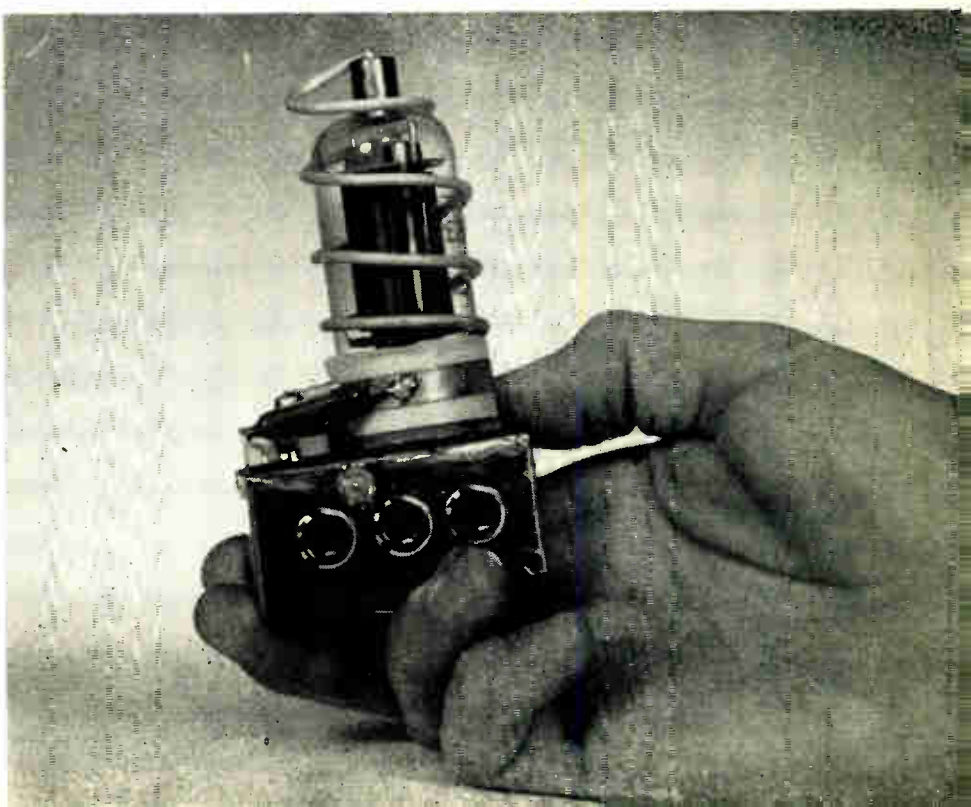


MOON SCANNER

TV-type space camera to scan the face of the moon uses the 2½-in. mirror shown here. The 8-lb. camera rides in Moon probe rockets

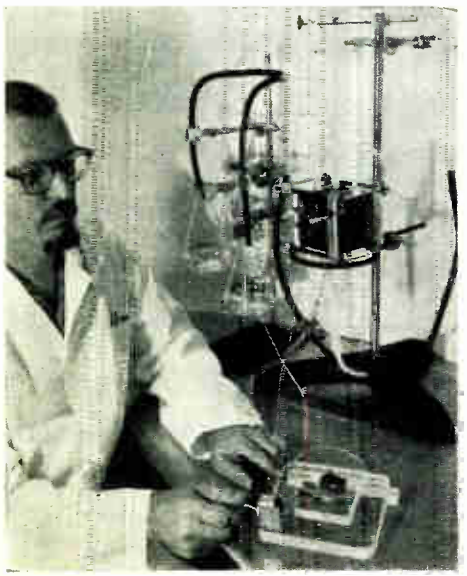
SPACE TRANSMITTER (Below)

Two-and-a-half ounce crystal-stabilized transmitter used in the Navy moon scanning system. Transmitter puts out 50 watts, transmits a television picture 240,000 mi.



ENERGY CONVERSION (Below)

At Lockheed a fuel cell converts energy to electricity to power motor. Scientists predict that a fuel cell to power autos or planes could be developed within five years



FXR

New... UNIVERSAL RATIOMETER *

Model B811A

NOW IN ONE COMPACT PACKAGE TWO INSTRUMENTS

FXR's — B811A Universal Ratiometer combines, at less cost, the many features of a separate ratiometer and standing wave amplifier.

- COMPACT PACKAGE — PRINTED WIRING CONSTRUCTION
- INCREASED SENSITIVITY FOR MORE ACCURATE REFLECTOMETER MEASUREMENTS
- TWO CYCLE PRECISION LOG METER — VSWR REFLECTOMETER READINGS OF 1.02 TO ∞ ON ONLY TWO SCALES
- VSWR, DB AND Γ SCALES ELIMINATE CONVERSION TABLES
- BUILT-IN INPUT TRANSFORMERS — NO ACCESSORIES REQUIRED
- EXPANDED VSWR SCALES AND FULL 70 DB STANDING WAVE AMPLIFIER OPERATION
- CRYSTAL AND BOLOMETER OPERATION

* *Accessories for reflectometer measurements also available . . . Write for details.*

FXR, Inc. formerly F-R MACHINE WORKS, Inc.

DESIGN • DEVELOPMENT • MANUFACTURE

FXR

PRECISION MICROWAVE EQUIPMENT
•
HIGH POWER MODULATORS
•
RADAR COMPONENTS
•
ELECTRONIC TEST EQUIPMENT

26-12 BOROUGH PLACE, WOODSIDE 77, N. Y.

TELEPHONE: AStoria 8-2800

Circle 15 on Inquiry Card, page 117

Electronic Industries International

United Kingdom—Britain has shelved plans for a 17-nation free trade area in Western Europe. The plan would have widened the scope of the common market plan which France, West Germany, Italy, Belgium, Netherlands, and Luxembourg will put into operation Jan. 1, 1959. The British plan would have brought 11 other European Nations into the common market plan—but under separate agreements. France had suggested that the British join the common market completely and had objected to some features of the free trade plan which would have exempted the empire from the agreements. The British, who stand to be squeezed out of old markets in the six nations by the common market plan, will probably consider reprisals which could touch off bitter economic rivalries. Some hope remains for a settlement of the problem since both sides have shown a willingness to resume negotiations.

Sweden—Two plants are being built by Dr. Axel Wenner-Gren, at Norrkoping and Bollmora, for electronic data processing equipment and computers. The machines, the Wegematic type, are designed for factory automation applications. Yearly output of the factories, scheduled to be operating by May 1959, is estimated at $7,000,000 each. Over $3,000,000 in orders have already been placed.

Argentina—The Standard Electric Co. of Buenos Aires, an IT&T subsidiary, has contracted to supply telephone equipment for the Argentine National Telecommunications Enterprise (ENTEL). The $7,255,000 contract calls for the manufacture and installation of 51,000 lines of automatic central office equipment with associated message registers and pay-stations.

United Kingdom—F. N. Sutherland, former General Manager of Marconi's Wireless Telegraph Co., Ltd., has been elected to the Board of Directors and appointed Managing Director of the company. Paul de Laszlo has been elected to the Boards of Dirctors of Marconi's Wireless Telegraph Co., Ltd., and Marconi Instruments, Ltd.

United Kingdom — Radar beacons for the United Kingdom's long-range missile program will be produced by the Avion Division of ACF Industries, Inc., 11 Park Pl., Paramus, N. J. The beacons will be used in missile test firings to extend the tracking range of ground radar. The order was placed by the United Kingdom's Treasury and Supply Delegation in the U. S.

Canada—Sound-powered telephones in noisy locations on Royal Canadian Navy ships will be equipped with signal increasing amplifiers supplied by the Canadian Admiral Corp., Ltd., Port Credit, Ontario. The contract was awarded by the Canadian Department of Defense Production.

N.A.T.O. — $280,000,000 of radar equipment has been ordered from Marconi's Wireless Telegraph Co., Ltd., by the Norwegian Ministry of Defense as part of NATO's Infrastructure program for a coordinated radar defense of member countries. The order includes two control and reporting stations (radomed) each of high-power and long-range. The transmitters are designed for unattended operation and have full remote control facilities.

Europe—"Scientific instrument exports to Europe will decline as the Common Market Program develops," says Dr. Van Zandt Williams, Executive Vice President of the Perkin-Elmer Corp., Norwalk, Conn. Scientific instrument manufacturers should establish manufacturing operations in Europe to protect their present short-run techological advantages, to participate in the certain economic growth of the area, and to combat the long-range economic war with the communist bloc. His company, he said, has established manufacturing subsidiaries in England and West Germany and a major sales subsidiary in Switzerland to cover the rest of Europe.

United Kingdom—The first comprehensive all-British exhibition in the U. S. is scheduled for the New York Coliseum, June, 1960. In addition to a wide range of British industrial products, there will be a prestige display of scientific, technological, educational and cultural subjects. It will be sponsored by the Federation of British Industries, and has the support of the British-American Chamber of Commerce in New York, the Dollars Exports Council, and Britain's Board of Trade.

South Africa—The "Spinning Jimmy", an electro-static fluxmeter, invented at the University of the Witwatersrand, Johannesburg, is whirling around the earth in Sputnik III supplying Soviet scientists with information about outer space. The Russians picked up the device from a paper the inventors published in Britain in 1950.

United Kingdom—EMI Electronics, Div. of Electrical and Musical Industries, Ltd., Hayes, Middlesex, is now distributing their line of vacuum tubes throughout the U. S. and they will begin marketing electronic instruments here early in 1959. EMI is marketing a computer competitive with large, American ($1,000,000 plus) data processing machines. Catalogues covering the EMI products are available from the company's American rep: H. L. Hoffman & Co., Inc., 35 Old Country Road, Westbury, L. I., N. Y.

United Kingdom—The three Nobel-prize winning inventors of the transistor, Dr. W. B. Shockley, Professor John Bardeen, and Dr. W. H. Brattain, will deliver the opening lectures at the International Convention on Transistors and Associated Semi-conductor Devices in London, May 25-29, 1959. The convention will include product displays covering all aspects of transistors and semi-conductor devices.

Canada — Closed-circuit TV, supplied by General Precision Labs., Inc., Pleasantville, New York, is coordinating roughing and rolling mill operations at the Hamilton, Ontario plant of Dominion Foundries and Steel, Ltd. This new TV installation enables the operator to "see" both operations from over 700 ft. away.

"Sight" checks by closed circuit TV give the operator of this Canadian steel plant a precise control of steel movements

Electronic Industries' News Briefs

Capsule summaries of important happenings in affairs of equipment and component manufacturers

EAST

NEW YORK TESTING LABS., INC., 47 West St., New York, N. Y., has acquired a new environmental temperature altitude chamber capable of simulating altitudes up to 200,000 ft.

MATERIALS FOR ELECTRONICS, INC., a new firm, will serve the electronics industry with special-purpose chemicals, metals, ceramics, minerals, and components. Headquarters will be at the Continental Hotel, Jamaica 34, N. Y.

GEOPHYSICS CORP. OF AMERICA has been formed to provide government and industry with advanced research and development services in the field of environmental physics, concentrating initially in radiation physics, extraterrestrial radiation, physical and chemical properties of gases and properties of magnetic and electrical fields. Offices at 700 Commonwealth Ave., Boston, Mass.

ITT COMPONENTS DIV. is the new corporate name for Federal Telephone and Radio Co. While the recently consolidated Federal Telephone and Radio Co. and Farnsworth Electronic Co. become the ITT FEDERAL DIV.

CHECKMATE AUTOMATIC TEST EQUIPMENT CO. has been formed as a division of CGS Laboratories, Inc. It develops and manufactures equipment for automatically checking electronic systems for overall performance.

GULTON INDUSTRIES, INC., has revised its employee relations program by adding educational and family insurance benefits.

POWER SOURCES, INC., Burlington, Mass., is now manufacturing a transistorized inverter operating from any dc source to provide sinusoidal ac. It is called the Sineverter.

BELL AIRCRAFT CORP. has received a USAF contract to develop an advanced version of the company's unique automatic landing system.

CONTROL ELECTRONICS CO., INC., moved into their new plant at 10 Stepar Place, Huntington Station, N. Y. The new plant comprises 11,000 sq. ft.

G-V CONTROLS INC. have taken possession of their newly built plant in Livingston, N. J. The new building, with an area of 36,000 sq. ft., permits the firm for the first time to have all its R & D, manufacturing, engineering, and administrative activities in one building.

BENDIX AVIATION CORP., RADIO DIV. in conjunction with Station WBAL, Baltimore, Md., now makes it possible for armchair weather experts to spot storms by radar right from their own living rooms.

GENERAL RADIO CO was recently host to a prominent group of West German electrical manufacturers participating in a study tour of various facets of the electrical industry.

LOCKHEED AIRCRAFT CORP. has started production on the 600 mph economy-sized JetStar at its Georgia Div.

PHILCO CORP.'s G & I DIV. has established a specialized Space Communication Systems laboratory. F. X. Rettenmeyer, Manager-Space Communication Systems Engineering, will be in charge of the laboratory.

RCA VICTOR has just started production of the "Magazine-Loading" stereo tape player-recorder.

RAYTHEON MFG. CO. now offers a new microwave relay system for 120-240 channel operation in the 5925-8500 MC band.

SPERRY GYROSCOPE CO. has developed a unique electronic system which makes miniature target drones look like giant intercontinental bombers. The new system is called SEE (Sperry Echo Enhancer.)

STROMBERG-CARLSON will deliver an electronic printer to the Curtis Publishing Co., Philadelphia, for use in printing address labels on such large distribution Curtis magazines as the Saturday Evening Post, Holiday, and Ladies' Home Journal.

VECTOR ASSOC., INC., have moved to a new 8,000 sq. ft. plant at 139-34 34th Rd., Flushing 54, N. Y.

MAGNETIC METALS CO. is offering production laminations with heretofore unmatched permeability levels for the magnetic engineer.

A. B. DU MONT, INC., will design and produce yokes, shields, and other accessory equipment for industrial, military, and special cathode-ray tubes in its Industrial Tube Div.

GENERAL PRECISION LABORATORY INC. has received a USAF contract for over $1.15-million for components for the AN/APN-81—one of GPL's family of self-contained airborne navigation systems.

RADIO CORP. OF AMERICA will introduce a new transistorized portable radio direction finder for the first time at the National Boat Show in New York, January 17-20.

GENERAL HERMETIC SEALING CORP. has been awarded a USAF contract covering modification kits for communications equipment now in use by SAC.

MID-WEST

D. W. ONAN & SONS INC. is expanding its service with the introduction of 21 new generating plants. The firm supplies standby and portable electric power to maintain operation of essential equipment during outages for over three decades.

HOFFMAN ELECTRONICS CORP. has appointed the Sampson Co., Chicago's largest independent appliance distributor, television and hi-fi distributor for Northern Illinois.

BROWN INSTRUMENTS DIV., MINNEAPOLIS-HONEYWELL REGULATOR CO. has delivered reactor simulators to two more U. S. universities—Syracuse and Minnesota—for training of nuclear engineering students.

THE GEOTECHNICAL CORP. moved into a new 40,000 sq. ft. plant at 3401 Shiloh Rd., Garland, just north of Dallas, Tex. In addition to R&D work, the firm produces FM telemetering, recording, data reduction, and seismograph equipment for commercial and government applications.

FORMICA CORP. will strengthen its overall manufacturing operation by concentrating industrial laminate manufacture at the Spring Grove Avenue plant, Cincinnati, Ohio. Harry Grunewald has been named Manager of Production.

STROMBERG-CARLSON will supply the nuclear instrumentation and safety systems for the reactor of the Enrico Fermi Atomic Power Plant, now under construction near Detroit, Mich.

WEST

ELECTRO INSTRUMENTS, INC., San Diego, has been awarded two contracts totaling over $410,000 for equipment on two missile programs. A. C. Spark Plug Div. of General Motors Corp. awarded the firm a $1.4-million contract for the Thor program and Frankford Arsenal, Philadelphia, a contract for the remainder for equipment for the Nike program.

THE AVNET CORP. changed its headquarters to 5877 Rodeo Rd., Los Angeles 16, Calif. The move to the new 18,500 sq. ft. building will enable the firm to consolidate their entire facilities under one roof.

ELECTROSOLIDS CORP. has moved into a specially constructed building at 13745 Saticoy, Panorama City, Calif.

BLAINE ELECTRONETICS INC., Van Nuys, Calif., has received a Hughes Aircraft Co. contract for a broadband, paraboloid transmitting antenna in the high frequency range. The transmitting antenna will be used to conduct antenna pattern studies.

HOFFMAN ELECTRONICS CORP. has been awarded a contract which will total approximately $33-million for TACAN air navigation equipment by USAF.

DATATAPE DIV., CONSOLIDATED ELECTRODYNAMICS CORP. has received a USAF contract for magnetic-tape recorder/reproducer equipment that will be used with range instrumentation previously supplied to the AF Missile Test Center, Patrick AFB, Fla.

BURROUGHS CORP. made delivery of its first new 220 electronic data processing system. The new system is an intermediate-scale computer, costing $800,000.

BOURNS LABORATORIES, INC., will expand its Trimpot Div. at Riverside, Calif.

CUBIC CORP. signed a $76,000 contract for R & D for a missiles telemetering switching device with the Flight Control Laboratory at Wright Air Development Center.

AUTONETICS has started construction on a new 151,000 sq. ft. manufacturing facility on a 16 acre site at the rear of the division's headquarters plant in Downey, Calif.

KIN TEL DIV., COHU ELECTRONICS, INC., has just dedicated a third major unit of its San Diego, Calif., plant. The new 30,000 sq. ft. building provides facilities for customer sales and service, product demonstration and an auditorium for customer training programs in the operation of instrumentation for communication, measure and control.

FAIRCHILD SEMICONDUCTOR CORP. has begun construction on a new 65,000 sq. ft. plant facility in Mountain View, Calif. The facility will enable the year-old firm to not only meet the demand for its initial products, but to provide expanded space for research projects.

AERONAUTICAL AND INSTRUMENT DIV., ROBERTSHAW-FULTON CONTROLS CO., has just changed name designations covering its entire capacitance level-measurement and level control systems product line.

THE GARRETT CORP. will develop and manufacture the highly sensitive nerve center that will feed data to the pilot and other systems of the USAF F-108 interceptor, while flying three times faster than the speed of sound.

Tele-Tips

RULY ENGLISH makes little sense in conversation but works fine on computers. It's a new unambiguous language to aid in programming. The "words" are not necessarily pronounceable but they are beautiful on magnetic tape. Distinguished from Unruly English, which we speak and write, Ruly English is made up of roots modified by prefixes and suffixes. One root, for example, is RESILRIG, whose meaning combines resilience and rigidity.

SPACE PILOTS will not be the dare-devil youngsters of a few years back. The Air Force has already announced the first requirement—a scientist-engineer, in the mid-thirties. For the Dyna-Soar project they add physical limitations, height of 5 feet 10-10½ in.; and weight—150-155 lbs.

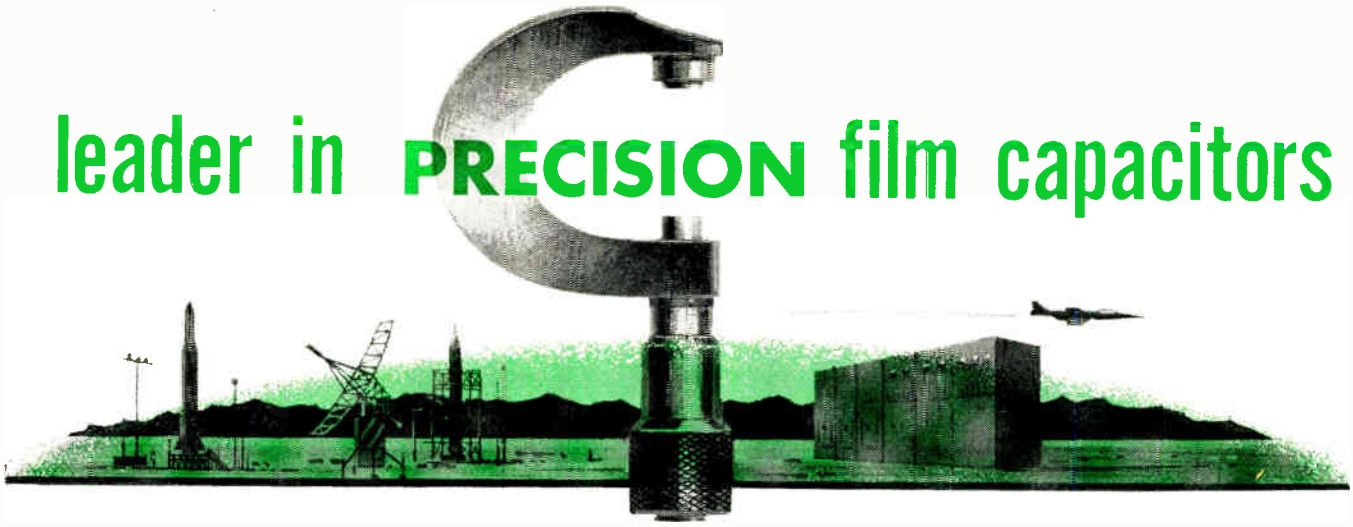
STEREOPHONIC, as defined by the Magnetic Recording Industry Association: "A technique of transmitting sound which employs two or more complete transmission channels for the purpose of creating in the listening environment the sense of auditory perspective inherent in the source environment. Each channel must include a separate microphone, amplifier and loudspeaker, and may have one channel of a multichannel recorder and reproducer interposed as time storage device." The definition, it is hoped, will provide a yardstick for the Better Business Bureaus and others to measure fraudulent advertising of products.

COMPUTERS have taken over many of man's functions but they have a long, long way to go before they can replace man completely. Automation experts admit that it would take 60,500 computers crowded into something the size of a skull to make human decisions. But last month a very significant step was taken in that direction. At the Weather Bureau in Washington scientists are designing a new type of computer

(*Continued on page* 34)

new from EFCON

leader in PRECISION film capacitors



TYPE RH
HIGH STABILITY CAPACITOR

high insulation resistance
low dielectric absorption
exact temperature coefficient with tolerance as close as .001%
available in rectangular, bathtub and tubular construction
Applications: laboratory standards, compensating networks, R.F. filters and other critical applications.

SPECIFICATIONS:

Capacitance Range: .1 to 10 mfd
Voltage Range: 100 to 1,000 volts D.C.
Tolerance: 10%, 5%, 1%, .5%
Temperature Range: —55°C to +85°C
Insulation Resistance:
1 x 10^6 megohms/mfd @ 25°C
3 x 10^5 megohms/mfd @ 70°C
Dissipation Factor: .01% to .07%
Temperature Coefficient: negative 100 ppm/°C ± 20 ppm/°C
Stability Retrace: .01% to .03%
Available in non-standard values, tolerances, mechanical configurations, terminals and leads to meet application requirements

WRITE ON COMPANY LETTERHEAD FOR SPECIFICATION BULLETIN SB103

TYPE AG
"GLASSCON"® GLASS CASED HIGH VOLTAGE CAPACITOR

plastic film dielectric
silicone impregnated
threaded studs or wire leads
glass or steatite tube construction eliminates high voltage insulators
Applications: high voltage D.C. and low voltage A.C.

SPECIFICATIONS:

Capacitance Range: .001 to .1 mfd
Voltage Range: 600 to 60,000 volts D.C.
Tolerance: 10%, 5%. Closer tolerances upon request
Operating Temperature Range: —60°C to +125°C
Insulation Resistance: 10^4 megohms/mfd to 10^6 megohms/mfd
Test Voltage: 1.5 times rated voltage

WRITE ON COMPANY LETTERHEAD FOR SPECIFICATION BULLETIN SB104

TYPE MD
EPOXY ENCAPSULATED MYLAR* DIELECTRIC CAPACITORS

impregnated for high reliability
smaller in size, lighter in weight, lower in price
non-inductive foil construction
greater miniaturization because the tube enclosure, end seals, tube fillers and ground insulation is eliminated by non-conductive case
hard, extremely thin, moisture-resistant outer shell
moisture absorption equivalent to hermetically sealed unit
high insulation resistance
round or flat tubular case style
Applications: filters, general coupling applications

SPECIFICATIONS:

Capacitance Range: .001 to 1 mfd
Voltage Range: 100 to 800 volts D.C.
Tolerance: 10%, 5%
Operating Temperature Range: —60°C to +125°C without derating
Insulation Resistance: 100,000 megohms/mfd
Dissipation Factor: less than 1% at 25°C measured at 1 KC
Test Voltage: 2 times rated voltage

***Du Pont Trade Mark**

WRITE ON COMPANY LETTERHEAD FOR SPECIFICATION BULLETIN SB102

EFCON

INDUSTRY'S PRIME SOURCE OF CLOSE TOLERANCE AND/OR NONSTANDARD VALUE FILM CAPACITORS.

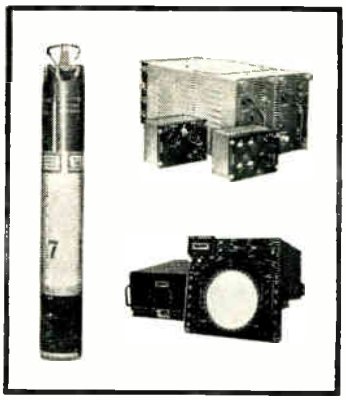
682 BROADWAY NEW YORK 12, N. Y.

Circle 18 on Inquiry Card, page 117

AN ASW SYSTEM...DISPLAY/AIRBORNE RECEIVER/SONOBUOYS

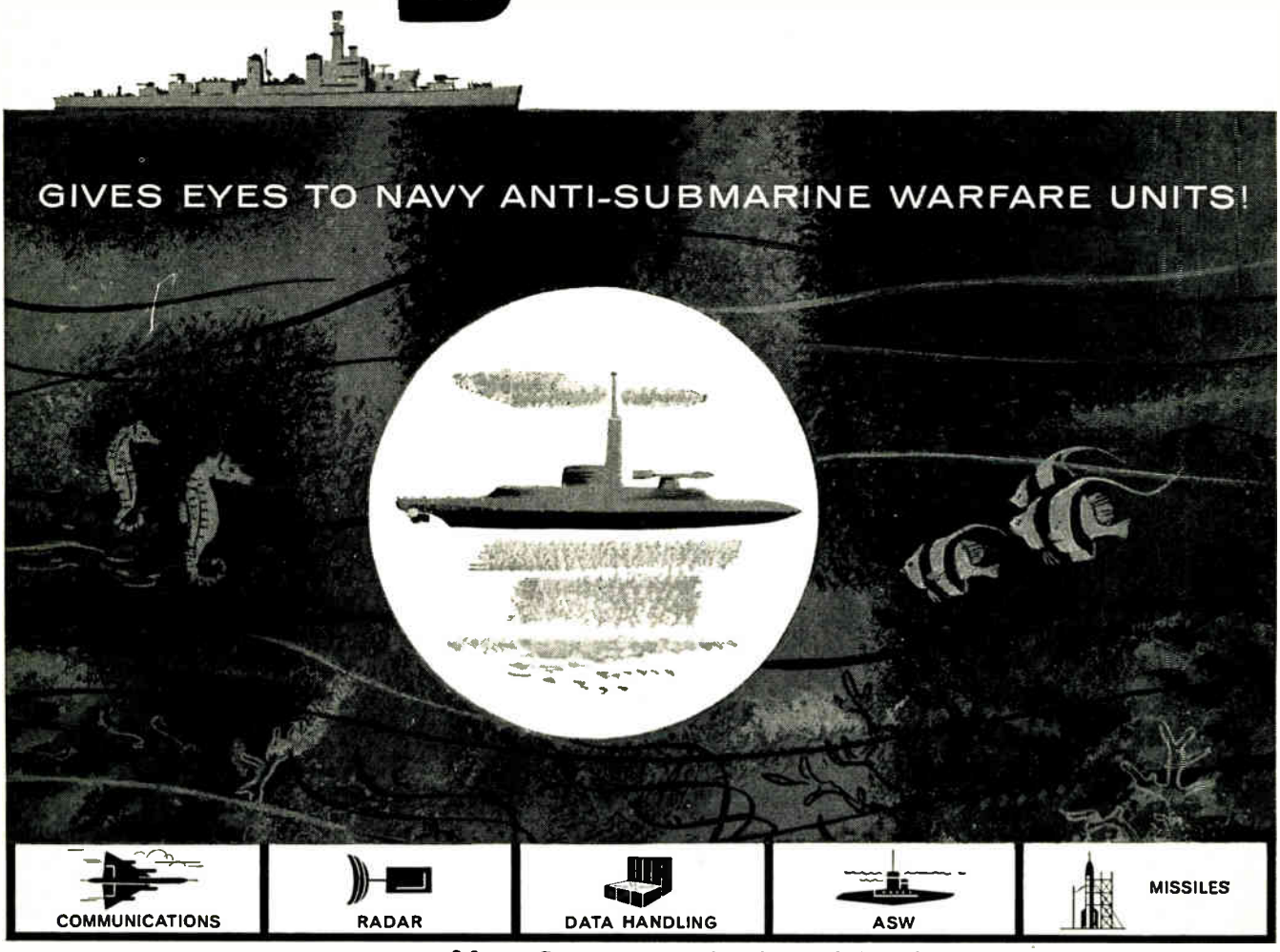
Anti-submarine warfare equipment designed, developed and produced by *The Magnavox Company*, in conjunction with the Navy Department, provides patrol aircraft with eyes that see underwater by day and by night. The AN/ASA-16 Display System, together with SONOBUOYS, AN/ARR-26 Receiver systems and other associated equipment provide aircraft with a clear picture of the ocean-depths below them. They are part of the continuing contributions of *The Magnavox Company* in aiding the U.S. Navy to combat the growing submarine menace.

MAGNAVOX capabilities are in The Fields Of Airborne Radar, ASW, Communications, Navigation Equipments, Fusing and Data Handling . . . your inquiries are invited.



PRODUCTS
THAT SEE BY
THEMSELVES

Magnavox



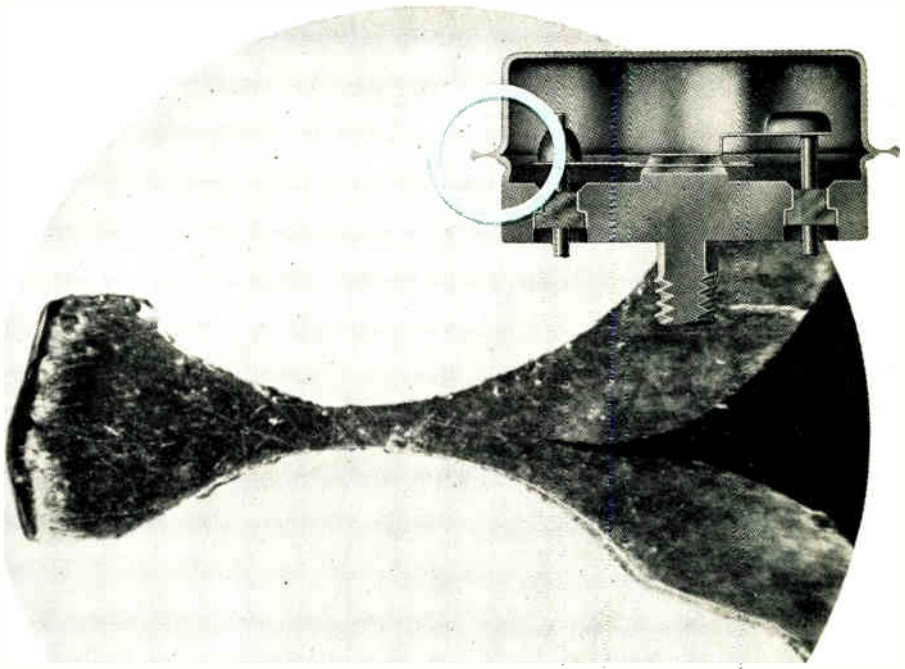
THE MAGNAVOX CO. • DEPT. 30 • *Government and Industrial Division* • FORT WAYNE, IND.

Tung-Sol moves ahead!

High power transistors with new **cold-weld** seal

Improved cold-weld seal gives new Tung-Sol high-power transistors three-way quality boost

- True hermetic, copper-to-copper seal improves transistor thermal characteristics.
- Elimination of heat-damage, heat-caused moisture and "splash" increase reliability.
- Vacuum-tight, moisture-proof cold-weld seal lasts even through "breathing" over long life operation.



Photomicrograph (45X) shows circled area of cross section of Tung-Sol high-power germanium transistor cold-weld seal. Note absence of seam, indicating actual integration of coppe molecules and a true, hermetic, copper-to-copper seal.

Once again Tung-Sol shows the way. Now, for the first time, Tung-Sol brings designers high-power germanium transistors with quality benefits of the advanced cold-weld seal.

The new Tung-Sol types feature a stud-mounted package and maximum collector current of 13 amps. Military environmental tests combine with the radioactive gas leak detection test to assure maximum reliability.

Technological advancements such as this keep Tung-Sol ahead of the field. For full data on the new high-power switching transistors . . . to meet any need with the latest in transistor design and efficiency, contact: Semiconductor Division, Tung-Sol Electric Inc., Newark 4, New Jersey.

Circle 20 on Inquiry Card, page 117

Tele-Tips

(*Continued from page* 30)

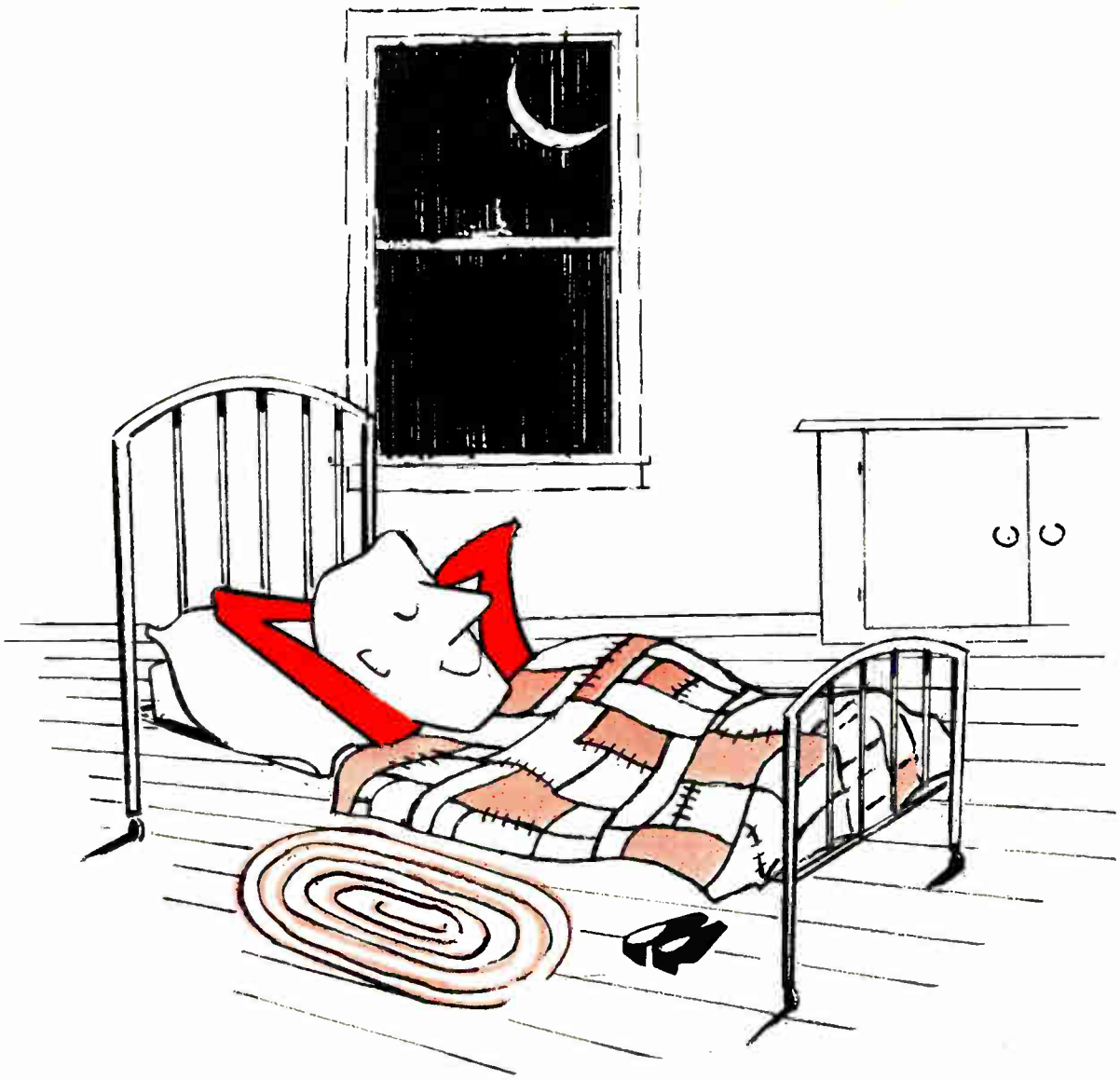
they call the "Perceptron" which they say will be "the first nonliving mechanism 'capable of receiving, recognizing and identifying its surroundings without any human training or control.'"

RECORDING a complete magazine on phono discs is now being attempted by a Paris publishing house. The magazine, "Sonorama," a monthly, consists of plastic microgroove discs that take a total of 40 minutes to play. They can be played up to 1,000 times without wearing out. The first issue included crowd noises from the Algiers Forum, a scene from a new play, and an interview with Brigitte Bardot.

ROCKET FUELS, we hear, are yielding some surprising and unusual derivatives useful in the treatment of mental disorders. But this comes as no surprise at all to ex-submariners. Shucks, remember the after-effects of torpedo juice!

PHONE TAPPING could become a popular national pastime with a new, tiny device invented by a British RAF medical officer. According to the report, the device costs only $4.20 and takes such a minute amount of power from the wires that the loss could be attributed to damp wires.

ACCURACY, as is well known, means many things to many people. But it will be hard to disagree with the machinists in the future. Within 10 years, says L. F. Polk, of Bendix, measurement accuracy to a tenth of a millionth of an inch will probably be attained. He added these new definitions: a "jiffy," he said, is the time required for light (going at the speed of 186,000 miles/sec) to travel one centimeter; and a "barn," which is an area used to measure atom action, is the part of a square centimeter that would be expressed by the fraction 1/1 followed by 24 zeros; and a "shed" is one-millionth of a "barn."



WHEELOCK SIGNALS INTRODUCES • • • •

TITILLATED MAN

A composite of design engineer, purchasing agent, production foreman, quality control supervisor, and executive defender of the company dividend.

Each individual need of his corporate personality is coddled and gratified by Wheelock's rational design concepts, space minimalization techniques, environmental stability, price, and delivery capabilities.

He is at once, and by himself . . . a family, and a divinely happy one. And he sleeps the sleep of the self-assured because, stitched onto his chest in a place far from the prying eyes of alert competitors is the secret of his serenity:

"For reliable relays (miniature, subminiature and standard), call Wheelock."

TO BE TITILLATED TOO, WRITE US OF YOUR RELAY NEEDS

Wheelock SIGNALS INC

RELAYS W S LONG BRANCH, N. J.

©N

Letters

to the Editor

"Tuition Plan Inc."

Editor, ELECTRONIC INDUSTRIES:

The article in the November 1958 issue of the "Electronic Industries Magazine," page 199, entitled "Pay-as-you-go Tuition eases College Expenses" was very interesting, but did not tell the address of Tuition Plan Incorporated of New York. I am very much interested in learning more concerning this plan, and would appreciate knowing where I can obtain more information regarding it.

M. J. Dougal
Liaison Engineering

Ed: We would write to you if we could, Mr. D.—but you didn't give us your return address. So, here for you, and any other interested readers, is the place to contact: Tuition Plan, Inc., 347 Fifth Ave., N.Y.C., N. Y.

"CW and Pulse Radars"

Editor, ELECTRONIC INDUSTRIES:

Your "What's New" article (November 1958, page 72) comparing CW and pulse systems is completely unfounded and, as such, is bound to provoke considerable comment from infuriated "pulse radar engineers."

To begin with, pure Doppler navigators are not radars since the name RADAR implies a *ranging* capability not possible in a pure CW system. Hence, the first limitation.

The article states quite often that CW systems can transmit and receive 100 percent of the time whereas a pulse radar cannot. This is true only by definition since "pulse" implies non-continuous transmission. Your comparison, however, is unfounded since you implicitly compare a two-antenna CW system with a single-antenna duplexing pulse system. No such restriction exists for the pulse system. As a matter of fact, the duplexed pulse radar, utilizing the total antenna area employed by your CW system, would have a range capability of 1.41 times $\sqrt[4]{3}$ that of the CW system, all other factors being equal.

Based on a two-antenna comparison for *both types*, it is senseless to imply the non-simultaneity of transmission and reception for either system. It is equally incorrect to assume that the pulse transmission rate is limited by range considerations; simple reasoning indicates that the pulse transmission rate can approach full duty (100%). As such a transmission rate were approached, the components involved in either system would become more nearly identical, for identical system requirements.

Contrary to the article, either system possesses similar altitude restrictions. When the received signal is of

such large magnitude as to render signal handling capability impractical, then minimum altitude conditions prevail. When the signal is of such small magnitude that receiver noise or transmitter leakage equals or exceeds the received signal, then maximum altitude conditions prevail.

The article has completely overlooked the major factor which enhances the capability of CW systems; namely, required bandwidth. The transmission of short duration bursts of energy involves the utilization of considerably wider bandwidth in transmission and reception than is required in the CW case. This factor seems to make the CW system seem more efficient. However, if the CW system were to meet the same requirements of range determination, resolution, etc., it would soon be found that both types of systems are quite comparable.

Andrew O. Sperber
Senior Engineer
Airborne Radar Department
Sperry Gyroscope Co.
Great Neck, N. Y.

"FM Stereo Multiplexing"

Editor, ELECTRONIC INDUSTRIES:

In the "News Briefs" column of your October 1958 issue, there is an article to the effect that FM broadcasters are concerned that wideband stereo multiplexing on FM will wipe out SCA background music or other point-to-point services on FM multiplex. We do not question the fact that such concern exists, but we hasten to point out that it is groundless. This concern is based upon one fact and one erroneous assumption which has been circulating more or less unchallenged among broadcasters.

The *fact* is that wideband stereo multiplex adaptors can pick up the music services and other point-to-point FM multiplex operations. The pick up is relatively poor, however, and noisy since the subcarrier is usually interrupted between selections, and the wideband multiplex receiver picks up a good deal of main channel cross talk.

The *false assumption*, however, is that nothing can be done about such unauthorized reception. In point of fact, something can be done in a most positive way to eliminate such pirating of a music service. The SCA broadcaster merely has to put out a jamming frequency at a relatively low modulation level and apart from his regular subcarrier band. This does not disturb his customers using narrow band receivers, but produces a hopeless hash of distortion and crosstalk in a wideband stereo receiver.

You are perhaps aware that WJBR is the second station in the country to be authorized to experiment with wideband Compatible FM Stereo using the Crosby multiplex system.

(*Continued on page* 38)

Letters

to the Editor

(*Continued from page* 37)

We have been broadcasting experimental stereo by this means on a nightly schedule since October 6. Before we undertook these efforts we spent nearly a year studying the various aspects of the new technique to determine that it would indeed be compatible for unimpaired reception on monophonic receivers, and that means could be arranged to protect the privacy and income of background music operations in this area. The jamming method outlined is simple and need not be expensive. It is positive because it does not depend upon receiver modifications but is applied by the SCA broadcaster.

We believe that the Crosby system of Compatible FM Stereo represents a great advancement of the broadcast art. We feel that its acceptance by all branches of the FM broadcast industry should not be obstructed or prejudiced by false or misleading information. Therefore, we would greatly appreciate your printing at least the portions of this letter refuting the basis of the CA broadcaster's fears.

Robert R. Walsh
Chief Engineer
FM Station WJBR,
Wilmington, Del.

"Jacobians"—

Editor, ELECTRONIC INDUSTRIES:

Would you please send me a reprint of the article entitled "Jacobians—A New Computational Tool" as seen on page 69 of the November issue of your magazine.

The formula that appears on the bottom of page 70, y^2/z^2, should read $\frac{yz}{z^2}$ — in order to be correct.

F. A. Roberts
Seismograph Service Corp.
P. O. Box 1590
Tulsa 1, Okla.

Ed.—You're so right!

US to Build Largest Radio Telescope

A $5 million radio telescope, designed to reveal hitherto unknown facts about outer space, will be built in Green Bank, W. Va., as part of the National Radio Astronomy Observatory facilities there.

The National Science Foundation announced that the telescope will be operated for the Foundation by Associated Universities, Inc., a non-profit organization of nine eastern universities.

KEMET TRADE-MARK SOLID TANTALUM CAPACITORS PROVIDE UNMATCHED STABILITY UP TO 125°C

The curve at the right illustrates actual leakage current for a "Kemet" 5 mfd. 30 volt capacitor over a 2000 hour test interval *when measured at 125°C* (not at room temperature). This characteristic is extremely important where equipment must provide stable operation at elevated temperatures.

"Kemet" capacitors offer precision electrical performance over long periods of storage and service life . . . proved temperature stability from −80° C to +125° C . . . and exceedingly low dielectric losses.

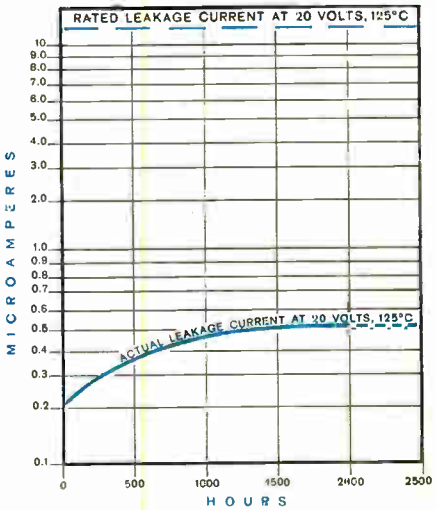
KEMET COMPANY — supplier of a complete line of solid tantalum capacitors — is not dependent on other suppliers for the mining or processing of tantalum.

WRITE TODAY FOR FREE
"ELECTRONICS PRODUCTS ENGINEERING BULLETIN"
This four-page folder provides performance curves, operating characteristics and specifications.

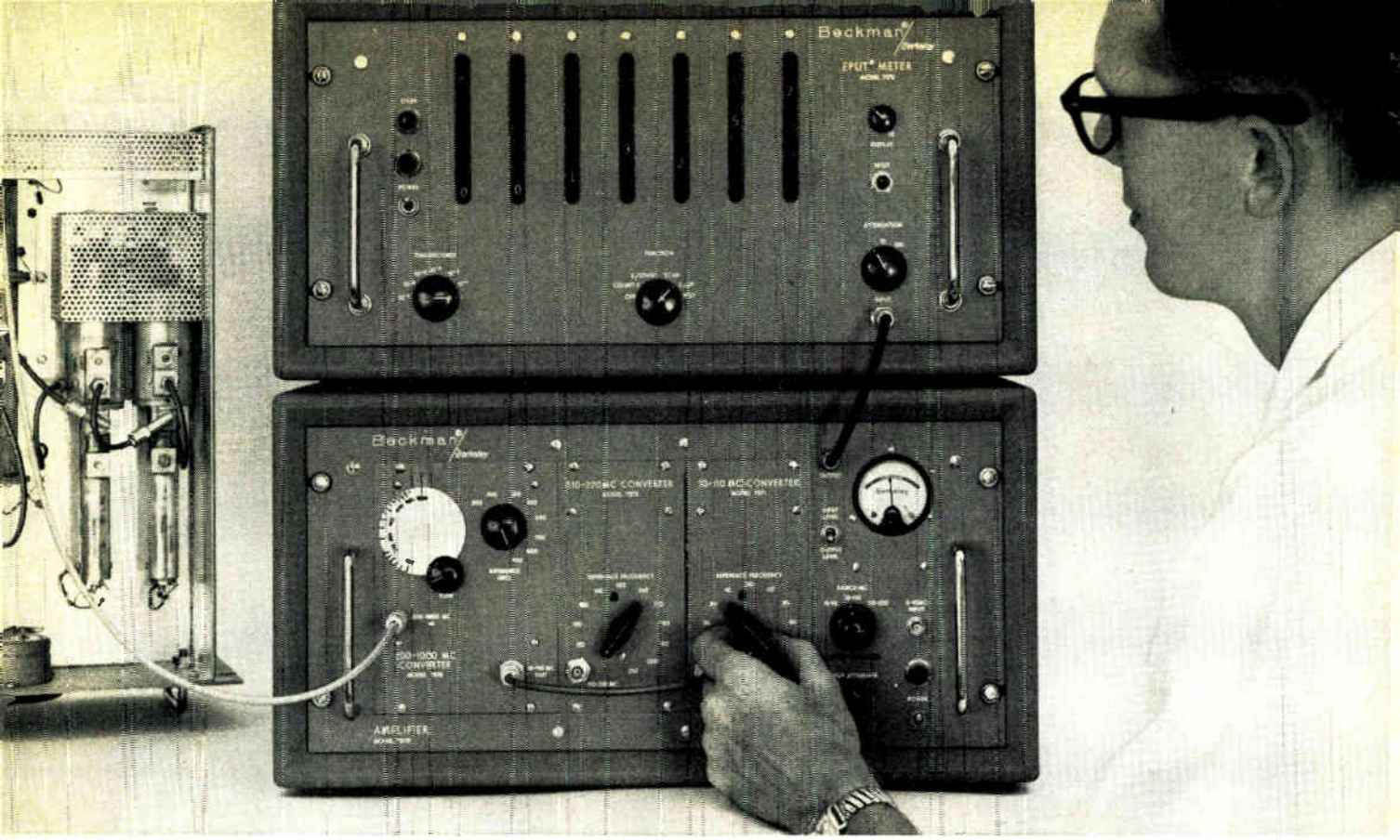
KEMET COMPANY

DIVISION OF UNION CARBIDE CORPORATION

OFFICES: 11901 Madison Avenue, Cleveland 1, Ohio



LEAKAGE CURRENT vs. TIME AT 125° C
"KEMET" K5H30 SOLID TANTALUM CAPACITOR
(Average of Typical Capacitors)



Heterodyne converters extend range of EPUT® Meter to 1000 Mc

Model 7570 Series Amplifier & Converters (bottom cabinet) used with Model 7170 EPUT Meter (top cabinet) or with Model 7370 EPUT & Timer (not shown).

Frequency measuring range with EPUT meter:

Model 7571 converter only	dc to 110 Mc
7571 & 7572 converters	dc to 220 Mc
7571, 7572 & 7573 converters	dc to 1000 Mc

Sensitivity (rms) & input impedance:

dc to 10 Kc	100 mv into 1M ohm
10 Kc to 10 Mc	1 mv into 1M ohm
10 Mc to 220 Mc	10 mv into 50 ohm
220 Mc to 1000 Mc	1 mw into 50 ohm

Video amplifier:

All converters are installed in the Model 7570 cabinet which includes a video amplifier used independently to increase the sensitivity of the counter. See 10 Kc to 10 Mc sensitivity above.

Prices:

Model 7570	$300	Model 7573	$ 500
Model 7571	$250	Model 7370	$1975
Model 7572	$250	Model 7170	$1675

159

Shown above measuring the output frequency of a 1000 Mc cavity resonator is a full complement of frequency converters operated with a 10 Mc counter. The bottom cabinet *permanently* houses all three converters covering the full range from 10 Mc to 1000 Mc. Initial requirements for a more limited range can be accommodated by installing only one or two converters – without affecting the ease of future expansion. Extraordinary sensitivity (see specs.) insures that loading effects will not distort measurements of weak signals.

Measurements are extremely easy to make. No tuning is required up to 220 Mc. Simply select range, couple signal, adjust output level with aid of "low-satisfactory-high" meter and read counter indication, adding reference frequencies. Percentage accuracy exceeds that of counter alone.

For more information on this and other recent advances in digital frequency measuring techniques, write for the new Data File 111. Address department F-1.

Beckman®

Berkeley Division

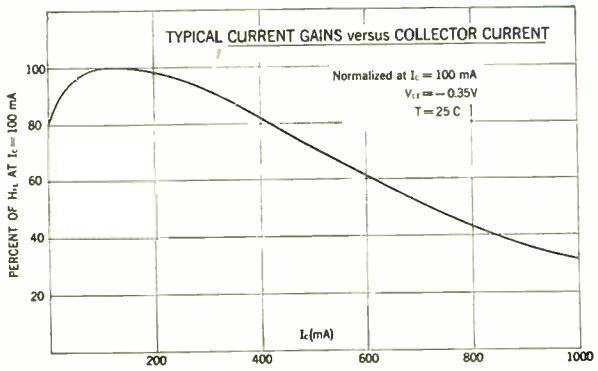
2200 Wright Avenue, Richmond 8, California

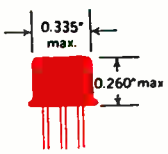
a division of Beckman Instruments, Inc.

Circle 27 on Inquiry Card, page 117

1 for RAYTHEON 2N660 ampere, high frequency switching use RAYTHEON

RELIABLE COMPUTER TRANSISTORS





actual size
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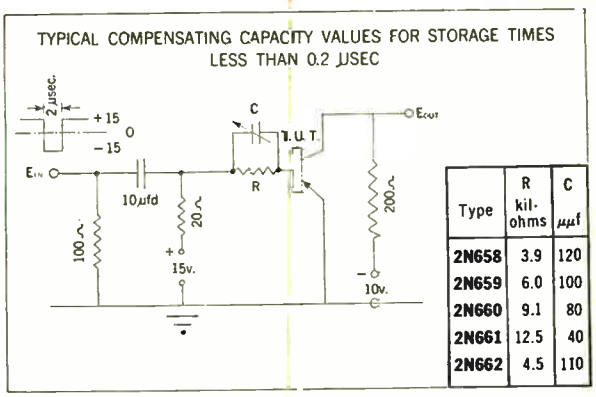

Type	R kil-ohms	C μμf
2N658	3.9	120
2N659	6.0	100
2N660	9.1	80
2N661	12.5	40
2N662	4.5	110

Type	Punch through Voltage max.	$f_{\alpha b}$ ave. Mc	H_{FE_1} ave. I_B = 1 mA V_{CE} = −0.25v	H_{FE_2} ave. I_B = 10 mA V_{CE} = −0.35v	I_{CO} at −12v μA	r_b' I_C = −1 mA ohms	C_{ob} V_{CB} = −6v μμf
2N658	−24	5	50	40	2.5	60	12
2N659	−20	10	70	55	2.5	65	12
2N660	−16	15	90	65	2.5	70	12
2N661	−12	20	120	75	2.5	75	12
2N662	−16	8	30 min.	50	2.5	65	12

Typical values at 25°C unless otherwise indicated

Dissipation Coefficients: In air 0.35°C/mW; Infinite Sink 0.18°C/mW

These new PNP Germanium Computer Transistors made by Raytheon's reliable *fusion-alloy* process add to the already comprehensive line of Raytheon Reliable Computer Transistors which include several in the *Submin* (0.160" high, 0.130" dia.) package. Write for Data Sheets.

RAYTHEON SEMICONDUCTOR DIVISION
Needham Heights, Massachusetts
SILICON AND GERMANIUM DIODES AND TRANSISTORS • SILICON RECTIFIERS

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CHICAGO: 9501 Grand Ave., Franklin Park, NAtional 5-4000
LOS ANGELES: 5236 Santa Monica Blvd., NOrmandy 5-4221

Circle 28 on Inquiry Card, page 117

Books

Logical Design of Electrical Circuits

By Rene A. Higonnet and Rene Grea. Published 1958 by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 37. 232 pages. Price $10.00.

This book offers a thorough and systematic treatment of Boolean methods for analyzing relay, diode, and vacuum tube circuits, particularly for use in the design of control circuits in telephone dial systems, automation systems, computers, and similar applications.

The basic principles of Boolean algebra are explained in a manner that can be understood by engineers who have had no special training in switching ciruits. Only a knowledge of simple electrical laws is required to understand the book; no advanced mathematics is needed.

Covering virtually all the fields used by the present-day circuit designer, the book takes up combinational circuits (steady state); treats sequential circuits by a modern, simpler method; and fully describes shunt-down circuits (inhibitors) by Boolean algebra.

Introduction to the Design of Servomechanisms

By John L. Bower and Peter M. Schultheiss. Published 1958 by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16. 510 pages. Price $13.00.

This work emphasizes a basic understanding of stability and feedback system design, both single and multiple loop. The authors provide a systematic approach to design, dealing with the principal performance requirements, such as harmonic response, time response, error coefficients and noise response, and giving attention to the common aspects of non-linear operation.

An attempt is made to treat this synthesis problem on a basis that permits the specifications on performance, given components, and noise to be handled at the same time.

To make the volume self contained, an appendix covering servomechanism components is included which enables the reader to follow examples used in the text and to work representative problems without resorting to outside references.

Loudspeakers, 5th Edition

By G. A. Briggs. Published 1958 by Wharfedale Wireless Works, Ltd., U. S. A. Agent: British Industries Corp., 80 Shore Road, Port Washington, N. Y. 336 pages.

All aspects of the design and performance of loudspeakers and enclosures are dealt with in non-technical terms, with the inclusion of two chapters of reminiscences briefly covering the writer's 25 years' experience in the loudspeaker field. Separate chapters are devoted to electrostatic speakers and stereo.

The pages are salted with the touches of popularity of the author's previous books.

(*Continued on page 44*)

WIDE RANGE HETERODYNE FREQUENCY METER

Divco-Wayne Electronics Model 1021 Heterodyne Frequency Meter Advantages

Broadest RF Spectrum:
125KC to 1000MC . . . a range normally requiring three separate meters.

Accuracy:
.005% overall frequency.

RF output:
100 microvolts on all calibrated fundamentals.
50 microvolts on all calibrated harmonics.

Field or laboratory operation:
Ruggedly built for battery or 115/230 volt 50-450 cps power supply . . . for operation in field or lab.

Calibration data:
Accurate calibration data supplied for 5000 dial readings . . . allowing unskilled operators to make accurate measurements.

Temperature conditioned:
Each meter conditioned in Tenney environment chamber at temperature extremes for conditions under which it will actually operate.

Low cost:
Priced below many meters with narrow RF spectrums.

The Divco-Wayne Electronics 1021 frequency meter works equally well in the laboratory or out in the field. It's the only wide range meter covering the entire range of 125KC to 1000MC. Widely used in missile work, radar, communications, or for any laboratory work in frequency determination or as a signal source. Fully illustrated and described in new bulletin DW-102. For your free copy, write Divco-Wayne Electronics, 9701 Reading Road, Cincinnati 15, Ohio.

D W E
DIVCO WAYNE ELECTRONICS

A Division of the Divco-Wayne Corporation
DESIGNERS • ENGINEERS • MANUFACTURERS
Custom-built precision mechanical, electro-mechanical and electronic equipment for industry and defense.

Circle 30 on Inquiry Card, page 117

Books

(*Continued from page 42*)

Reliable Electrical Connections, 1958

Published 1958 by Engineering Publishers, GPO, Box 1151, New York 1. 286 pages. Price $7.75.

This work contains the 32 papers presented at the Third EIA Conference on Reliable Electrical Connections in Dallas, Tex., in December, 1958.

Electronic Avigation Engineering

By Peter C. Sandretto. Published 1958 by International Telephone and Telegraph Corp., 67 Broad St., New York 4. 755 pages. Price $9.50.

This book covers radio and electronic aids to aviation. The various systems are grouped for classes based on the operational problems of aircraft in (1) flight toward a destination airport, (2) flight near that airport, (3) approach and landing, and (4) movement on the airport surface. Emphasis is placed on the engineering principles of these systems and unusual features are detailed.

Books Received

Proceedings 14th Annual Meeting Metal Powder Association

Published by the Metal Powder Association, 130 W. 42nd St., New York 36. 125 pages.

EIA Membership List and Trade Directory (1958-59)

Published 1958 by Electronic Industries Assoc., 1721 DeSales St., N. W. Washington 6, D. C.

Dynamometer Design Book

Published 1958 by W. C. Dillon Co., Inc., P. O. Box 3008, 14620 Kedwick St., Van Nuys, Calif. 90 pages. Price 50¢.

Fundamentals of Transistors 2nd Edition

By Leonard Krugman. Published 1958 by John F. Ryder Publisher, Inc., 116 W. 14th St., New York 11. 176 pages. Price $3.50.

Servicing Transistor Radios

By Leonard D'Airo. Published 1958 by Gernsback Library, Inc., 154 W. 14th St., New York 11. 224 pages. Price $2.90.

Metallic Rectifiers and Crystal Diodes

By Theodore Conti. Published 1958 by John F. Ryder Publisher, Inc., 116 W. 14th St., New York 11. 164 pages. Price $2.95.

Audio Measurements

By Norman H. Crowhurst. Published 1958 by Gernsback Library, Inc., 154 W. 14th St., New York 11. 224 pages. Price $3.50.

Basic Pulses

By I. Gottlieb. Published 1958 by John F. Ryder Publisher, Inc., 116 W. 14th St., New York 11. 176 pages. Price $3.50.

Transistor Theory and Circuits Made Simple

By Harvey Pollock. Published 1958 by American Electronics Co., 1203-05 Bryant Ave., New York 59. 124 pages. Price $1.75.

NEW TI SILICON ECONOMY RECTIFIERS

ACTUAL SIZE PHOTO

. . . give you 750 mA at 200, 400 and 600 PIV

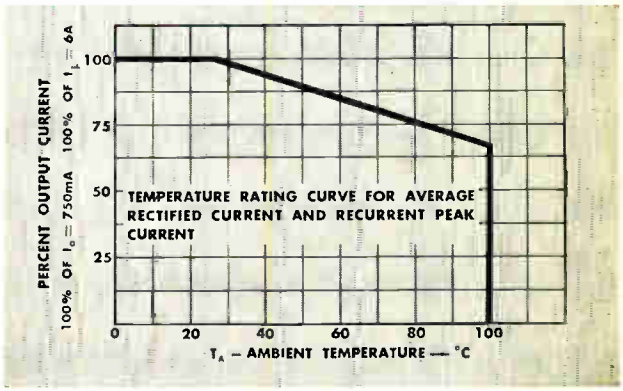
IMMEDIATE DELIVERY! You get the inherent high reliability of silicon with new TI silicon economy rectifiers *now available in commercial production quantities!*

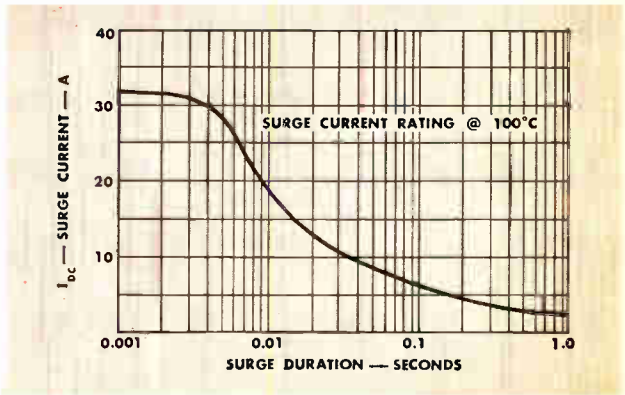
These newest TI rectifiers withstand a surge current of 32 amps up to one millisecond and operate at temperatures up to + 100°C. Miniature nylon-epoxy case, 0.25 inch long and 0.20 inch in diameter, meets the rugged environments of MIL-STD-202A.

Priced competitively with selenium and germanium rectifiers, the new TI series is ideal for use in your low current power supplies, computer circuits . . . for your large volume applications where small size, reliability and *low cost* demand important consideration.

Check the specifications below for the unit most suited to your particular requirements.

Quantities to meet your immediate needs are now in stock at TI distributors or through your nearest TI sales office.





Max Ratings at 25°C

		1N2069	1N2070	1N2071	
PIV	Peak Inverse Voltage	200	400	600	V
Vrms	RMS Voltage	140	280	420	V
I_o	Average Rectified Forward Current	750	750	750	mA
i_f	Recurrent Peak Current	6	6	6	A
T_A	Operating Temperature	——	to +100	——	°C

Electrical Specs at 100°C

	Maximum Dynamic Reverse Current	.2	.2	.2	mA
	Maximum Dynamic Forward Voltage Drop	.6	.6	.6	V

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TEXAS INSTRUMENTS
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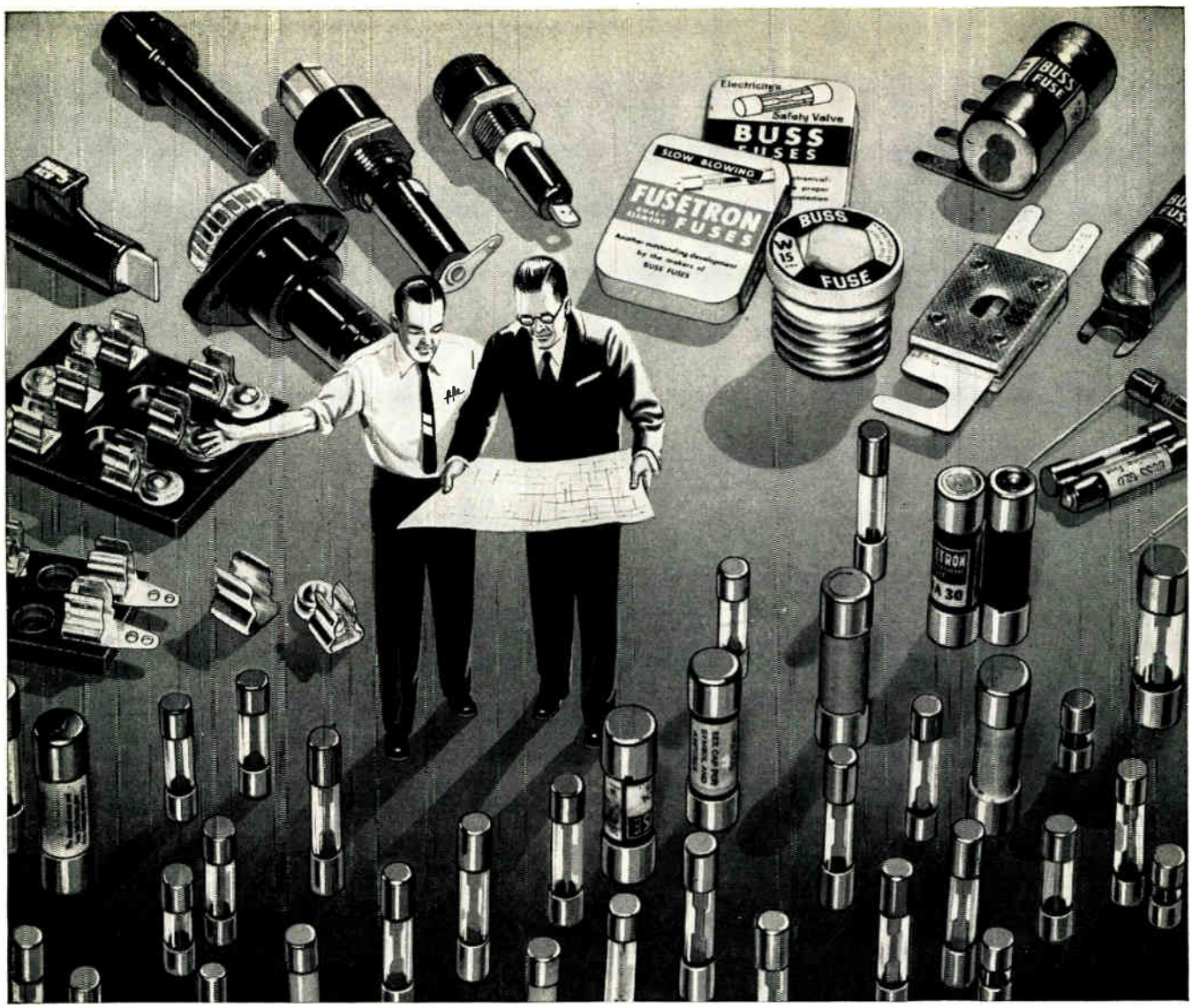
Circle 32 on Inquiry Card, page 117



Here's why you get the safest, most dependable electrical protection . . . *when you specify BUSS or Fusetron Fuses*

Each BUSS and FUSETRON fuse is designed and made to meet the highest standard of dependability. Every fuse is then tested in a sensitive electronic device that automatically rejects any fuse not correctly calibrated, properly constructed and right in all physical dimensions.

The dependability of BUSS and FUSETRON fuses provides equipment with maximum protection against damage due to electrical faults and — prevents useless shutdowns caused by faulty fuses blowing needlessly.

By operating as intended, BUSS and FUSETRON fuses help safeguard the reputation of your equipment for service and reliability.

To meet your needs, — there's a complete line of BUSS and FUSETRON fuses in all sizes and types, . . . plus a companion line of fuse clips, blocks and holders.

If you have an unusual or difficult electrical protection problem . . .

. . . the BUSS fuse research laboratory and its staff of engineers are at your service. In many cases, our engineers can help you save engineering time. Whenever possible, a fuse will be selected that is readily available in local wholesalers' stocks so that your equipment can easily be serviced.

For more information on the complete line of BUSS and FUSETRON Small Dimension Fuses and Fuseholders, write for bulletin SFB.

BUSSMANN MFG. DIVISION, McGraw-Edison Co., University at Jefferson, St. Louis 7, Mo.

BUSS fuses are made to protect — not to blow needlessly

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

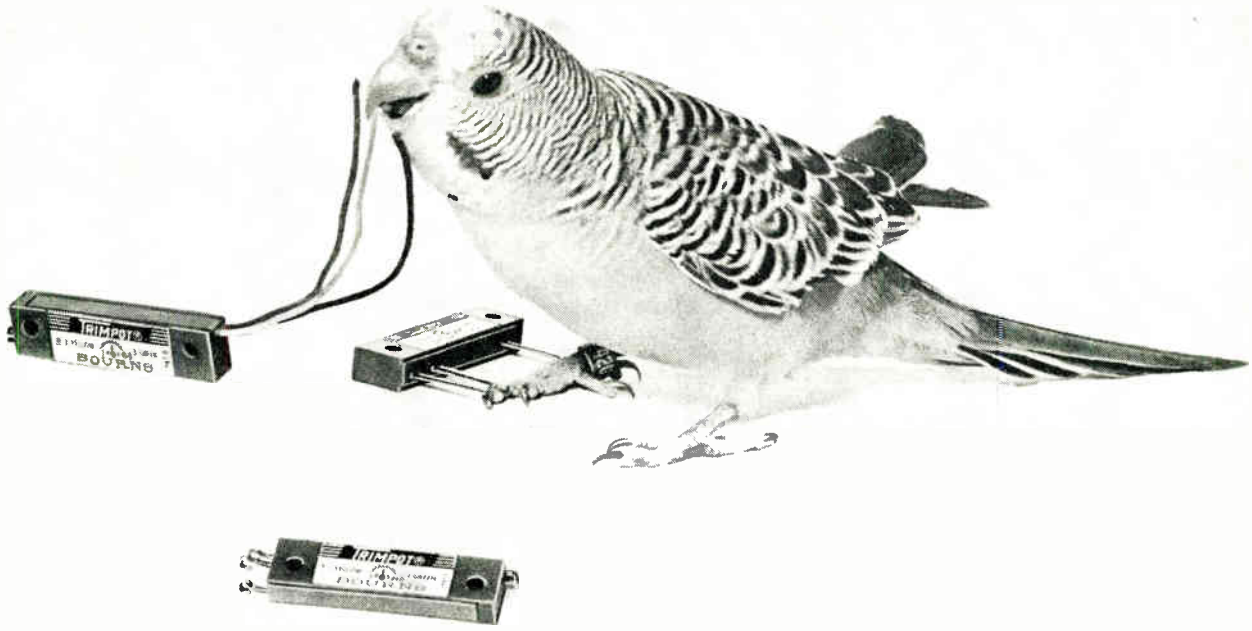
A COMPLETE LINE OF FUSES FOR HOME, FARM, COMMERCIAL, ELECTRONIC, AUTOMOTIVE AND INDUSTRIAL USE.

159

ONLY ONE POTENTIOMETER THIS SMALL GIVES YOU THESE 5 FEATURES

Mount 16 units per square inch—cross-section only 0.190" x 5/16"

1. High temperature operation—to 175°C.
2. Humidity-proof—new plastic molding technique makes possible a smaller, fully-sealed potentiometer exceeding specifications of MIL-STD-202A, 10 days.
3. Power rating: one watt at 70°C.
4. Standard mounting holes on one-inch centers.
5. Easier, more accurate settings—25 turn screw driver adjustment gives you 33 times the adjustability of single-turn potentiometers, easy repeatability. Settings are stable and self-locking.



IT'S THE NEW BOURNS TRIMPOT® MODEL 224

Available immediately from factory or distributors' stock with insulated stranded leads, solder lugs or printed circuit pins. Resistances: 100Ω to 50K. Exceeds military shock and vibration specs. For data on the new Model 224 TRIMPOT write to:

BOURNS *Laboratories, Inc.* P.O. Box 2112F, Riverside, California

EXCLUSIVE MANUFACTURER OF TRIMPOT® AND TRIMIT® • PIONEERS IN POTENTIOMETER TRANSDUCERS FOR POSITION, PRESSURE AND ACCELERATION

News of Manufacturers' Reps

REPS WANTED

A manufacturer of transformers, filters, toroids, magnetic amplifiers and transistorized power supplies, has the New England and Atlantic Seaboard territory available for representation. (Box Rl-1, Editor Electronic Industries).

J. C. Angel & Co., Chicago, Ill., is the rep in Illinois, Northern Indiana, Wisconsin and Eastern Iowa, for Technical Wire Products Inc.

Peninsula Assoc. is now rep in California, Washington, and Oregon for the Slaughter Co.'s line of standard high voltage insulation testers.

R. E. Vinson, Denver, Colo., has been appointed sales rep for Burnell & Co. in the Colorado, New Mexico, Utah, and Wyoming areas.

Ray Perron & Co., Boston, Mass., is now rep in the New England area for Digitronics Corp.

The Richard A. Strassner Co., Los Angeles and Redwood City, Calif., is now sales rep for Litton Industries' precision potentiometers in California, Arizona, Nevada, and New Mexico.

International Resistance Co. has two new reps: **McKinney Sales Co.**, Dallas, Tex., will represent the company in Texas, Oklahoma, Arkansas, Louisiana, Mississippi and Western Tennessee. **C. Hower**, Scottsdale, Ariz., will handle the account in Arizona.

F. F. Sylvester Assoc., Springfield, N. J., will represent Deltime Inc. in the New York-New Jersey Metropolitan area.

F. G. Harlow, Washington, D. C., is now the special rep in Washington, D. C., for Price Electric Corp.

V. J. Huntoon Co., Springfield, Mass., has been named sales rep in the New England area for Magnetic Controls Co.

Sanders Assoc., Inc., has appointed two new reps for its Flexprint line. **W. F. & John Barnes & Co.**, Rockford, Ill., and Detroit, Mich., will cover Wisconsin, Iowa, Indiana, Illinois and Michigan. **Jackson Edwards Co.**, North Hollywood, Calif., will cover southern California and Arizona.

Vernistat Div., Perkin-Elmer Corp. has announced that **Avionics Liaison, Inc.**, Seattle, Wash., is the new rep for the Washington and Oregon territory, and **Eder and Assoc.**, Milwaukee, Wis., for Wisconsin, Minnesota, northern Illinois and eastern Iowa.

Power Sources, Inc., has announced the appointment of **Danco Corp.**, Fairview Village, Pa., as sales-engineering rep in the eastern Pennsylvania, southern New Jersey, and Delaware areas.

George Gregory and Assoc., West Newton, Mass., have been named New England sales rep for Cubic Corp., in Massachusetts, Connecticut, Rhode Island, New Hampshire, Maine, and Vermont.

E. J. Casey, until recently with Remington Rand Univac, has announced the opening of a consulting engineering service at 2800-40th Ave., So., Minneapolis, Minn.

Jeta, Inc., has announced the appointment of **Teltech International Corp.**, New York City, as export rep for its JETAPOWER line of electric generating plants.

The L. L. Schley Co., West Newton, Mass., has been appointed rep for Telemeter Magnetics, Inc., in the New England area.

H. Schwartz, Briarcliffe Manor, N. Y., is now Resident Sales Engineer in the Metropolitan New York territory for the Isochem Resins Corp.

Lloyd F. Murphy & Assoc., Minneapolis, Minn., are now reps for H. H. Buggie, Inc.

Mid-Eastern Electronics, Inc., announces the following as new reps, **J. L. Pierce Co.**, Detroit, Mich., for Michigan; **Wilco Assoc.**, Washington, D. C., for District of Columbia, Virginia, West Virginia, and Maryland; **Bilray**, Louisville, Ky., for Indiana and western Kentucky; **Lowry Dietrics Co.**, Pittsburgh, Pa., for Ohio, western Pennsylvania and Eastern Ky., and **R. E. Weber Co.**, So. River N. J., for Metropolitan New York, eastern Pennsylvania, New Jersey and Delaware.

The Taylor Co., Winter Haven and Tampa, Fla., will represent Westinghouse Electronic Tube Div. for sales of receiving, picture, power and special purpose tubes, and semiconductor devices.

Consolidated Avionics Corp., a subsidiary of Consolidated Diesel Electric Corp., has designated **Aircraft Electronics Co.** of Wichita, Kans., as manufacturers' rep in Kansas, Texas, Oklahoma, Missouri and Washington.

Carrier & Gable, Inc., Detroit, Mich., is now manufacturers rep in Michigan, for the Rotron Mfg. Co., Inc., line of cooling devices for the electronics industry.

Tally Register Corp. has appointed **H. W. Ruby & Assoc.** of La Canada, Calif., as sales rep in California and the southwestern United States.

Circle 36 on Inquiry Card, page 117 →

use beam switching tubes for DISTRIBUTING

use beam switching tubes for . . SWITCHING

use beam switching tubes for . . .SAMPLING

use beam switching tubes for . . . . .CODING

use beam switching tubes for . . . . . TIMING

use beam switching tubes for counting

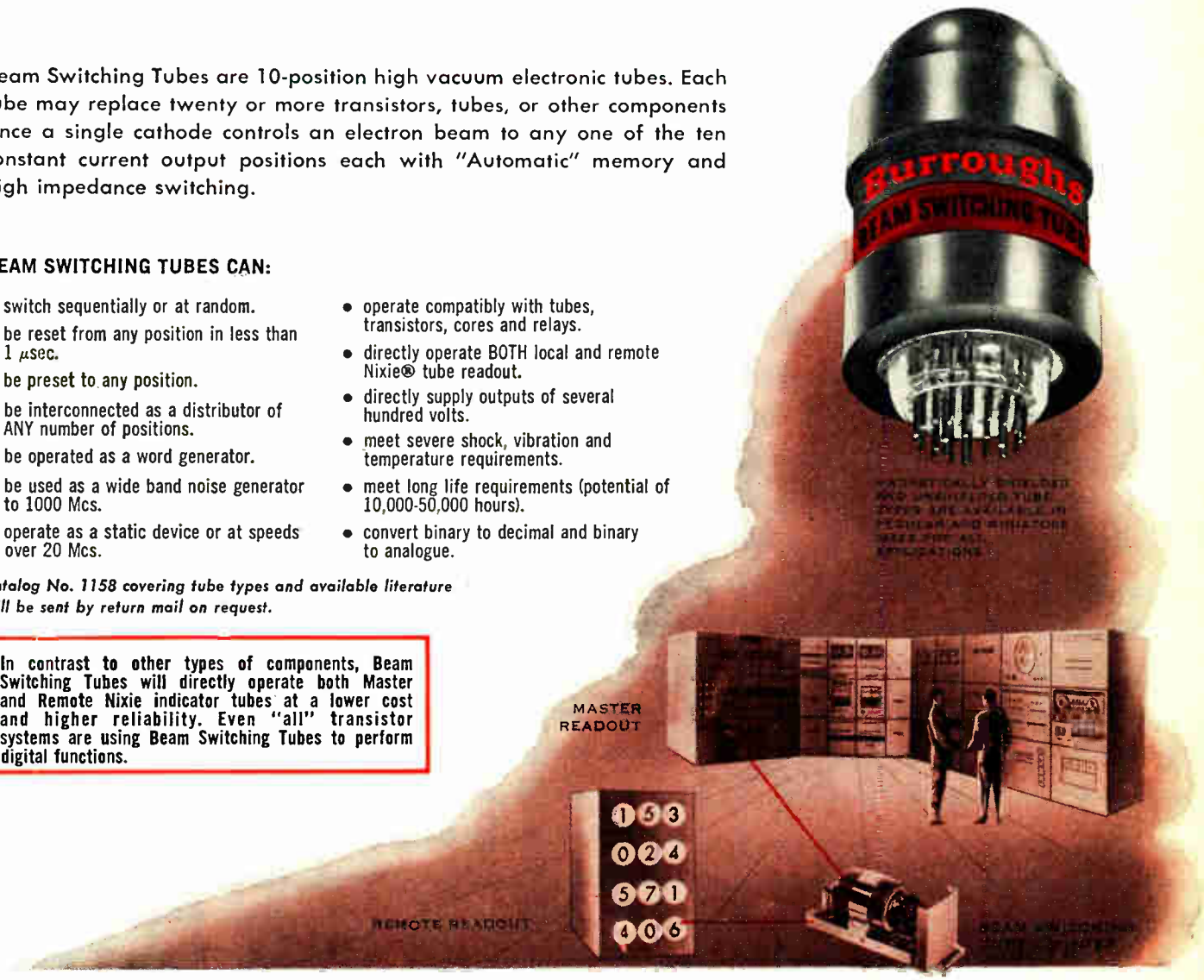
Beam Switching Tubes are 10-position high vacuum electronic tubes. Each tube may replace twenty or more transistors, tubes, or other components since a single cathode controls an electron beam to any one of the ten constant current output positions each with "Automatic" memory and high impedance switching.

BEAM SWITCHING TUBES CAN:

- switch sequentially or at random.
- be reset from any position in less than 1 μsec.
- be preset to any position.
- be interconnected as a distributor of ANY number of positions.
- be operated as a word generator.
- be used as a wide band noise generator to 1000 Mcs.
- operate as a static device or at speeds over 20 Mcs.
- operate compatibly with tubes, transistors, cores and relays.
- directly operate BOTH local and remote Nixie® tube readout.
- directly supply outputs of several hundred volts.
- meet severe shock, vibration and temperature requirements.
- meet long life requirements (potential of 10,000-50,000 hours).
- convert binary to decimal and binary to analogue.

Catalog No. 1158 covering tube types and available literature will be sent by return mail on request.

In contrast to other types of components, Beam Switching Tubes will directly operate both Master and Remote Nixie indicator tubes at a lower cost and higher reliability. Even "all" transistor systems are using Beam Switching Tubes to perform digital functions.



ANOTHER ELECTRONIC CONTRIBUTION BY

Burroughs Corporation

ELECTRONIC TUBE DIVISION

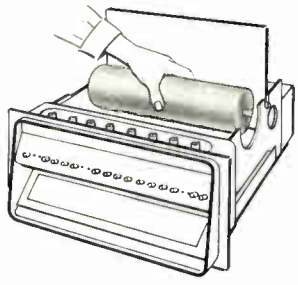
Plainfield, New Jersey

These features of

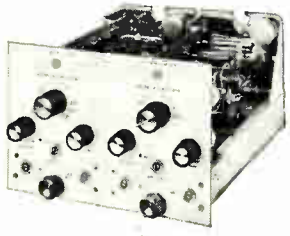
new Brush ultralinear recording systems...

. . . give you more application versatility!

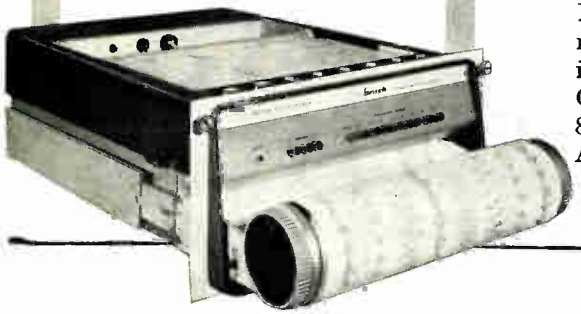
Simplified Chart Re-loading.



Interchangeable, plug-in signal conditioners.



Positive Chart Take-up Drive.



In the fields of telemetry, ground support systems, analog computing and laboratory testing, Brush recording systems have incorporated features which have consistently kept ahead of engineering requirements. Here are a few that show why—

INTERCHANGEABLE PLUG-IN SIGNAL CONDITIONERS. You get your *choice of sensitivities*—you get high input impedance—zero suppression.

SIMPLIFIED FAST CHART RE-LOADING. Loaded from the top—features automatic alignment and tracking.

ACCURATE, EASILY REPRODUCIBLE RECORDINGS. Your choice of rectilinear or curvilinear charts—rugged "throw-proof" pens.

Illustrated above is a Brush RD-1684 rectilinear, 8 channel recording system. Sensitivity of 10 millivolts per chart line—input impedance, 10 megs balanced or 5 megs grounded. Complete system includes mobile cabinet, oscillograph and 8 signal conditioners. No additional preamplifiers required. Available from stock.

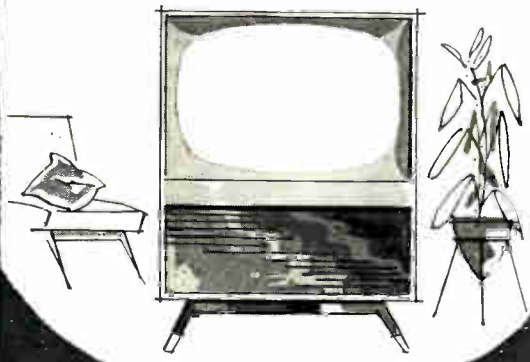
brush INSTRUMENTS

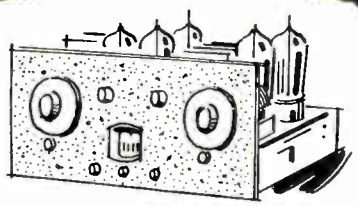
DIVISION OF

37th & PERKINS — CLEVITE CORPORATION — CLEVELAND 14, OHIO

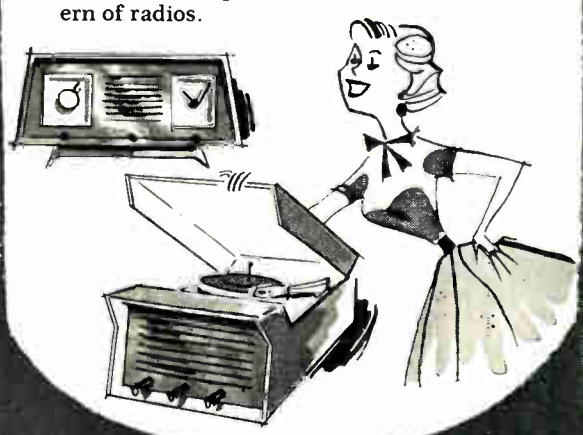
Circle 37 on Inquiry Card, page 117

FROM "GIANT" 10-INCHERS TO "SUPER-COLOSSAL" 27'S . . . early black-and-white to the latest rainbow colors . . .





FROM PRIMITIVE "TRF'S" TO THE HIGHEST OF THE "FI" . . . the earphone era to the most modern of radios.



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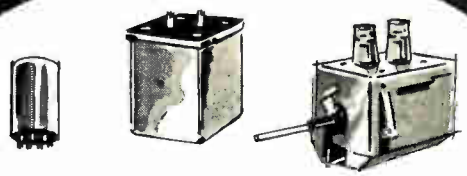
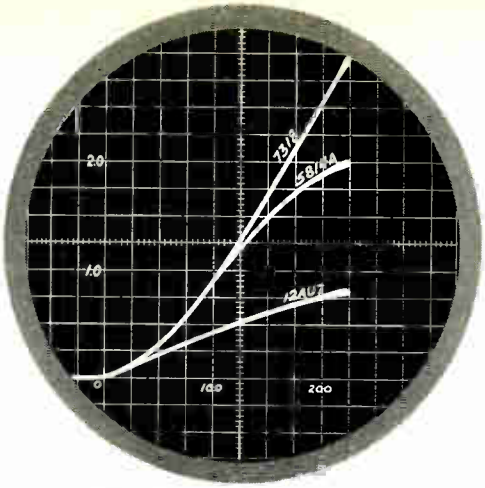
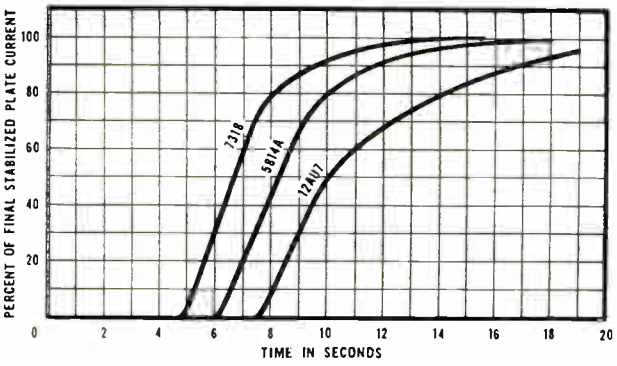


FOR MORE THAN HALF A CENTURY, one of the "constants" of the ever-expanding electronics industry has been Kester Solder. Equipment and components originally soldered with Kester continue to give excellent service; regardless of their age, the soldered joints stay in perfect condition for the life of the unit. That's why Kester Flux-Core Solder has the greatest acceptance in the industry . . . why you should always insist on Kester.

WRITE TODAY for the KESTER 78 page textbook "Solder . . . Its Fundamentals and Usage." Free!



"Y" Axis Peak Cathode Current in Amperes
"X" Axis Grid Drive in Volts



Warm-up characteristics of 7318 • 5814A • 12AU7

New 7318 miniature pulse tube offers . . .

. . . 2 AMPERES PEAK CURRENT
The compact CBS-Hytron 7318 will provide, for example, 2 amperes peak current in 1.5-microsecond pulses at 2300 p.p.s.

. . . FAST OPERATIONAL WARM-UP
In less than 10 seconds the 7318 reaches 80% of steady-state plate current.

. . . ENVIRONMENTAL TESTS EXCEEDING MIL-E-1
Severe environmental tests and factory stabilization insure dependability of the 7318.

COMPARE THESE ENVIRONMENTAL TESTS

Test	CBS-Hytron 7318	JAN 12AU7 JAN 5814A
High-frequency vibration	√	None
High-frequency fatigue	√	None
Low-frequency vibration	√	√
Linear acceleration	√	None
Temperature cycling	√	None
Shock (JAN-5-44)	√	None

CBS-Hytron 7318 exceeds MIL-E-1 standard environmental requirements, most of them by factors of 3 or 4 times.

More Reliable Products through Advanced-Engineering

CBS-HYTRON, Danvers, Massachusetts
A Division of Columbia Broadcasting System, Inc.

MANY USES for this rugged 9-pin medium-mu twin triode include: industrial, computer, missile, satellite and manned-aircraft applications. The CBS-Hytron 7318 is ideal for blocking oscillators, square-wave modulators, multivibrators and hybrid tube-transistor circuits.

Write for Bulletin E-318. It gives complete technical and application data, characteristic curves and environmental ratings on the CBS-Hytron 7318.

This is the second in a planned series of editorial features on wire and cable and their applications in the electronic industry.

What Every Engineer Should Know About

High Temperature Wire & Cable

If you specify wire for high temperature use in the electronic field, then you should know all the facts about wire which are given here. Information about the latest types of conductor material, insulation, and methods of applying insulation to the conductor are included to aid you in selecting the right wire for your particular use.

By F. X. BUSCHMAN
Vice Pres. of Operations
Tensolite Insulated Wire Co., Inc.
West Main St.
Tarrytown, N. Y.

Part One of Two Parts

Fig. 1: The tensile tester is being used to determine the breaking strength and elongation quality of extruded Teflon.

THE primary purpose of wire is to transmit electrical energy from one point to another with a minimum of loss. A material low in electrical resistance must therefore be used as a conducting medium. The most commonly used metal is copper.

Copper possesses other characteristics that make it desirable:

1. It is reasonably abundant in nature.
2. It possesses extreme malleability and ductility, thereby enabling it to be worked into the many shapes and sizes required.
3. It alloys readily with other metals so that protective coatings can be readily applied.

Metals other than copper are used in many electrical applications as conductors, but copper continues to be the prime metal. Aluminum, as an example, is lower in density than copper, but in the purest form where its conductivity is closest to that of copper (approximately 60%), it is extremely difficult to cold work and is not generally available in the small wire sizes

The copper which is used in electrical conductors is generally electrolytically refined from mined ores and in a finished ingot is referred to as Electrical Tough Pitch (ETP Copper). This copper is rated at 99.90 of the conductivity of pure copper with any silver content being allowed as copper.

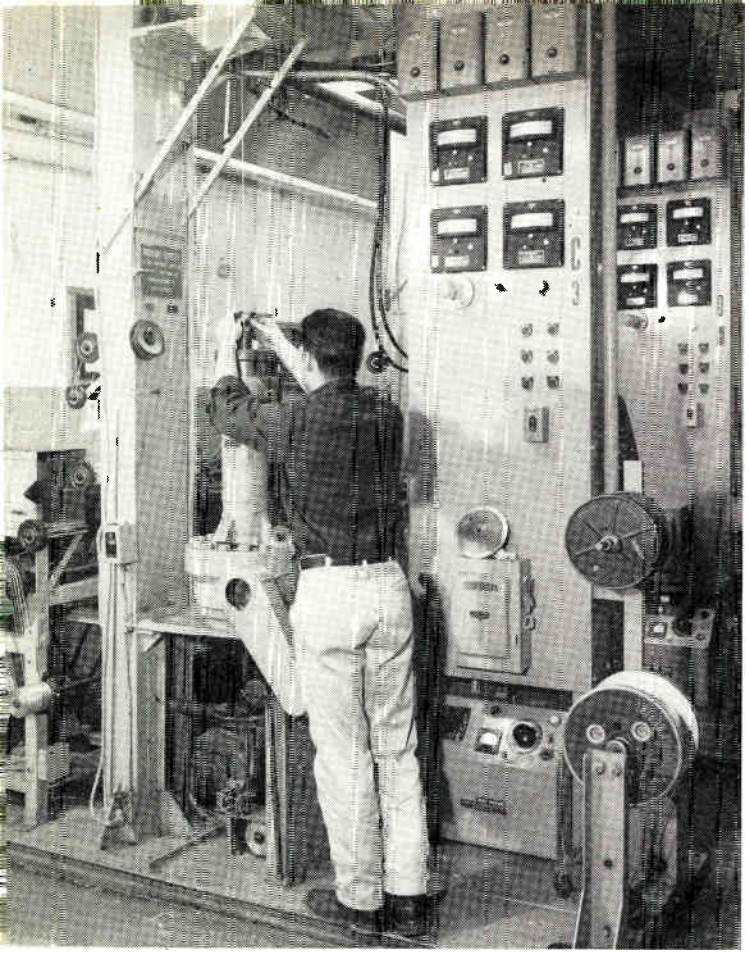


Fig. 2: Ram type extruders are used to manufacture Teflon insulated hook-up wire. Diameter is being checked by operator.

High Temperature Wire

(Continued)

There is another grade of electrolytic copper known as OFHC (Oxygen Free High Conductivity) in which special processing is used to provide a more oxygen free copper which possesses slightly lower tensile properties.

After refinement, the copper bars are rolled into rods and then drawn into finished wire sizes on wire drawing machines. In this type of equipment, the copper is pulled through a successive smaller series of dies making the wire smaller in diameter and longer in length. Copper, because of its extreme ductility, can be reduced in size by the process described above from rod 5/16 of an inch in diameter to wire two thousandths of an inch in diameter without any intermediate annealing or heat treatment.

Standards must be used to define wire diameters on a comparative basis and to relate these with the resistance to the flow of electrical current that will be anticipated at varying diameters. The standard which is almost universally used is the Brown and Sharpe Gauge (B & S) or the American Wire Gauge (AWG). The higher the gauge the smaller the diameter.

The following five general rules apply to the American Wire Gauge (AWG):

1. A #10 AWG wire has a diameter of approximately 0.10 in., an area of approximately 10,000 circular mils and a resistance of approximately 1.0 ohm per 1,000 ft.

2. A size increase of 3 AWG numbers, that is, from #10 to 7, doubles the cross-sectional area and weight, and consequently halves the dc resistance. Conversely, as size decrease of 3 AWG numbers, that is, from #10 to 13, halves the cross-sectional area and weight and consequently doubles the dc resistance.

3. A size increase of 6 AWG numbers, that is, from 10 AWG to 4 AWG, doubles the diameter, and conversely, a decrease of 6 gauge numbers, that is, from 10 AWG to 16 AWG, halves the diameter.

4. A size increase of 10 gauge numbers multiplies the area and weight by 10 and divides the resistance by 10.

5. The weight of #2 AWG copper wire is very close to 200 lbs. per 1,000 ft.

All copper conductivity measurements stem from the International Annealed Copper Standard (IACS) which defines the resistance of annealed copper to be 10.371 ohms (mil ft.) at 20°C. In many electrical applications, copper wire is over-plated with another metal to either provide protection from corrosion in use or in processing, or to facilitate soldering when this will be required in the final usage of the finished electrical wire. The more commonly used coatings are tin, tin lead alloys, lead, or pure silver. In terminology, tinned copper is usually abbreviated TC and silver plated copper SPC. In nearly all high temperature wire applications, the copper conductor is silver plated. For extremely specialized applications, coatings other than the above may be used but they are not too common.

Fig. 3: Stranded conductor cross section shows the different types of wire construction.

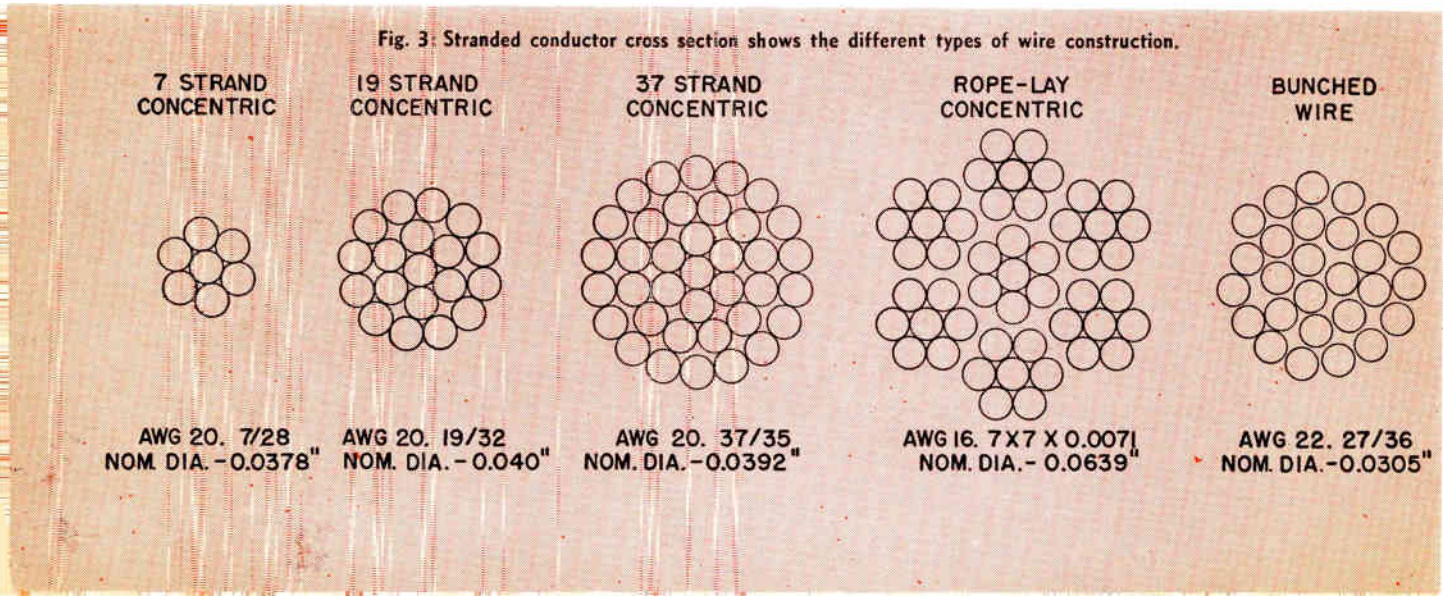


Fig. 4: A Munsell color book is being used to check wire color.

Stranding

In order to arrive with an electrical conductor which has a high degree of flexibility, greater flex life, and more resistance to vibration than a single strand of copper wire, most electrical copper conductors are composed of a multiplicity of individual strands or filaments of wire twisted together.

There are two general methods of twisting individual ends of wire to form a finished stranded wire. These are known as bunch stranding and concentric stranding. In bunch stranding a number of wires are twisted together in a common direction and with a uniform pitch (or twist per inch).

In concentric stranding the final wire is built up in mathematical layers so that the inner diameter of a succeeding layer is always equal to the outer diameter of the underlying layer. Thus, in a 20 AWG wire, a concentric stranded wire would be 19/32 AWG implying that 19 strands of the 32 gauge wire are used in the finished wire. In this construction, 6 ends of wire are first twisted around one used as a core, and then 12 wires are laid around these 7.

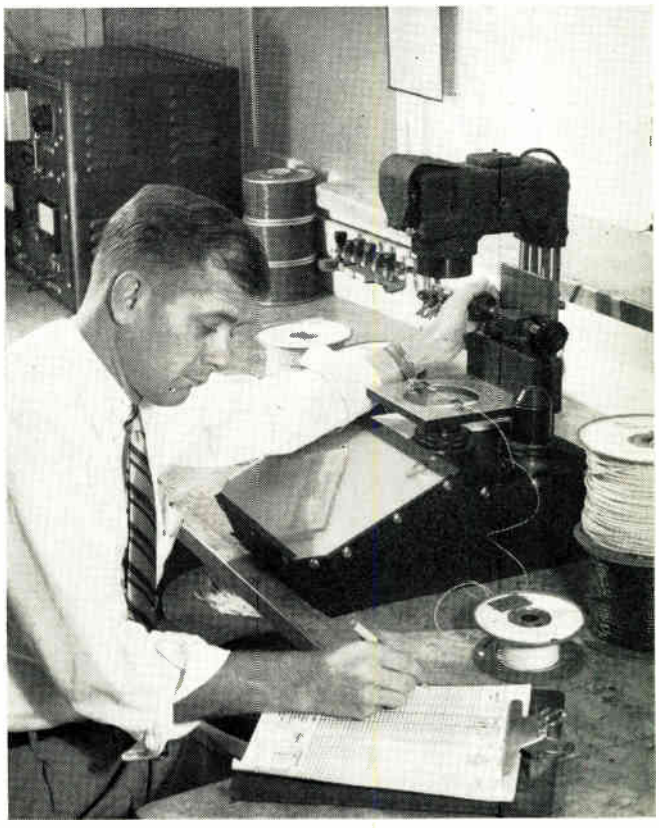
In general, bunched stranded wire is more flexible than concentric stranded wire but is less uniform in diameter. An extremely important consideration in either bunched, stranded or concentrically stranded wire is the pitch or the number of twists per inch and the direction in which the wire is twisted. Both of these characteristics are commonly referred to as the lay of the wire. As an example, in the 19/32 stranding, were we to say that it has a half inch left hand lay, we would mean that the distance between the re-occurrence of any one strand on the outer layer of 12 is ½ in., and the wire, when held in front of an observer, would twist in a counterclock-wise direction or to the observer's left.

In concentric stranding it is common to oppose the directions of lay in succeeding layers. In some large sizes of wire where extreme flexibility is required, rope lay stranding is employed. In this type of conductor, a number of individual ends of wire are first twisted together and they are then built up as described above in concentric stranding. As a general rule, shorter lays in stranded conductors will be less

Table 1—Common Strandings

AWG	Type	Stranding	Single End Wire Size	Nominal Diameter
10	Concentric	37/26	0.0159	0.111
10	Rope Lay Concentric	133/31 (19x7x0.0089)	0.0089	0.1335
12	Concentric	19/25	0.0179	0.0895
12	Rope Lay Concentric	133/33 (19x7x0.0071)	0.0071	0.1065
12	Bunched	65/30	0.010	0.092
14	Concentric	19/27	0.0142	0.071
14	Concentric	37/29	0.0113	0.079
14	Rope Lay Concentric	133/35	0.0056	0.084
16	Concentric	19/29	0.0113	0.0565
16	Concentric	27/30	0.010	0.0576
16	Bunched	26/30	0.010	0.0615
18	Concentric	7/26	0.0159	0.0477
18	Concentric	19/30	0.010	0.050
18	Concentric	27/32	0.008	0.046
20	Concentric	7/28	0.126	0.0378
20	Concentric	19/32	0.008	0.040
20	Bunched	41/36	0.005	0.039
22	Concentric	7/30	0.010	0.030
22	Concentric	19/34	0.0063	0.0315
22	Bunched	27/36	0.005	0.030
24	Concentric	7/32	0.008	0.024
24	Concentric	19/36	0.005	0.025
24	Bunched	16/36	0.005	0.024
26	Concentric	7/34	0.0063	0.0189
26	Concentric	19/38	0.004	0.020
26	Bunched	10/36	0.005	0.019
28	Concentric	7/36	0.005	0.015
30	Concentric	7/38	0.004	0.012
32	Concentric	7/40	0.003	0.009

Fig. 5: An optical surface projector is used for diameter measurements and for concentricity measurements at 20X and 50X.



High Temperature Wire
(Continued)

flexible than longer lays but will provide more uniform diameters throughout the length of the wire.

It is important in ordering wire, when the construction of the conductor is not referred to in any specification, to specify the type of conductor required for a specific gauge size to be used in the cable. Over many years standard wire constructions have been evolved which suit many requirements of flexibility, etc., in particular finished gauge sizes. (See Table 1.) Selecting the wire constructions shown in this table will simplify procurement since these conductors are generally readily available.

Insulation

The energy transmitted may be the many kilovolt amperes or it may be the small amount of electrical energy required to transmit signals in electronic components measured in microvolts and milliamperes. In nearly all cases, however, an insulating material is applied to the conductor to minimize the loss of electrical energy, protect the conductor from external influences which may damage it, or further losses.

Electrical insulating materials fall into four general classes which may in turn be subdivided.

1. Solid: Natural; vitreous; fibrous; organic; rubber; and substitutes.

2. Plastics: Synthetic resins; waxes; and gums.

3. Liquids: Natural oils; mineral oils; varnishes; solvents.

4. Gases.

Teflon, polyvinylchloride, nylon are some examples of plastic insulating materials.

Liquids and gases are rarely used as insulating materials for electronics and aircraft wire, although many types of lacquers and varnishes are used as sealing agents in connection with other types of insulating mediums. Most of the more commonly used insulating materials are outlined in Table 2.

In comparing insulating mediums to select for a specific application, it is obvious that some method of evaluating, on a relative basis, their respective properties must be done. The more important characteristics which must be considered are:

1. Temperature Rating: That is, the maximum temperature at which the material may be used in operation continuously without loss of its other basic properties.

2. Dielectric Constant: A measurement of its insulating efficiency. Dielectric constant is in itself a comparison of the insulating effectiveness of a material as compared to a vacuum which is arbitrarily assigned a constant of unity.

3. Chemical Resistance: If the finished wire will operate in or around presence of materials which can corrode or otherwise deteriorate a conductor, or if penetrable to the conductor can cause dielectric loss, an insulating medium must be chosen to prevent these actions.

4. Flexibility: Particularly in electronics and aircraft or missile installation where assemblies are made in restricted spaces, a high degree of flexibility must be maintained.

Fig. 6 (below): Dielectric test is being performed on a tape sample of insulation.

Fig. 7 (right): Cabler used to twist several single conductors into a multi-conductor.

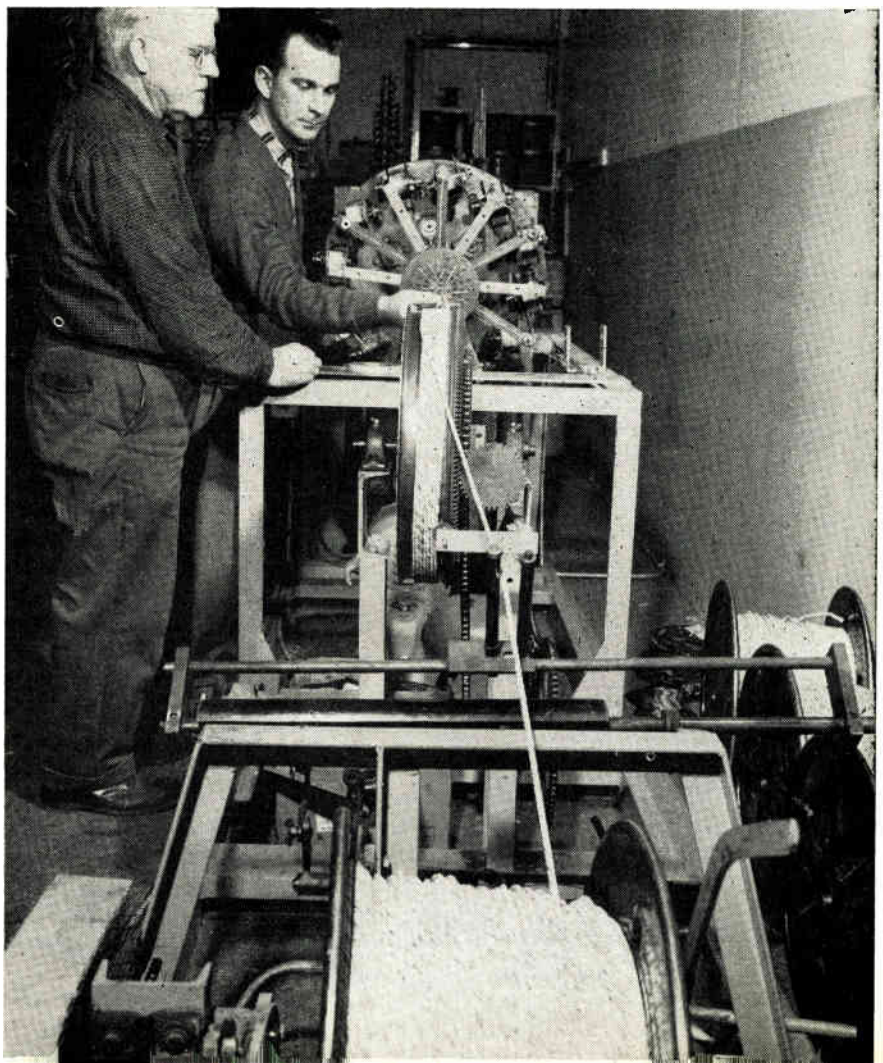


Table 2—Insulation Properties

Material	Temperature Rating	Dielectric Constant	Volume Resistivity, OHMS/CM	Flexibility	Moisture Absorption	Chemical Resistance
Asbestos[1]	500°C	7.0	—	Good	—	—
Dacron*[1]	150°C	3.8	—	Good	—	—
Glass[1 2]	1000°C	5.3	—	Good	—	—
Kel-F**	150°C	2.37	$1.2–10^{18}$	Fair	0.0%	Not resistant to certain halogenated materials.
Mylar*	150°C	3.16–3.7	10^{19} (1 mil tape)	Poor	0.5%	Not resistant to concentrated acids, alkalies.
Neoprene	120°C	5.0	10^{8} –10^{12}	Excellent	0.02%	Not resistant to hydrocarbon oils.
Nylon	120°C	3.4	$4x10^{14}$	Poor	1.6%	Not resistant to strong acids, phenol, formic acid.
Polyethylene	80°C	2.3	10^{16}	Fair	0.0%	Not resistant to aliphatic and aromatic chlorinated hydrocarbons.
Silicone	200°C–260°C	2.98–3.2	$10^{13}–10^{14}$	Excellent	0.04%	Not resistant to concentrated sulphuric acid, diesters, acetone. Resistance varies with compound and formulation.
Teflon*	250°C	2.1	$>10^{15}$	Good	0.0%	Alkali metals and fluorine at high temperatures.
Vinyl	105°C	3.0 –7.5	$1.0x10^{12}$ $2.5x10^{12}$	Good	0.5%	Not resistant to organic solvents.

[1] These materials usually used in fibrous forms. Have no wet dielectric strength unless saturated.
[2] Under glass are included ceramic fibers.
* DuPont. ** Minnesota Mining and Manufacturing Co.

NOTES
Dielectric constant is dependent on frequency and temperature. Compounded insulations will have a dielectric constant dependent on the formulation used.
Flexibility is defined as the relative stiffness of the various materials. In the case of an insulated wire, it is dependent on conductor size and stranding, and insulation thickness.

5. Moisture Absorption: Where conditions of high humidity or the presence of water are anticipated, a resistance to the absorption of moisture becomes critical in the selection of insulating materials.

6. Effects of Soldering: Since many wire terminations in electronics and aircraft assemblies are accomplished by soldering the conductor to a termination point, and this is frequently done in confined spaces, an insulating material which is not affected by the heat present in the soldering operation is very frequently a must.

In analyzing the various properties of insulating materials as shown in Table 2, it will be noted that Teflon possesses those properties which make it most nearly perfect for wire insulation for the design considerations anticipated for electronics and other similar applications. It will be noted that of all the mediums, it possesses the lowest dielectric constant, the greatest resistance to chemical attack, a zero moisture absorption and a high degree of flexibility. In addition, the effects of soldering on Teflon are nil since the decomposition temperature of this plastic is above that of normal soldering temperatures.

Methods of Insulation

In general, there are four methods of applying an insulating material. These are done by wrapping, extrusion, dip coating, or braiding. Each method has a specific purpose and is performed by different types of equipment.

1. Extrusion: Basically, the extrusion process consists of flowing plastic materials through a forming die and subsequently cooling the material to form an homogeneous solid cylinder around the wire. With Teflon, however, this process is somewhat different in that a Teflon extrusion compound is applied to the conductor through a suitable forming die at low temperatures and is then subsequently heated to a sintering or fusing temperature through a series of continuous ovens.

2. Wrapping: This method of insulating wire consists of serving insulating tapes around a conductor. This may be accomplished by a process such as is employed in the Flexolon wire or by wrapping tapes spirally in a close helix around a conductor.

3. Dip Coating: In dip coating, the conductor is passed through an applicator containing a liquid insulating medium, then sized, then through a series of ovens to solidify the insulation. This is a common method for magnet wire.

4. Braiding: In braiding, multiple ends of fine filaments of insulating materials are woven as a cylinder around the conductor.

Secondary Operations

After an electrical conductor has been insulated,

(*Continued on page* 148)

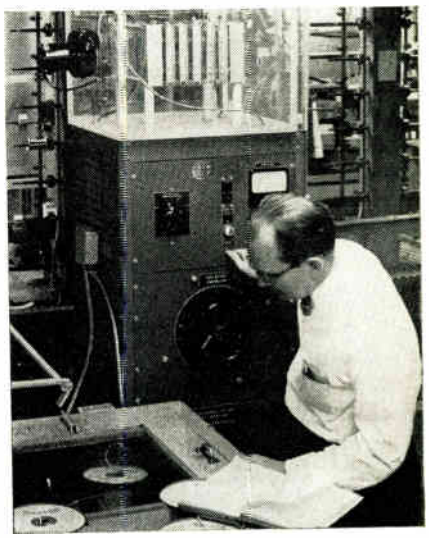


Fig. 8: "High pot" tester checks dielectric strength of wire totally immersed in water.

Focusing Traveling Wave Tubes

In the past traveling wave tubes were focused with permanent magnets. This focusing method greatly increased their weight and bulk. Electrostatic focusing described here eliminates these magnets and also the problem of aligning the tube in the magnetic field.

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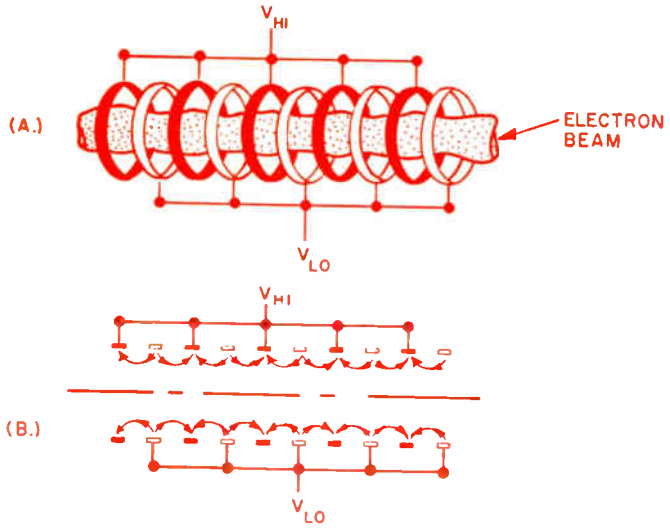
TRAVELING-WAVE tubes usually employ a long, thin cylindrical electron beam that must be confined continuously throughout its length by electric and/or magnetic forces. Although a somewhat similar beam is used in kinescopes and image orthicons without confining forces, the density of the beam in these applications is several orders of magnitude smaller than that required in traveling-wave tubes. The common method of overcoming the diverging space-charge forces in a high-density stream of electrons is to use an axial magnetic field, either uniform or alternating, along the axis of the beam. By using a series of small ceramic permanent magnets to provide a periodic magnetic field on the axis of the beam, the weight and focusing power required can be reduced substantially below that necessary for uniform magnetic fields. However, much of the bulk and weight in a packaged traveling-wave tube of this type is still due to the magnets. The use of electrostatic forces to focus the electron beam in a traveling-wave tube eliminates the need for magnet structure, considerably reducing the weight of the packaged tube and also eliminating the problem of alignment of the tube within the magnetic field.

Fig. 1: Electrostatic focusing of an electron beam



Electrostatic Focusing

A number of ways of accomplishing this type of focusing have been explored by several research laboratories. The simplest approach is to direct the electron beam through a succession of electrostatic lenses[1] formed by a series of rings or disks held alternately at high and low potentials (V_{HI} and V_{LO}) with respect to cathode. Such a structure is shown in Fig. 1a. The electrostatic field resulting from the voltage between adjacent rings produces forces on an electron as shown by the arrows in Fig. 1b. The electrons move slowly when they are in the vicinity of a low-voltage ring where the radial component of electrostatic force on them is directed inward, and faster when they are near the high-voltage rings where the electrostatic forces are directed radially outward. Because of this difference in velocity, the electrons spend more time in the neighborhood of the low voltage ring. The over-all effect, therefore, is an inward

Part of the development of the electrostatically-focused device, the Estiatron, which is discussed in this paper was sponsored by the Air Force Cambridge Research Center, Air Research and Development Command, Bedford, Mass., under Contract No. AF19(604)-1947.

focusing force on the electrons which serves to balance the space-charge repulsion in the beam. The electrostatic field which focuses the electron beam also serves as an ion trap, drawing any positive ions created in the beam out to the low-voltage rings.

Because the helix used in conventional traveling-wave tubes is a relatively simple structure that makes possible the transmission of r-f energy over extremely wide bandwidths, it is apparent that an electrostatic focusing method that utilizes the helix structure is highly desirable. A convenient way of preserving the basic r-f properties of the helix and at the same time permitting electrostatic focusing is to interwind two helices in a bifilar manner.[2] An electrostatic-focusing action similar to the one described above can be obtained by operating the two helices at different potentials. The average beam velocity must be very nearly equal to the wave velocity to obtain interaction between the component of the r-f wave traveling along the tube axis and the electron beam. The average of the two helix voltages, therefore, must be approximately the voltage at which the tube would operate if focused conventionally.

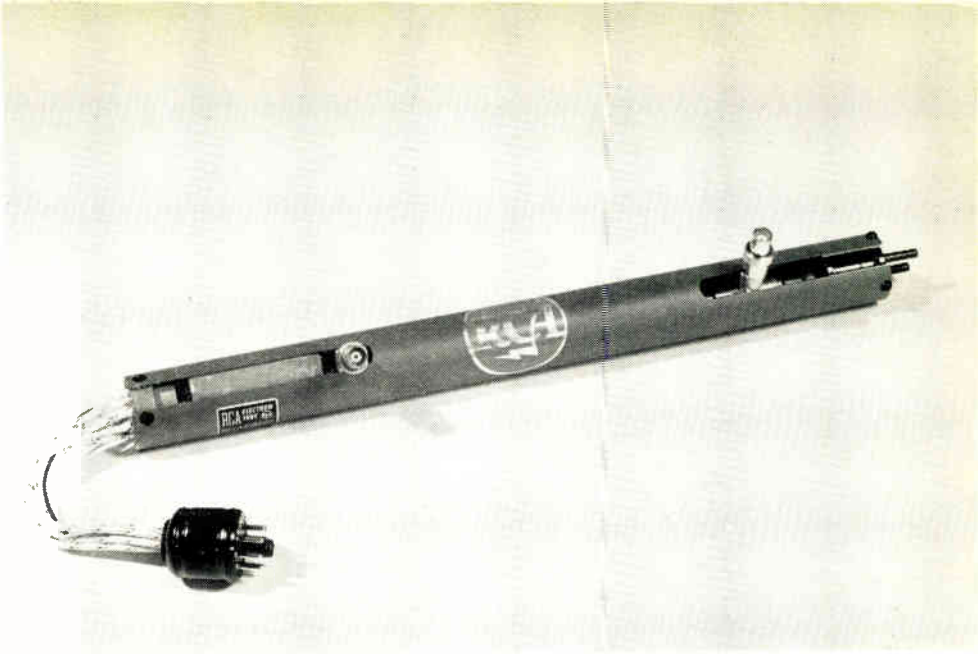


Fig. 2: The Estiatron traveling wave tube is electrostatically focused

The Estiatron

The bifilar helix design is used by RCA in a developmental, 10-watt, S-band "Estiatron".* Fig. 2 is a photograph of a packaged Estiatron, and Fig. 3 is a cutaway drawing showing its construction. The convergent-flow electron gun launches the beam into the bifilar helix region where it is focused electrostatically until it reaches the hollow collector. Because the beam power is approximately 100 watts, the collector has cooling fins to radiate heat. Coupled-helix-type r-f input and output transducers external to the glass envelope of the tube provide well-matched transitions over an octave bandwidth. The attenuator, which is also an external coupled helix, is embedded in a hollow cylinder of lossy material to provide a cold insertion loss of 50 db. This prevents oscillation which might otherwise occur if the input or output were mismatched.

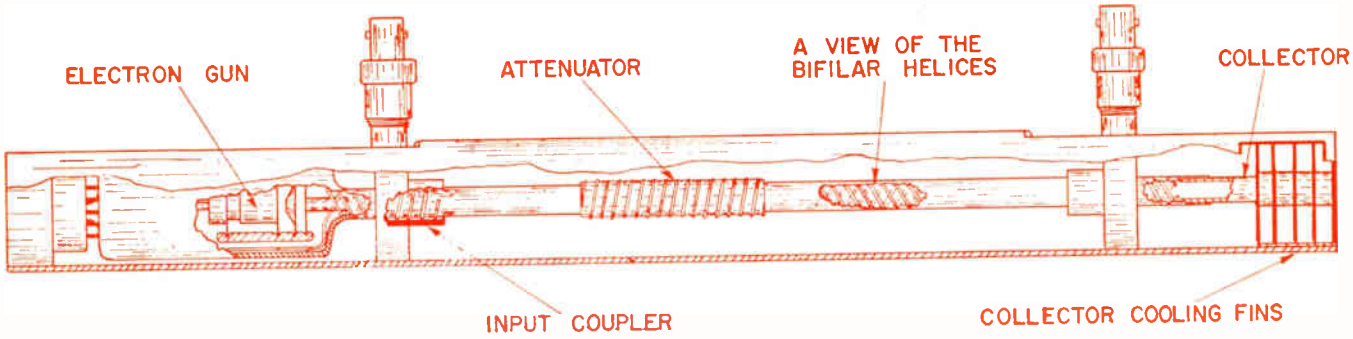
The focusing performance of the Estiatron is shown in Fig. 4. The curve shows that, in the absence of r-f input, over 99% of a 50 ma. beam is transmitted when the voltage difference between the two helices is 2000 volts. The effect of the r-f signal on the beam is slight. At r-f saturation (maximum possible r-f power output for this beam current), the beam transmission is still 98.5%. The interception depends on the voltage difference between helices. As this voltage is decreased below 2000 volts, the interception increases sharply, although the power output remains constant at 16 watts CW and the gain holds steady at 21 db over a wide range of voltages. Thus, small voltage variations will not materially affect gain or power output or cause undue interception.

The gain and power output are shown in Fig. 5. In this Fig. CW power output is plotted as a function of power input for 3 frequencies, the voltages being held constant at the saturation synchronous values. Dashed lines of constant gain are drawn through the figure. At 1900 MC, for example, the gain is constant at 28 db up to a power output of 13 watts, and saturates at a power output of 21 watts with 23 db gain.

The tube will deliver 8 to 10 watts of cw power

* RCA's contribution to electrostatic focusing of traveling wave tubes dates back to work in 1954 at the RCA Laboratories, by K. K. N. Chang.[3]

Fig. 3: Cut-away drawing of the packaged Estiatron traveling wave tube. Tube requires no focusing magnets



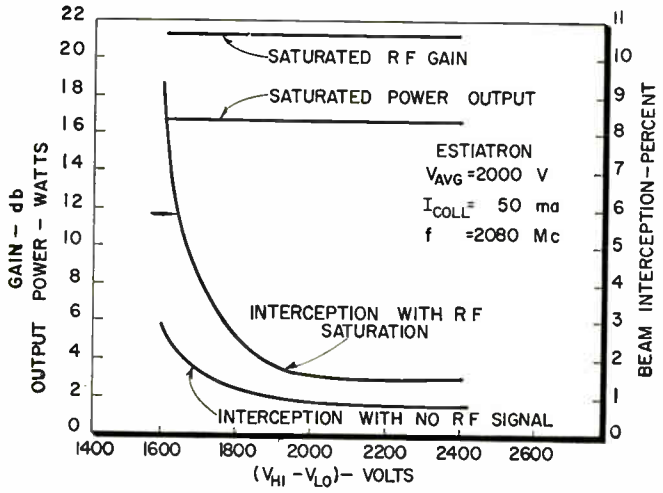
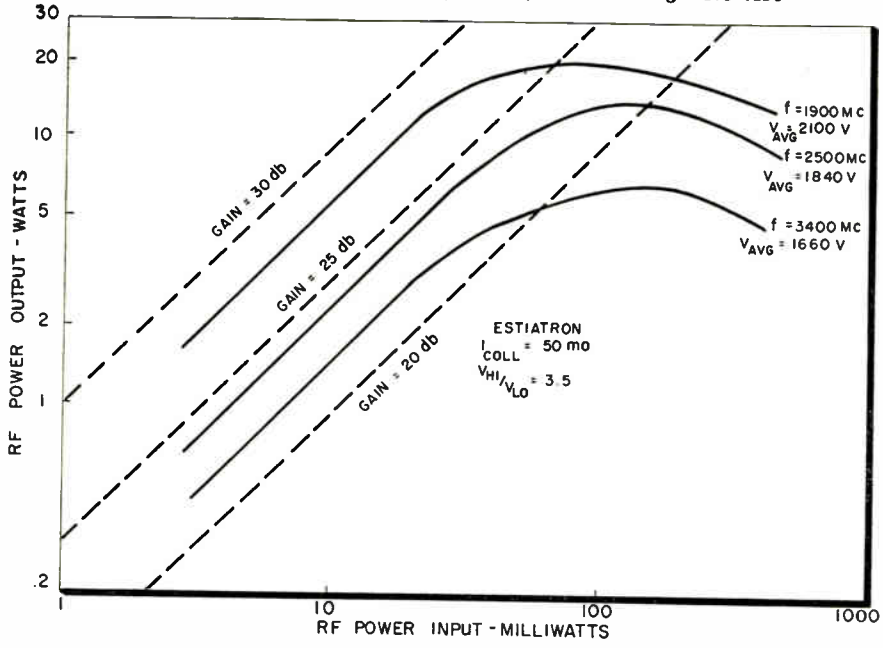


Fig. 4: Gain, power output, and beam interception vs. voltage difference between helices for Estiatron

TWT Focusing *(Continued)*

at 25 db gain over a 1000-megacycle bandwidth without any mechanical or electrical adjustments, and will give even more power and gain over lesser bandwidths. The Estiatron principle is not limited to intermediate power levels. Conservative extrapolation shows that a bifilar-helix Estiatron can deliver more than half a kilowatt at S-band frequencies for a 1% duty cycle. These tubes can be designed for higher or lower frequency ranges, and can be used to particular advantage at low frequencies (VHF and UHF) where conventional traveling-wave tubes are long and their magnets heavy.

Fig. 5: R-F power output vs. r-f power input for traveling wave tube



Other Means of Focusing

Although the periodic electrostatic focusing described above is simple and convenient, it is not the only approach. In "Harris flow,"[4] illustrated in Fig. 6, a small magnet over the gun region causes the annular electron beam to rotate. The centrifugal force of rotation of the electrons is then balanced by a strong radial electrostatic field between the helix and an axial electrode held positive with respect to the helix. The space-charge forces can be made negligible with respect to the electrostatic and centrifugal forces.

"Slalom" focusing,[5] named for the downhill ski-race, is illustrated in Fig. 7. It makes use of the fact that among all the equipotential fields surrounding a parallel array of straight wires between two ground planes there is only one pair of *continuous* equipotential surfaces, the two which intersect at the midpoint between wires. If a ribbon-shaped electron beam having exactly the right direction and velocity is launched along this equipotential surface, it will follow the surface in and out among the wires. "Slalom" focusing can in theory focus large currents at low voltage, but actually lends itself mainly to incorporation into r-f circuits of the "ladder" type—for example, those used in low-power backward-wave (voltage-tunable) oscillators.

Advantages

R-F circuit configurations associated with the Harris and "Slalom" focusing methods make them less desirable than simple periodic electrostatic focusing using bifilar helices for the construction of broadband, high-efficiency tubes. The practical advantages of periodic electrostatic focusing as employed in the Estiatron have been found to be three-fold:

a. Periodic electrostatic focusing eliminates the weight and alignment problems associated with the use of focusing magnets.

b. Periodic electrostatic focusing removes ions from the electron beam, thus eliminating spurious signals due to ion oscillations and prolonging tube life by preventing ion bombardment of the cathode.

c. In contrast to focusing by permanent magnets, periodic electrostatic focusing is not altered by variations in ambient temperature.

The Estiatron weighs ½lb. with all the "essentials," and about 1 lb. with ruggedized packaging. Thus, periodic electrostatic beam-focusing permits the size and weight of the complete tube to equal that of a conventional traveling-wave tube without a magnetic focusing structure.

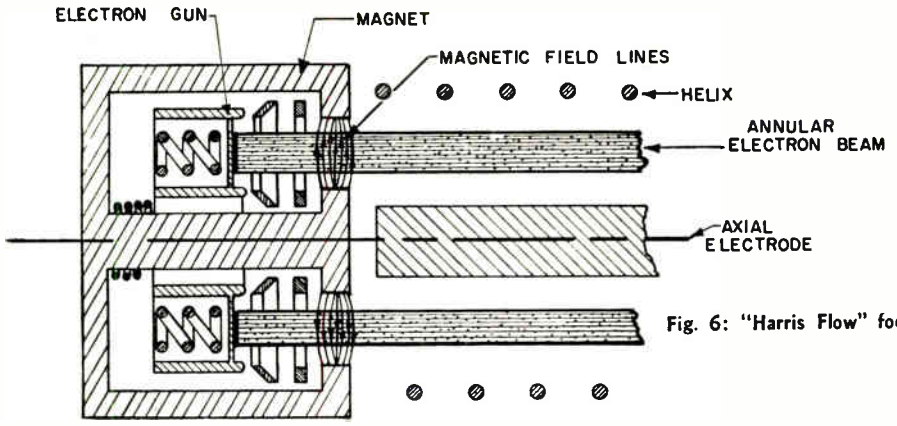


Fig. 6: "Harris Flow" focusing of an annular electron beam

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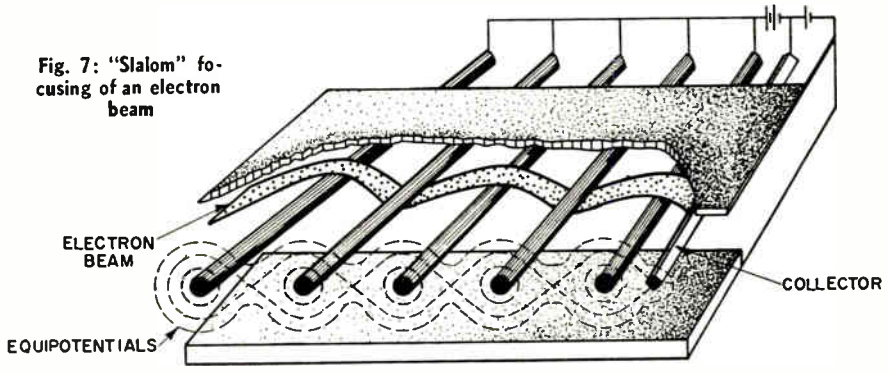


Fig. 7: "Slalom" focusing of an electron beam

Automatic Reader for High-Precision Balances

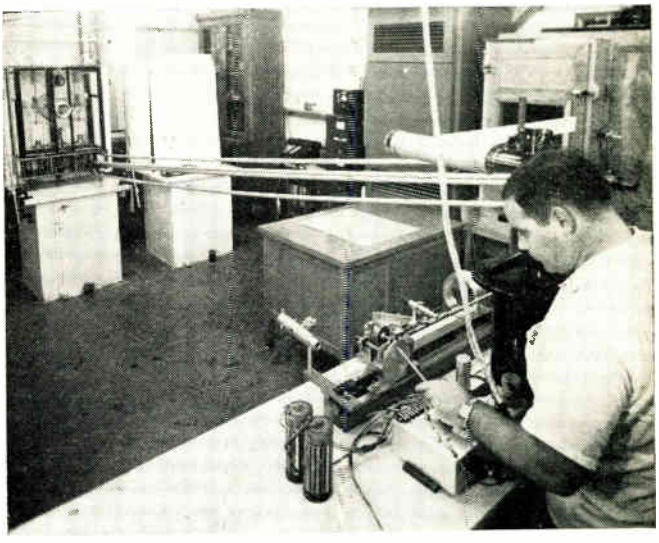
THE National Bureau of Standards has developed a photoelectric device that automatically and continuously indicates the position of the swinging beam of a high-precision balance.[1] At the same time it provides a greatly increased reading sensitivity, the minimum readable displacement on the scale being 0.0001 in. as compared with 0.004 in. for the conventional visual method.

The device was developed primarily as a research tool for obtaining a better understanding of balance errors; data from such studies are now being accumulated and will be used in working out improved balance designs. The photoelectric reader can provide data on the motion of the balance beam (i.e., of the horizontal arm from which the balance pans are suspended) in two forms: (1) as a voltage whose magnitude represents the instantaneous position of the beam; or (2) as numerical data that represent turning points (extremes of the swing), from which masses may be calculated. A plot of the output voltage on a recorder forms a graph that can be used in evaluating the dynamic characteristics of the oscillating structure. The turning points are read from a dial that ordinarily indicates the instantaneous position of the beam, but which remains stationary for a brief interval after each turning point is reached.

Though primarily a research tool, the photoelectric device also contributes in a more direct way to reduce the errors in precision mass measurements. Major errors in such measurements are due to small changes in temperature and humidity that occur during the course of the experiment. Since the automatic reader makes it possible to increase the speed of balance operations by from 5 to 10 times, it shortens the interval during which these changes in ambient conditions can act. Faster operation also increases the

(*Continued on page* 143)

Fig. 1: Interconnection of main components of the automatic reader are shown above



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A Non-Classified System for . . .

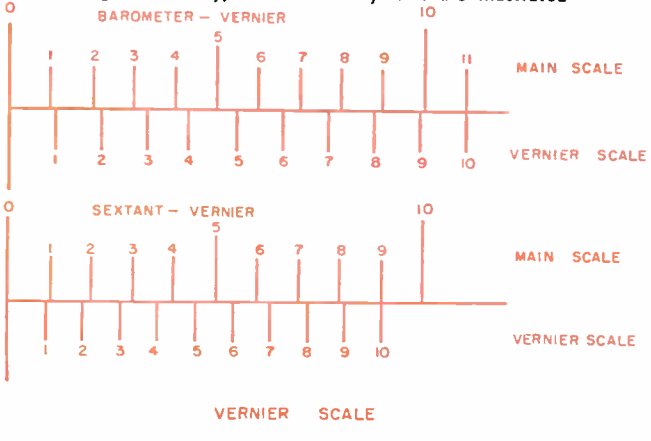
High Accuracy Time Interval

Methods and equipment for measuring time intervals with an accuracy of 0.1 μsec. are known. A system is described here which makes possible measurements with 0.01 μsec. accuracy between events taking place in widely separated locations. Complete design information is given to permit constructing this system.

METHODS and equipment for measuring time intervals with an accuracy of ±0.1 microsecond are well known. However, these methods and equipment are inadequate when it becomes necessary to measure with an accuracy of ±0.01 microsecond, the time elapsed between two events at two locations that are separate by a considerable distance.

As a result of investigation of time measuring equipment, a system has been produced which will precisely measure time intervals between two pulses. The system consists of two pulsed crystal ringing oscillators, a coincidence detector, several gates, and flip-flops, and two electronic counters that accurately display the time difference between the start and stop pulses and the coincidence pulse.

Fig. 1: Two types of vernier systems are illustrated



The system works satisfactorily for time intervals having a range of 0.9 to 1000 μsec. All component assemblies are commercially available with the exception of the pulsed crystal ringing oscillators and the coincidence detector, which were designed by the Frequency Control Branch.

From the investigation the following important features were determined:

a. The accuracy of the system is 0.01 μsec.

b. The ambiguity of ±1 count is eliminated.

c. The system identifies directly which of the two pulses to be measured precedes the other in time.

The accuracy of the system meets the design objective and was ample for the intended application. The accuracy could be further improved by reducing the difference between the periods of the coarse and vernier pulses, by designing a more selective coincidence detector and by increasing the stabilities of the pulsed crystal ringing oscillators.

Principle of Measurement

The system of vernier measurement is widely used in the measurement of length. Figure 1 illustrates the principle of operation of the system. The system uses two scales. There are two kinds of vernier in use: those known as the Barometer-Vernier and the Sextant-Vernier, which require separate descriptions.

The Barometer-Vernier is graduated as follows: a line is set off on the vernier equal to 11 divisions on the main scale. This line is divided into ten equal parts. Each of these parts is therefore equal to 1-1/10

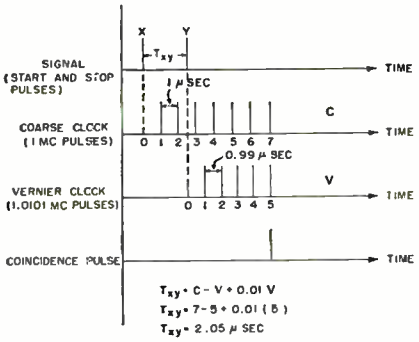


Fig. 2 (left): Input signals, coarse clock pulses, vernier clock pulses, and coincidence pulse vs. time.

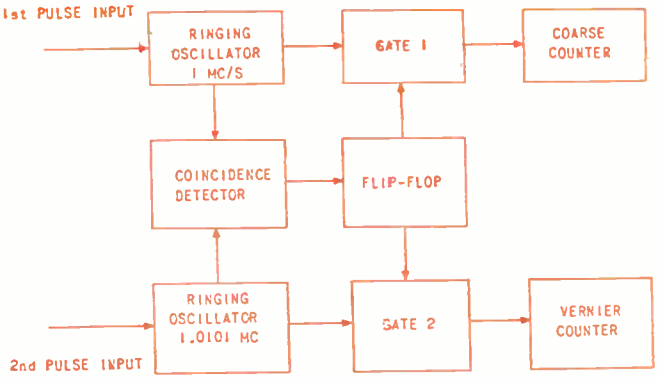


Fig. 3 (right): Basic diagram of time interval measuring system

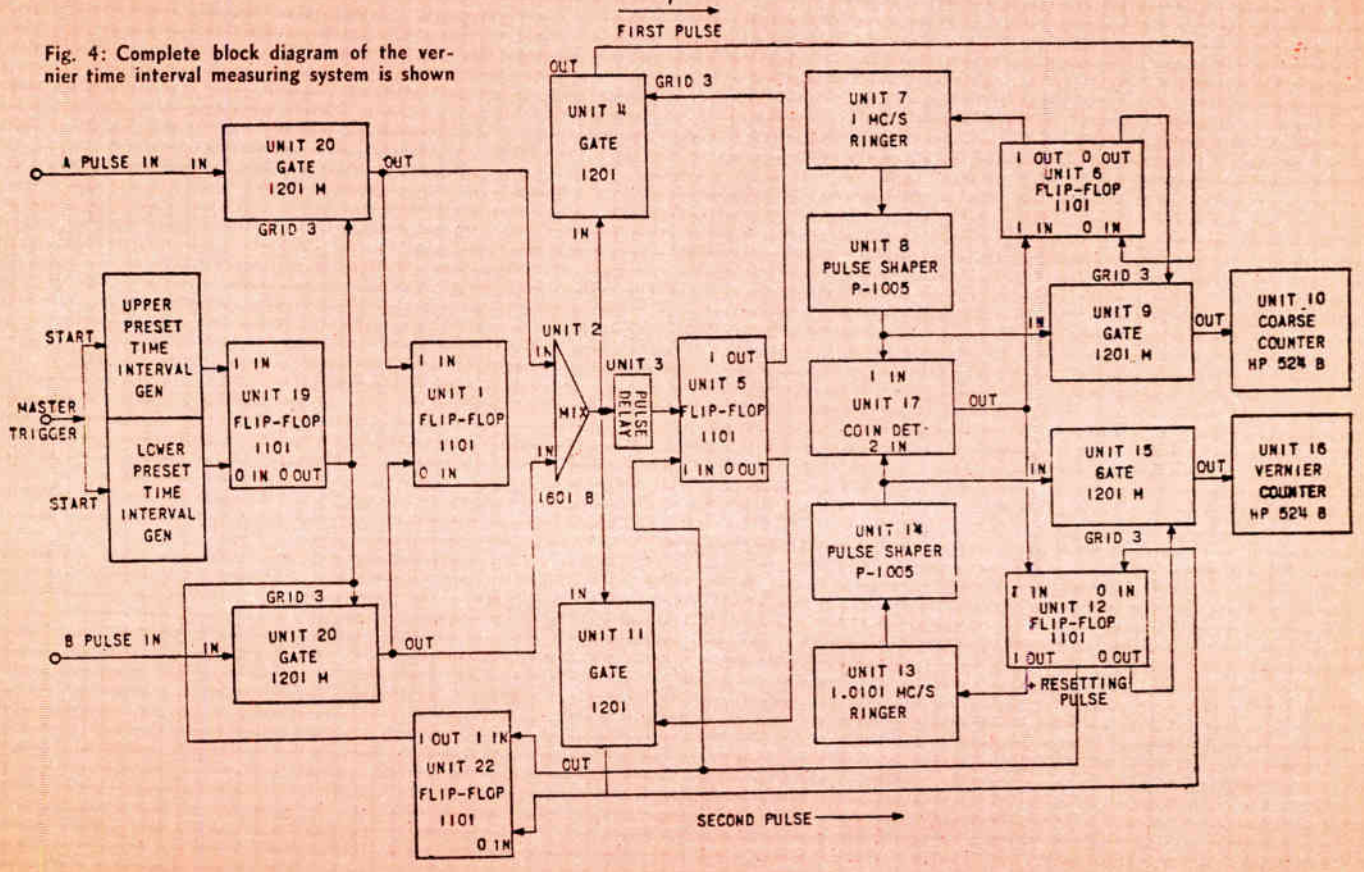
Measurements

division on the main scale. If the main scale be divided into tenths of an inch, the difference between a division on the main scale and one on the vernier is 1/100 in.

In the Sextant-Vernier the divisions on the vernier run in the same direction as those on the main scale. A line is set off on the vernier equal to 9 divisions on the main scale; this is divided into 10 parts, each of which is equal to nine-tenths of a division on the main scale. The vernier is moved until its zero point is brought opposite the end of the object to be measured, and the mark up the vernier which first coincides with a division mark on the main scale gives the figure required. The length of the scale necessary to measure a fraction of a division with an accuracy of 1 part in 10 requires 9 divisions; if the accuracy is equal to 1 part in 100, 99 divisions are required.

The application of the basic vernier principle to the time interval measurement is shown in Fig. 2. The operation of the circuit may be understood by referring to the timing sequences. For purposes of illustration, a timing interval between the start and stop pulses of 2.05 μsec has been assumed. Pulse X starts the coarse clock and Pulse Y starts the vernier

Fig. 4: Complete block diagram of the vernier time interval measuring system is shown



clock. The pulse Y occurs 0.05 μsec after the second coarse clock pulse. The first pulse delivered by the vernier clock occurs 0.04 μsec after the third coarse clock pulse, the second vernier clock pulse occurs 0.03 μsec after the fourth coarse clock pulse, etc. In other words, because of the 0.01 μsec difference in the periods of the two clocks, each succeeding vernier pulse advances 0.01 μsec relative to the corresponding coarse clock pulse. Therefore, after 5 vernier pulses are generated, there will be a coincidence between the coarse clock pulse and the vernier clock pulse. If the coarse count reading is C and the vernier count reading is V, then the time interval between X and Y is given by

$$T_{xy} = C - V + 0.01V$$

where C and V are in microseconds;
therefore, $T_{xy} = 2.05$ μsecs

System Description

The basic block diagram of the system appears in Fig. 3.

The first pulse into the system will start the 1 MC ringing oscillator and the second will start the 1.0101 MC ringing oscillator. It should be noted that gates 1 and 2 are open all the time before and during the counting operation and closed only after coincidence has been achieved. As soon as coincidence is obtained between the 2 trains of pulses in the coincidence detector, gates 1 and 2 are closed by means of the flip-flop and the course counter and vernier counter stop. Since the counting rate for both the coarse and vernier counter is approximately 1 MC, the delay closing the gate can be as much as 0.5 μsec without interfering with the accuracy of the system. This is one of the reasons for selecting a 1:100 ratio vernier system.

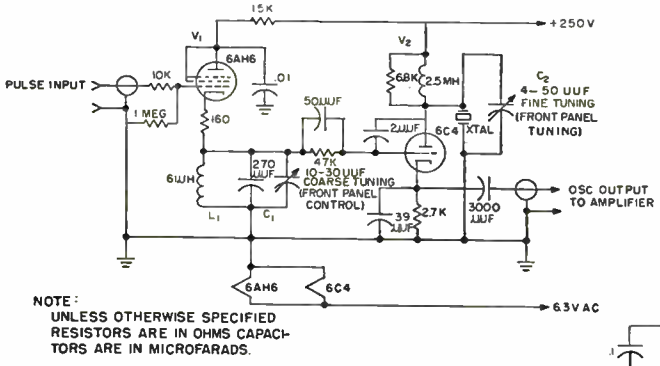


Fig. 6 (above): Schematic shows crystal ringing oscillator circuit

Fig. 7 (right): Schematic diagram shows the limiting amplifier circuits

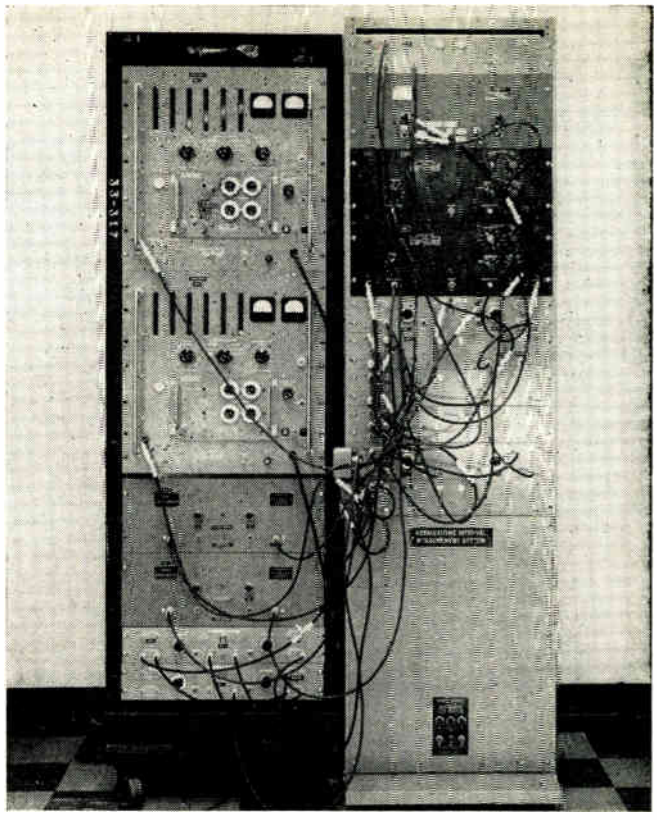
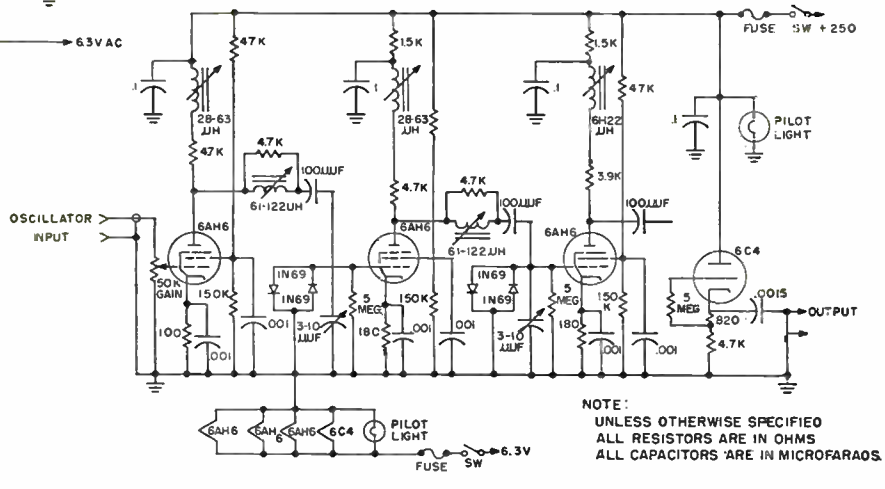


Fig. 5: Photograph gives some indication of system's size

Figure 4 illustrates the final arrangement of the system in block diagram form. The upper and lower preset time interval generators are not part of the vernier system and will not be described.

The first pulse in on Line A or B can pass into the system only if Units 19 or 22, flip-flops, are in the "one state." This condition places zero volts on grid 3 of Unit 20, a gate, and allows the signal to pass through this unit. If Unit 19, flip-flop, is in the "zero state," —23 volts are applied to grid 3 of Unit 20, a gate. This will block all signals from entering the system. The second pulse into the system, after all units have been set in the proper state, will change Unit 22 from the "one state" to the "zero state" and block all additional pulses from entering the system until the reset button is pressed. This button is located on Unit 12, flip-flop.

The first pulse in on Line A will either flip Unit 1



to the "one state" or let it remain in the "one state" depending on the initial condition of the flip-flop. A lamp will indicate which pulse entered the system last. Unit 2, a mixer, accepts the first pulse from Line A and feeds it to Units 3, 4, and 11. Unit 2 combines pulses from Lines A and B into a common input line. The diodes in Unit 2 will not allow pulses to be fed back into Lines A and B.

Then this places Unit 5, flip-flop, in the "one state," Unit 4, a gate, is open and therefore the first pulse will go through Unit 4 into Unit 6. Also, Unit 5 is connected with gate, Unit 11. Since Unit 5 is in the "one state" Gate 11 is closed and the pulse cannot pass through. The pulse into Unit 6 changes the flip-flop from the "one state" to the "zero state." The —23 volt pulse out of Unit 6 pulses Unit 7 which is the 1 CM ringer. Also, Unit 6 opens Gate, Unit 9. The output of Unit 7 is fed to Unit 8, pulse shaper. The output of Unit 8 is fed through Unit 9 which has been opened, into the coarse counter which is Unit 10. The first pulse leaving Unit 2, the mixer, is also fed through Unit 3 which is a 0.1 μsec delay line. This delayed pulse is fed into the complement connector of Unit 5 and changes this flip-flop from the "one state" to the "zero state." This action closes gate, Unit 4, and opens gate, Unit 11. Therefore, the next pulse will go through Unit 11, gate, and be blocked from going through the gate, Unit 4. This all occurs after the first pulse enters the system. The coarse counter is now counting the 1.0 MC signal derived from Unit 7. The second pulse entering on Line B enters Unit 1 placing the zero light on. It is also fed into the mixer, Unit 2, which places it on a common line. Since Unit 11, gate, is open due to the state of Unit 5, gate, the pulse goes through gate, Unit 11, and into flip-flop, Unit 12, changing the state of Unit 12 from the "one state" to the "zero state." This in turn feeds a —23 volt pulse to Unit 13 which is the 1.0101 MC ringer. Unit 12 also opens Unit 15, gate. The output of ringer, Unit 13, is fed into Unit 14 which shapes the output of the 1.0101 MC ringer. The output of shaper, Unit 14, is fed through Unit 15, gate, into the vernier counter, Unit 16. Unit 16 is now counting the pulses derived from the 1.0101 CM ringer. Outputs from pulse shapers, Units 8 and 14, are also fed into Unit 17, coincidence detector. When coincidence occurs between these two signals, a pulse is fed from Unit 17 to flip-flops, Units 6 and 12, changing the states of these flip-flops from the "zero state" back to the "one state." This in turn closes Units 9 and 15, gates. The display on Units 10 and 16 coarse and vernier counters, will indicate the time interval.

After two pulses have entered the system, the system is gated in such a manner that any further pulse will not trigger the coarse or vernier ringers again and cause a wrong reading.

With the exception of Unit 17, which is a true coincidence detector, all gates and flip-flops were commercial items manufactured by the Burroughs Corporation. The pulse shapers produce timing pulses which have a pulse width of 20 to 30 millimicroseconds at the base. The General Radio Company Pulse Shaper Type P-1005 is a general purpose wave-shaping instrument. It is used to produce either fast rise

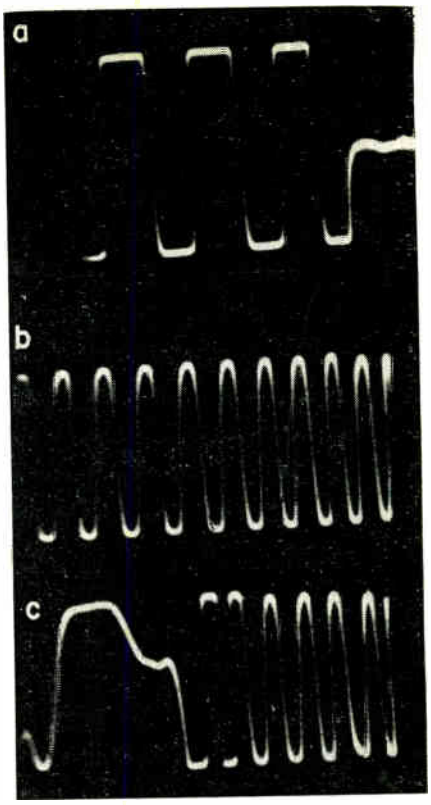


Fig. 8: The beginning, middle and end of ringing cycle wave shapes are shown.

time square waves to brief pulses when driven by an external source. The output voltage step occurs whenever the input voltage crosses the triggering level in a positive direction. A drive signal of almost any wave shape can be used. The coarse and vernier counters are H-P 524B Frequency Counters, but are being used as totalizers. The wired equipment is seen in Fig. 5.

Pulsed Oscillator

The time interval to be measured is determined by two electrical pulses. The first pulse will start a 1 CM ringing oscillator and the second pulse will start the 1.0101 MC ringing oscillator. The two ringing oscillators represent the normal and the vernier scale in the mechanical analogy. The normal or coarse clock oper-

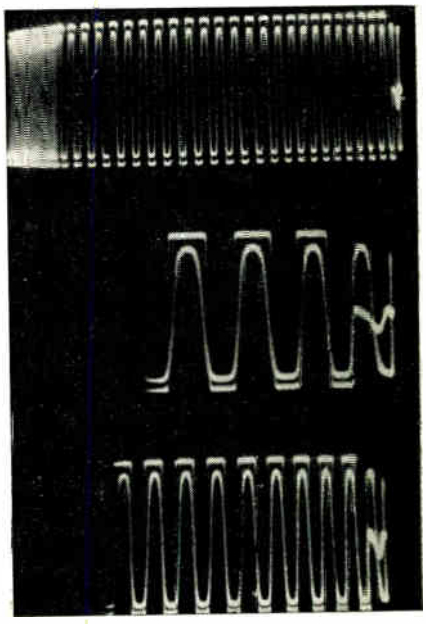


Fig. 9: Beginning of ringing cycle compared to end.

Time Measuring

(Continued)

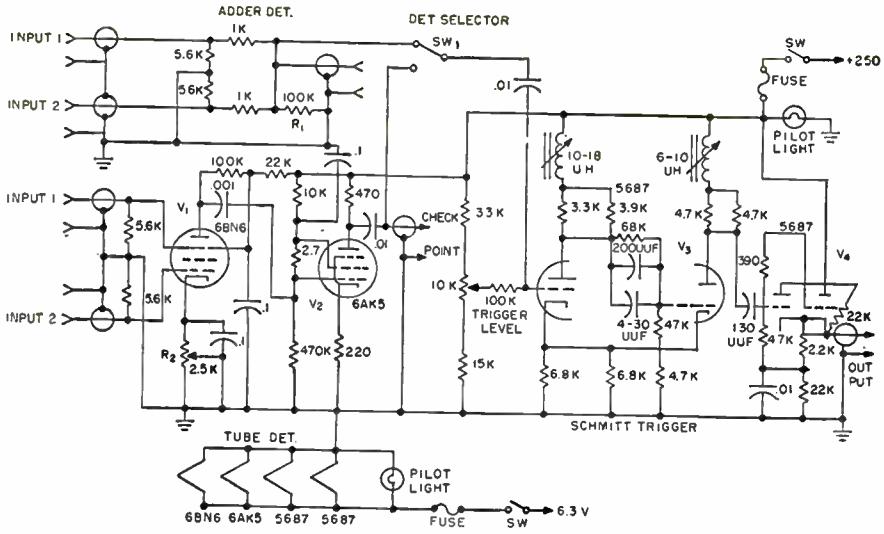


Fig. 10 (right): Schematic diagram of coincidence detector and Schmitt trigger

ates at 1 MC and the vernier clock at 1.0101 MC. This represents a ratio of 1 to 99 as far as period length or time measurement is concerned. The amplitude output must remain constant within certain limits over the entire measurement period. The maximum time interval to be measured is expected not to exceed 1000 μsec. The clocks must be stable and have a frequency accuracy of 1 part in 10^5 or better.

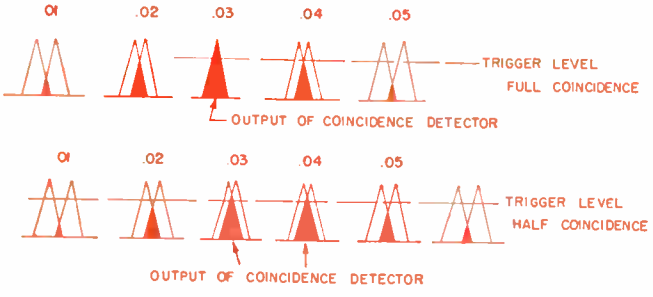
The design and development of the ringing oscillators presented a considerable problem. In the final circuit a shock excited combination of a crystal and a low Q (Q = 160) tuned circuit was used. This combination worked well. Figure 6 is a schematic of this crystal ringing oscillator. It is essentially a modified crystal controlled tuned plate-tuned grid oscillator. The tuned grid circuit of V_2 consists of L_1 and C_1, and the tuned plate circuit is formed by the crystal in conjunction with C_2. The crystal is tuned to the exact desired frequency by C_2. The tuned grid circuit is shunted by the resistance of V_1; this resistance is approximately 3600 ohms.

When V_1 is conducting, oscillations cannot take place due to the low circuit Q. On the application of a negative pulse of 7 volts or more, V_1 is cut-off. This removes the shunt resistance from the tuned grid circuit. The interrupted current induces a transient oscillating voltage into the resonant circuit. The h-f voltage is transferred from V_2 to the crystal, which is operating at the anti-resonant point, and being sufficiently shock excited, it will control the frequency of the oscillator circuit instantaneously.

The circuit will function as a crystal controlled oscillator for the duration of the negative pulse. At the end of the pulse, V_1 conducts and the oscillations are damped out. The output of the oscillator feeds into a limiting amplifier (See Fig. 7). A change in period cannot be noticed if the waveform at the beginning of the train of pulses is compared with the waveform at the end of the pulse train.

The error due to starting is constant and can be neglected. Figure 8a shows the beginning of a ringing cycle. Figure 8b shows the middle of a ringing cycle. Figure 8c shows the end of a ringing cycle. The oscilloscope sweep speed was varied in this photograph. Figure 9 shows beginning of ringing cycle compared with end of ringing cycle. The photograph was taken with constant sweep in order to show that there was no change in the period.

Fig. 11: Two possible extreme cases of coincidence are shown



Coincidence Detector

This unit of the system consists of a coincidence detector, a voltage adding circuit, a Schmitt trigger, and a cathode follower (See Fig. 10). The adder circuit is a simple coincidence indicating device. The two pulse voltages add in R_1, and since the triggering level of the Schmitt circuit is adjusted to the sum of these two voltages, an exchange of states takes place between the two halves of V_3.

Instead of the adder circuit, a tube coincidence detector may be used. V_1 is a 6BN6 gated beam tube. The quadrature grid has approximately the same transfer characteristics as the limiter grid; each functions as an off and on switch, each being able to cut off the plate current independently, and by the same token, it takes both grids to turn the tube on. The plate current is cut off by the the adjustment of R_2 and can be reinstated only by the application of a positive pulse to each grid at exactly the same time. V_2 functions as a phase inverter and delivers a positive pulse to the input of the Schmitt trigger. Selection is made between the two coincidence indicating devices with SW_1. Since all tests indicated that the detector using the gated beam tube was superior to the adder circuit, the tube coincidence detector was used in the final tests.

The Schmitt trigger is of a conventional design. V_4 is a cathode follower, the two halves of the tube are hooked up in parallel.

Figure 11 illustrates the two possible extreme cases of coincidence. The first case is the case of full coincidence. This occurs when the coincidence is 100% complete between the pulses. The second case, that of half coincidence, occurs exactly half-way between two 1 MC pulses. In this case, two maximum pulses of equal height appear in the output of the coincidence detector. All coincidences below this allowable minimum are eliminated by a pulse amplitude dis-

criminator which operates at about 75% of the maximum coincidence value. The case where two equal coincidences are obtained constitutes the case of maximum theoretical error of the system. This error is 0.005 μsec. In summarizing, there exist two different types of maximum coincidence pulses; one which has a distinct maximum and the other which has a maximum pair. The system is adjusted so that the first of the complete coincidence pulses always triggers the flip-flop and closes the gates.

Test Results

The final test circuits are shown in Figs. 12 and 13. The circuit in Fig. 12 operates in the following manner: The pulse generator A is manually triggered. A pulse with a rise time in the millimicrosecond region is transmitted over a microwave link to a slave station receiver which is located approximately 35 miles from the master station. It is then retransmitted and received at the master station where it triggers pulse generator B. The original pulse out of the pulse generator is called the start pulse and the received pulse is called the stop pulse. These pulses are fed into the vernier time interval measuring system.

Tests were conducted on two types of pulse generators. The block diagram of this circuit is shown in Fig. 13. The purpose of the tests was to determine the delay through the units and if these delays were constant. The Type 404R does not have a fixed delay for one particular setting and might vary as much as 2 μsec. Also the delay through this generator can be adjusted from approximately 5 to 14 μsec. The other unit tested was the Dumont Type 326 Time Delay Generator. This device had a constant delay of 1.85 μsec. Two additional Dumont 326 Generators were tested and the delay in each of these units was 0.34 and 0.07 μsec, respectively. The delay was also constant in each case, therefore, this type of generator was used in all round trip measurements.

Several tests sites were erected within the United States and round trip measurements were made. Fig. 14 shows the round trip time difference between the various test sites. These values were obtained by spotting the test sites on the U. S. Geological Survey maps. A small error was caused by the fixed delay in the pulse generator plus the delays in the transmitting and receiving equipment.

Measurements were made on 500 ft. of RG-9/U cable which was being used as a delay line. A 0.01 μsec difference between the calculated value and the measured value was caused by the delay in the cathode follower and connecting leads.

Conclusions

By using the vernier system, the price that had to be paid for the increase in resolution of the time scale was an increase in the time consumed by the apparatus before measurement results became available for display. This increase in time also decreased the availability of the system for successive measurements. Since this time increase is of the order of 100 μsec, the increase in measuring time is of no significance for the particular application.

The system as outlined can be modified so that it can be used for making continuous measurements.

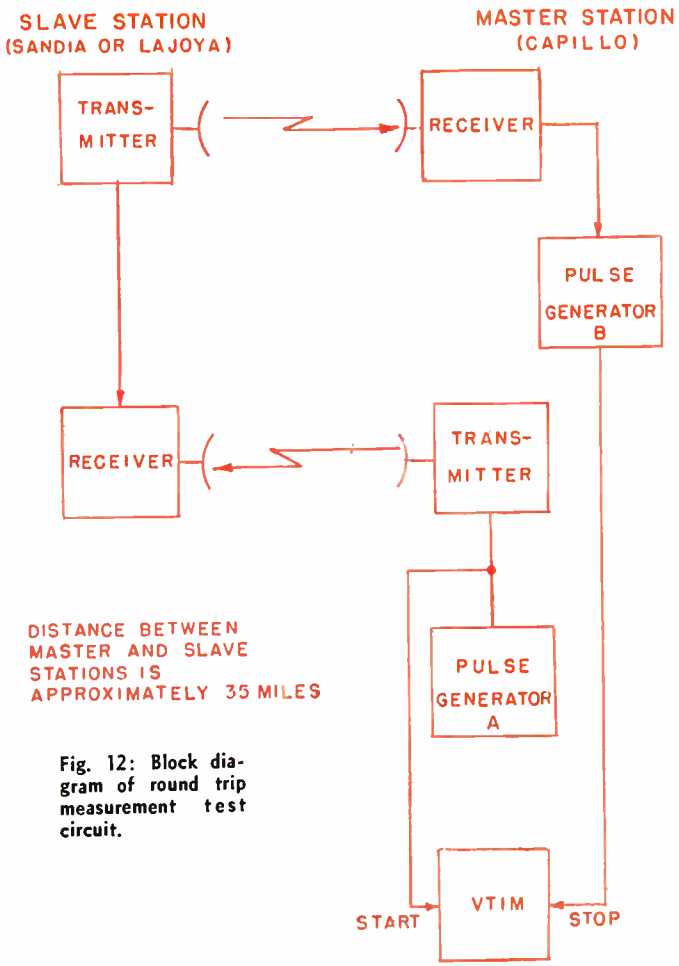


Fig. 12: Block diagram of round trip measurement test circuit.

These modifications would include a device for automatically recording the information presented on the counters. A system of this type will be built for further investigations.

The system as described worked satisfactorily for a period of several months.

References

[1]Robert G. Baron, "The Vernier Time-Measuring Technique," *Proceedings of the I.R.E.*, Vol. 45, pp. 21-30. January 1957.
[2]F. K. Priebe, D. Schwab, H. D. Tanzman, "Precision Measurement of Short Time Intervals," Proceedings of the 11th Annual Symposium on Frequency Control, pp. 597-613.

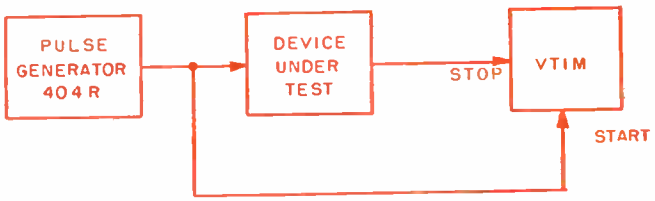


Fig. 13: Diagram (above) shows delay test circuit

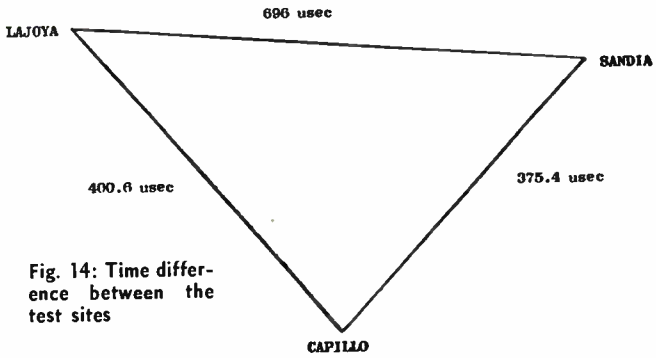


Fig. 14: Time difference between the test sites

1958-1959 Statistics of the

1959 ELECTRONIC MARKETS (EST)

CONSUMER GOODS	4,500,000,000
MILITARY & GOVERNMENT	4,400,000,000
INDUSTRIAL	1,400,000,000
COMMERCIAL COMMUNICATIONS	350,000,000
	10,650,000,000

SERVICE

During 1958 the annual retail bill for servicing of home electronic appliances is summarized:

190,000,000 replacement receiving tubes	$ 340,000,000
6,600,000 replacement picture tubes (Includes Rebuilds)	260,000,000
Antennas, components, parts, instruments	830,000,000
Labor	1,170,000,000
Total servicing bill	$2,610,000,000

ANNUAL BILL OF U. S. FOR RADIO-TV 1958

Sale of Time by Broadcasters	$2,063,250,000
Electricity, Batteries, etc., to operate 215,200,000 Radio & TV Receivers	897,000,000
12,550,000 Radio Sets, at Retail Value	468,000,000
5,300,000 Television Sets, at Retail Value	912,000,000
Hi-Fidelity Audio	230,000,000
Phono Records, 320,000,000 at Retail Value	405,000,000
Radio-TV Servicing and Installation (Retail Value):	
190 Million Replacement Receiving Tubes	340,000,000
6.6 Million Replacement TV Picture Tubes	260,000,000
Radio-TV Component Parts, Antennas, Accessories	830,000,000
Labor	1,170,000,000
TOTAL	7,575,250,000

VITAL TELEVISION STATISTICS 1946-58

	Total TV Sets Manufactured		Receiving Tubes Used in New TV Sets and for Replacements		Total TV Picture Tubes Manufactured		Total AM-FM-TV Receiving Sets Manufactured	TV Stations on the Air	Total TV Sets in Use in U. S.	At Close of
	Number	Retail Value	Number	Retail Value	Number	Retail Value				
1946	10,000	$ 5,000,000	350,000	$ 588,000	20,000	$ 1,000,000	14,010,000	5	8,000	1946
1947	250,000	100,000,000	8,500,000	15,000,000	300,000	15,000,000	17,250,000	20	230,000	1947
1948	1,000,000	350,000,000	32,200,000	53,000,000	1,500,000	75,000,000	17,000,000	44	1,000,000	1948
1949	3,000,000	950,000,000	87,000,000	146,000,000	3,500,000	210,000,000	13,000,000	100	3,800,000	1949
1950	7,500,000	2,700,000,000	225,000,000	378,000,000	8,000,000	400,000,000	22,100,000	107	10,500,000	1950
1951	5,600,000	2,100,000,000	161,000,000	270,000,000	6,000,000	300,000,000	19,100,000	108	15,750,000	1951
1952	6,300,000	2,360,000,000	168,000,000	380,000,000	6,500,000	260,000,000	16,300,000	123	21,800,000	1952
1953	7,300,000	1,675,000,000	210,000,000	400,000,000	9,000,000	360,000,000	20,700,000	350	28,000,000	1953
1954	7,300,000	1,278,000,000	215,200,000	409,000,000	10,300,000	360,500,000	17,700,000	415	33,000,000	1954
1955	7,800,000	1,263,600,000	220,000,000	407,000,000	10,800,000	371,000,000	20,000,000	457	39,400,000	1955
1956	7,500,000	1,237,500,000	200,000,000	400,000,000	11,000,000	318,000,000	21,900,000	491	42,300,000	1956
1957	6,500,000	1,270,000,000	175,000,000	371,000,000	10,000,000	340,000,000	22,000,000	519	45,500,000	1957
1958	5,300,000	912,000,000	128,000,000	270,000,000	8,200,000	332,000,000	18,350,000	570	50,000,000	1956

U.S. PRODUCTION OF RADIO SETS—1922 TO 1958

	Total Radio Sets Manufactured		Total Receiving Tubes Manufactured		Automobile Sets Manufactured		Auto Sets in Use	Homes with Radio Sets	Total Radio Sets in Use in U. S.	
	Number	Retail Value	Number	Retail Value	Number	Retail Value	Number	Number	Number	
1922	100,000	$ 5,000,000	1,000,000	$ 6,000,000	.....	.....	.....	260,000	400,000	1922
1923	550,000	30,000,000	4,500,000	12,000,000	.....	.....	.....	1,000,000	1,100,000	1923
1924	1,500,000	100,000,000	12,000,000	36,000,000	.....	.....	.....	2,500,000	3,000,000	1924
1925	2,000,000	165,000,000	20,000,000	48,000,000	.....	.....	.....	3,500,000	4,000,000	1925
1926	1,750,000	200,000,000	30,000,000	58,000,000	.....	.....	.....	5,000,000	5,700,000	1926
1927	1,350,000	168,000,000	41,200,000	67,300,000	.....	.....	.....	6,500,000	7,000,000	1927
1928	3,281,000	400,000,000	50,200,000	110,250,000	.....	.....	.....	7,500,000	8,500,000	1928
1929	4,428,000	800,000,000	69,000,000	172,500,000	.....	.....	.....	9,000,000	10,500,000	1929
1930	3,827,000	300,000,000	52,000,000	119,600,000	34,000	$ 3,000,000	.....	12,048,782	13,000,000	1930
1931	3,420,000	225,000,000	53,000,000	89,550,000	108,000	5,940,000	100,000	14,000,000	15,000,000	1931
1932	3,000,000	140,000,000	44,300,000	48,730,000	143,000	7,150,000	250,000	16,809,562	18,000,000	1932
1933	3,806,000	180,500,000	59,000,000	49,000,000	724,000	28,598,000	500,000	20,402,369	22,000,000	1933
1934	4,084,000	214,500,000	58,000,000	38,600,000	780,000	28,000,000	1,250,000	21,456,000	26,000,000	1934
1935	6,026,800	330,192,480	71,000,000	50,000,000	1,125,000	54,562,500	2,000,000	22,869,000	30,500,000	1935
1936	8,248,000	450,000,000	98,000,000	69,000,000	1,412,000	69,166,000	3,500,000	24,800,000	33,000,000	1936
1937	8,064,780	450,000,000	91,000,000	85,000,000	1,750,000	87,500,000	5,000,000	26,666,500	37,800,000	1937
1938	6,000,000	210,000,000	75,000,000	93,000,000	800,000	32,000,000	6,000,000	28,000,000	40,800,000	1938
1939	10,500,000	354,000,000	91,000,000	114,000,000	1,200,000	48,000,000	6,500,000	28,700,000	45,300,000	1939
1940	11,800,000	450,000,000	115,000,000	115,000,000	1,700,000	60,000,000	7,500,000	29,200,000	51,000,000	1940
1941	13,000,000	460,000,000	130,000,000	143,000,000	2,000,000	70,000,000	8,750,000	29,700,000	56,000,000	1941
1942	4,400,000	154,000,000	87,700,000	94,000,000	350,000	12,250,000	9,000,000	30,800,000	59,340,000	1942
1943	.....	.....	17,000,000	19,000,000	.....	.....	8,000,000	32,000,000	58,000,000	1943
1944	.....	.....	22,000,000	25,000,000	.....	.....	7,000,000	33,000,000	57,000,000	1944
1945	500,000	20,000,000	30,000,000	35,000,000	.....	.....	6,000,000	34,000,000	56,000,000	1945
1946	14,000,000	700,000,000	190,000,000	200,000,000	1,200,000	72,000,000	7,000,000	35,000,000	60,000,000	1946
1947	17,000,000	800,000,000	220,000,000	260,000,000	3,200,000	194,000,000	9,000,000	37,000,000	66,000,000	1947
1948	14,000,000	600,000,000	200,000,000	230,000,000	4,100,000	293,000,000	11,000,000	40,000,000	74,000,000	1948
1949	10,000,000	500,000,000	190,000,000	350,000,000	3,500,000	240,000,000	14,000,000	42,000,000	81,000,000	1949
1950	14,800,000	721,000,000	383,000,000	644,000,000	4,780,000	248,000,000	17,000,000	45,000,000	90,000,000	1950
1951	13,000,000	605,000,000	430,000,000	640,000,000	4,800,000	255,000,000	20,000,000	45,850,000	100,000,000	1951
1952	10,000,000	500,000,000	330,000,000	740,000,000	2,750,000	148,000,000	25,000,000	46,000,000	114,500,000	1952
1953	13,400,000	536,000,000	410,000,000	920,000,000	4,800,000	250,000,000	29,000,000	48,000,000	120,500,000	1953
1954	10,000,000	400,000,000	400,000,000	880,000,000	4,300,000	220,000,000	32,000,000	50,000,000	127,000,000	1954
1955	14,400,000	559,000,000	481,000,000	852,000,000	6,900,000	346,000,000	35,700,000	52,000,000	138,700,000	1955
1956	14,000,000	553,000,000	465,000,000	906,000,000	5,000,000	258,000,000	37,500,000	53,200,000	143,500,000	1956
1957	15,500,000	603,000,000	450,000,000	882,000,000	5,500,000	303,000,000	39,800,000	53,400,000	148,400,000	1957
1958	12,550,000	468,000,000	330,000,000	729,000,000	3,570,000	193,000,000	43,900,000	53,850,000	185,200,000	1958

Radio-TV-Electronic Industries

ELECTRONIC PARTS DISTRIBUTORS—BY STATE—AND AVERAGE SALES

	Establishments (Number)	State Sales ($1,000)	Average Sales (Dollars)
Alabama	22	2,200	100,000
Arizona	12	2,000	170,000
Arkansas	10	3,300	325,000
California	189	62,500	320,000
Colorado	18	5,300	305,000
Connecticut	35	6,800	200,000
District of Columbia	21	7,400	360,000
Delaware	4	420	105,000
Florida	49	10,800	215,000
Georgia	18	7,500	400,000
Idaho	5	920	175,000
Illinois	113	49,000	425,000
Indiana	46	13,000	280,000
Iowa	15	5,100	350,000
Kansas	18	5,000	275,000
Kentucky	23	6,000	250,000
Louisiana	32	7,600	225,000
Maine	7	1,900	270,000
Maryland	27	7,200	260,000
Massachusetts	60	20,000	350,000
Michigan	65	18,000	300,000
Minnesota	34	12,600	375,000
Mississippi	13	1,400	105,000
Missouri	42	14,200	325,000
Montana	6	660	105,000
Nebraska	13	2,600	200,000
New Hampshire	3	270	90,000
New Jersey	85	49,000	575,000
Nevada	3	260	87,000
New Mexico	4	360	90,000
New York	369	100,000	275,000
North Carolina	22	8,300	375,000
North Dakota	2	160	80,000
Ohio	96	36,000	375,000
Oklahoma	15	3,800	240,000
Oregon	8	2,700	355,000
Pennsylvania	120	52,000	450,000
Rhode Island	8	2,900	360,000
South Carolina	18	1,800	100,000
South Dakota	2	160	80,000
Tennessee	19	6,300	340,000
Texas	88	24,400	275,000
Vermont	1	90	90,000
Virginia	25	5,400	200,000
Washington	30	8,800	292,000
West Virginia	13	4,300	325,000
Wisconsin	47	10,500	225,000
Wyoming	3	340	110,000
Utah	10	2,700	290,000
Total—United States	1,888		325,000

ELECTRONIC FIRMS—BY STATES

Headquarters offices by number and state for the 4,500 electronic manufacturers

State	No. of Companies
Alabama	2
Alaska	None
Arizona	12
Arkansas	1
California	679
Colorado	17
Connecticut	226
Delaware	13
Wash., D. C.	15
Florida	35
Georgia	4
Idaho	None
Illinois	501
Indiana	95
Iowa	25
Kansas	8
Kentucky	8
Louisiana	5
Maine	3
Maryland	46
Mass.	329
Michigan	87
Minn.	62
Miss.	1
Missouri	46
Montana	None
Nebraska	10
Nevada	None
New Hampshire	26
New Jersey	484
New Mexico	10
New York	961
North Carolina	17
North Dakota	None
Ohio	240
Oklahoma	13
Oregon	15
Penna.	319
Rhode Island	38
South Carolina	6
South Dakota	None
Tennessee	10
Texas	41
Utah	6
Vermont	11
Virginia	22
Washington	10
West Virginia	4
Wisconsin	75
Wyoming	4
Canada	40
Foreign	17
Total: United States	4542
Canada	40
Foreign	17
	4599

These figures are from the "Electronic Industries Marketing Guide," copyright 1958, Chilton Company.

THE ELECTRIC INDUSTRY'S RECORD FOR 1958 AND PREDICTIONS FOR 1959

	1957	1958	1959
Generation, non-industrial	631 billion kwhr	641 billion kwhr	.....
Generation, industrial	85 billion kwhr	80 billion kwhr	.....
Generation, all components	716 billion kwhr	721 billion kwhr	.....
Use per residential customer (average)	3,174 kwhr	3,385 kwhr	.....
New addition to capacity by private utilities	.....	11.5 million kw	10.2 million kw
New addition to capacity by government agencies	.....	2.5 million kw	3.4 million kw
Total new capacity	.....	14.0 million kw	13.6 million kw
Construction expenditures	$3,799,900,000	$3,800,000,000	$3,800,000,000
Revenue (gross)	$8,054,000,000	$8,416,000,000	
Net income	$1,427,000,000	$1,534,000,000	
Wages and salaries	$1,426,000,000	$1,490,000,000	
Fuel costs	$1,370,000,000	$1,365,000,000	

BROADCAST STATIONS IN U.S.

AM	3,300	FM	550
TV	Comm. 535	Educ.	35
	VHF 433	VHF	28
	UHF 77	UHF	7

Hi-Fi Sales

Since 1955, hi-fi package sales have increased from $100-million to $400-million. During the same period, hi-fi component sales rose from $80-million to $200-million.

More Statistics On Page 70

Government Electronic Contract Awards

This list classifies and gives the value of electronic equipment selected from contracts awarded by government procurement agencies during Fiscal Year 1958.

Accelerometers	422,770
Amplifiers	2,470,165
Analyzers	1,768,784
Antennas & accessories	8,529,330
Attenuators	66,118
Batteries, dry	8,336,183
Battery chargers	863,435
Battery packs	73,010
Batteries, storage	6,143,624
Beacon equipment, radio	1,623,879
Cable, sets & assemblies	1,490,645
Calibrators	276,028
Capacitors	304,334
Cavities, tuned	83,300
Circuit breakers	151,411
Coder-decoder	1,180,283
Coils	67,359
Communication systems	4,885,367
Computers & accessories	8,058,322
Computers, airborne	5,722,495
Connectors	445,889
Controls	48,184
Converter equipment	321,237
Co-ordinate data equipment	3,497,702
Countermeasures equipment	2,999,770
Crystal units	223,516
Delay lines	
Dummy loads	206,791
Echo box	342,618
Electronic equipment	108,073
Facsimile equipment	271,063
Filters	49,731
Fire control equipment	1,380,139
Frequency standards	625,122
Galvonometers	90,035
Generators, signal	2,998,252
Generators, special electronic	126,506
Gyroscopes	5,554,904
Headsets	970,070
Headsets, microphone	1,110,963
Identification sets	120,000
Indicators	11,258,207
Indicators, radar	1,182,948
Infrared equipment	1,018,305
Intercam equipment	177,482
Inverters	626,427
Kits, modification	4,231,983
Kits, training	36,997
Loudspeakers	104,062
Meters	207,282
Meters, field	167,281
Meters, frequency	1,781,718
Meters, frequency power	
Meters, ohm	62,334
Meters, volt	238,339
Meters, watt	43,038
Microphones	554,351
Microwave equipment	1,776,739
Modulators	260,400
Manitors	109,526
Multimeters	766,851
Multiplexers	1,258,980
Navigational equipment & systems	2,465,230
Networks	186,505
Oscillators	986,164
Oscilloscopes & accessories	2,297,083
Patching racks, video	54,000
Potentiometers	52,108
Power supplies	967,231
Power supplies, dynamometer	328,315
Public address sets	70,433
Radar equipment	21,559,486
Radiac equipment	1,004,100
Radio direction finders	2,648,602
Radio equipment	160,630
Radio equipment SSB	59,975
Radio receivers	11,235,280
Radio receivers-transmitters	2,199,693
Radio set controls	302,044
Radio sets	22,677,795
Radio transmitters	3,232,420
Radiosonde equipment	1,868,220
Radomes	162,296
Recorders & accessories	2,742,056
Recorders-reproducers	4,129,682
Rectifiers	205,357
Rectifiers, semiconductors	112,556
Relays	994,105
Relay assemblies	257,835
Relays, solenoid	116,901
Resistors	831,497
Resolvers	586,425
Rheostats	36,191
Semiconductors diodes	518,885
Simulators	149,565
Single sideband equipment	59,430
Sonar equipment	1,570,432
Spare parts	958,074
Switches	979,303
Synchro assemblies	52,500
Synchra signal amplifiers	322,436
Synchros	1,232,040
Tape, recording	649,989
Telemetering equipment	769,194
Teletype equipment	8,860,711
Television equipment	315,944
Test sets	11,238,932
Test sets, meter	33,350
Test sets, radar	5,302,547
Test sets, radio	2,111,359
Testers, tube	183,677
Transformers	308,504
Transistors	212,084
Transponder sets	289,149
Tubes, electron	38,021,039
Ultrasonic equipment	60,319
Voltage regulators	87,025
Waveguide & accessories	109,863
Wire & Cable	11,814,954

Contracts awarded by government procurement agencies during the first quarter of FY 1959

Accelerometers	33,775
Antennas & accessories	4,665,940
Amplifiers	2,856,970
Amplifiers, audio	271,239
Amplifiers, r-f	71,843
Amplifiers, synchro	86,156
Analyzers	488,490
Analyzers, spectrum	167,649
Battery charges	1,318,928
Batteries, dry	3,869,064
Batteries, storage	1,866,757
Beacon equipment, radar	757,801
Beacon equipment, radio	202,090
Cable assemblies	806,810
Calibrators	79,542
Circuit breakers	95,601
Coder-decoder	5,631,577
Communication systems	114,194
Computers & accessories	23,125,472
Computers, airborne	14,494,777
Connectors	282,399
Controls	243,368
Converter equipment	456,299
Crystal units	187,520
Co-ordinate data equipment	1,048,800
Countermeasures equipment	346,572
Electronic equipment	529,951
Facsimile equipment	248,632
Filters	102,002
Fire control equipment	3,240,000
Fuses & accessories	281,853
Generators, signal	2,504,717
Gyros & gyroscopes	828,520
Headsets-microphone	254,024
Indicators	5,237,284
Intercom	297,678
Integrator, video signal	146,098
Indicators, radar	425,250
Kits, installation	682,678
Kits, modification	4,696,241
Loudspeakers	105,338
Meters	113,770
Meters, amp	96,143
Meters, frequency	903,669
Meters, r-f	73,198
Meters volt	507,779
Meters vtvm	50,068
Meters, watt	63,864
Microwave equipment	155,934
Mine detectors	1,341,026
Monitors	130,562
Multimeters	512,039
Multiplexer equipment	670,371
Navigational systems & equipment	4,434,517
Networks	108,709
Oscillators	430,393
Oscilloscopes & accessories	1,764,006
Potentiometers	224,893
Power supplies	913,256
Radiac equipment	819,076
Radar equipment	35,731,683
Radio direction finders	2,630,622
Radia equipment	1,073,330
Radia receivers	4,041,457
Radio receivers-transmitters	23,014,941
Radio sets	9,107,039
Radio transmitters	14,268,053
Radio set controls	1,366,361
Radiosonde equipment	168,675
Radomes	880,223
Relays	659,854
Recorders & accessories	5,317,167
Recorders-reproducers	372,775
Relays, salenoid	95,997
Research	5,304,636
Resistors	486,254
Semiconductor diodes	221,153
Simulators, target	1,629,911
Spare parts	3,656,303
Switchboard equipment	370,802
Switches	506,385
SSB equipment	8,202,486
Sonar equipment	3,723,810
Synchros	2,092,861
Tape, recording	3,164,647
Test sets, radar	849,486
Test sets, radio	834,843
Testers	4,869,720
Telemetering, equipment	1,392,596
Television equipment	720,864
Teletype equipment	3,456,112
Testers, tube	289,789
Test bridges	262,800
Transformers	248,535
Transistors	257,477
Transponder sets	1,369,277
Tubes, electron	15,124,798
Tubes, klystron	190,120
Wire & cable	2,168,940
X-ray equipment	196,420

Rapid transistor circuit analysis can be aided by this listing of current stability factor equations.

Equation Speed Common Emitter Design

By J. S. MacDOUGALL
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WHEN designing transistor bias circuits for temperature stability an often used parameter is the incremental dc current gain or stability factor. This is defined as:

$$S = \frac{dI_c}{dI_{co}} \qquad (1)^*$$

where dI_c is the change in collector current associated with a change in collector to base leakage current dI_{co}. In circuit design, dI_{co} can be found from the manufacturers' literature and the permissible dI_c can be determined by consideration of the load line on the collector characteristics. Thus S can be calculated to give the maximum permissible stability factor.

Derivation of the stability factor equations for a number of common emitter circuits has shown that the relation:

$$S = \frac{k}{k - \alpha} \qquad (2)$$

is generally true with the equation for k depending on the particular circuit. Accordingly, only the k-factors are shown with the circuits given in the figures. For design purposes it is often more useful to re-arrange Eq. 2 to the form:

$$k = \frac{S\alpha}{S - 1} \qquad (3)$$

In some cases k can be simplified to the form:

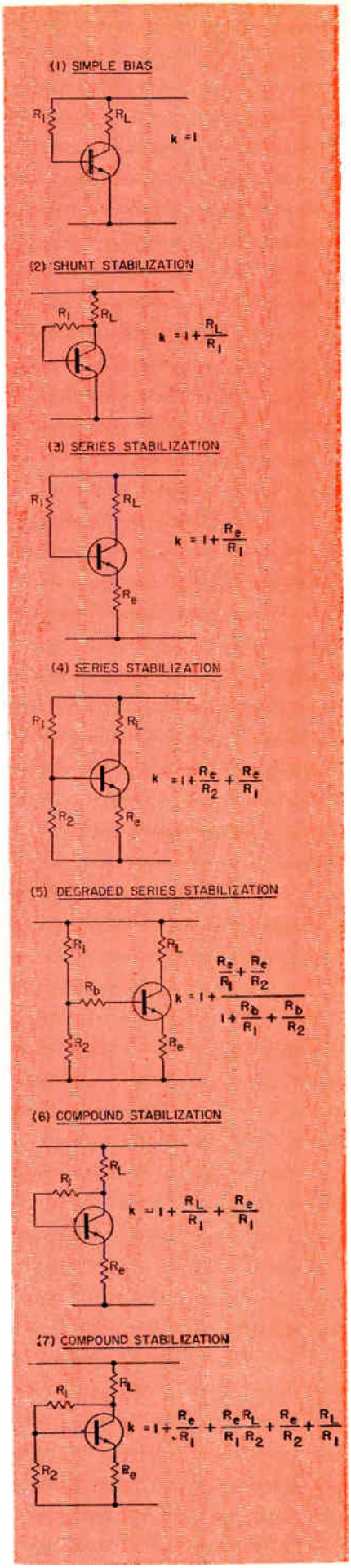
$$k = 1 + \frac{R_e}{R_2} \qquad (4)$$

to serve as a first approximation and, since R_e is usually chosen or known, R_2 can be found from:

$$R_2 = \frac{R_e}{k - 1} \qquad (5)$$

* R. F. Shea, *Principles of Transistor Circuits*, John Wiley and Sons, Inc., New York.

* * *



What's New . . .

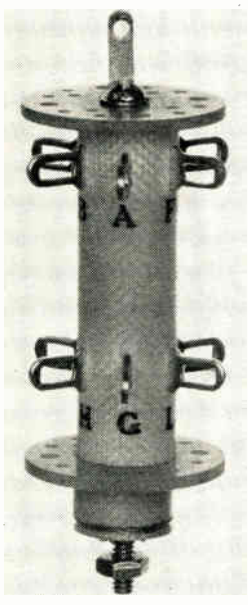
Transistor Wafer Turrets

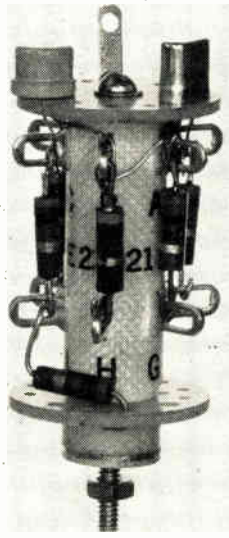
PERFORATED wafers at top and bottom of a tubular post provides a versatile mounting device for transistors, diodes and their associated circuit components. The 1 in. diameter wafer has a unique pattern of holes adapted to receive transistor leads of either the JETEC triangular pattern or the "three-in-line" configuration. In addition, the holes may be used to mount various types of terminals, sockets, transistor clips or component wires. The turrets are manufactured by Vector Electronic Co. 1100 Flower St., Glendale 1, Calif.

Transistor lead wires pass through the wafer holes and connect to terminals on the turret post thus anchoring the transistor firmly in place. Components may be connected to the turret post terminals or from wafer holes to post terminals, from wafer to wafer, or across the wafers. Wafer holes and post terminals combine to provide 14 pairs of mounting holes or terminals for components. Circuits with two or three transistors can be mounted satisfactorily in most cases and even four transistors may be used if moderate numbers and sizes of components are associated.

A very useful modification consists of mounting the turret to a tube base plug for insertion in a tube socket or printed circuit. When the plug is used the bottom wafer is generally omitted since components can be connected directly to the plug pins.

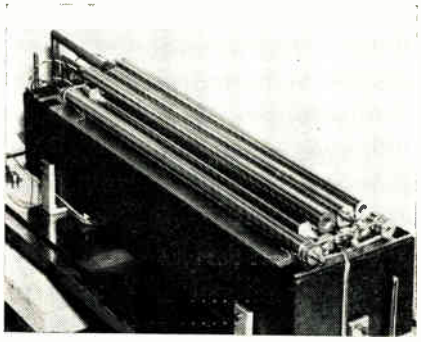
Wafer turret accommodates 4 transistor circuit when only a few components are required.





New Capacitance Standards

AS part of its continuing program to improve the precision and reliability of electrical standards and measurements, the National Bureau of Standards (NBS) has recently completed apparatus for the precise intercomparison of small capacitors. The apparatus employs a special 3-winding transformer and a bank of very stable capacitors which are combined to balance the unknown capacitance. This apparatus improves both the sensitivity and precision of capacitance measurements made by Bureau laboratories.



Temperature compensated capacitors are maintained as secondary standards at NBS.

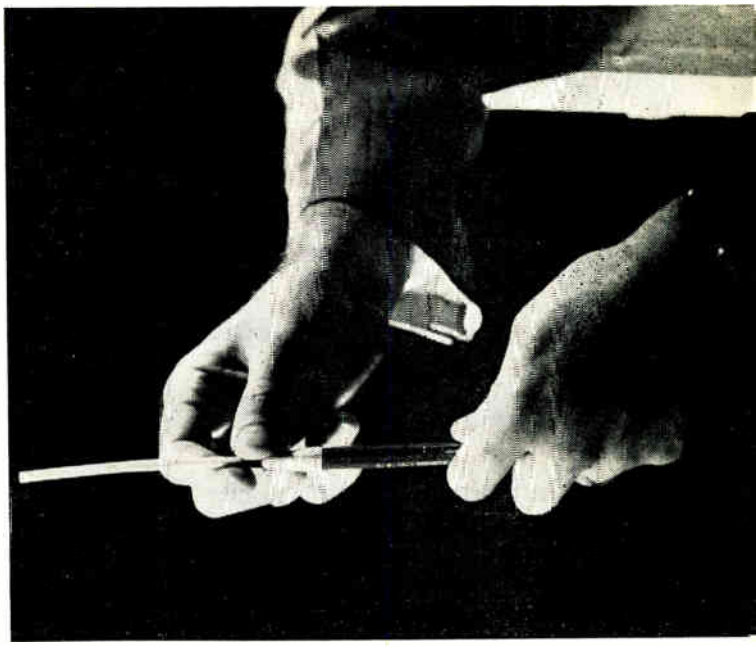
To realize fully this advantage, an improved absolute standard of capacitance has also been constructed. Its design, based on a recently discovered theorem in electrostatics, allows its value to be calculated in terms of a single measured length. It is believed that the uncertainty in the value assigned to this standard does not greatly exceed one part in a million.

The ratio arms of the capacitance bridge are the two secondary windings of a special 3-winding transformer, the third winding being a common primary. The induced secondary voltages, essentially equal to the voltages at the terminals of the capacitors being compared, depend on the number of turns in each secondary winding.

By appropriate construction the terminal voltage ratio has been made equal to the turns ratio within a part in ten million. Knowing the ratio of the voltages supplying

(Continued on page 102)

Silicone-Rubber Tubing Tough and Flexible



Inserting a pencil into the tubing shows the elasticity of Ben Har 1151. Diameter can be expanded up to four times.

A HIGH temperature fiber glass insulating sleeving with a silicone rubber coating can be really tough and flexible. To prove how tough their Ben-Har 1151 sleeving is, Bentley, Harris Manufacturing Co., Conshohocken, Pa., supplies a piece of sand paper with each sample so that the customer can test it himself. And to see how flexible the new tubing is they suggest inserting a pencil into the tubing sample to show its elasticity. Diameter of the tubing can be stretched up to four times.

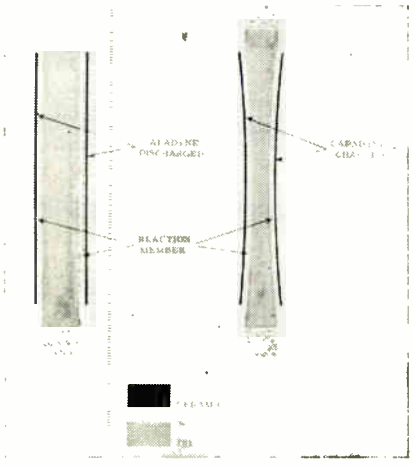
Lack of mechanical strength and abrasion resistance has been a chronic weakness of silicone rubber coated fiber glass insulations. This new sleeving overcomes these problems. It is manufactured under a production process licensed exclusively to Bentley, Harris by Industrial Accessories. The tubing will meet MIL-I-18057A, NEMA and ASTM specifications for high temperature (200°C+) applications.

Ben-Har 1151 has applications for motors and generators, transformers, relays, solenoids, and the air frame industry as well as the electronic field. It will replace their existing line (BH 1151) at the same cost.

"Ceramic" Meter Movements

THE unique properties of newly discovered electrostrictive ceramics make them particularly attractive in the design of low-cost, reliable meter indicators.

Fig. 1: Voltage applied across the ceramic makes it contract, causing a cupping action. The oil is pushed out into a capillary tube.



As applied in the meter indicator, the ceramics are in the form of discs which enclose a reservoir of fluid. The discs are silver coated and bonded to a reaction member of metal or glass. When voltage is applied across the ceramic disc it contracts, causing a cupping effect on the reaction member (Fig. 1). The oil reservoir is compressed, changing the oil level in a transparent capillary tube (Fig. 2).

The ceramic is mainly barium titanate, commonly used in piezoelectric applications. New additives and processing techniques inhibit the piezo-electric effect and emphasize the electrostrictive response. The response is proportional to the applied field, and is independent of its direction. The Curie-Point crystal changes can also be reduced, giving a material substantially free of temperature limitations. Electromechanical response is instantaneous, but the viscous resistance and the inertia of the system affect the meter indication.

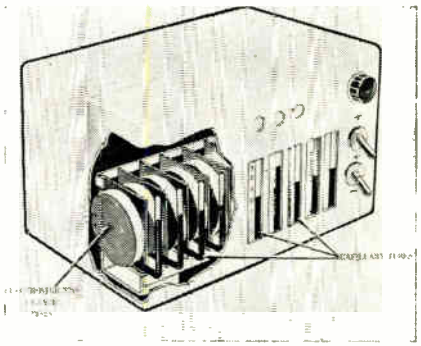


Fig. 2: Level of fluid in tubes indicates volts or amps depending on what is being measured.

The ceramics are now being supplied in experimental quantities by the Mullenbach Div. of Electric Mfg. Co., Los Angeles.

Diagnosing With Strain Gages

The flow rate of expired gases is pertinent to heart disorder study. A portable, recording pneumotachograph, employing a strain gage transducer, makes more realistic studies possible. The system is described here.

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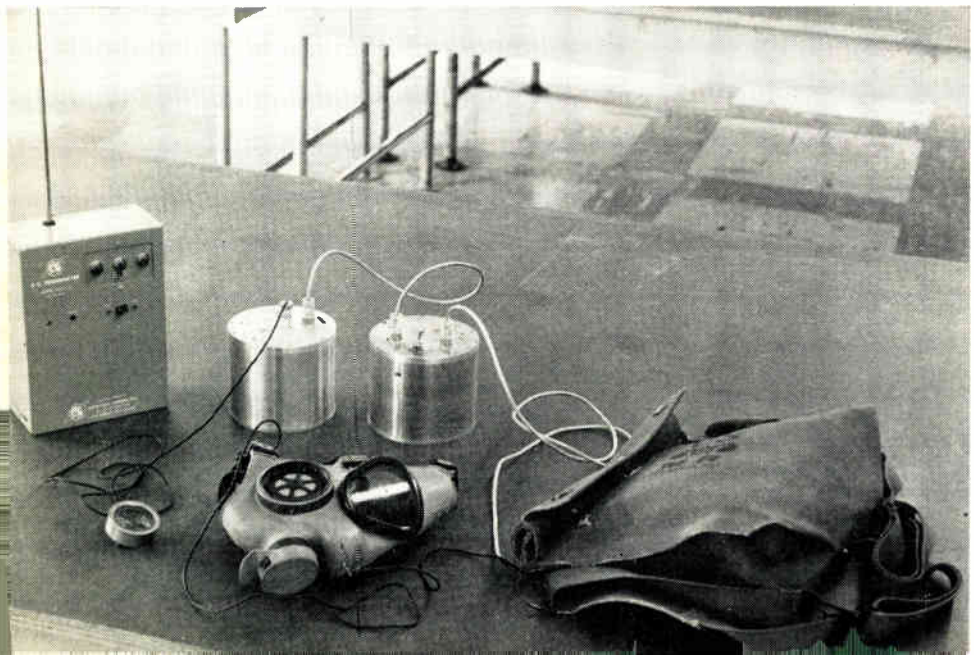
Gulton Industries, Inc.
Metuchen, New Jersey

Dr. H. E. Dahlke

Dr. W. Welkowitz

Fig. 1: The complete equipment: flow transducer, mask, transmitter, bridge, and recorder.



ONE pertinent piece of information for the diagnosis of pulmonary and cardiac disorders is the flow rate of the respired gases.[1] From this measurement, flow volumes can also be obtained by integration.

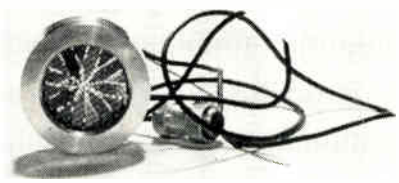
There have been a number of pneumotachographs which have been designed and built for laboratory use.[2, 3] While satisfactory for laboratory use, they generally are not suited for field measurements under normal working conditions.

Construction of these units generally includes an impedance screen mounted in bulky flow tubes, pneumatic connecting tubes, a pressure transducer, and a bulky recorder. Such a system does not lend itself to portability by the subject. To obviate many of these disadvantages, a portable pneumotachograph recording system has been designed and built. The express purpose is the making of respiration flow measurements on subjects under almost any field and work condition which may be encountered.

This unit, Fig. 1, includes a flow transducer mounted directly in the face mask, transistorized circuitry, and a miniature recorder. Total weight about 3 lbs. It can easily be carried around. Magnetic tape recordings of the flow can be made for 3½ min. under violent exercise conditions, if necessary, since the recorder is ruggedized to withstand heavy shocks.

1. Comroe, J. H., *Methods in Medical Research*, Year Book Publishers, Chicago (1950).
2. Fleisch, A., Pneumotachograph: Apparatus for Recording Respiratory Flow, *Arch., f.d., gas. Physiol* 209:713 (1925).
3. Lee and Silverman, *Rev. Scien. Inst.* 14, 174 (1943).

Fig. 2: Close-up of the flow transducer shows the vanes and supporting triangles.



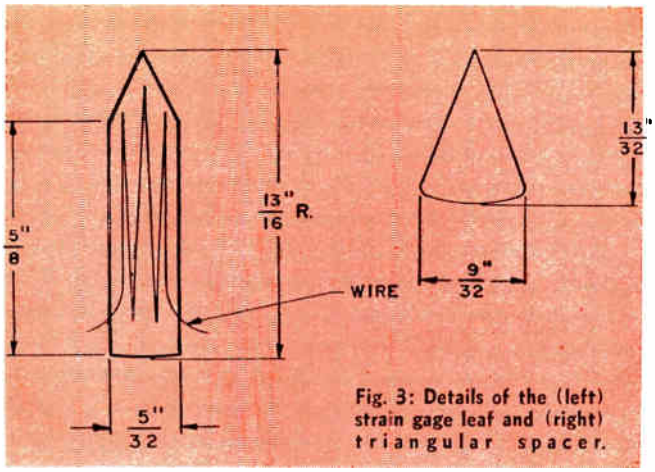


Fig. 3: Details of the (left) strain gage leaf and (right) triangular spacer.

Air Flow Transducer

The heart of this portable system is the lightweight, rapid responding, strain gage transducer. To obtain useful records, the following requirements for the transducer were established: (a) a range of 5-250 liters/min. of flow, (b) an accuracy of about 5%, (c) a back pressure of less than 20mm of H_2O and (d) a response time of better than 0.02 sec.

The air flow transducer, Fig. 2, consists of 8 cantilevered arms. Each of these gages consists of a piece of stainless steel 13/16 in. long, 5/32 in. wide and 0.002 in. thick, shaped as in Fig. 3a. An enameled constantan wire, 0.001 in. dia. and 3.2 in. long is cemented on each gage lengthwise, yielding a resistance for each gage of approx. 100 ohms. The set of gages is cemented onto a fiberglass ring, Fig. 4.

Eight triangular shaped stainless steel sheets, 0.002 in. thick, Fig. 3b, are placed between the gages to increase the pressure on the leaves. Thus producing higher sensitivity at minimum air flow. The gage wire ends are soldered to terminals provided on the fiberglass ring. The gages are then connected in series, Fig. 4. This arrangement provides a uniform air pressure applied to each gage.

A two conductor shielded cable connects the transducer to the bridge. The total resistance of each active arm of the bridge is approx. 400 ohms. The frame with the gages is supported in an aluminum holder, 1⅞ in. O.D. and ⅝ in. deep, by rings of synthane and rubber with protective screens at each end. A cross section of the holder is shown in Fig. 5. This holder is mounted in a Flexofoam dust mask.

Operation Principle

The principle of operation of this system is as follows: the cantilever arms bend under the influence of the air flow, producing a tensile strain on the surfaces that are directed into the air stream and a compressional strain on the opposite sides.

The bonded strain gage wire is strained by this action and changes its length L and cross sectional area A. On the tension side, the length and area are respectively $L + \Delta L$, and $A - \Delta A$, while on the compression side they are $L - \Delta L$, and $A + \Delta A$. As the resistance of the bonded wire is $R = K\frac{L}{A}$, the bending of the cantilevers in the air stream produces a resistance change ΔR in the bonded wire.

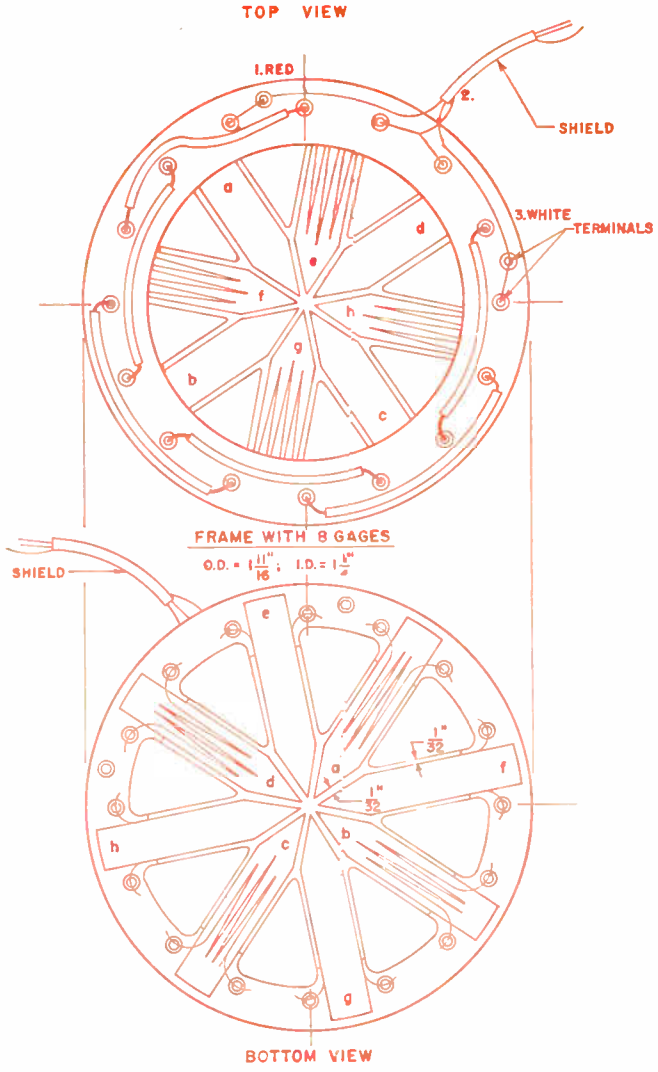
The relation between strain and resistance changes is expressed by the gage factor $G = \frac{\Delta R/R}{\Delta L/L}$. G, a constant, dependent on the type and size of wire, equals 2 approx. Thus when $\frac{\Delta L}{L} = 1\%, \frac{\Delta R}{R} = 2\%$. When the wire is bonded on the tension side of the cantilevers, the resistance increases; on the compression side, it decreases.

An air flow through the transducer in one direction, therefore, produces a positive output while the air flow in the opposite direction causes a negative output. In this way, it is possible not only to determine the amount of air flow but also the direction of the flow for inhalation and exhalation. As the resistance change is in the amonut of less than 0.1%, it is necessary to use an accurate bridge circuit to determine the change. In this unit, an ac bridge with a phase modulation circuit is used to indicate the amount and direction of the air flow.

Transducer Bridge Circuit

The circuitry of the bridge is shown in Fig. 6.

Fig. 4: Details of the breathing transducer frame with gages, spacers, and wiring properly placed. Note reversing of alternate gages to measure the tensile strain and compressional strain, respectively.



Strain Gages

(Continued)

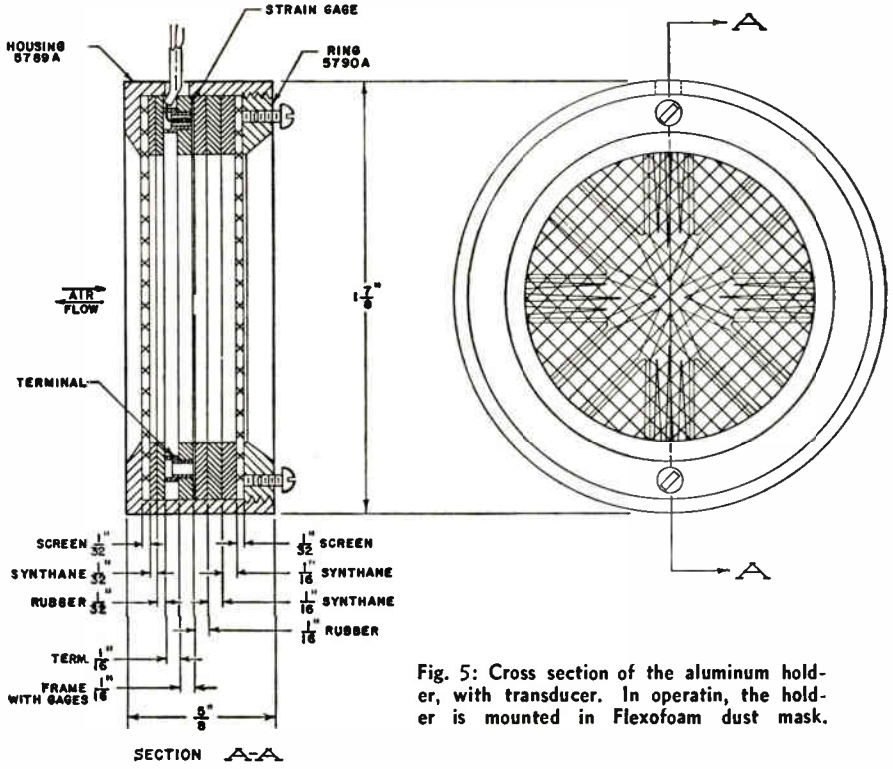


Fig. 5: Cross section of the aluminum holder, with transducer. In operatin, the holder is mounted in Flexofoam dust mask.

From the bridge and strain gage equations, it follows that the open circuit voltage of the bridge is

$$E_o = \frac{GE_BNS}{4}$$ where:

E_o = bridge output (volts)
G = gage factor of the strain gage
E_B = bridge supply voltage (volts)
N = number of bridge arms with gages
S = L/L = strain (inches/inch)

For this bridge circuit with $E_B = 2$ v., gage factor G = 2, number of active arms N = 2, the bridge output voltage is $E_o = \frac{2\Delta L}{L}$ or $E_o = \frac{\Delta R}{\Delta R}$ volts. If $\frac{\Delta R}{\Delta R} = 0.1\%$, then the output voltage $E_o = 1$ mv.

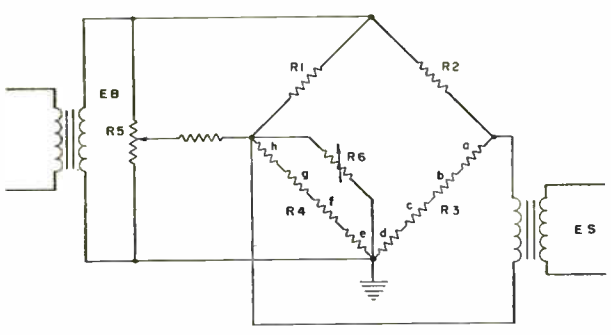
As the output voltage, E_o, is proportional to the bridge supply voltage, E_B, E_B should be as high as possible. The maximum, however, is limited by the rating of the gage wire to be used and by the wire length. E_B is limited to about 2 v. RMS in this case.

The bridge circuit contains 8 gages. The application of 8 gages instead of 2 makes the circuit highly sensitive and the output voltage more stable. Four gages, a, b, c, and d, are connected in series in arm R_3 and the other 4 gages, e, f, g, and h, are in series in the adjacent arm R_4. The bridge is balanced when $R_1/R_2 = R_4/R_3$.

However, to not get a cancellation of resistance change R_3 and R_4, the arrangement of the 8 gages is such that when the resistance of R_3 increases the resistance of R_4 decreases and vice versa. This can be achieved when the gages are so arranged in the air stream that the four gages of one arm, a, b, c, d, have their wired sides facing in one direction and the four gages e, f, g, h, in the adjacent arm are directed oppositely, Fig. 4. When an air flow is applied, the wires of the gages in one arm undergo a tensile strain and increase in resistance, while the gage wires in the other arm undergo a compressional strain and decrease in resistance.

The arrangement of the gages in the adjacent arms of the bridge also provides the advantage that the effect of resistance change with temperature is compensated; although the temperature coefficient of resistance of the constantan wire used is very small at the start. The bridge can be balanced by the potentiometer R_5 and the variable resistor R_6.

Fig. 6: Transducer gages form arms R_3 and R_4 of bridge. Alphabetical designations of the arm members refer to gages shown in Fig. 4.



Portable Recorder

The portable recorder is essentially that described by Upham and Dranetz[4]. The units consist of a transistorized circuit and a ruggedized mechanical tape recorder mechanism.

The circuit is the pulse position modulation system analyzed in the article. Some circuit changes were made to permit operation from a strain gage bridge rather than a differential transformer. The circuit, Fig. 7, consists of two channels; the information channel connected to the transducer, and the reference channel. Both of these are fed by a carrier oscillator of 1KC. The 1KC sine wave in each channel is then fed to a pulse shaping network and the resultant square waves of each channel are combined and fed to the head of the tape recorder. A 60KC oscillator delivers the bias voltage to the tape head.

The tape transport mechanism with the motor batteries, the B+ supply and tape head is mounted on an aluminum plate of 4 in. diameter. The motor is driven by a 7.5 v. battery. This in turn drives a spool of

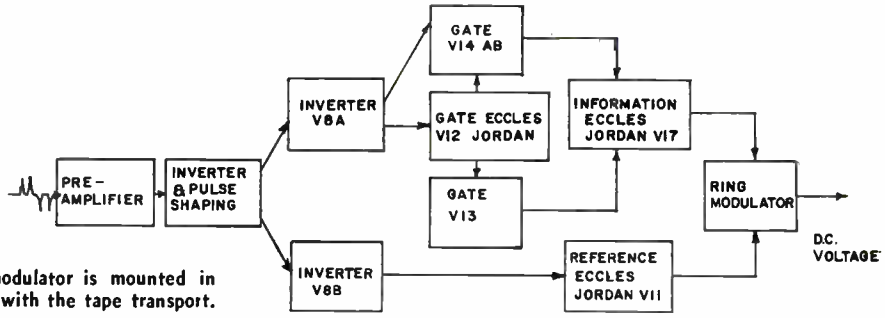


Fig. 8: This demodulator is mounted in the playback unit with the tape transport.

¼ in. wide magnetic tape, 0.0005 in. thick and 1350 in. long for minutes. The recording occurs on a single center track at a speed of 7.5 ips. Supply and take-up spools are driven by anti-acceleration friction drives while a capstan drive eliminates normally encountered resonances.

Playback

Since the information from the transducer is contained in the form of pulse position modulation on the tape, it is necessary to decode this information to produce a dc voltage proportional to the resistance change of the strain gage transducer. The conversion from pulse position modulation to a varying dc voltage occurs in the playback unit. This unit consists of the tape transport mechanism and the demodulator, Fig. 8, both rack mounted in a cabinet. The playback unit is similar to the unit described by Upham and Dranetz[4].

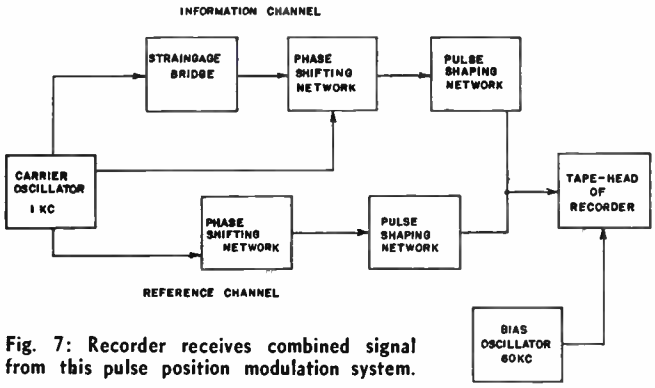


Fig. 7: Recorder receives combined signal from this pulse position modulation system.

System Characteristics

Shock and Vibration

When the cantilevers of the transducer bend under the influence of a force, a voltage is developed in the output of the transducer bridge. It is necessary that there be essentially no output voltage produced when the transducer is shocked, such as occurs when the subject under test jumps or falls. To test this property, the transducer connected to the bridge was dropped from 3 ft. and no measurable output voltage was found.

In addition, the transducer was mounted on a mechanical shaker and vibrated at an acceleration of 1g at frequencies from 0.4 cps to 200 cps. The bridge output voltage vs. frequency is shown in Fig. 9. It can be observed from the figure that there is no output voltage under 100 cps. At 104, 116, 132 and 162 cps, the resonance frequencies occur.

The output voltage at 116 cps and 1g acceleration is 0.03 mv. or the equivalent of an air flow of 30 liters/min. The voltages produced at the three other resonance frequencies are 30% of this value.

Since breathing flows do not normally produce frequency components as high as 100 cps it is possible to eliminate any error due to these resonance frequencies. To accomplish this, there is a filter in the demodulator which cuts off all responses above 50 cps. The response time of the transducer is better than 10 msec.

Calibration

The transducer was calibrated against a Fisher & Porter Rotometer[5]. The calibration curve of output voltage vs air flow in liters/min. is shown in Fig. 10. The voltage reading is that measured at the output of the demodulator. The calibration curve is linear from 2.5 to 250 liters/min. Units such as this have been run successfully for flow rates up to 300 liters/min.

Breathing Tests

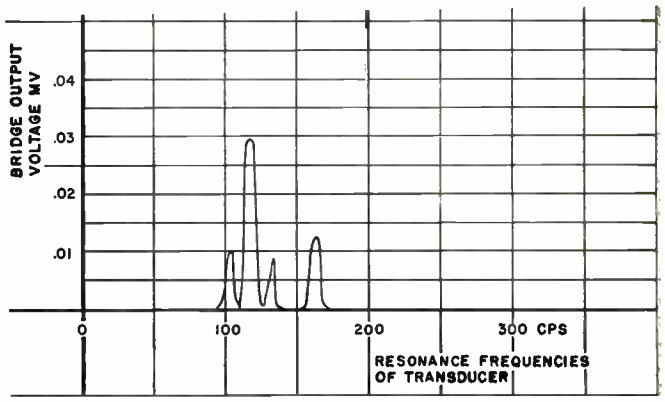
Fig. 11 illustrates some breathing records taken with different test persons.

A1) The horizontal line represents no breathing, i.e., the breath being held. The area above this line is due to exhalation and the area under this line is due to inhalation. In the horizontal direction, 5 mm. correspond to 1 sec.; vertically to 0.2 dc or 40 liters/min. Further calibration can be obtained by referring to Fig. 10.

A2) This represents a deep exhalation of 2.9 liters of air.

A3) This represents normal breathing with ap-

Fig. 9: System characteristics while vibrating at acceleration of 1g.



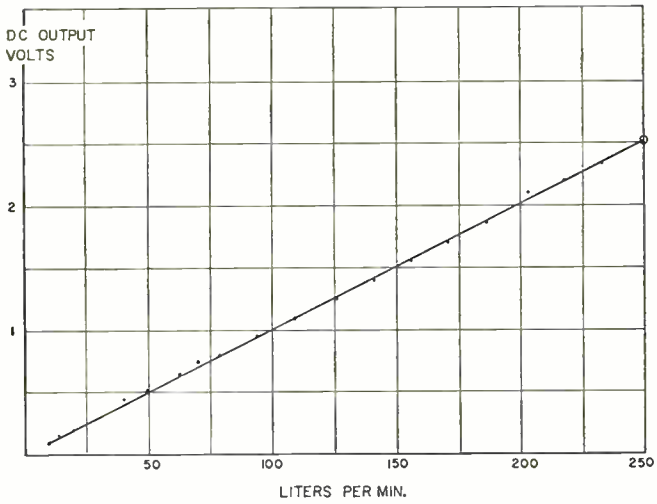


Fig. 10 (above): For calibration, demodulator voltage is measured.

Strain Gages *(Continued)*

proximately 0.8 liter inhalation and the same amount of exhalation. The time between two inhalations is 3 sec.

A4) This represents a deep inhalation of 3 liters air.

A5) This is a period of no breathing.

A7) This represents the breathing of the same test person on the next day.

A8) This represents no breathing but with the subject jumping during the period.

A9) This represents fast breathing of the same subject with 1.3 seconds between successive exhalations.

B, C, D, E and F are breathing records of five different test persons. Of interest are the short and deep inhalations and the long and shallow exhalations of test person E.

According to these subjects, the back pressure was so low as to be non-objectionable. The system has been found to be rugged enough to be useful in field operations even under adverse shock and vibration conditions.

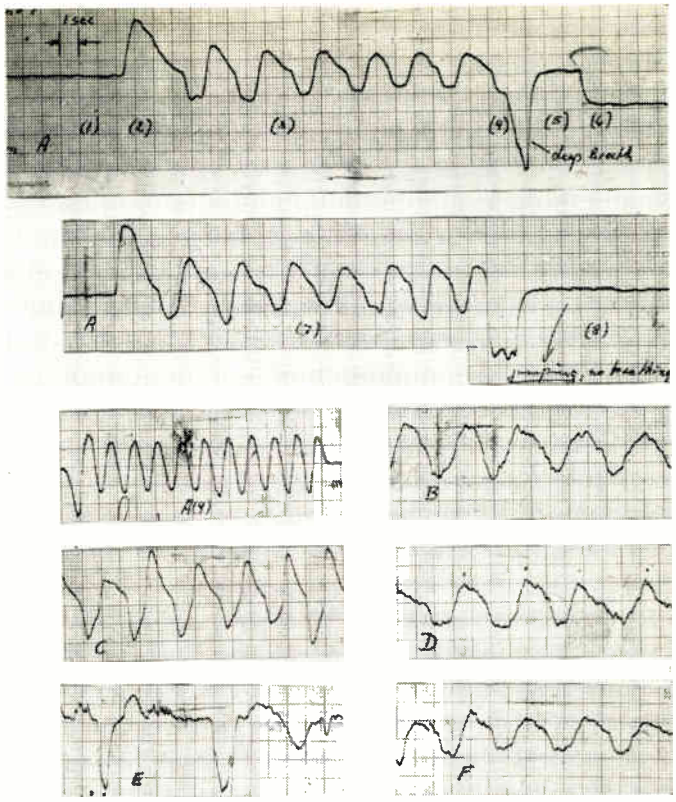


Fig. 11 (above): The breathing records of several test persons.

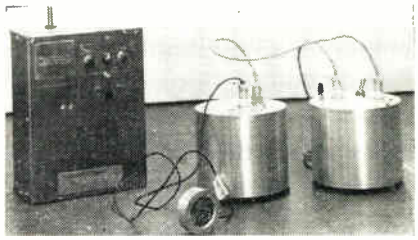


Fig. 12 (right): Close-up of flow transducer and associated equipment of system.

Acknowledgment

The authors wish to acknowledge the many helpful suggestions of Dr. F. Craig of the Army Chemical Corps and to thank J. Kilduff and J. Palush for their work in building and testing the system.

Developed under Contract DA18-108-CML-5948, with the Army Chemical Corps, Edgewood, Maryland.

Space Age Antennas

THE adaption of a new antenna principle to scatter propagation antennas is not specifically aimed at offering improved rf performance over tropo parabolas or conventional ionospheric arrays. This principle has been incorporated into scatter antenna designs to

(*Continued on page* 102)

Important antenna developments in the fields of interplanetary space vehicle tracking and airborne early warning radar systems are demonstrated.

Rapid, reliable, high quality communications ●
Long distance, high resolution detection and identification ●
Long distance, ultra-precise navigation ●
These are the objectives of the USAF Ground Electronic Program

The Air Force Explores

The Future with Solid State Devices

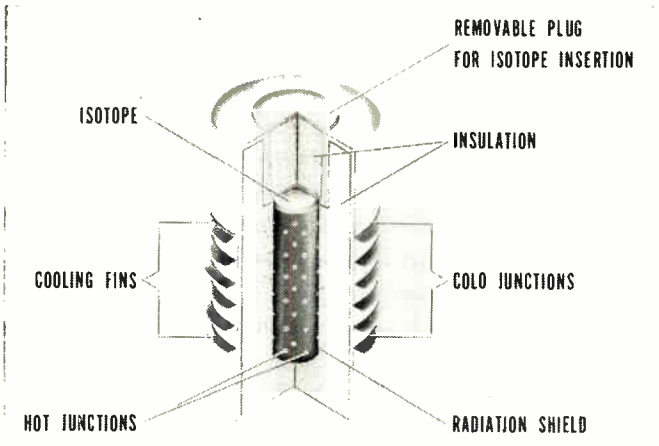
By JOSEPH B. BRAUER
Chief, Electronics Materials Sect.
Rome Air Development Center
Griffiss AFB, Rome, N. Y.

Part Two of Two Parts

Energy sources in space are a relatively unknown quantity. There may be as yet undiscovered radiant sources, energy fields, atmospheres and planetary surface materials which could provide the input for conversion devices supplying power for space missions. Then again, it may be necessary to consider either carrying the power source with the mission or beaming source power from the earth or a satellite to the user in space.

The types of devices conceived and potential applications are innumerable. Small output, radioisotope powered, thermoelectric generators,[3] Fig. 7, could be included in individual devices or circuit packages as permanent integral power supplies unaffected by environment. More unique items might include "thermal transistors,"[4] or devices which derive operating energy directly from a thermal input. Such devices would allow partial electrical isolation where circuit elements were handling frequencies from dc thru r-f, and total electrical isolation of optical frequency circuit elements.

Fig. 7: Thermoelectric generators could be integral power supplies.



Where low or intermittent power drains are involved, it may be practical to consider "two-headed" devices which derive driving power by detection and conversion of r-f energy radiated from a large fixed site and use this power to feed the useful circuit elements operating at a different frequency.

Superconductivity Effects

Recent advances in low temperature technology in general and in some very interesting devices based on the phenomena of superconductivity have resulted in extensive effort being applied in this area.

Consider the cryotron which takes advantage of the fact that a magnetic field affects the superconducting transition temperature. This principle is applicable to almost any conceivable computer circuit and to a host of other electronic devices such as amplifiers, modulators, and wave form generators. This can be achieved by enough quantization using basic binary elements such as the flip-flop, Fig. 8, but analog effects could also exist—linear over a region—using for example, non-homogenous alloys or mixtures in the active element.

The trend in computers using these and other solid

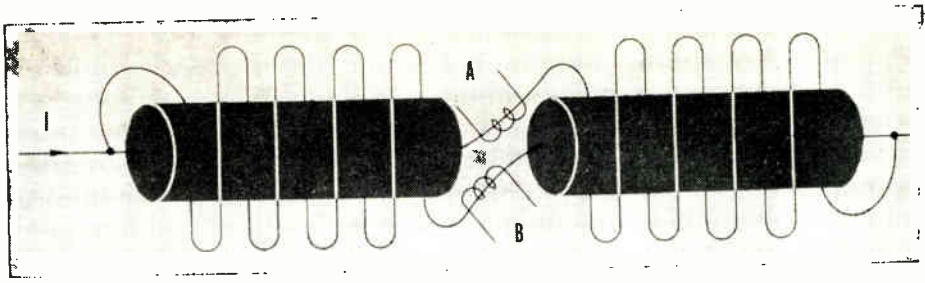


Fig. 8 (right): This cryotron flip-flop exploits the fact that a magnetic field affects superconducting transition temperature.

state devices is toward larger high speed memories which could enable them to easily handle complex differential equations of many variables. These devices are also leading to renewed interest in systems more closely approaching self-organizing or "thinking-machine" concepts with sufficient element density, random correlation of data, built-in sub-routine cataloging and selection, learning processes and the other functions characteristic of the operation of the human brain. The small size and low power drain of these devices makes such concepts realistic.

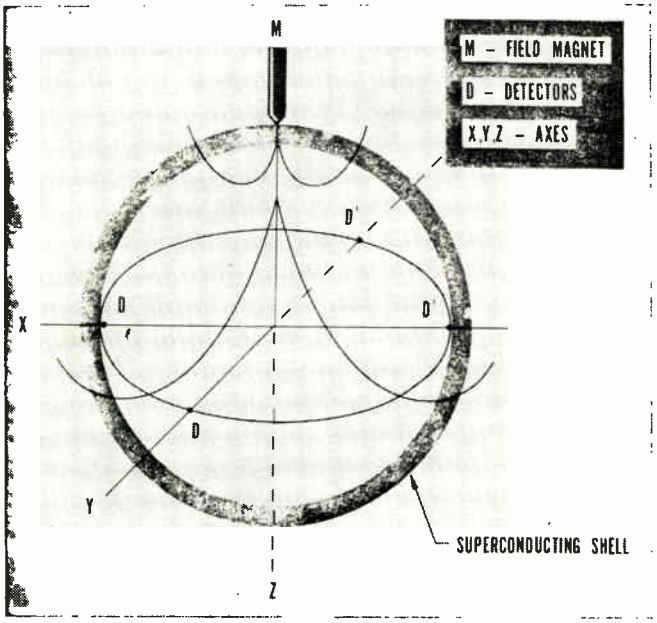
One fundamental limitation on our approach to thinking machine concepts is the singularity of our coding or programming techniques which requires the recognition of each result in the chain as necessarily true. In the human brain, the dual interpretation of data on a non-linear value scale permits interpretation of each resultant as probably true or almost certainly true. This, in turn, permits "dynamic programming" or continuous reprogramming throughout the computation cycle to fit data or results not capable of anticipation. Thus, a concept of decision making based on not quite sufficient data is substituted for the present true-false concept. Application of this principle could enable our new solid state computers to think for themselves and make decisions within limits

Our entire concept of computer devices, solid state or otherwise, would have to be changed to accommodate this approach.

Superconducting Gyroscope

Another superconductive device which is presently being investigated involves the use of a superconductor medium to establish a fixed polar coordinate reference system in a moving body, Fig. 9. A spherical body is mechanically fixed and cooled to liquid *He* temperature. The device depends on the establishment of a supercurrent which is fixed with respect to inertial space and the relative motion of the spherical body is detected by magnetoresistive sensing devices.

Fig. 9: This proposed superconducting gyroscope depends on establishment of a supercurrent which is fixed with respect to inertial space.



Incidentally, if this device does not prove successful as a gyroscope, it should at least prove to be a very sensitive magnetic field detector.

Conventional components such as inductors and capacitors are not excluded from the application range of cryogenic techniques. Such concepts are very realistic, e.g., as filters of virtually infinite "Q" (limited only by dielectric loss) which are microscopic in size, ideal transformers for impedance level changing and perfect shielding (both electric and magnetic).

Materials and Circuit Design

We must refine our raw materials to a state of purity which will allow precise correlation of the observed properties with the fundamental lattice or structure. Only then can we apply the concepts of molecular engineering and build "to-order" the solid state materials for the devices of the future. Theoretical limitations on solid state devices are virtually non-existent.

We encounter some problems in purification and processing of materials, effects of surface contamination, effects of nuclear radiation, aging effects, temperature dependency and limits, and other very real obstacles. These are all, however, capable of solution or elimination as significant factors for specific applications. The state of the art in solid state materials including dielectric, magnetic, semiconductor, thermoelectric and others indicates that the ultimate in performance has not yet been reached and in only a few cases can it be accurately predicted.

Great strides are possible in the development and applications of solid state devices if our thinking can be revitalized so that we consider the whole chain of electronic functions in any given system as open to criticism. In the past, there has been a tendency to perform the same circuit functions in the same manner except for the substitution of transistors for tubes, junction diodes for dry rectifiers, and so on. Considerable improvement could be realized by the reduction or elimination of the number of frequency conversions presently made as we proceed from the detection of an incoming signal through many stages of amplification, filtering, delay or modulation to the final utilization of the data it contains.

Future Systems

We might rigorously apply some of the concepts and devices previously discussed to the visualization of some typical electronic systems of the future.

A communication system for instance might take the form indicated in Fig. 10. Collecting optics and a variable transmission semiconductor chopper would collect ultraviolet radiation in space and focus it into a narrow beam. FM excitation of an electrical field controlling the transmission properties of the system could result in a useful communications link. Where maintenance of a suitable time base was no problem, pulse time code (PTC) modulation could be used instead of FM.

The receiving portion of the system might be conceived as a collecting lens feeding the signal to a semiconductor ultraviolet prism. This prism could analyze the frequency components and distribute them along a suitable image detector consisting of a photo-responsive film with synchronized readout matrix. FM decoding would then extract the information from this communications system. Requiring no primary transmit power the system could derive energy for its data handling functions from solar radiation.

The ideal detection system, Fig. 11, of the future should be sufficiently sensitive and efficient to operate passively, i.e., to test the existence and location of all objects in its field of view as a result of radiation originating from the object. For maximum effectiveness, the system must have the ability to sense its entire radiant environment and to analyze and display all the useful information present in this environment. This immediately invokes a requirement for a vast amount of circuitry with which to perform the functions of selective filtering, signal correlation or integration, and data analysis necessary to interpret and apply the information content of the many signals. Almost every conceivable solid state device would be a candidate for application to such a system.

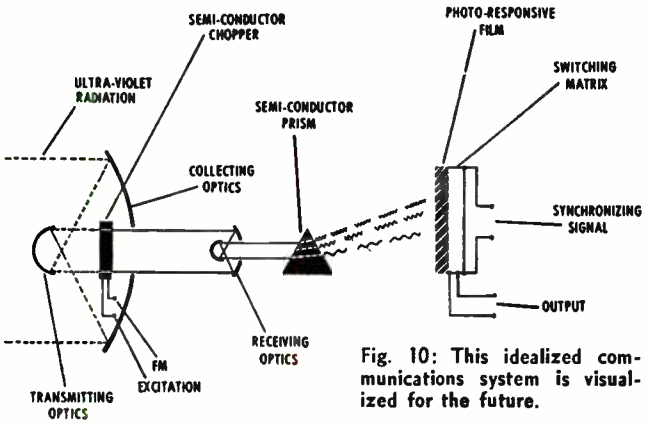
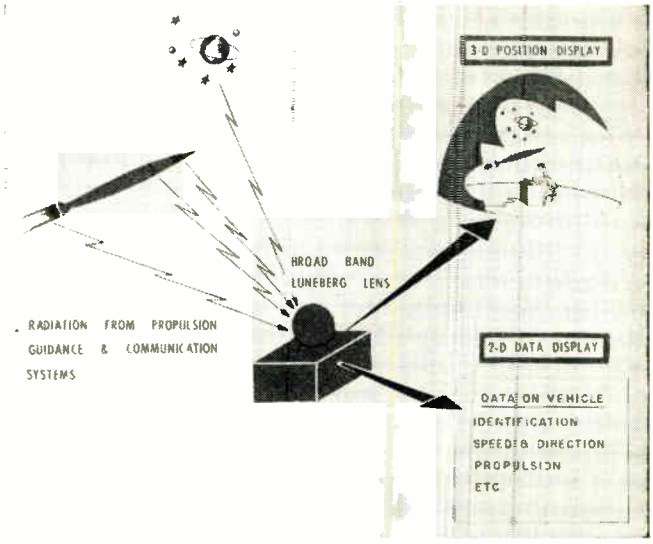


Fig. 10: This idealized communications system is visualized for the future.

Primary data on the position and relative motion of both natural and man made objects could be fed directly into two or three dimensional solid state situation displays. Nature of the object (i. e., size, composition, propulsion system for vehicles), and other significant data would require analysis by rather elaborate computer systems, feasible only with extreme application of solid state techniques and devices. This data would be presented by solid state numeric displays.

Fig. 11: The ideal detection system should operate passively—use radiation originating from object to test existence and location.



The receiving antenna for this system might be conceived as a solid state structure such as a modified Luneberg Lens. Assume the existence of material whose index of refraction is independent of frequency, i. e., the dielectric constant graduations which are required for refraction of microwaves must coincide with graduations in optical index of refraction. This would allow design of a Luneberg type lens for reception throughout the electromagnetic spectrum. The detectors could be narrow band with frequency sweep to maximize signal to noise ratio.

The navigation system of the future would be basically a combination of some of the features of the communications and detection systems. Primary requirement here would be ultra precise oscillators, techniques for establishment of adequate time standards and coordinate systems, and exceptionally versatile computers.

Although some of the ideas presented here are rather visionary, we believe it is safe to say that future solid state devices offer orders of magnitude improvement in the communication, detection and navigation functions of the USAF. We need this improvement to meet our extrapolated future requirements, and we are sure that closer understanding and cooperation between our research people and equipment designers could obsolete many of the concepts presented here in a relatively short span of time.

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2. J. L. Ryerson, "Exploitation of Physical Phenomena for Communications," *IRE Convention Record*, 1958.
3. J. L. Briggs and L. J. Sirois, "Radioisotope Thermoelectric Generator," *IRE Convention Record*, 1957.
4. Andrew Kelen and Per Svedberg, "The Thermoelectric Transistor, A Possible Batteryless Amplifying Semiconductor Device," *Applied Scientific Research*, Section B, Vol. 6, Pages 369-378 (k956-57).

New Products . . . for the Electronic Industries

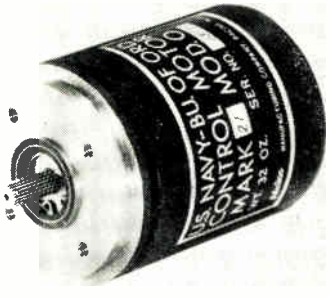
INPUT TRANSFORMER

This in-line microphone input transformer is designed to be inserted in cable circuits and is built to withstand mechanical abuse. The Mu-Metal and electrostatic shielding improve signal to noise ratio. The unit's 20 to 20,000 cycle, plus or minus 2 db response assures broadcast quality. The input transformer is 1⅛ inches in diameter and 2⅜ inches long. It weighs 11 ounces, and is supplied with a 6 inch shielded microphone cable which mates with Amphenol 91-PC-4F plug. Microtran Co., Inc., 145 East Mineola Ave., Valley Stream, N. Y.

Circle 203 on Inquiry Card. page 117

SERVO MOTOR

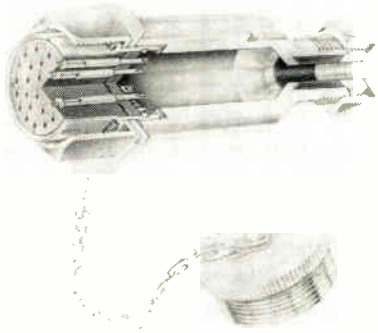
The Type 23-5251-01 a continuous duty, hi-temp, size 23 servo motor conforms to BuOrd Mark 21 Mod 0 specifications. It meets requirements of MIL-S-17087 and environmental requirements of MIL-E-5272A. No load speed is 5000 rpm; stall torque, 6.5 oz in; rotor moment of inertia, 15.5 gm cm²; ambient temperature range, 54°C to +125°C, and weight, 32 oz. Rating is 115 v on phase 1 and 115/57.5 v on phase 2, with power input 22 w/phase at stall. Bearings and housing are stainless steel. John Oster Manufacturing Co., Avionic Division, 1 Main St., Racine, Wis.



Circle 204 on Inquiry Card. page 117

CONNECTORS

The series LR and MR, weatherproof connectors can withstand extreme conditions of mud, ice and water. Used on arctic radar warning systems, such as the "DEW Line," they feature clear and black anodic coating for maximum corrosion resistance built-in rubber gland and gland nut for moisture sealing around the cable; and chain-attached caps for sealing off the connector faces when plugs and receptacles are unmated. Coupling threads and sizes are standard to MIL-C-5015. Cannon Electric Co., 3208 Humbolt St., Los Angeles, Calif.



Circle 205 on Inquiry Card. page 117

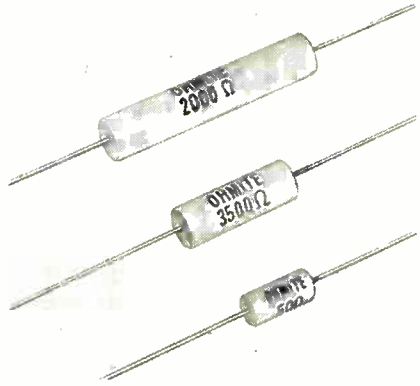
SOLDERING IRONS

Magnastat temperature control gives precise temperature at the tip reducing radiation loss and temperature "peaks" and "lows." The irons save heat when not in use, consuming about half of the designated wattage. Oxidation is reduced minimizing the need for tip redressing. The temperature controller is located in the tip of each iron. The 40 w. model is designed for lower temperature use, the 60 w. iron for light to medium soldering, and the 120 w. iron for medium to heavy work. Weller Electric Corp., 601 Stone's Crossing Rd., Easton, Pa.

Circle 206 on Inquiry Card. page 117

PRECISION RESISTORS

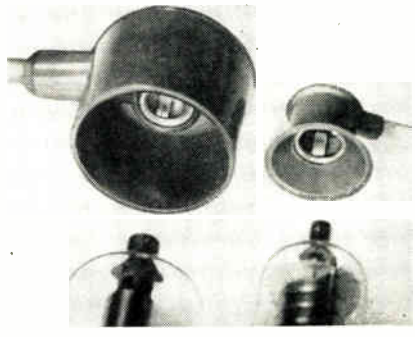
These molded wire-wound resistors are provided in precision tolerances at 3, 5, and 10 w. The wire is wound in a single layer on ceramic cores. The cover is a jacket of silicone-ceramic molded around the resistor under great pressure. They pass the 1000 volt V-block test and may be used next to electrically "hot" parts. Available tolerances are: 0.1%, 0.25%, 0.5%, 1.0% and 3.0%. Maximum resistance is: 3 w size—10,000 ohms, 5 w size—25,000 ohms, 10 w size—50,000 ohms. Designed to meet MIL-R-26C Specifications. Ohmite Mfg., Co., 3696 Howard St., Skokie, Ill.



Circle 207 on Inquiry Card. page 117

TUBE CAP CONNECTORS

A tube cap connector series having the thermo, electrical, and mechanical characteristics of silicone molding compounds is available. Included are: glass filled silicone for highest temperature application from −65°F to 750°F and will withstand up to 1000°F for a short time (meets MIL-M-14E specifications), and silicone rubber for flexibility and resiliency under special applications. Silicone rubber insulated connectors are available for high voltage applications, temperatures from −70°F up to 500°F. Alden Products Co., Brockton, Mass.



Circle 208 on Inquiry Card. page 117

New Products . . . for the Electronic Industries

STEP-DOWN TRANFORMERS

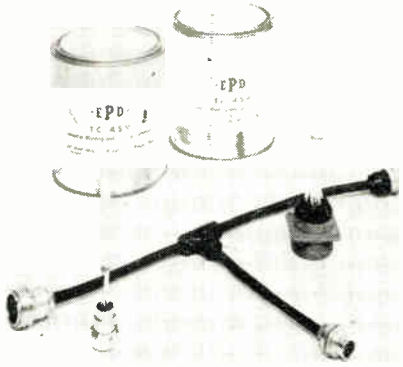
Line of low power transformers for remote control and signal circuits featuring: windings insulated from core with nylon plastic, low heat rise, small size, high temperature plastic

and metal shells, screw terminals molded in the plastic case, and moisture-proofing. Units are available with various mounting arrangements and connection facilities. Two power ratings of 10 va and 25 va in five outputs from 6 to 24 v are standard. Anderson Controls, Inc., 9959 Pacific Avenue, Franklin Park, Illinois.

Circle 197 on Inquiry Card, page 117

EPOXY RESIN

TC-459 is a two-part epoxy resin used for sealing and reinforcing electrical connectors, wiring, cable and other equipment against corrosion, insulation failure, and moisture

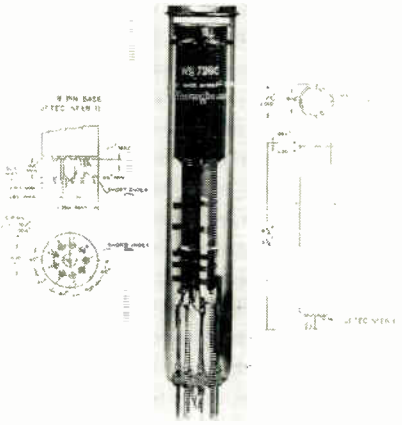


contamination. It meets or exceeds applicable Military Specifications. Featured are: dielectric constant—3.2, dielectric strength—1500 v/mil, and insulation resistance 10^{12}-10^{14} ohms. The change in dielectric properties is negligible from —65° to +250°F. Electronic Production & Development, Inc., El Segundo, Calif.

Circle 199 on Inquiry Card, page 117

VIDICON TUBE

A small-size vidicon camera tube (WL-7290), designed for slow speed scanning operations, useful for transmitting high resolution information over conventional audio circuits. It

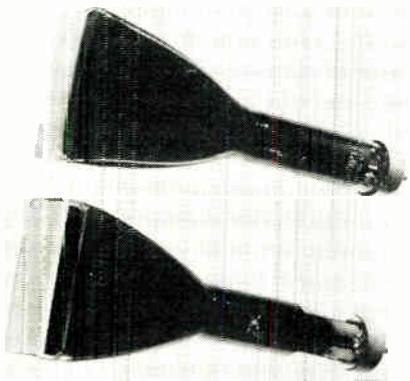


can store or "freeze" an image for several minutes, provided the surface is not scanned by the beam during this time. A high-quality picture, 350 line resolution, can be held for two minutes. It is most applicable where a narrow bandwidth signal is desired. Westinghouse Electronic Tube Div., P. O. Box 284, Elmira, N. Y.

Circle 201 on Inquiry Card, page 117

CATHODE-RAY TUBE

Direct replacement for the Type 3XP cathode-ray tube, the three-inch screen, flat-face rectangular tube is available with P1, P2, P5, P7, and P11 phosphors. The 3 in. x 1½ in. rectangular screen tube is 8¾ in. long and has electrostatic deflection and focus. It is designed to operate with an accelerating voltage of 1000 to 2000 v dc. Deflection factors in the



y direction with 1000 v are 12.5 to 17.5 v d-c to move 1 in., and 25 to 35 v d-c with 2000 v accelerating voltage. Allen B. DuMont Laboratories, Inc., 750 Bloomfield Ave., Clifton, N. J.

Circle 198 on Inquiry Card, page 117

ELECTROLYTIC CAPACITORS

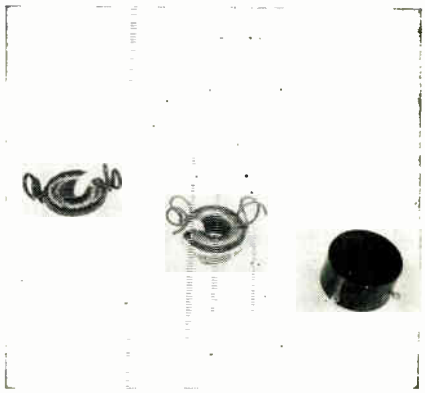
These Type QE, computer-grade, electrolytic capacitors are engineered for high reliability and long operating life. Applications include: power supply filters, telephone networks, industrial electronic equipment and precision laboratory and commercial test equipment. They have a useful life expectancy of greater than 10 years when operated within ratings. Oper-

ating life will further improve when the ambient temperature is below 65°C. Units are rated for operation at temperatures from 20μC. to+85°C. Aerovox Corp., New Bedford, Mass.

Circle 200 on Inquiry Card, page 117

TOROIDAL INDUCTORS

Line of standard inductance coils, toroidally wound on molybdenum permalloy powder cores, provides a stable and high Q inductance over the audio frequency range. Stock values range from 5 mh to 5 h, with a tolerance of 1%. Standard finishes are available. Overall size is: 1 5/16 in. x 11/16 in. Special values of inductance, Q, frequency and temperature



range are available. These units are useful in filter work, resonant tuned circuits, and delay lines. Magnetico, Inc., 6 Richter Court, East Northport, L. I., New York.

Circle 202 on Inquiry Card, page 117

WASHINGTON News Letter

POSSIBLE UNEMPLOYMENT RISE — Promulgation of the aircraft industry increased minimum wage—$1.75 an hour or even up to $2—could well result in unemployment for electronic-missile system workers who have recorded a high rate and stability of employment even during the recent recession. In addition, a number of important electronics manufacturing companies would be severely hampered from competing for defense business in the missile electronics systems' field particularly. This is felt to be true since the aircraft industry in its defense work receives a certain amount of government subsidies. Another factor for the differential in minimum wage treatment between the two industries is that the skills and working operations of airframe and electronics and missile workers are in no way similar.

COMMITTEE MAKEUP — The committee was headed by former president and chairman of the Southwestern Bell Telephone Co. Victor E. Cooley who was deputy director of the Office of Defense Mobilization from 1953 to 1958. The other members were Dr. Irvin Stewart, FCC Commissioner from 1934-37 and recently retired president of West Virginia University who during the war was the chief aide to Dr. Vannevar Bush and in 1951 headed President Truman's Communications Policy Board; Frank Gregg Kear, a leading consulting broadcasting-television engineer since 1934; William G. Thompson, retired assistant vice president of the American Telephone & Telegraph Long Lines Department in charge of overseas communications who is now advisor to the Defense Department on Communications policies; and Maj. Gen. W. Preston Corderman, Deputy Chief Signal Officer from 1955-57 who retired from the Army in September after commanding Fort Monmouth, a vice president of Litton Industries.

PICKS UP BALL—The committee's recommendations which were understood to propose establishment of a permanent group meant that the Eisenhower administration picked up the ball dropped by Congress in the final days of its session last summer when the House failed to act on a resolution providing for a study of the government's use of the spectrum by a commission of experts. The House Committee's failure to approve the resolution resulted from opposition pressures by broadcasting and television interests. However, the broadcasting and television fields have been portrayed as unhappy with the Presidential committee makeup on the ground that it has a preponderance of communications-minded members. But in the view of impartial Washington observers this fear is baseless as the committee membership is composed of men competent in the field of analyzing spectrum requirements.

ADVISES PRESIDENT—Early this year a five-member advisory committee of top industry and former government authorities was slated to present to President Eisenhower, through Director of Civil & Defense Mobilization Leo A. Hoegh, its recommendations on methods to bring about improvements in the management and use of telecommunications resources by the federal government, particularly in the allocation of the radio spectrum. The group during several meetings in December examined existing governmental policies, use of facilities, administrative arrangements and proceedings for the allocation, management and control of telecommunications, including the radio frequency spectrum for government and non-government use.

ELECTRONICS WAGE OBSTACLE—National defense costs for electronic equipment and components and for missiles' electronic systems would be increased more than an estimated billion dollars if a minimum wage increase for the aircraft industry is finalized. This situation is likely to occur, it is believed by government and industry sources, if the aircraft industry places their employees engaged in electronic missile system production under the same minimum wage pattern as its labor force working on airframes and airplane construction, which is sought by the aircraft industry's employees unions —the United Automobile Workers and the International Association of Machinists.

MICROWAVE IS KEY—The motor carrier industry through the American Trucking Association emphasized to the FCC that it is "thirsting for long lines communications" and microwave is "the possible key that may provide the greatest forward step in the trucking efficiency in the next ten or twenty years." This viewpoint was presented to the FCC by the ATA in a recent proceeding. The trucking industry has a tremendous potential, it was cited, in private microwave facilities in contrast to using the higher-cost services of the Bell System and Western Union.

FCC RECOGNITION—One of the largest segments of mobile radio service which has come into being in the past five years, the Special Industrial Radio Service Association was recently given formal recognition by the FCC as a frequency advisory agency to the Commission. Special industrial radio licensees comprise a broad cross-section of the nation's economy — agriculture, construction, mining, concrete, fuel oil, radio equipment installation and maintenance firms and radio-electronics manufacturing companies.

National Press Building
Washington 4

ROLAND C. DAVIES
Washington Editor

CINCH HEAT DISSIPATING

TUBE SHIELDS

☆ NOW AVAILABLE—

from CINCH—the complete line of HEAT DISSIPATING TUBE SHIELDS, for Miniature, Subminiature, Octal and Power Tubes.

T5 and T6

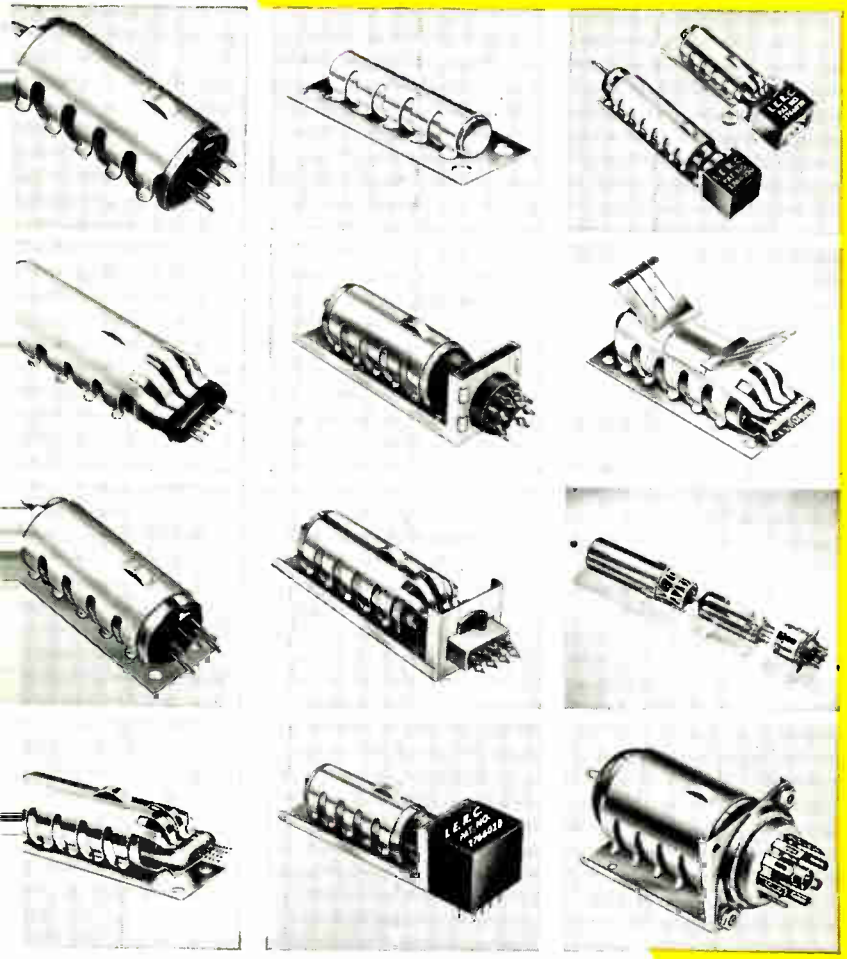
TR5 and TR6

The 7 and 9 pin Miniature Series, T, TR and NW Series are variously covered by Military Specifications:

MIL-S-9372B (USAF)
MIL-S-242A (Ships)
MIL-S-19786A (Navy)
SCL-6307/2 (Signal Corps)

In the Octal and Power Series, the shields are covered by Redstone Arsenal and Signal Corps approval.

Where shields are required blackened, Henderlube is supplied as the Standard finish.



SUBMINIATURE AND MINIATURE SHIELDS

OCTAL and POWER SHIELDS

entrally located plants at cago, Illinois, Shelbyville, ina, La Puente, California and St. Louis, Missouri.

☆ *Under license arrangement with International Electronics Research Corporation.*

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1026 South Homan Ave., Chicago 24, Illinois
Subsidiary of United-Carr Fastener Corporation, Boston, Mass.

Circle 40 on Inquiry Card, page 117

SELECTION CHART....

Listed below are the essential characteristics and typical performance data of unclassified G-E microwave power tubes including traveling-wave amplifier tubes, lighthouse-planar types, klystrons and magnetrons.

The tubes are listed under each category according to frequency. Commercially-available types are indicated in bold-face type. All other types are developmental and intended for prototype design.

VOLTAGE-TUNABLE MAGNETRONS, PACKAGED

FREQUENCY, MEGACYCLES	POWER OUTPUT, WATTS	NOMINAL ANODE VOLTS	NOMINAL ANODE AMPERES	TUBE TYPE
2200-3850	2.0 min.	900-1600	0.010-0.020	Z-5300
2350-3600	0.0005	1460-1540	0.010-0.020	Z-5266
2900-3100	10.0	1210-1290	0.020	Z-5321
2900-3500	0.1	1400-1600	0.010-0.020	Z-5265

FIXED-FREQUENCY PULSED MAGNETRONS, PACKAGED

2750-2860	4500 Kilowatts (Peak)	69,000	130	Z-5306
		71,000	130	GL-6410

TRAVELING-WAVE AMPLIFIER TUBES

CLASSIFICATION	OPERATION	FREQUENCY RANGE, MEGACYCLES	MINIMUM POWER OUTPUT	MAXIMUM NOISE FIGURE, DECIBELS	POWER GAIN, DECIBELS	MAXIMUM DUTY CYCLE	HELIX VOLTAGE, VOLTS	HELIX CURRENT, AMPERES	ANODE VOLTAGE, VOLTS	TUBE TYPE
CW, Low-noise, Glass-Metal	Electro-magnetic Focus	4000-8000	1.0 Milliwatt	10	25	——	700	2 Micro-amperes	55	Z-5160
		7500-11,300	1.0 Milliwatt	11	20	——	700	2 Micro-amperes	55	Z-5082
CW, Low-noise, Metal-Ceramic	Electro-magnetic or PM Focus, Ruggedized	4000-8000	1.0 Milliwatt	10	25	——	550	2 Micro-amperes	55	Z-3028
		8000-12,000	1.0 Milliwatt	10	20	——	700	20 Micro-amperes	750*	Z-5259
	Permanent Magnetic Focus, Ruggedized	7000-11,000	3.0 Milliwatt	15	35	——	700	20 Micro-amperes	750*	Z-3036
Pulsed, Glass-Metal	Electro-magnetic Focus	2000-4000	1.0 Megawatt (peak)	—	27	0.001	——	——	150,000	Z-5117
CW Metal-Ceramic	Permanent Magnetic Focus, Liquid Cooled	7500-11,300	100 Watts	—	25	——	——	——	0	Z-5161

*Collector Voltage

VHF-UHF METAL-CERAMIC TETRODES

FREQUENCY FOR MAXIMUM RATINGS, MEGACYCLES	COOLING	PLATE POWER OUTPUT FREQUENCY, MC	PLATE POWER OUTPUT KILOWATTS	MAXIMUM RATINGS DC PLATE VOLTAGE, VOLTS	MAXIMUM RATINGS DC PLATE CURRENT, AMPERES	MAXIMUM RATINGS PLATE INPUT, KILOWATTS	MAXIMUM RATINGS PLATE DISSIPATION, KILOWATTS	TUBE TYPE
500	Forced Air	500	50.0 peak*	10,000	10.0	——	100.0	Z-5319
800+	Water & Forced Air	800	1.25CW	7000	1.0	6.0	3.5	Z-5102
		400	3.00CW		1.0			
		400	1.00**		0.600			
900	Forced Air	900	0.150CW	1600	0.300	0.450	0.300	GL-6283
		400	0.200CW					
		400	0.100**					
900	Forced Air	900	1.20CW	4000	0.700	2.5	1.5	GL-6942
900	Water & Forced Air	900	1.20CW	4000	0.700	2.8	2.0	GL-6019

*Class B RF Power Amplifier (Duty—0.001; Pulse Width—15 μ sec)

**Carrier Level for Class B Linear Amplifier Service

Developmental and Commercially-Available G-E Microwave Power Tubes

KLYSTRONS

CLASSIFICATION	OPERATION	FREQUENCY RANGE, MEGACYCLES	POWER OUTPUT	MAXIMUM DUTY CYCLE	MAXIMUM BEAM VOLTAGE, KILOVOLTS	MAXIMUM BEAM CURRENT, AMPERES	MINIMUM POWER GAIN, DECIBELS	MINIMUM EFFICIENCY, PERCENTAGE	TUBE TYPE
Three Resonator, Tunable, Pulsed	Electro-static Focus	960-1215	25 KW (peak)	0.012	20	10.0	30	—	Z-3037
			22 KW (peak)	0.001	18	6.6	—	—	GL-6625
	Electro-magnetic Focus	8500-9600	1 megawatt (peak)	0.003	120	42.0	33	30	Z-5096
Three Resonator, Tunable CW	Electro-magnetic Focus	470-890	15 KW*	———	18	3.0	200	—	GL-6237-GL-6242
Four Resonator, Tunable	CW, Electro-magnetic Focus	7500-8500	750 W (Min.)	———	10	0.55	37	20	Z-5214
	Pulsed, Electro-magnetic Focus	8500-9600	200 KW (peak)	0.003	53	15.5	50	30	Z-5095

Saturation Level

LIGHTHOUSE-PLANAR TYPES

FREQUENCY FOR MAXIMUM RATINGS	TYPICAL PERFORMANCE	TUBE TYPE
	RADIO-FREQUENCY AMPLIFIERS—CLASS A	
3370	8.5 db Noise, 15 db gain at 700 mc	GL-2C40 GL-2C40A
	CLASS A_1 AMPLIFIERS	
3000	13.2 db Noise, Greater than 10 db gain 8.2 db Noise, Greater than 15 db gain, at 1200 mc 4 to 5 db Noise, Greater than 17 db gain, at 400 mc	GL-6299
	RADIO-FREQUENCY AMPLIFIERS & CW OSCILLATORS—CLASS C	
1000	Extended-life CW version of the GL-2C43	Z-5033
1500	Frequency-Multiplier Service—Tripling to 300 mc Two Tubes in Push-Pull—4.4 watts output	GL-2C43
2500	19 watts output. 40 watts output at 500 mc	GL-2C39B GL-6897
	2.0 watts output	GL-6442
	Modified GL-6442. Heater and heater terminal modified for CW lumped constant circuitry. Fuse clip mounting.	Z-5317
3000	250 milliwatts output at 1000 mc. Oscillator version of the GL-6299 Amplifier	Z-5139
3370	0.075 watts output	GL-2C40 GL-2C40A
4000	250 milliwatts—CW Oscillator—Class C	Z-1910
	PLATE-PULSED POWER OSCILLATORS	
3370	300 watts peak output at 3000 megacycles	GL-2C40A
	1.75 kilowatts Peak Output	GL-2C43
4000	2.0 kilowatts Peak Output at 3500 mc Envelope temperature 175 C	GL-6442

● The specifications on all developmental types are subject to change. Delivery of developmental samples and the existence of the data shown do not imply continued availability of tubes with the same characteristics. For the most recent information concerning the status of these developmental types, please contact your local regional Power Tube Department Sales Office.

EASTERN REGION
General Electric Company
200 Main Avenue, Clifton, New Jersey
Phones: (Clifton) GRegory 3-6387
(N.Y.C.) WIscorsin 7-4065, 6, 7, 8

CENTRAL REGION
General Electric Company
3800 North Milwaukee Avenue
Chicago 41, Illinois
Phone: SPring 7-1600

WESTERN REGION
General Electric Company
11840 West Olympic Boulevard
Los Angeles 64, California
Phones: GRanite 9-7765; BRadshaw 2-8566

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semiconductor
achievement

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with the revolutionary new

Tri-AMP

SELENIUM RECTIFIER

3 times normal current density

- life expectancy of 100,000 hours.
- 26 volt cells — lower forward voltage drop.
- no parallel devices for voltage division.
- no series devices for load sharing.

THE DIFFERENCE AT A GLANCE!			
New Tri-AMP *3-phase Bridge*		Standard Type *3-phase Bridge*	
Dimensions	Amp.	Dimensions	Amp.
4" x 4" *Fan Cooled	54	4" x 4" *Fan Cooled*	16.8
4" x 4" *Convection Cooled*	18	4" x 4" *Convection Cooled*	6.7

Now you'll understand why conventional selenium rectifiers are now obsolete!

Not just a variation of standard selenium rectifiers — TRI-AMP is a *new* selenium semiconductor with far greater reliability, operating at *three times* the current density of standard stacks. It has the overvoltage and overcurrent advantages of selenium, which means there is no need for the expensive and elaborate protective devices so necessary when using other semiconductors.

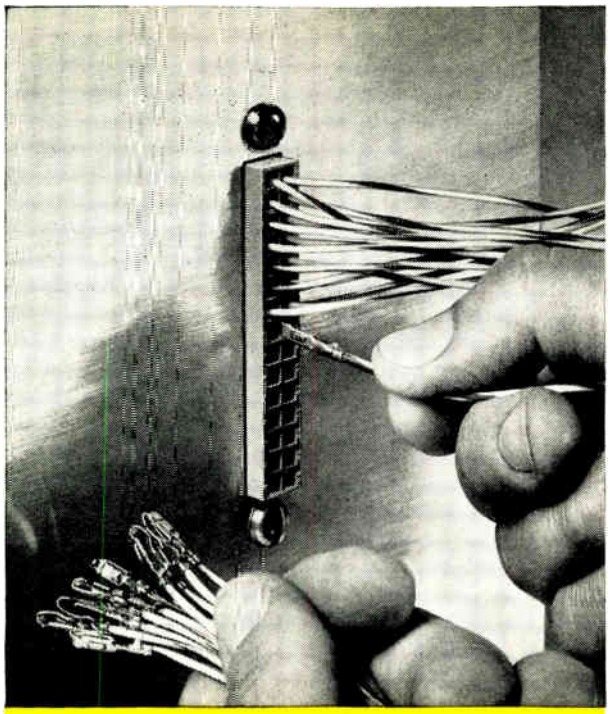
Our Radio Receptor plant, working with unique equipment developed by Siemens of West Germany, is now producing TRI-AMP selenium semiconductors for immediate delivery. Please request full information from Section **EI-1R**.

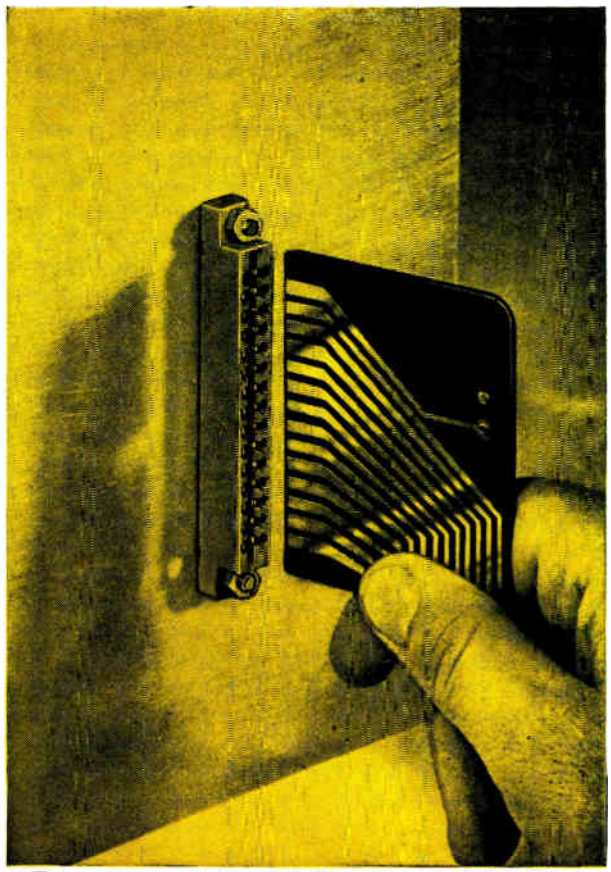
General Instrument Corporation also includes Automatic Manufacturing Division, F. W. Sickles Division, Micamold Electronics Manufacturing Corporation (subsidiary)

GENERAL INSTRUMENT
GI
SEMICONDUCTORS

semiconductor division
RADIO RECEPTOR COMPANY, INC.
Subsidiary of General Instrument Corporation
240 Wythe Avenue, Brooklyn 11, N. Y.

GENERAL INSTRUMENT DISTRIBUTORS: *Baltimore:* D & H Distributing Co. • *Chicago:* Merquip Co. • *Cleveland:* Pioneer Electronic Supply • *Los Angeles:* Valley Electronics Supply Co., Burbank • *Milwaukee:* Radio Parts Co., Inc. • *New York City:* Hudson Radio & Television Corp., Sun Radio & Electronic Co. *Philadelphia:* Herbach & Rademan, Inc. • *San Francisco:* Pacific Wholesale Co. • *Seattle:* Seattle Radio Supply • *Tulsa:* Oil Capitol Electronics





SNAP IN CLIP IN

THE NEW AMP PRINTED CIRCUIT EDGE CONNECTOR

This A-MP unit is more than new—it is the only *solderless, direct-contact* connector on the market. Designed for both commercial and military requirements, it means faster assembly, greater reliability and versatility to you—at lower cost!

You get construction of unmatched close tolerances in both the contact and the one-piece molded housing. And—because each contact is wholly enclosed within its own housing barriers, there's no need for post insulation. Contacts feature spring-lock design which assures positive contact with board—yet will not cause damage to board paths, even after repeated insertions.

Assembly is easy: An A-MP high speed machine crimps contacts to circuit wires. Contacts are quickly and completely snapped into housing, locked in place with a lance to eliminate damage from shorts, bending or strain. The printed circuit board is then inserted for unlimited circuit combinations.

Snap in . . . clip in—it's that simple to save time, money and increase quality.

Send for full product information today.

AMP INCORPORATED

GENERAL OFFICES: HARRISBURG, PENNSYLVANIA

A-MP products and engineering assistance are available through subsidiary companies in: Canada • England • France • Holland • Japan

IMPROVED CHARACTERISTICS

...OF SPECIAL INTEREST TO EVERY ENGINEER

DELCO HIGH POWER TRANSISTORS

UNEXCELLED FOR SWITCHING, POWER HANDLING, EFFICIENCY, RELIABILITY

TYPICAL CHARACTERISTICS AT 25°C.

	†2N1100	‡2N1099	*2N174A	2N174	2N173	2N278	2N277	2N443	2N442	2N441
Maximum Collector Current	15	15	15	15	15	15	15	15	15	15 amps
Maximum Collector Voltage (Emitter Open)	100	80	80	80	60	50	40	60	50	40 volts
Saturation Resistance	.02	.02	.02	.02	.03	.03	.03	.03	.03	.03 ohms
Thermal Gradient (Max.) (Junction to Mounting Base)	.8	.8	.8	.8	.8	1.0	1.0	1.0	1.0	1.0 °C/watt
Base Current I_B (V_{EC}=2 volts, I_C=5 amps)	135	100	135	135	100	100	100	150	150	150 ma
Collector to Emitter Voltage (Min.) Shorted Base (I_C=.3 amps)	80	70	70	70	50	45	40	50	45	40 volts
Collector to Emitter Voltage Open Base (I_C=.3 amps)	70	60	60	60	50	45	40	55	45	40 volts

*Designed to meet MIL-T-19500/13A (Jan) 8 January 1958 †Formerly DT100 ‡Formerly DT80

Check your requirements against the *new, improved* characteristics of Delco High Power transistors. You will find improved collector-to-emitter voltage . . . higher maximum current ratings—15 amperes, and extremely low saturation resistance. Also, note the new solid pin terminal design.

And of special importance to you is the fact that diode voltage ratings are at the maximum rated temperature (95°C.) and voltage.

Write today for engineering data on the *new, improved* characteristics of *all* Delco High Power transistors.

DELCO RADIO

Division of General Motors • Kokomo, Indiana

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Santa Monica, California
726 Santa Monica Boulevard
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Reduce | Core losses
Core weight, size
Copper requirements
of high frequency equipment
With Armco Thin Electrical Steels

Exceptional magnetic qualities, extensive design data create opportunities to improve performance, cut costs of 400 to 200,000 cycle magnetic and electronic components.

Armco Thin Electrical Steels offer you all the advantages of thin laminations plus exceptional magnetic properties. Armco's precise processing and control provides high permeability, low hysteresis loss, high lamination factor, and minimum interlamination energy loss.

Grades and Gages for Your Needs

Three different grades enable you to make maximum use of the advantages of Armco Thin Electrical Steel in your products. Armco TRAN-COR® T (7 and 5 mils) has good permeability in all directions. It is designed for rotating and other equipment where flux disposition is random.

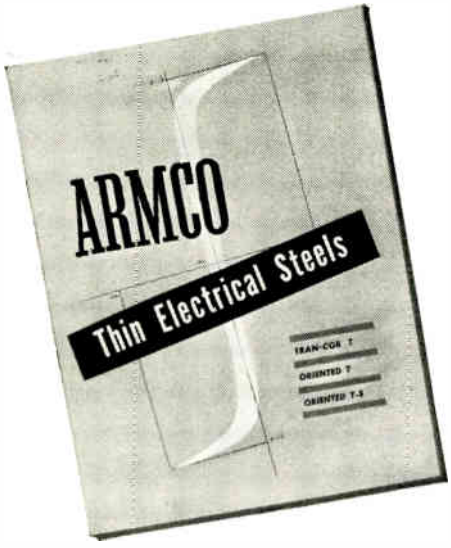
Armco ORIENTED T (4, 2 and 1 mil) is "oriented" with best permeability in the direction of rolling.

Armco ORIENTED TS (4 mils) provides exceptionally high permeability in the rolling direction. A super-oriented steel for 400 cycle service.

Design Data Available

The latest edition of the catalog "Armco Thin Electrical Steels" gives you 39 pages of design curves plus other basic information. With these data you can make the most effective use of the material's magnetic properties and select the grade and gage for most efficient balance of performance and cost.

For your copy of this useful design manual on Armco Thin Electrical Steels, write to Armco Steel Corporation, 1039 Curtis Street, Middletown, Ohio.



New steels are born at Armco

ARMCO STEEL

Armco Division • Sheffield Division • The National Supply Company • Armco Drainage & Metal Products, Inc. • The Armco International Corporation • Union Wire Rope Corporation • Southwest Steel Products

New Tech Data for Engineers

Paper-Base Laminates

Synthane Corp., Oaks, Pa, has prepared a new engineering bulletin on Grade EP-22, a paper-base epoxy resin laminate. Bulletin describes the new laminate, recommends applications for the grade, and gives sheet properties in detail.

Circle 161 on Inquiry Card, page 117

Cold Drawn Wires

A new booklet describing the properties and applications of a wide variety of cold drawn fine wires has been made available by the Parts Div. of Sylvania Electric Products Inc., Warren, Pa. Listing both the physical and chemical properties of the company's alloy, plated and clad wires, the booklet analyzes factors which determine the most economical and efficient wires for specific applications.

Circle 162 on Inquiry Card, page 117

Custom-Built Transformers

Microtran Co., Inc., 145 E. Mineola Ave., Valley Stream, N. Y., has issued a 24-page catalog which describes many types of transformers that can be produced by them as custom items. Catalog gives a comprehensive idea of the mounting types and electrical ratings possible in custom units.

Circle 163 on Inquiry Card, page 117

Terminal Blocks

An illustrated catalog sheet gives specifications, outline dimensions and general information on new Series 200-19 plug and socket terminal block for heavy duty applications. DeJur-Amsco Corp., 45-01 Northern Blvd., Long Island City 1, N. Y.

Circle 164 on Inquiry Card, page 117

Teflon Handbook

Halogan Insulator & Seal Corp., 9960 Pacific Ave., Franklin Park, Ill., has made available a 28-page Teflon Stock Catalog and Machine Handbook. The catalog prices 1087 sizes of Teflon tubing and rod available for machining into parts.

Circle 165 on Inquiry Card, page 117

Recording Equipment

The Defense Sales Div. of Burroughs Corp., 6071 Second Ave., Detroit 32, Mich., has issued a brochure which describes their electrographic recording equipment. It reviews early technique developments in the important high speed electrographic printing and recording field, as well as electrographic equipment currently under development contract for various branches of the military.

Circle 166 on Inquiry Card, page 117

Synchros & Rotary Components

Clifton Precision Products Co., Galvin Div., 9014 West Chester Pike, Upper Darby, Pa., has just issued a 20-page, 2-color booklet which describes in detail their complete line of synchros and rotary components. Booklet contains photographs, drawings, and specifications in easy to follow tabular form.

Circle 167 on Inquiry Card, page 117

Videotape Splicing

An 8-page booklet has been issued by the Ampex Corp., 934 Charter St., Redwood City, Calif., which describes in complete easy to follow, step-by-step detail the method of splicing videotape.

Circle 168 on Inquiry Card, page 117

Regulated Power Supplies

A technical bulletin issued by Quan-Tech Labs., Morristown, N. J., describes their transistor regulator power supplies. Complete electrical and mechanical specifications are included.

Circle 169 on Inquiry Card, page 117

Sweep Generator

Marconi Instruments, 111 Cedar Lane, Englewood, N. J., have issued a 4-page technical bulletin which describes their 20MC sweep generator Model 1099. Bulletin is complete with electrical and mechanical specifications and photographs.

Circle 170 on Inquiry Card, page 117

Production Aids

Alden Systems Co., Alden Research Center, Westboro, Mass., has issued a 42-page booklet which describes in detail equipment available for plants. Equipment for power, work center, work transfer lines, libraries, lighting, furniture, small space machinery, study lab. and automation components are described. They offer complete equipment for setting up a new plant or department or modifying existing plants.

Circle 171 on Inquiry Card, page 117

Speed Measurements

Speed measurements is the subject of a 16-page catalog now available from Servo-Tek Products Co., 1086 Goffle Rd., Hawthorne, N. J. Catalog introduces many new items in addition to the established line of dc tachometer generators. A full range of tachometer indicators, tachometer generators, portable testers, and tachometer calibrators are described, together with complete specifications and prices.

Circle 172 on Inquiry Card, page 117

Antenna System

The Andrew Corp., 363 East 75th St., Chicago 19, Ill., has issued Catalog 22 which is a 96-page product and facility book. It covers fully their complete line of antennas, antenna systems and transmission line products. In addition to complete engineering data on their products, the catalog includes a special 16-page section of general antenna systems engineering information.

Circle 173 on Inquiry Card, page 117

Particle Accelerators

Applied Radiation Corp., Walnut Creek, Calif., have issued a technical bulletin which describes particle accelerators and associated apparatus which are available. Technical information and photographs are included in the bulletin.

Circle 174 on Inquiry Card, page 117

Precision Potentiometers

A 6-page fully illustrated brochure covering trimmer, linear motion, unitized non-linear, special purpose, LT series and TV series precision potentiometers, complete with mechanical, electrical specifications and non-linear functions is available from Technology Instrument Corp., 7229 Atoll Ave., N. Hollywood, Calif.

Circle 175 on Inquiry Card, page 117

X-ray Instrumentation

A 12-page booklet issued by Philips Electronics, Inc., 750 S. Fulton Ave., Mt. Vernon, N. Y., describes their latest X-ray instruments. Text covers basic diffraction equipment including cameras, the X-ray diffractometer and the X-ray spectrograph.

Circle 176 on Inquiry Card, page 117

Selsyn Transmitter-Receiver

Descriptive bulletin (CM-14) available from Rotron Controls Corp., Woodstock, N. Y., describes their new rugged and reliable Selsyn transmitter-receivers. Complete technical and electrical specifications are included in the bulletin.

Circel 177 on Inquiry Card, page 117

Reciprocating Pumps

Data Sheet WF 1642 describes a line of self-contained, lightweight, reciprocating pumps incorporating means for demand-responsive flow-control and automatic pressure regulation of gases and liquids. Waldorf Fluid Systems, Waldorf Instrument Co., Wolf Hill Rd., Huntington Station, L. I., N. Y.

Circle 178 on Inquiry Card, page 117

Circle 112 on Inquiry Card, page 117

Circle 46 on Inquiry Card, page 117

Industry News

J. H. Zillman has been appointed General Manager of Daystrom Pacific. He was formerly President of Whirlajet, Inc. and Manager of U. S. Industries Research & Development Corp.

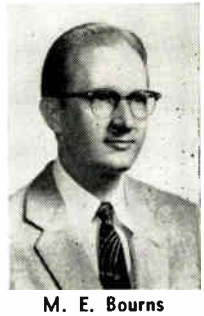
C. C. Snider succeeds W. F. Johnson, recently named Director of the company, as Director of sales at Consolidated Electrodynamics Corp.

H. F. Schoemehl has been promoted to General Sales Manager and **R. J. Herter** to Ass't Director of Marketing of the Semiconductor Div., Hoffman Electronics Corp.

R. H. Rudolph is now Manager of Marketing, Motorola Semiconductor Div. He was formerly Manager of Marketing for Diamonite Products Manufacturing Co., Div., U. S. Ceramic Tile Co.

A. H. DuFlon has been named Northwest District Marketing Representative for Autonetics, a division of North American Aviation, Inc. He was formerly Representative for the Eclipse-Pioneer Div. of Bendix Aviation Corp.

M. E. Bourns has been elected to Membership in the Young Presidents' Organization. He is President of Bourns Laboratories, Inc.



M. E. Bourns

J. P. Gordon

J. P. Gordon is now serving as General Manager of Tube Operations at Allen B. Du Mont Laboratories, Inc.

Recent Philco Corp. appointments include: **Dr. C. H. Sutcliffe**, Manager of Component Development; **Dr. J. B. Angell**, Manager of Circuit Research; **Dr. M. E. Lasser**, Manager of Applied Physics Research and Mr. **Edmundo Gonzales-Correa** as Manager of Research Planning.

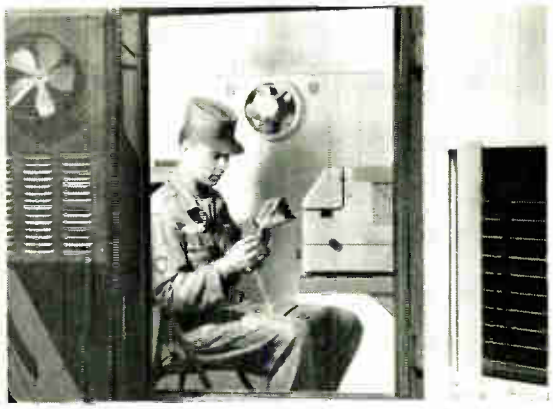
E. P. Tagge has been appointed to the new corporate position of General Auditor of Beckman Instruments, Inc., and **A. Lineberger** to Controller of the company's Helipot and Scientific and Process Intruments Div.

C. Hakimian is to be the General Manager of Philco Distributors, Inc. branches in St. Louis, Los Angeles, Chicago, New York, and Boston.

(*Continued on Page* 98)

AIR LIFT

for mobile teleprinter center



Interior view of mobile teleprinter center

Kleinschmidt super-speed teletypewriters provide world's fastest printed combat communications for the U.S. Army!

Taking the jolts and jars of movement by air in stride, the new Kleinschmidt telecommunications units handle *printed* messages at speeds up to 750 words a minute! Using these machines, developed in cooperation with the U. S. Army Signal Corps, information on enemy movements could move accurately and rapidly to friendly units widely dispersed under nuclear battlefield conditions. In recognition of Kleinschmidt's high standards of quality, equipment produced for the U. S. Army is manufactured under the Reduced Inspection Quality Assurance Plan. Today, the advanced commercial application of electronic communications is unlimited.

KLEINSCHMIDT

DIVISION OF SMITH-CORONA MARCHANT INC., DEERFIELD, ILLINOIS

Pioneer in teleprinted communications systems and equipment since 1911

Circle 48 on Inquiry Card, page 117

New Tech Data for Engineers

Bobbin Cores

An illustrated 16-page bulletin on bobbin cores has been issued by Magnetics, Inc., Butler, Pa. It provides preliminary information which engineers and designers may use to tentatively complete circuit designs without the need for expensive experimentation. Included in the bulletin, BC-203, are the first published guaranteed maximum-minimum limits for tape wound cores, measured according to industry-accepted pulse techniques which are detailed in this text.

Circle 179 on Inquiry Card, page 117

Pressure Transducer

Ultradyne, Inc., P. O. Box 3308, 2625 San Mateo, N.E., Albuquerque, N. M., has just issued a 2-color, 4-page technical brochure which describes in complete detail their pressure transducers for various uses.

Circle 180 on Inquiry Card, page 117

Pulse Transformers

A technical bulletin describing a series of miniature encapsulated pulse transformers wound on high permeability ferromagnetic cores has just been issued by Technitrol Engineering Co., 1952 E. Allegheny Ave., Philadelphia 34, Pa.

Circle 181 on Inquiry Card, page 117

Power Supplies

Sorensen & Co., Richards Ave., So. Norwalk, Conn., has available Data Sheet DC270 describing their new line of variable-output unregulated power supplies. Complete specifications are included in the bulletin.

Circle 182 on Inquiry Card, page 117

Silicon Rectifiers

A 2-color technical bulletin issued by Sarkes Tarzian, Inc., Rectifier Div., 415 N. College Ave., Bloomington, Ind., describes in detail their very small Type F silicon rectifiers. Prices and technical information are included.

Circle 183 on Inquiry Card, page 117

UHF Beam Power Tube

The Radio Corp. of America, Harrison, N. J., has just issued an 8-page bulletin which describes their 7213 Beam Power Tube. The tube has 2500 watts up to 1215 MC with a CW input and forced-air-cooled. Complete electrical and mechanical specifications are included along with photographs and drawings.

Circle 184 on Inquiry Card, page 117

FM Analysis

Panoramic Radio Products, Inc., 520 S. Fulton Ave., Mt. Vernon, N. Y., has just issued an 8-page bulletin entitled "FM: Theoretical and Practical Analysis." Basic FM theory, complex modulation, FM spectrum measurements, combined AM and FM are discussed.

Circle 185 on Inquiry Card, page 117

Paper Electrical Tapes

A 4-page, 2-color booklet issued by Minnesota Mining and Mfg. Co., 900 Bush St., St. Paul 6, Minn. lists physical and electrical properties of "Scotch" brand paper tapes, as well as the military specifications met by the tapes.

Circle 186 on Inquiry Card, page 117

Mechanical Stops

Kearfott Co., Inc., 1378 Main Ave., Clifton, N. J., has just issued technical information which describes their mechanical stops. Stops are suited for precise control of rotary motion in instruments and gear trains. Complete technical information is given.

Circle 187 on Inquiry Card, page 117

Silicon Junction Diodes

Hoffman Electronics Corp., 930 Pitner Ave., Evanston, Ill., has just issued a new price list for their Type HB silicon junction diodes. The diodes listed are priced at 44 cents each in lots under 1000.

Circle 188 on Inquiry Card, page 117

Audio Equipment

An audio equipment bulletin is now available to audio engineers and broadcasters from the General Electric Company's Technical Products Dept., Electronics Park, Syracuse, N. Y. The 81-page booklet describes everything in audio equipment from audiomatic limiting amplifiers to zipper-laced custom audio systems.

Circle 189 on Inquiry Card, page 117

Ceramic Transducers

An 8-page, 2-color illustrated brochure issued by Gulton Industries, Inc., 212 Durham Ave., Metuchen, N. J., describes a new series of Glennite high temperature, piezoelectric ceramic transducers. Transducers described have applications in the fields of underwater sound, ultrasonics, medicine, shock and vibration and in general equipment such as, surface gauges, control devices and delay lines.

Circle 190 on Inquiry Card, page 117

V-R Tubes

A dissertation on the application of Corona discharge V-R tubes as an economical power-saving source of voltage regulation over the range from 300 v to 50 kv is available. Typical types are described and theoretical and practical aspects are discussed. Additional data is included for the use of design engineers. Anton Electronics Laboratories, Inc., 1226-38 Flushing Ave., Brooklyn 37, N. Y.

Circle 191 on Inquiry Card, page 117

Laminated Plastics

The Richardson Co., 2731 Lake St., Melrose Park, Ill., has issued catalog No. 20.000.13, which describes in 12 pages their family of laminated plastics, known as Insurok. Complete information is given.

Circle 192 on Inquiry Card, page 117

Flexible Shafting

F. W. Stewart Corp., 3411-13 Ravenswood Ave., Chicago 13, Ill., has issued a new bulletin on their Circle Ess Flexible Shafting. It explains briefly the advantages and the simplicity of designing a flexible shaft into products having an application which requires control from remote places.

Circle 193 on Inquiry Card, page 117

Germanium Power Transistors

Texas Instruments, Incorporated, P. O. Box 312, 13500 N. Central Expressway, Dallas, Tex., has just issued a 4-page, 2-color brochure which describes their broad line of germanium power transistors. Complete electrical and technical specifications are included along with schematics and photographs.

Circle 194 on Inquiry Card, page 117

Pulse Transformers

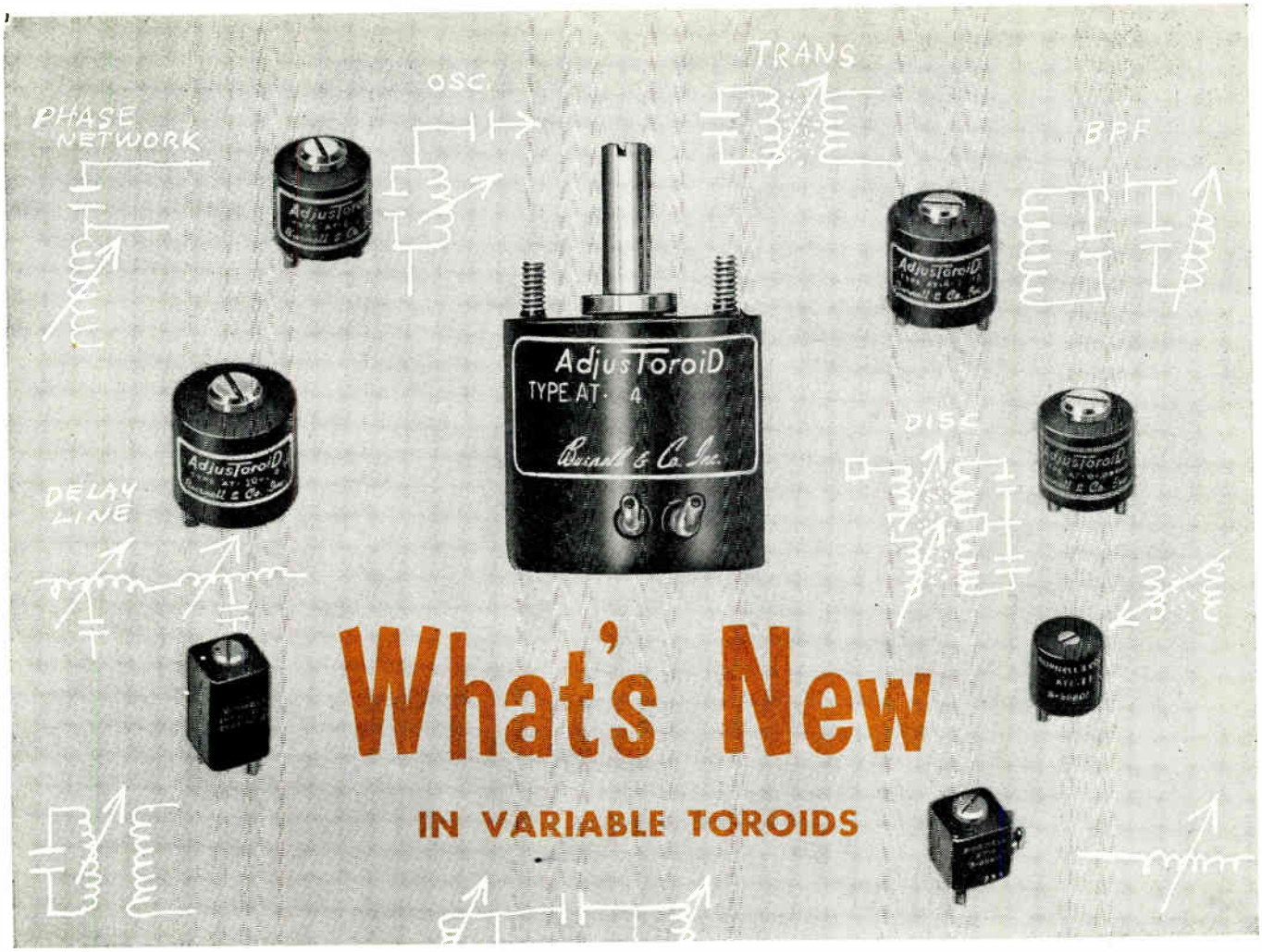
Pulse transformer catalog issued by Acme Electric Corp., Cuba, N. Y., list specifications for six popular types of miniature and sub-miniature pulse transformers. Break-away drawings show how these transformers are constructed and indicate the comparative importance of the various types of materials used in the completed unit.

Circle 195 on Inquiry Card, page 117

Mounting Hardware

A new specification sheet illustrating a variety of mounting hardware for Bourns TRIMPOT and TRIMIT potentiometers is now available from Bourns Laboratories, Inc., P. O. Box 2112, Riverside, Calif.

Circle 196 on Inquiry Card, page 117



Burnell Adjustoroids® are always new because they are always being designed for newer and broader electronic and mechanical applications.

NEW Burnell's complete line of encapsulated Adjustoroids are particularly adaptable to printed circuit use.

NEW A screw mount PC type Adjustoroid for greater durability in high acceleration, shock and vibration environments.

NEW 'Pot' mounting Adjustoroids for panel mounting and knob adjustment wherever slotted controls are difficult to reach.

NEW Continuous internal improvements including adjustment range, Q, size, etc. Burnell Adjustoroid engineers are constantly seeking solutions to space, accessibility and performance problems.

Burnell Adjustoroids and sub-miniature Adjustoroids are supplied hermetically sealed to meet government specifications MIL E 15305A or encapsulated in many sizes and shapes to meet the application. If your Adjustoroid needs can't be met from our stock catalogue, we'll be glad to manufacture to your specifications. For additional information, write for Adjustoroid bulletin.

	Length/ Dia.	Width	Hgt.	Wt.	Useful Freq. Range	Max Q	Max L in hys
AT-0	1 1/16		1"	2 oz	1 kc to 20 kc	10 kc	3 hys
AT-1	1 3/4	1 3/4	1 1/4"	7.25 oz	2 kc to 10 kc	4 kc	15 hys
AT-2	2 3/4	2 3/4	2 1/4"	24 oz	Below 2.5 kc	2.5 kc	125 hys
AT-4	1 1/64		1 1/4"	4 oz	1 kc to 16 kc	6 kc	15 hys
AT-6	1 1/16		1"	2 oz	10 kc to 100 kc	30 kc	.75 hys
AT-10	1 1/64		1 1/4"	4 oz	3 kc to 50 kc	20 kc	.75 hys
*AT-11	45/64	45/64	3/4"	.83 oz	2 kc to 25 kc	15 kc	5 hys
*AT-12	45/64	45/64	3/4"	.83 oz	15 kc to 150 kc	60 kc	.5 hys
AT-15	1 31/32		1 7/8"	14 oz	Below 5 kc	4 kc	125 hys
AF-51	1 1/64		2"	5 oz	30 cps to 500 cps	120 cps	1000 hys
AF-52	1 1/64		2"	5 oz	50 cps to 1 kc	250 cps	1000 hys
*AF-87	45/64	45/64	1 1/4"	1.7 oz	90 cps to 2 kc	400 cps	80 hys
*AF-88	45/64	45/64	1 1/4"	1.7 oz	.16 kc to 4 kc	800 cps	42 hys
†ATE-11	3/4		3/4"	.83 oz	2 kc to 25 kc	15 kc	5 hys
†ATE-12	3/4		3/4"	.83 oz	15 kc to 150 kc	60 kc	.5 hys

**Special "pot" type sub-miniature Adjustoroids are not available with AT-11, AT-12, AF-87, AF-88.*

†Special screw mountings are available with the ATE-11 and ATE-12 in printed circuit applications for "plug in" types. Where vibration and shock are significant considerations, mounting screws serve as terminal connections.

®Trade Name Pat. #2,762,020

Burnell & Co., Inc.

PIONEERS IN TOROIDS, FILTERS AND RELATED NETWORKS

EASTERN DIVISION
DEPT. I-13
10 PELHAM PARKWAY
PELHAM, N. Y.
PELHAM 8-5000
TELETYPE PELHAM 3633

PACIFIC DIVISION
DEPT. I-13
720 MISSION ST.
SOUTH PASADENA, CALIF.
RYAN 1-2841
TELETYPE PASACAL 7578

Circle 49 on Inquiry Card, page 117

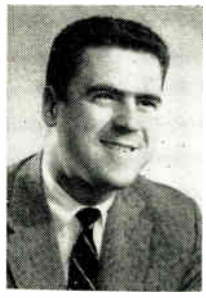
Industry News

(*Continued from page* 94)

Recent Sylvania Electric Products Inc. appointments include: **T. D. Fuller**, Marketing Manager, Special Tube Operations—**D. M. Christie**, Manager at the Buffalo Systems Plant—and **R. D. Evans**, Assistant Technical Liaison Manager, Waltham Labs.

Appointment of **J. LeGette** as Manager of the Interference Control Laboratory, Sprague Electric Company has been announced. He was previously with Chance-Vought Aircraft.

J. Vrungos has been appointed Manager of Marketing at Electronic Control Systems, Stromberg-Carlson. He had been Manager of Government Contracts.



J. Vrungos

J. M. Macdonald

J. M. Macdonald, formerly a Senior Auditor at Convair, San Diego, has been named Contracts Administrator for Tamar Electronics.

A. J. Alt is now General Superintendent at Wilbur B. Driver Co. He has been: Executive Secretary, Paymaster, Assistant to the Sales Manager, and Director of Production Control.

M. Cooperstein is now Head of the Fire Control Dept., Missile Systems Laboratory, Sylvania Electric Products Inc. Prior to this assignment, he had been Supervisor of the Guidance and Control Section for the laboratory.

Dr. C. E. Barnes has been elected Vice President for Research at Minnesota Mining & Manufacturing Co. Dr. Barnes had been Central Research Director.

R. W. Hughes, J. E. Kahelin and **C. G. Sherwood** are new vice-Presidents of International Electric Corp. newly-formed unit of IT&T Corp. International Electric Corp. was formed to manager the production of a worldwide electronic (information) control system for the Strategic Air Command.

(*Continued on Page* 100)

PRIME ACCEPTANCE

4 of the 5 principal manufacturers of AM, FM and TV transmitters, now specifically include

the Amperex® Type 5924A Triode

and the Amperex® Type 6076* Tetrode

in the design of their transmitting equipment

Shown approx. ½ size

The Amperex Type 5924A is a rugged, forced-air-cooled triode, specifically designed for an exceptionally high power yield in the VHF range

Shown approx. ½ size

The Amperex Type 6076 incorporates modern tube design for excellent power capabilities throughout the RF, VHF and UHF ranges. AND, it is uniquely suited to single sideband operation.

THE REASONS:

High Power Amplification
Type 5924A, anode capable of dissipating 6 kilowatts
Type 6076, anode capable of dissipating 3 kilowatts

Broad Frequency Range
Ratings for both tube types apply up to 220 mc.

Long Tube Life
Average life in excess of 5000 hours of operation under normal load conditions

Compact Design
Dimensions closely controlled for cavity operation

Rapid Heat Dissipation
Extra-heavy copper wall anodes with high overload capacity
All brazed cooler-fin radiator assembly

Proven Materials
Thoriated tungsten filaments
Platinum-clad molybdenum grids
All external surfaces silver-plated

Unique Design Features
Low-inductance coaxial grid terminals permit improved isolation of input and output circuitry
Short electrode structure for economical and compact transmitter design

Designates the air-cooled version. The water-cooled version bears the designation, Type 6075.

TUBE TYPE 6076

CLASS AB, GROUNDED GRID LINEAR R.F. AMPLIFIER
SINGLE SIDEBAND SUPPRESED CARRIER OPERATION
Maximum Ratings, Absolute Values (Frequencies up to 110 Mc)

TYPICAL OPERATION	Two Tone Modulation CCS
DC Plate Voltage	5000 volts
DC Grid No. 2 Voltage	600 volts
DC Grid No. 1 Voltage	−50 volts
Zero Signal DC Plate Current	350 ma
Zero Signal DC Grid No. 2 Current	2 ma
Effective RF Load Resistance	1600 ohms
Average DC Plate Current	1110 ma
Average DC Grid No. 2 Current	42 ma
Average DC Grid No. 1 Current	44 ma
Max. Resultant Peak RF Cathode Voltage	275 volts
Average Plate Power Output	2675 + 214 watts
Peak Envelope Plate Power Output	5350 + 428 watts
Average Driver Feedthru Power	214 watts
Peak Envelope Feedthru Power	428 watts
3rd Order Intermodulation Distortion	37 db

ask **Amperex**
about communications tubes for RF, VHF and UHF applications.

AMPEREX ELECTRONICS CORP., 230 DUFFY AVENUE, HICKSVILLE, L. I., N. Y.
In Canada: Rogers Electronic Tubes & Components, 116 Vanderhoof Ave., Toronto, Ont.

Circle 51 on Inquiry Card, page 117

Industry News

(*Continued from page* 98)

D. E. Stocking has been appointed Sales Manager, Rochester Div., Consolidated Electrodynamics Corp. He was formerly Manager of the company's district sales office in Buffalo, N. Y.

The Personnel Supervisor, semiconductor operations, at CBS-Hytron is now **R. J. Harding,** who was formerly associated with the Ford Motor Co. in its industrial relations section.

P. K. Bennett is now Sales Manager of Dressen-Barnes Corp., and **H. W. Middlecoff** is Chief Engineer.

Appointment of **Gene F. Straube** as General Sales Manager has been announced by Advance Relays, Electronics Div., Elgin National Watch Co.

Dr. R. F. Mettler is the Executive Vice-President and General Manager of the newly incorporated Space Technology Laboratories. He was formerly Vice-President and Assistant General Manager. STL is in charge of scientific direction of the Air Force's Ballistic Missile Program.

Dr. R. F. Mettler

W. Robins, Jr.

W. Robins, Jr. is the Regional Sales Manager at Technitrol Engineering Company's new sales office in Wakefield, Mass.

J. G. Hamelin is now Advertising and Public Relations Manager of Gulton Industries, Inc. He was formerly with the G. M. Basford Co.

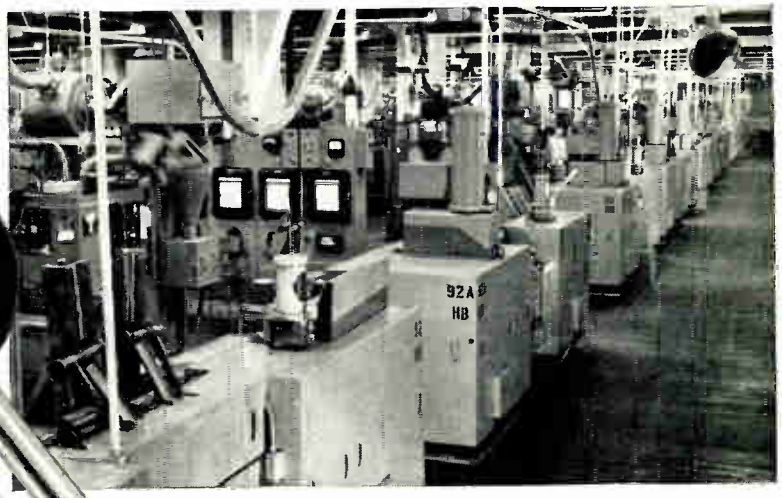
E. S. Willis has been promoted to General Manager, Electro-Mechanical Div., at Erie Resistor Corp. Prior to his appointment he was Sales Manager of the Division.

RCA has announced several new appointments: **G. K. Bryant** is now Manager, Special Projects, **A. B. Polock** is General Plant Manager—"Victrola" Production Unit, **F. R. Demmerly** is Controller and **P. R. Slaninka,** Personnel Manager for the Consumer Products Administrative Services unit and **G. R. Vanie** is now Manager, Sales Coordination at the Electron Tube Division.

Circle 52 on Inquiry Card, page 117

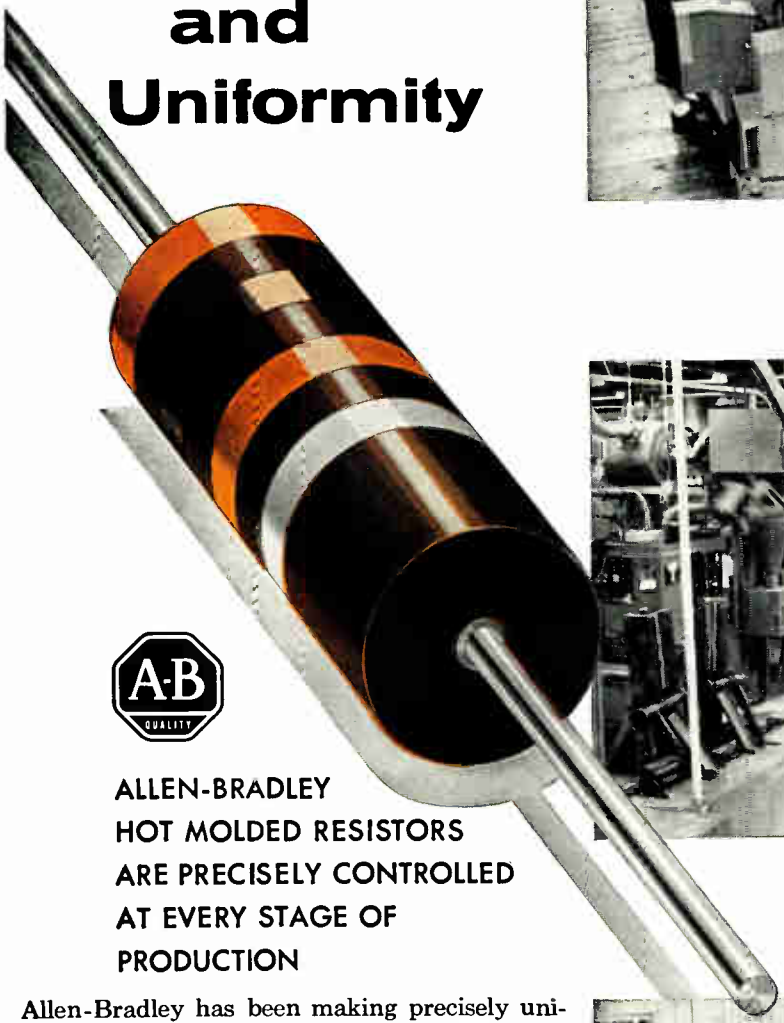
Miracle of Precision and Uniformity

AUTOMATIC HEADING MACHINES form heads on the end of lead wires to make sure they will be solidly anchored in the resistor body. Wire has been previously tinned for easy soldering.



AUTOMATIC MOLDING MACHINES take the resistance powder, insulation powder, and lead wires, and hot mold them under closely controlled high temperature into one integral unit.

AUTOMATIC COLOR CODING MACHINES apply color bands and oven-bake the enamel at high temperatures to assure that the color coding will withstand the maximum operating temperatures of 150°C and all types of cleaning solvents.



A-B QUALITY

ALLEN-BRADLEY HOT MOLDED RESISTORS ARE PRECISELY CONTROLLED AT EVERY STAGE OF PRODUCTION

Allen-Bradley has been making precisely uniform resistors — not by the millions *but by the billions* — over the years. The *exclusive* hot molding process — developed and perfected by Allen-Bradley — uses specially designed automatic machines that incorporate precision control at *every* step of production. Shown here are a few of the special machines that make possible the amazing uniformity — from resistor to resistor, year after year — for which Allen-Bradley composition resistors are famous.

Allen-Bradley Co., 1342 S. Second St.
Milwaukee 4, Wisconsin

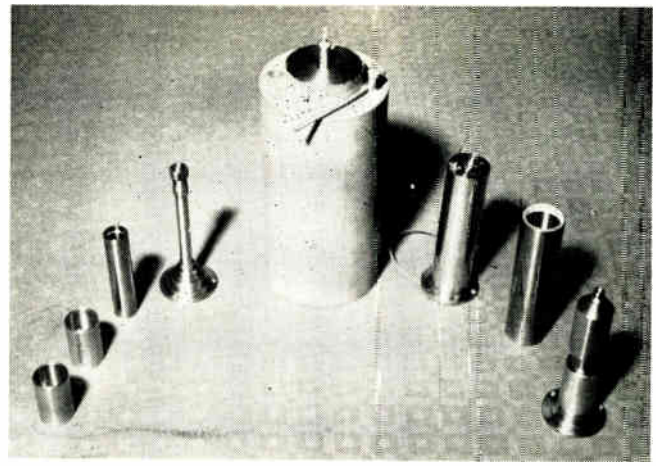
In Canada: Allen-Bradley Canada Ltd.
Galt, Ontario

ALLEN-BRADLEY
QUALITY

Electronic Components

Circle 53 on Inquiry Card, page 117

Design of improved capacitance standards allows capacitance value to be calculated in terms of length.



New Capacitance Standards

(Continued from page 72)

an unknown and a known capacitance permits the direct determination of the unknown. This is accomplished by balancing the bridge through the adjustment of a bank of known, stable 3-terminal capacitors. The balance value multiplied by the voltage ratio is the capacitance of the unknown, and this value can be determined with a precision not previously possible. For example, when 1 picofarad (1 micro-microfarad) capacitors are compared, differences as small as 10^{-6} pf can be easily measured. Although balancing values up to 1 microfarad are provided, the apparatus is most effective in comparing capacitors of less than 10,000 picofarads.

The new capacitance standard was designed to improve the accuracy of capacitance determinations to the level made possible by the transformer bridge. This standard is dependent only on the lengths of two cylinders when certain symmetry conditions are fulfilled and end effects eliminated. The capacitance is defined in terms of two 10-in. gage bars whose lengths can be measured mechanically with an accuracy considerably better than 1 part in a million. Evaluation of the various sources of error in the transformer bridge and in the calculable standard leads to the conclusion that values of capacitance assigned from it are accurate within three parts in a million at the one picofarad level.

Space Age Antennas

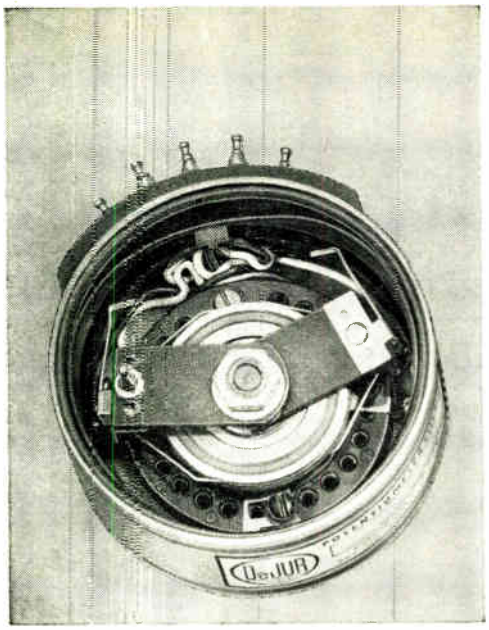
(Continued from page 78)

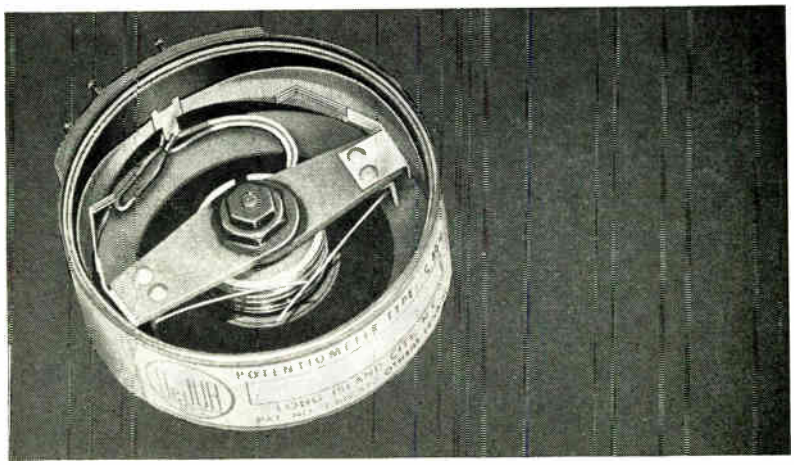
achieve equal characteristics of standard parabolic designs at a fraction of the installed cost. This is accomplished with an SVE array which has minimum surface, a smaller diameter, and less depth. To accelerate the application of the SVE antenna principle, General Bronze Corp., Garden City, N. Y., engineers have disclosed the design data to key engineers of numerous government research staffs as well as the leading members of the commercial scatter communications groups engaged in systems engineering.

The firm's research group has worked intensively towards the goal of accelerating into being those projects which are delayed due to limited funds, or difficulties in transportation and installation in those remote areas selected after test path loss evaluations.

Here are the facts on the SVE Scatter Antenna System based on the installed system philosophy:

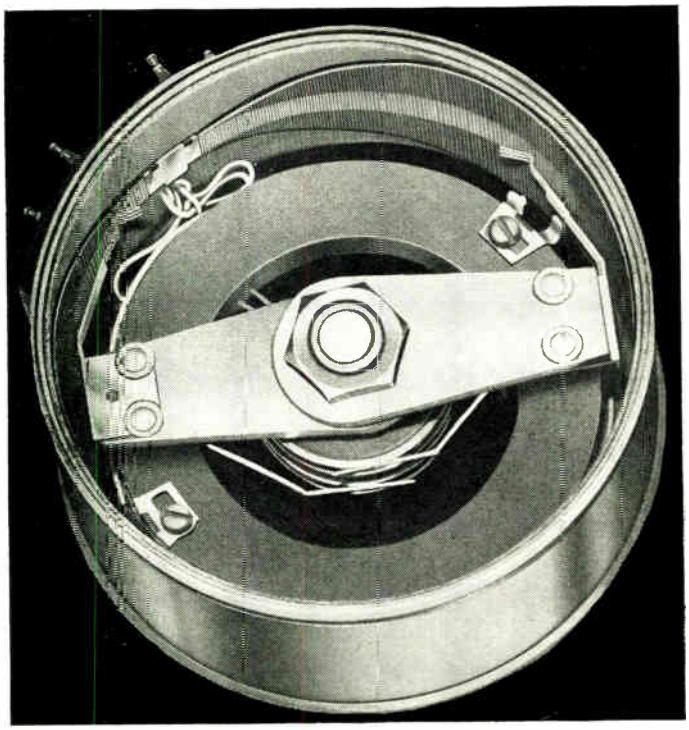
1. Far less product cost
2. Far less weight
3. Simplicity of shipping and assembly
4. Can be hung on slopes, sides of mountains, with simplified supports
5. Adaptable to stringent environmental specifications. Easily deiced when necessary
6. Ease of pattern change allows custom field engineering
7. Simpler structure with far less maintenance cost
8. Effective for ionospheric scatter in single bank form





NEW DeJUR SINE-COSINE POTENTIOMETERS

achieve exceptional functional conformity



Unique design and production techniques make it possible for DeJUR to offer sine-cosine function accuracies previously unknown in wire-wound potentiometers.

The new line includes 1⅝" and 2" diameter units with standard function accuracies of 0.5% peak-to-peak. BOTH ARE AVAILABLE WITH 0.25% ACCURACIES ON SPECIAL ORDER. Also available is a 3" diameter unit in the same group with standard peak-to-peak conformity of 1%; or 0.5% on special order.

All DeJUR Sine-Cosine Potentiometers are fully enclosed, self-contained units with independent brush contacts 90° apart and mounted on a common shaft, to produce accurate sine-cosine voltages. Any practical number of ganged units are available with individual sections in simultaneous function or other conformity.

For complete details on DeJUR potentiometers write today to Electronic Sales Division, DeJUR-Amsco Corporation, 45-01 Northern Boulevard, Long Island City 1, New York.

You're always sure with

DeJUR

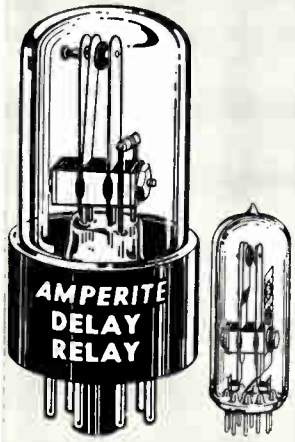
ELECTRONIC COMPONENTS

Manufacturers of precision potentiometers for over thirty years

Circle 55 on Inquiry Card, page 117

AMPERITE

THERMOSTATIC DELAY RELAYS



2 to 180 Seconds

Actuated by a heater, they operate on A.C., D.C., or Pulsating Current.

Hermetically sealed. Not affected by altitude, moisture, or climate changes.

SPST only—normally open or closed.

Compensated for ambient temperature changes from —55° to +70° C. Heaters consume approximately 2 W. and may be operated continuously. The units are **rugged, explosion-proof, long-lived,** and—**inexpensive!**

TYPES: Standard Radio Octal, and 9-Pin Miniature . . **List Price, $4.00.** Standard Delays

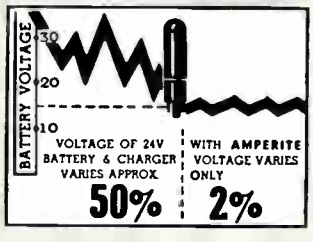
Also — **Amperite Differential Relays:** Used for automatic overload, under-voltage or under-current protection.

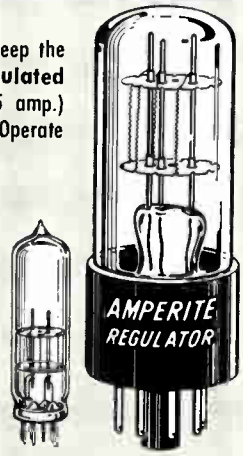
PROBLEM? Send for Bulletin No. TR-81

AMPERITE

BALLAST REGULATORS

Amperite Regulators are designed to keep the current in a circuit **automatically regulated** at a definite value (for example, 0.5 amp.) . . . For currents of 60 ma. to 5 amps. Operate on A.C., D.C., or Pulsating Current.





Hermetically sealed, they are not affected by changes in altitude, ambient temperature (—55° to +90° C.), or humidity . . . Rugged, light, compact, most inexpensive . . . . . **List Price, $3.00.**

Write for 4-page Technical Bulletin No. AB-51

AMPERITE

561 Broadway, New York 12, N. Y. . . . CAnal 6-1446

In Canada: Atlas Radio Corp., Ltd., 50 Wingold Ave., Toronto 10

Circle 56 on Inquiry Card, page 117

HI-POWER EFFICIENCY

RIGHT ANGLE ADAPTER, 350-5000 MCS.

CABLE CONNECTOR, 350-5000 MCS.

WAVEGUIDE TO COAX ADAPTER, 2350-3600 MCS.

S-BAND SCIMITAR ANTENNA, 2350-5000 MCS.

COAX SLOTTED LINE, 1500-5000 MCS.

LT TO "N" TYPE TRANSITION, 350-5000 MCS.

These operational configurations comprise a representative selection of Tamar "hardware" designed and tested to meet all military and industrial specifications.

TAMAR ELECTRONICS, INC.

2339 COTNER AVENUE • LOS ANGELES 64, CALIFORNIA

Circle 57 on Inquiry Card, page 117

Send your specifications for prompt quotation

Hundreds of standard

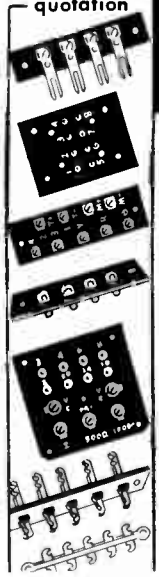
JONES

TERMINAL PANELS

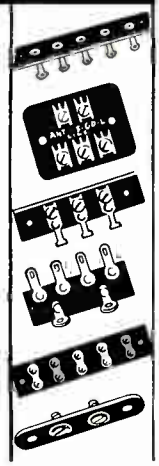
Complete Equipment

FOR

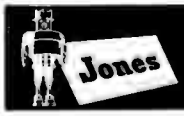
SPECIALS



Several pages of Jones Catalog No. 22 illustrate standard and special panels we are constantly producing. Latest special equipment enables us promptly to produce practically any panel required. Send print or description for prices, without obligation. Hundreds of standard terminal strips also listed. Send for Catalog with engineering drawings and data.



JONES MEANS ***Proven Quality***



HOWARD B. JONES DIVISION

CINCH MANUFACTURING CORPORATION

CHICAGO 24, ILLINOIS

SUBSIDIARY OF UNITED-CARR FASTENER CORP.

Circle 58 on Inquiry Card, page 117

Circle 59 on Inquiry Card, page 117 →

FOR YOUR APPLICATION FROM STOCK...

700 STOCK ITEMS to cover every electronic application.

300 HERMETIC ITEMS... proved to MIL-T- 27A, eliminates test delays.

All with the UTC plus value... HIGHEST RELIABILITY IN THE FIELD.

FILTERS

LOW PASS HIGH PASS BAND PASS
60 to 12000 CYCLES.

TELEMETERING
400 to 70000 CYCLES.

TELEGRAPH
425 to 2975 CYCLES.

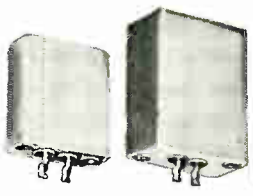
HIGH Q INDUCTORS

VARIABLE STANDARD

VARIABLE HERMETIC

DECADE INDUCTOR

LOW FREQU. TO 2500 HYS.



PERMALLOY DUST TOROIDS HIGHEST Q, ACCURACY, STABILITY.

HERMETIC AUDIOS

FOR TUBE, TRANSISTOR, CHOPPER, AND MATCHING SERVICE. .8 to 12 OZ.

HERMETIC POWER COMPONENTS *Military, Industrial*

POWER TO 1200 VCT

PLATE TO 6 KV CT

REACTORS TO 1.25A.

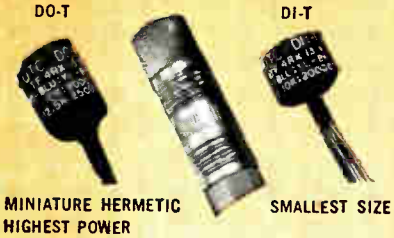
FILAMENT TO 5V 60A.

FILAMENT 400 CYCLE.

TRANSISTOR AUDIO

DO-T

DI-T



MINIATURE HERMETIC HIGHEST POWER

SMALLEST SIZE

COMPACT WIDE RANGE

OUNCER

PLUG-IN

ULTRA COMPACT

HIGHEST FIDELITY

LINEAR STANDARD

HIPERMALLOY

BROADCAST AND HI-FI FAVORITES

TRANSISTOR POWER

INVERTERS TO 550V .2A FROM BATTERY

TRANSISTOR SUPPLY TO 50V 7.5A

COMMERCIAL GRADE

A COMPLETE LINE OF AUDIO AND POWER UNITS FOR COMMERCIAL EQUIPMENT.

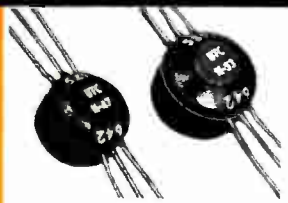
AMATEUR SERIES

COMPLETE LINE OF AUDIO AND POWER FOR HAM, MARINE, ETC. COMMUNICATIONS.

LINE ADAPTORS

VOLTAGE ADJUSTORS . . . STEPDOWN . . . ISOLATION UNITS TO 2500 W.

PULSE MAGN. AMPS.



MINIATURE, WOUND CORE, .05 TO 25 uSec.

FOR SERVO MOTORS 2 TO 18 WATTS.

REPLACEMENT TYPES

AUDIO, POWER, FILAMENT AND REACTORS TO 200 MA.

And Special Units to Your Specifications

UNITED TRANSFORMER CORPORATION

150 Varick Street, New York 13, N. Y.

PACIFIC MFG. DIVISION: 4008 W. JEFFERSON BLVD., LOS ANGELES 16, CALIF.

EXPORT DIVISION: 13 EAST 40th STREET, NEW YORK 16, N. Y. CABLES: "ARLAB"

READY FOR TOMORROW'S CIRCUITS—

Only tubes can perform many difficult jobs of tomorrow's advanced systems and still give the performance, flexibility, and reliability you require. The significance of these tube advantages is increasing through General Electric's program to improve constantly such 5-Star qualities as known, predictable reliability.

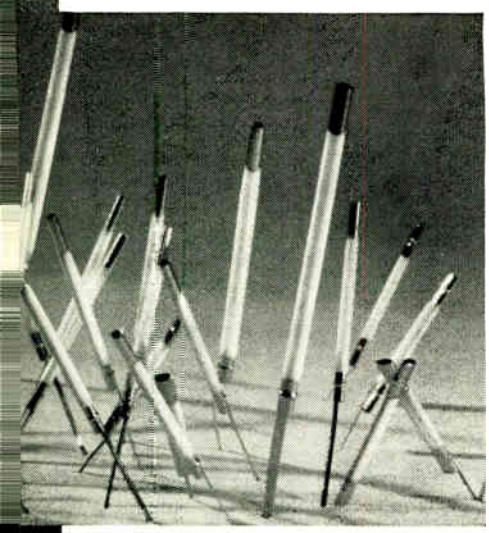
GENERAL ELECTRIC 5-STAR TUBES!

ELECTRONIC TUBES are, and will remain, superior in these areas of performance:

- **Proved reliability.**
- **VHF and UHF capability, and flexibility at these frequencies.**
- **One third the number of devices.**
- **Economy.**
- **Stable under ambient-temperature variations. Tolerate high temperatures.**
- **Low noise in wide-band RF circuits.**
- **High-voltage capability.**
- **Uniform product, with predictable performance to ratings.**

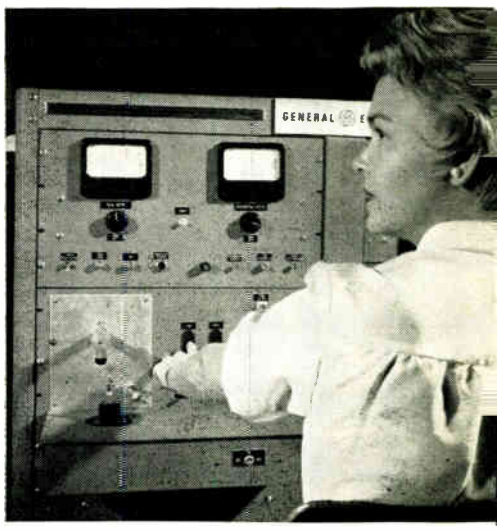
This margin of superiority grows as General Electric's active program of improvement makes 5-Star Tubes still more efficient and reliable. Design; manufacture; test; application—every product stage from development to final use in circuits shows progress in materials, methods, or both, as illustrated and described below.

14,000 tubes, using various cathodes and cathode coatings, make up one of many tests by General Electric to help determine the specifications for future 5-Star Tubes having even better performance. Equipment designers can be sure that General Electric leadership in high-reliability tubes is being maintained and strengthened; that 5-Star types will continue to meet the challenges of advanced electronic circuitry.



PROGRESS IN DESIGN. New cathodes for G-E 5-Star Tubes reduce interface and degradation of characteristics throughout life, mean built-in reliability. 100% tube stabilizing—used only by General Electric—adds to cathode and tube dependability and long life. New glass technology gives G-E tubes greater resistance to heat.

PROGRESS IN MANUFACTURE. Ultrasonic cleaning now is used for critical tube parts. This further extends General Electric's famed SNOW WHITE technique for excluding impurities of all kinds—notably dust and lint—during 5-Star Tube manufacture... A new direct-flow coating method for tube heaters accurately centers the wire, and provides an even coating, for more uniform insulating properties.



PROGRESS IN TESTING. General Electric's new impulse test, with vibrational output measured both in peak and integrated values, promotes lower-noise tubes where shock and vibration occur. Interface life tests; 100% DC testing for shorts and opens: these are among the many checks that make 5-Star tubes constantly more reliable.

For further information, phone nearest office of the G-E Receiving Tube Department below:

EASTERN REGION
200 Main Avenue, Clifton, New Jersey
Phones: (Clifton) GRegory 3-6387
(N.Y.C.) WIsconsin 7-4065, 6, 7, 8

CENTRAL REGION
3800 North Milwaukee Avenue
Chicago 41, Illinois
Phone: SPring 7-1600

WESTERN REGION
11840 West Olympic Boulevard
Los Angeles 64, California
Phones: GRanite 9-7765; BRadshaw 2-8566

Progress Is Our Most Important Product

GENERAL ELECTRIC

12-11-207

Circle 60 on Inquiry Card, page 117

Personals

J. Auditore and **S. Newberger** have been appointed Chief Electronic and Chief Mechanical Engineer respectively at Adler Electronics.

G. E. Kerr has been named Manager, Application Engineering, at Statham Instruments, Inc. Prior to joining Statham he was associated with Consolidated Electrodynamics Corp., Transducer Div.

Recent Stromberg Carlson appointments include: **F. S. Mitchell**, Chief Engineer-Industrial Products, **W. J. Stolze**, Manager of Technical Staff, and **L. D. Catlin**, Manager of Engineering Services in the Electronics Div. **R. C. Ritchart** is now the Assistant Chief Engineer at Stromberg Carlson, San Diego.

F. M. Cameron, Jr. has been appointed Chief Engineer, at Power Sources Inc. He has been associated with Ferranti Electric, Inc., White Industries, Inc., and Raytheon Mfg. Co.

D. Petrig has been promoted to Chief Engineer of the Manufacturing Div., ORRadio Industries, Inc. He was formerly with Continental Gin Co.

D. Petrig

E. Bollay

E. Bollay, is now the Director of Research, Meteorology Instrumentation at BJ Electronics, Borg-Warner Corp., Santa Ana, Calif. He was formerly President and Technical Director of Northam Electronics, Inc.

D. R. Greenberg is now Chief Development Engineer at Control Instrument Company. He will direct research in military electronics and electromechanical instrumentation.

E. Bachor has been appointed Assistant Chief Engineer of Electronics Div., Curtiss-Wright Corp. Prior to his present position, he was Administrative Engineer at Wright Aeronautical Div.

Dr. G. E. Hutter is now Chief Engineer, Special Tube Operations, Sylvania Electric Products Inc. He had been a Senior Engineer in the Sylvania Research Labs., Bayside, N. Y.

Ray Destabelle is now Chief Engineer, Transducer Div., at the Technology Instrument Corp.

New Products

SWEEPING OSCILLATOR

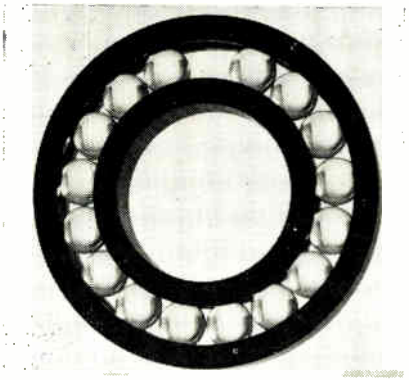
The Ligna-Sweep Model CP offers continuously variable sweep widths that cover Video, IF, and VHF in 6 switched bands. 18 crystal-controlled pulse markers are available. Specifi-

cations include: r-f output—0.25 v RMS into nominal 70 ohms (A), 1.0 v RMS into nominal 70 ohms (BC&D); Flatness—within ±0.4 db over widest sweep width; Sweep Rate — Var. around 60 CPS (locks to line freq.); Attenuators—switched 30 db, 20 db, 10 db, 6 db, plus continuously variable 6 db; Marker amplitude—Positive pulse, continuously variable, zero to 10 v peak approx.; Sweep output—Regular sawtooth, sync, with sweep oscillator, amplitude, 7.0 v approx.; Power supply—Input approx. 100 w, 117 v (±10%), 50-60 CPS a-c. Kay Electric Co., Dept. EI, Maple Avenue, Pine Brook, N. J.

Circle 219 on Inquiry Card, page 117

PHENOLIC BEARING

This bearing, manufactured from a linen base phenolic, uses pyrex balls for non-magnetic bearing applications. According to the type of phenolic used, it can be run immersed in water, acids, oils, and unusual en-



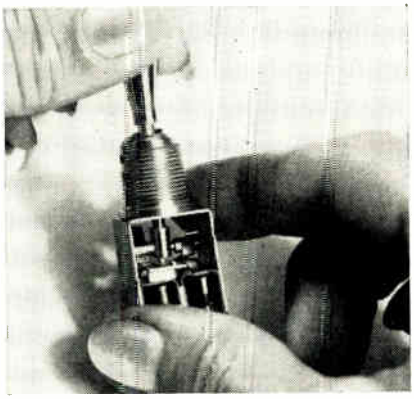
vironments that steel balls will not allow. They can be manufactured to meet specific requirements. Halax Corp., 17440 Shelbourne Way, Los Gatos, California.

Circle 220 on Inquiry Card, page 117

New Products

SNAP ACTION SWITCH

A safety lock-out feature in these toggle-actuated snap action switches prevents accidental switching to dangerous positions. In order to move the toggle off neutral, the operator must

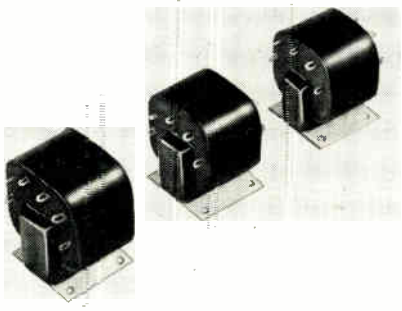


raise or pull out the toggle handle. The toggle can be moved to the opposite direction—usually a momentary position—without this safeguard. The switching action is available on DPDT high sensitivity switches affording four different switching combinations: momentary, neutral, maintained; maintained, neutral, momentary; momentary, neutral, momentary; and maintained, neutral, maintained. Milli-Switch Corporation, Frankford, Indiana.

Circle 221 on Inquiry Card, page 117

FILAMENT TRANSFORMERS

A 400 CPS filament transformer series is suited to ground or airborne applications. Units are vacuum molded to meet MIL-T-27 Grade 5. Primary is 105/115 v, 380-1000 CPS. The 4 standard units provide 6.3 v center tapped secondary with respec-



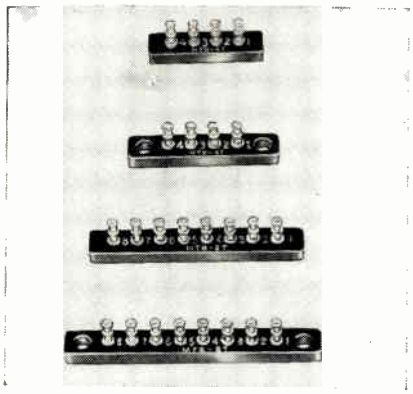
tive current ratings of 3, 5.5, 10, and 20 a. Sizes range from 1⅝ x 1¾ x 2 (0.25 lbs) to 2 1/2 x 2 13/16 x 3 (1.2 lbs). United Transformer Corp., 150 Varick Street, New York 13, N. Y.

Circle 222 on Inquiry Card, page 117

New Products

TERMINAL BOARDS

Series MT terminal boards available with four or eight turret terminals molded directly into the body material. One-eighth inch diameter mounting holes can be supplied on

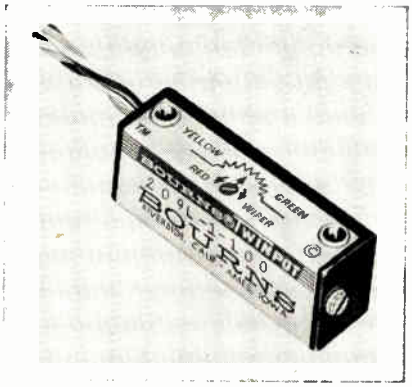


any size. Voltage breakdown at sea level is 2500 v RMS. The standard molding compound is mineral filled Melamine (MIL-M-14E, Type MME) or glass reinforced Dially Phthalate (MIL-M-19833, Type DGI-30). Other configurations and modifications to meet special applications and requirements are available. DeJur-Amsco Corporation, 45-01 Northern Boulevard, Long Island City 1, N. Y.

Circle 215 on Inquiry Card, page 117

POTENTIOMETER

A new version of the Model 209 TWINPOT lead screw actuated potentiometer is a dual arrangement of two potentiometers in one unit that provides simultaneous control of two circuits by a single adjustment of the slotted shaft. Featured is the Silverweld termination, a metal-to-metal bond. This model provides virtually a 100% usable potentiometer range plus stability and reliability. It mea-

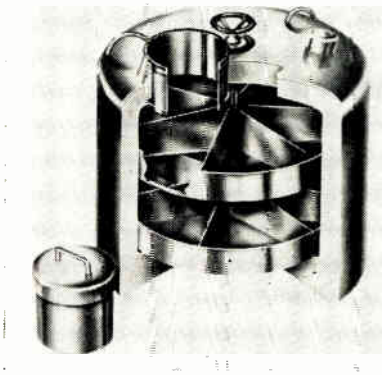


sures 5/16 in. x ½ in. x 1¼ in. and mounts individually or in stocked assemblies using 2-56 screws through body eyelets. Bourns Laboratories, Inc., P. O. Box 2112, Riverside, Calif.

Circle 216 on Inquiry Card, page 117

NITROGEN REFRIGERATOR

This non-mechanical liquid nitrogen refrigerator, a cryogenic tool, designated the LNR-640-B, stands 4 ft. high and has a diameter of 4 ft. It is designed to store 17½ cu ft of product at temperatures as low as

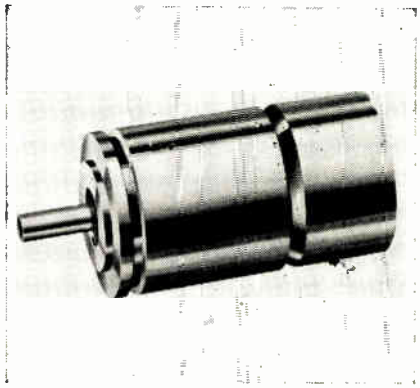


−320°F, the boiling point of liquid nitrogen. Products such as metallurgical samples can be stored in two 40 in. dia. trays. It has a low evaporation rate and a full container 640 liters, will last about 100 days without recharging. Linde Co., Div. of Union Carbide Corp., 420 Lexington Ave., New York, N. Y.

Circle 217 on Inquiry Card, page 117

SERVOMOTOR

Model 8 VM 420, velocity-damped servomotor, has the same transfer function as a motor-generator. An adjustability feature permits up to 50 dyne-centimeter-seconds per radian of additional damping if required. It has an undersized rotor with an inertia of 0.24 gm.cm.², and a stall torque of 0.25 oz-in. producing 73,000 rad/sec², acceleration at stall. No-load speed is 5,000 RPM. Power input 2.6 w, length—1.395 in., weight—1.9 oz. Meets MIL-E-5272A. Ambient tem-



perature range is from −55° to 130°C. It has a 26 v fixed phase and 40 v CT control phase windings. Helipot Div. of Beckman Instruments, Inc., Fullerton, Calif.

Circle 218 on Inquiry Card, page 117

for: MISSILE, ELECTRONIC and INDUSTRIAL CONTROLS

NEW ELECTRO SNAP modular mounting lighted push-button panel switch

Simplifies Control Panels; Saves Space, Cuts Cost. May be used singly or in "stacked" arrangement.

This new Electro-Snap push-button panel switch efficiently combines a name plate, pilot light assembly and a switching unit in one compact modular assembly. The trim, streamlined design permits easy "stacking" on control panels or consoles. It eliminates congestion by replacing three individual units (nameplate, pilot light assembly and switch unit). You can achieve greater operating efficiency and quality appearance while making substantial savings in space and cost. A wide variety of configurations is available in:

- circuit arrangements of switch and pilot lights
- colored buttons for color coding
- colored lights for color monitoring

The operating and indicating combinations possible through the variation of arrangements provides almost unlimited applications for sequencing, movement-limit, start-and-stop, position-indicating and similar control operations.

Check the design and construction advantages of this significant advance in panel switches for your own applications. For further details contact your local representative or write to:

ELECTROSNAP CORPORATION
4244 W. Lake St. • Chicago 24, Ill.
Tel. VA 6-3100 TWX #CG-1400

3 UNITS IN 1 COMPACT MOUNTING

NAME-PLATE + PILOT-LIGHTS + PUSH-BUTTON SWITCH UNIT

In one compact assembly, this unit provides new space and cost economy whether used individually or in "stacked" arrangement. You get quality appearance with "thumb-size" operation.

TWO-PIECE, PLASTIC NAME-PLATE PROVIDES EASY COLOR-CODING; SIMPLIFIES OPERATION IDENTIFICATION

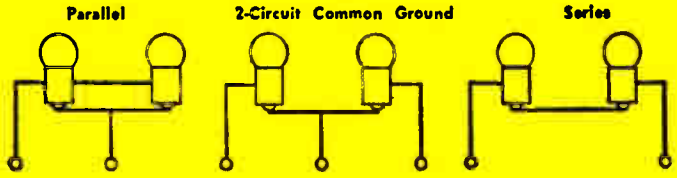
Virtually any operating condition can be identified with this push-button name-plate arrangement. The snap-in button is easily removed for insertion of slip-in name-plate. Use of various colored button bases, or various colored lamps, permits wide range of codings and monitoring.

- Snap-in button permits easy lamp replacement from front of panel
- Barrier can be color-anodized to your specification

The lighted push-button switch assembly is also available without the switch unit for use where only pilot light duty is required.

VARIETY OF CIRCUIT ARRANGEMENTS PERMITS WIDE RANGE OF INDICATING AND SWITCHING COMBINATIONS

- Lamp circuit can be wired independently of switch circuit—or through switch unit.
- Since two lamps are provided, independent external circuits can be indicated on single unit with different lamp colors and white push-button.
- Complete push-button switch unit or pilot-light assembly can be supplied in any of the three following circuit arrangements.

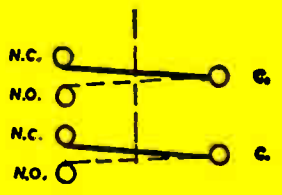


- 6V. or 28V. lamps may be used (solder terminals on lamp assembly)

Switch terminals available
- Solder
- Turret
- Double Turret
- AMP quick-disconnect

Switching Circuits to Meet Your Needs

The double-pole, double-throw switching unit may be wired normally-open or normally-closed.



a standard ELECTRO-SNAP UNIT

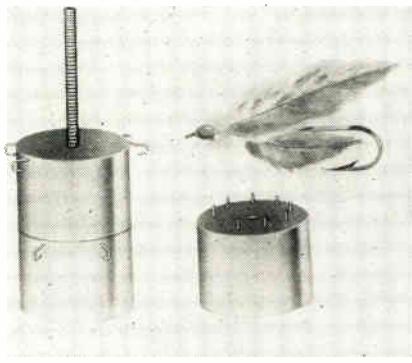
- Compact
- Space Saving
- Precision-Engineered
- Low Cost

Circle 70 on Inquiry Card, page 117

New Products

TOROIDAL INDUCTOR

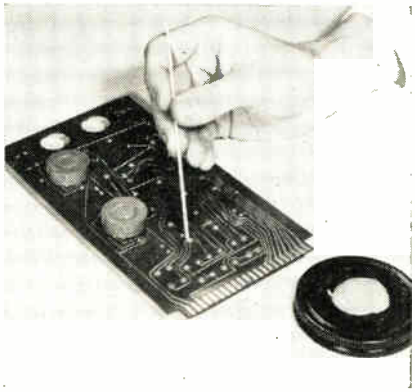
A temperature-stabilized (S type) line of small-size toroidal inductors featuring temperature stability across the −55° to +71°C range. Inductance change can be as little as ±0.25%



in this range. The units use stabilized cores and are fully encapsulated. Built to withstand extreme shock and high temperature, they meet MIL-E-5272A and MIL-T-27A. They are available with inductance values ranging from 0.1 mh to 17 h and with useful frequency ranges from 60 CPS to 500 KC. They are designed for printed circuit boards, or stacking on a single screw for chassis mounting. Arnold Magnetics Corp., 4613 W. Jefferson Blvd., Los Angeles 16, Calif.
Circle 223 on Inquiry Card, page 117

CONDUCTIVE CEMENT

A conductive cement, based on epoxy resins, the HYSOL 6250, is 100% solids. Volume resistivity is measured at 0.01 ohm-cm at 25°C. It is recommended for repair of printed circuits and for bonding of electrical components where soldering cannot be toler-

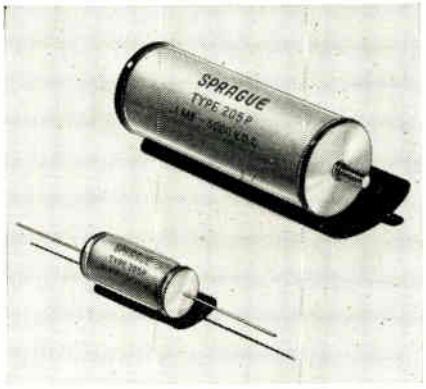


ated. The compound will cure fully in twenty-four hours at room temperature, or in two hours at 140°F. It is supplied in kit form. Houghton Labs Inc., Olean, New York.
Circle 224 on Inquiry Card, page 117

New Products

TUBULAR CAPACITORS

This series of glass-encased tubular capacitors for high-voltage applications employs a dual-dielectric of polyester plastic-film and paper. The Type 205P, features a glass-to-metal

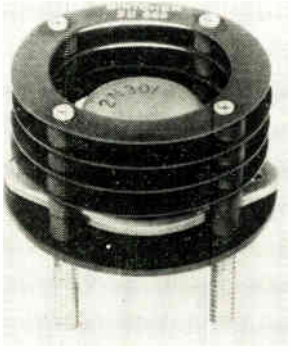


end seal which results in the practical elimination of impregnant leaks. These units are used to solve corona problems in airborne electronics, and find application in high-voltage ground equipment including power supplies for transmitters, induction heating equipment, and electrostatic precipitators, as well as in coupling and bypass applications in various industrial electronic control devices and allied equipment. Sprague Electric Co., 233 Marshall St., North Adams, Mass.

Circle 225 on Inquiry Card, page 117

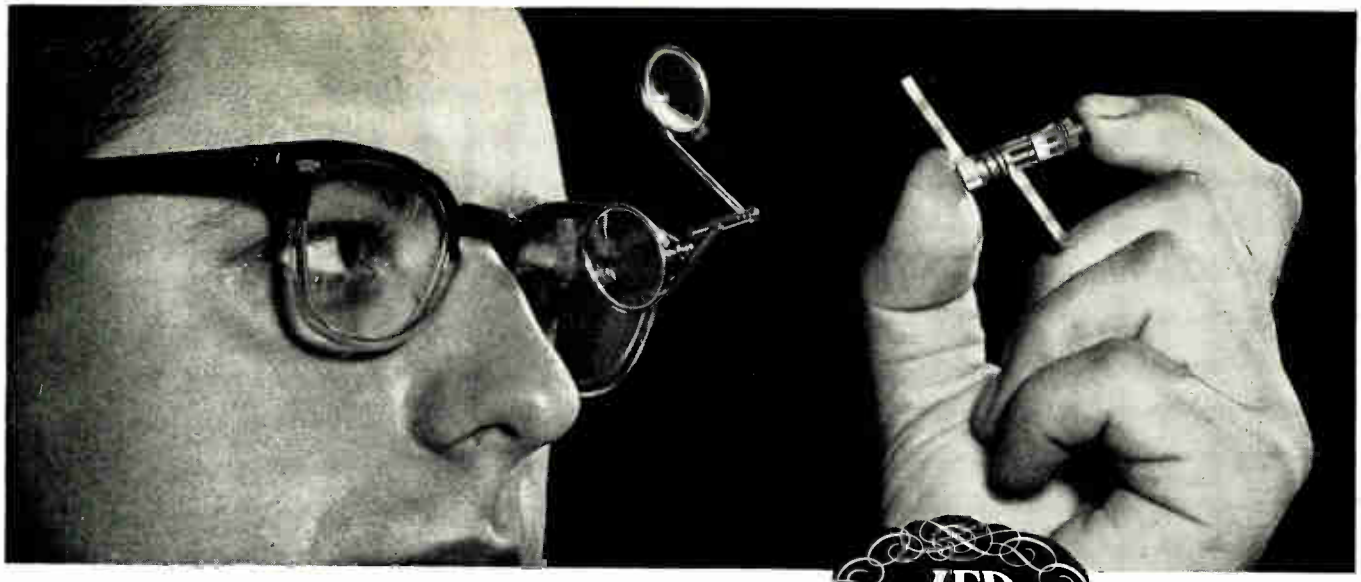
TRANSISTOR RADIATOR

A heat dissipation device the 3B-663 designed for diamond shape power transistors. A series of black ebanol finished metallic radiating fins are mounted on a base plate interposed between the transistor and the chassis. It may be used with or without a mica insulating washer. It may be used above ground potential. Tests indicate it reduces operating temperatures of transistors as much as 30°C



under typical operating conditions. Meets MIL-E-5272A (vibration) and MIL-STD-202A (environment). The Birtcher Corp., Industrial Div., 4371 Valley Blvd., Los Angeles 32, Calif.

Circle 226 on Inquiry Card, page 117



NEW FROM JFD Electronics

LC TUNERS

Why use *two*—a capacitor and inductor—when *one* will do? The new JFD LC Tuner combines a variable inductor *and* capacitor in one compact unit. For space-conscious design engineers this means more circuit in less space, better reliability, greater economy, faster assembly, reduced size and weight.

A few of the many advantages of JFD LC Tuners are:

1. Rugged electro-mechanical construction affords unusually high stability under conditions of severe shock and vibration.

2. Use of glass or quartz dielectric assures a low temperature coefficient and operation without derating over a wide range of extreme environmental conditions.

3. Sensitive adjustment with anti-backlash design for smooth and positive tuning.

4. Flexibility in design to suit circuit requirements. The number of turns, types of windings, size and type of capacitor plates, Q and other parameters can be designed to suit individual circuit requirements. Performance characteristics can also be varied by using other core materials, such as, brass or ferrites, by having the piston grounded or ungrounded and by other types of loading.

This is another example of JFD creative engineering to solve today's problems and tomorrow's applications. For information or engineering assistance on your specific tuning needs, call or write today.

Panel and Printed Circuit Mounting Types Standard LC Tuners Now Available

Model	Self Resonating Frequency Range	Length Above Panel	Diameter
LC303	450–700 MC	.635	5/16"
LC304	300–500 MC	.845	5/16"
LC306	200–450 MC	1.104	5/16"
LC309	125–200 MC	1.691	5/16"

PHONE DEWEY 1-1000

Pioneers in electronics since 1929

JFD ELECTRONICS CORPORATION

1462 62nd Street, Brooklyn, New York

JFD Canada Ltd.
51 McCormack St.
Toronto, Ontario, Canada

JFD International
15 Moore Street
New York, New York

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CIRCLE THE NUMBERS OPPOSITE THE NAMES OF THE

63 **Allen-Bradley Company**—Hot molded resistors

78 **American Time Products, Inc.** — Frequency standards

103 **American Super-Temperature Wires, Inc.** —Wire, cable and tubing

43 **AMP Incorporated**—Printed circuit edge connector

51 **Amperex Electronics Corp.** — Air-cooled triode, and tetrode

56 **Amperite** — Thermostatic delay relays, ballast regulators

88 **Anderson Controls, Inc.**—Solenoids

100 **Andrew Corporation**—Transmission line, Patch bay, and waveguide

45 **Armco Steel Corporation** — Thin electrical steels

83 **Arnold Engineering Company, The**—Alloy powder cores

69 **Arnold Magnetics Corporation**—Transistorized power supply

101 **Arnoux Corporation**—Temperature transducers

27 **Berkeley Division, Beckman Instruments, Inc.**—Heterodyne converter

71 **Borg Equipment Division, The George W. Borg Corp.**—Engineering, research & production facilities

74 **Borg Equipment Division, The George W. Borg Corp.**—Micro-potentiometers

34 **Bourns Laboratories, Inc.** — Potentiometers

72 **Bruno-New York Industries Corp.**—"Pigtailoring" machine

37 **Brush Instruments Division of Clevite Corporation**—Recording systems

49 **Burnell & Co., Inc.**—Adjustable toroids

35 **Burroughs Corporation, Electronic Tube Division**—Numerical readout tube

36 **Burroughs Corporation, Electronic Tube Division**—Beam switching tubes

33 **Bussmann Mfg. Division, McGraw-Edison Co.**—Fuses and fuseholders

59 **CBS-Hytron, A Div. of Columbia Broadcasting System, Inc.**—Miniature pulse tube

40 **Cinch Manufacturing Corporation**—Heat dissipating tube shields

63 **Cincinnati Sub-Zero Products**—Environmental test unit

29 **Cleveland Container Co., The**—Fly-back coil forms

82 **Clevite Transistor Products, A Division of Clevite Corporation** — Gold-bonded diodes

86 **Connecticut Hard Rubber Co., The** — Pressure sensitive TEFLON tapes

25 **Consolidated Electrodynamics, Transducer Divislon** — Seismic-type transducers

23 **Dale Products, Inc.**—Power resistors

24 **Dale Products, Inc.**—Hysteresis motor

55 **DeJur - Amsco Corporation, Electronic Sales Div.**—Sine-cosine potentiometers

44 **Delco Radio Division of General Motors** —High power transistors

73 **Designers for Industry**—Transistorized frequency standards

46 **Deutsch Company, The**—Miniature push-pull plugs

30 **Dlvco - Wayne Electronics, A Div. of Divco-Wayne Corp.**—Heterodyne frequency meter

18 **EFCON**—Precision film capacitors

106 **ElCO**—Electronics catalog

84 **Electric Regulator Corporation**—Voltage regulator

70 **Electrosnap Corporation**—Lighted push-button panel switch

90 **Federation Nationale des Industries Electroniques** — Second International Display of Electronic Components

112 **Film Capacitors, Inc.**—Precision capacitors, low current power supplies

15 **FXR, Inc.**—Electronic test equipment

66 **Gabriel Electronics Division** — Special purpose antennas

80 **General Chemical Division, Allied Chemical Corp.**—"Electronic grade" chemicals

60 **General Electric Co., Receiving Tube Department**—Electronic tubes

41 **General Electric Co., Power Tube Department**—Microwave power tubes

98 **General Transistor Corporation** — PNP drift transistors

99 **Gertsch Products, Inc.** — Ratio transformer

107 **Graphic Systems**—Visual control panel

2 **G-V Controls, Inc.**—Thermal time delay relays

7 **Hughes Products, Hughes Aircraft Co.**—Systems and components

8 **Hughes Products, Hughes Aircraft Co.**—Silicon junction diodes

9 **Hughes Products, Hughes Aircraft Co.**—Cathode ray storage tubes

11 **Hughes Products, Hughes Aircraft Co.**—Memory-type oscilloscope

105 **Horlick Co., Inc., William I.**—Variable frequency power supply, Motor generator unit

94 **Howard Industries, Inc.**—Induction motor

93 **Industrial Test Equipment Co.** — Test equipment

12 **Institute of Radio Engineers, The**—IRE National Convention and Radio Engineering Show

47 **International Electronic Research Corp.** —Heat-dissipating tube shield

3 **International Rectifier Corporation**—Zener diode

4 **International Rectifier Corporation**—Silicon zener voltage regulators

5 **International Rectifier Corporation**—Semiconductor substitution box

75 **JFD Electronics Corporation**—LC tuners

89 **Johnson Co., E. F.**—Low-loss KEL-F sockets

58 **Jones Division, Howard B., Cinch Mfg. Corp.**—Terminal panels

92 **Kay Electric Company** — Speech - time compressor and expander

26 **Kemet Company Division of Union Carbide Corporation** — Tantalum capacitors

38 **Kester Solder Company**—Flux core solder

81 **Klein & Sons, Mathias**—Pliers

48 **Kleinschmidt Division of Smith-Corona Marchant, Inc.** — Telecommunications units

68 **Lerco Electronics, Inc.**—Insulated terminals

77 **Litton Industries, Electron Tube Division**—Klystron

19 **Magnavox Co., The** — Anti - submarine warfare equipment

97 **Marconi Instruments**—Universal bridge

95 **Methode Manufacturing Corporation** — Flexible multi-conductor wiring

108 **Mica Importers Association, Inc.**—Mica

104 **Microwave Associates, Inc.**—Diffused silicon PN junction diode

79 **Narda Ultrasonics Corporation, Subsidiary of The Narda Microwave Corp.**—Ultrasonic cleaner

87 **Newark Electric Company** — Industria Electronics catalog

102 **Panoramic Radio Products, Inc.** — SSB spectrum analyzer

65 **Philbrick Researches, Inc., George A.**—Operational amplifier

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ADVERTISERS IN THIS ISSUE

ADVERTISERS FROM WHOM YOU DESIRE FURTHER INFORMATION

84 Philco Corporation, Lansdale Tube Company Division—VHF-UHF transistors
85 Pioneer-Central Division, Bendix Aviation Corporation—Sonic energy cleaning

PROFESSIONAL ENGINEERING OPPORTUNITIES

Circle number of company on card at right from whom you desire further information.

501 System Development Corporation—Engineering personnel.
502 Lockheed Missile Systems Division—Engineering personnel.
503 Garrett Corporation, The—Engineering personnel.
504 General Electric Co., Defense Systems Department—Engineering personnel.
505 Norden Laboratories, Norden Division, United Aircraft Corp. — Engineering personnel.
506 National Cash Register Company—Engineering personnel.
507 Sylvania Semiconductor Division—Engineering personnel.
508 McDonnell Aircraft — Engineering personnel.
509 Motorola, Inc.—Engineering personnel.
510 General Electric Co., Light Military Electronics Dept. — Engineering personnel.
511 Republic Aviation — Engineering personnel.
512 Melpar Incorporated A Subsidiary of Westinghouse Air Brake Co.—Engineering personnel.

10 Polarad Electronics Corporation—Microwave generator
1 Radio Materials Company—Disc capacitors
42 Radio Receptor Company, Inc.—Selenium rectifier
28 Raytheon Semiconductor Division—Computer transistors
52 Red Bank Division, Bendix Aviation Corporation—Silicon rectifiers
511 Republic Aviation — Engineering personnel
21 Revere Corporation of America—Temperature resistant wire
110 Rohn Manufacturing Co.—Communication tower
62 Scala Radio Company — Precision antennas, VHF Yagi
64 Scintilla Division, Bendix Aviation Corporation—High temperature capacitors
109 Shure Brothers, Incorporated—Communications microphone
31 Spectrol Electronics Corporation—Transistorized converter-inverters
6 Sprague Electric Company — Insulated-shell power resistors
76 Stanpat Co. — Adhesive-faced drafting symbols and details
67 Stromberg-Carlson A Division of General Dynamics Corp. — Printed circuit boards
91 Sylvania Electric Products, Inc.—NPN and PNP germanium transistors
13 Sylvania Electric Products, Inc.—Electron tubes
96 Syntronic Instruments, Inc.—Deflection yokes
57 Tamar Electronics, Inc.—Coaxial connectors and adapters
11 Telechrome Manufacturing Corp.—Video transmission test equipment
32 Texas Instruments Incorporated—Silicon rectifiers
17 Triad Transformer Corporation, A Subsidiary of Litton Industries — Transformers
20 Tung-Sol Electric, Inc. — High-power transistors
59 United Transformer Corporation—Transformers
61 Universal Atomics A Division of Universal Transistor Products Corp. — Transistorized power supplies
16 U. S. Semiconductor Products, Inc., A Division of Topp Industries, Inc.—Tantalum capacitors
54 Van Nostrand Co., D.—Algebra of Electronics book
50 Waveline, Inc.—Microwave instruments
22 Wheelock Signals, Inc.—Relays

Employment—Use the handy card below to get more information on the engineering positions described in the "Professional Opportunities" Section which begins on page 153 of this issue.

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501	506	511	516	521
502	507	512	517	522
503	508	513	518	523
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New Products—January '59

233 Analyzer—Weston Instruments Div. of Daystrom, Inc.
220 Bearing, phenolic—Halax Corp.
215 Boards, terminal—DeJure-Amsco Corp.
209 Camera, motion picture—Houston Fearless Corp.
200 Capacitors, electrolytic—Aerovox Corp.
225 Capacitors, tubular — Sprague Electric Co.
210 Carrier-on-radio package—Lenkurt Electric Co.
224 Cement, conductive — Houghton Labs, Inc.
205 Connectors—Cannon Electric Co.
208 Connectors, tube cap — Alden Products Co.
234 Control, miniaturized — Assembly Products, Inc.
236 Corner-strip—Panduit Corp.
213 Function fitter—George A. Philbrick Researches, Inc.
227 Generator, signal—BJ Electronics, Borg-Warner Corp.
238 Indicator, speed—Servo-Tek Products Co.
223 Inductor, toroidal — Arnold Magnetics Corp.
202 Inductors, toroidal—Magnetico, Inc.
206 Irons, soldering—Weller Electric Corp.
228 Instrument load—Alford Manufacturing Co.
237 Modules, plug-in — Packard-Bell Computer Corp.
232 Megohmmeter—Mid-Eastern Electronics, Inc.
239 Motor, miniature—Electro Products Div., Western Gear Corp.
219 Oscillator, sweeping—Kay Electric Co.
235 Oscillators, test—FXR, Inc.
216 Potentiometer—Bourns Labs, Inc.
231 Power Supplies — Universal Transistor Products Corp.
211 Processor, digital—Consolidated Electrodynamics Corp.
226 Radiator, transistor—The Birtcher Corp.
217 Refrigerator, nitrogen—Linde Co., Div. of Union Carbide Corp.
199 Resin, epoxy—Electronic Production & Development, Inc.
207 Resistors, precision—Ohmite Mfg. Co.
218 Servomotor—Helipot Div., Beckman Instruments, Inc.
204 Servomotor—John Oster Manufacturing Co.
221 Switch, snap action—Milli-Switch Corp.
203 Transformer, input—Microtran Co.
222 Transformers, filament — United Transformer Corp.
197 Transformers, step-down — Anderson Controls, Inc.
240 Transistors, high-power — Westinghouse Electric Corp.
198 Tube, cathode ray — Allen B. DuMont Laboratories, Inc.
212 Tube, UHF Beam Power—RCA Electron Tube Div.
201 Tube, vidicon—Westinghouse Electronic Tube Div.
214 TV, closed circuit—Industrial Products Div., IT&T Corp.

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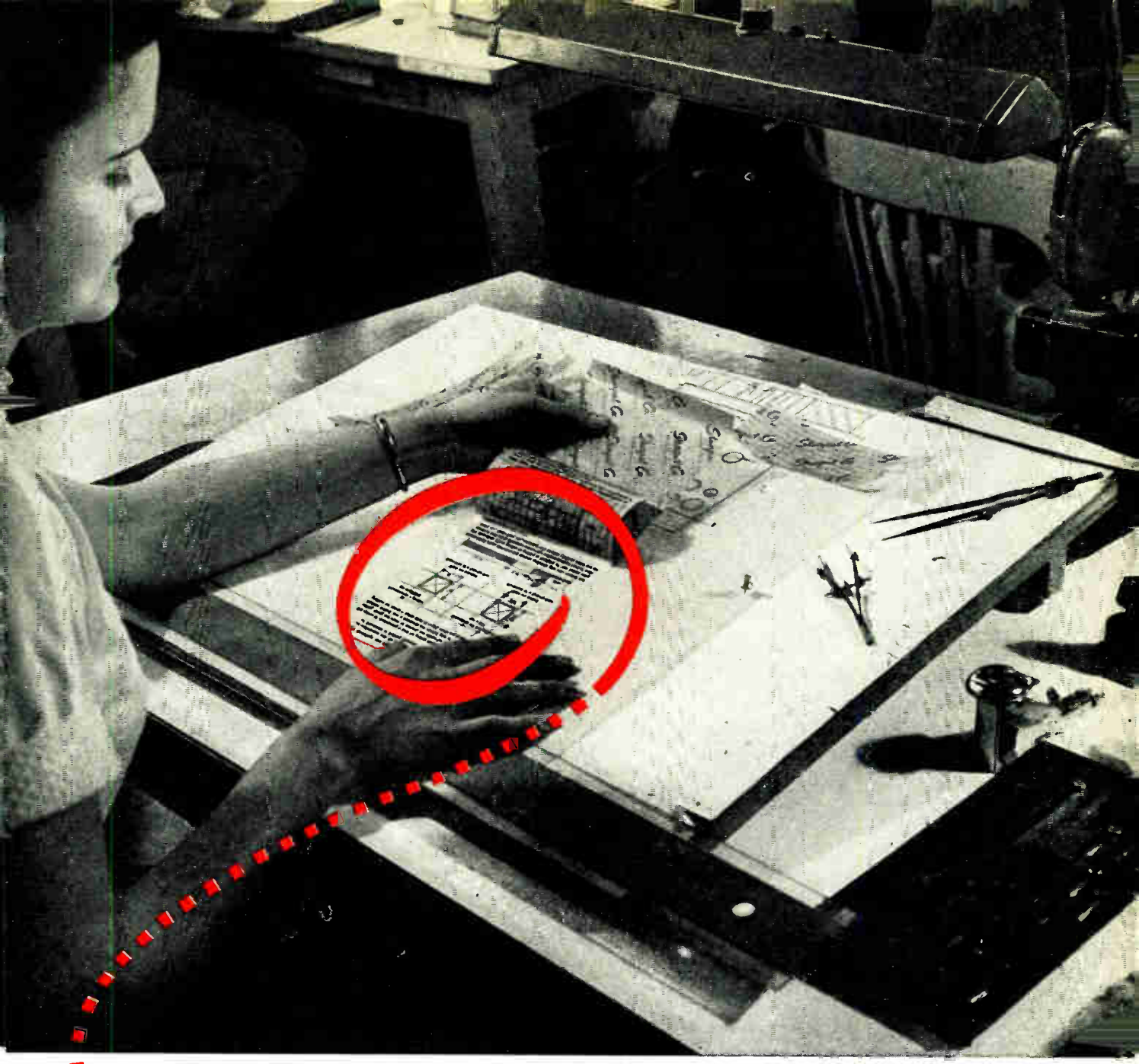
NEW TECH DATA

173 Antenna system—The Andrew Corp.
189 Audio equipment—General Electric Co.
179 Bobbin cores—Magnetics, Inc.
188 Diodes, silicon junction—Hoffman Electronics Corp.
185 FM analysis — Panoramic Radio Products, Inc.
170 Generator, sweep—Marconi Instruments.
196 Hardware, mounting—Bourns Labs., Inc.
192 Laminated plastics—The Richardson Co.
161 Laminates, paper-base—Synthane Corp.
187 Mechanical stops—Kearfott Co., Inc.
174 Particle accelerators—Applied Radiation Corp.
175 Potentiometers, precision — Technology Instruments Corp.
182 Power supplies—Sorensen & Co.
169 Power supplies, regulated — Quan-Tech Labs.
171 Production aids—Alden Systems Co.
178 Pumps, reciprocating—Waldorf Instrument Co.
166 Recording equipment—Burroughs Corp.
183 Rectifiers, silicon—Sarkes Tarzian, Inc.
177 Selsyn transmitter-receiver—Rotron Controls Corp.
193 Shafting, flexible—F. W. Stewart Corp.
172 Speed measurements — Servo-Tek Products Co.
167 Synchros & rotary components—Clifton Precision Products Co.
186 Tapes, paper electrical—Minnesota Mining & Mfg.
165 Teflon handbook—Halogan Insulator & Seal Corp.
164 Terminal blocks—DeJur-Amsco Corp.
190 Transducers, ceramic—Gulton Industries, Inc.
180 Transducers, pressure—Ultradyne, Inc.
163 Transformers, custom-built — Microtran Co.
181 Transformers, pulse — Technitrol Engineering.
195 Transformers, pulse — Acme Electric Corp.
194 Transistors, germanium power — Texas Instruments Incorporated.
191 Tubes, v-r—Anton Electronics Labs, Inc.
184 Tube, uhf beam power—Radio Corp. of America.
168 Videotape splicing—The Ampex Corp.
162 Wires, cold drawn — Sylvania Electric Products, Inc.
176 X-ray instrumentation — Philips Electronics, Inc.



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ANTENNAS, PROPAGATION

Methods of Calculating The Horizontal Radiation Patterns Of Dipole Arrays Around A Support Mast, P. Knight. "Proc. BIEE." Nov. 1958. 7 pp. Many v. h. f. broadcast transmitting aerials consist of an array of dipoles mounted on a supporting mast. Some theoretical methods which may be used to determine their horizontal radiation patterns are described and their limitations discussed. Patterns calculated by these methods are compared with those measured using small-scale models. (England.)

Large Aperture Antennas, Ernest Jacobs. "El. Des." November 12, 1958. 3 pp. Large aperture antenna gain can now be found graphically. No longer is there a need for the design engineer to work through the involved Fresnel region gain formulas. Three curves conveniently give the antenna's gain correction in the Fresnel Region. A practical design problem illustrates the use of these curves. (U.S.A.)

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* * *

For more information on domestic articles, contact the respective publishers directly. Names and addresses of publishers may be obtained upon request from the above address.

Frequency Variations in Short-Wave Propagation, Toru Ogawa. "Proc. IRE." December 1958. 6 pp. Frequency variations in the propagation of shortwave signals were observed at frequencies of 5 mc and 10 mc for about six months, beginning in August, 1957, utilizing the standard frequency transmission of station JJY in Tokyo. (U.S.A.)

AUDIO

The Reproduction of Sound Distribution in Rooms over one Channel by Pilot Frequency Levels under Threshold, F. Enkel. "El. Rund." Oct. 1958. 3 pp. High frequency methods of stereophonic reproduction suitable for broadcasting are considered almost exclusively. In addition to this the author proposes a new compatible method which uses a low frequency system only. A single broadcasting channel of conventional width is used for this. The information on the sound distribution in rooms is possible by pilot frequency levels. A delay line utilizing the Haas effect is applied for separating the channels. On the reception side the pilot signals are used to control spaced loudspeakers. (Germany.)

A Method of Stereophonic Broadcasting, H. Jubisch and H. Seidel. "El. Rund." Nov. 1958. 6 pp. Information theory is used to show that stereophonic broadcasting is possible using present VHF bandwidths. At the same time a twin modulation method is developed the band-width result of which confirms the information theory considerations. Cross modulation which occurs cannot be prevented by application of classical filter theory but is compensated for by phase-reversal stage. Further applications of the method are shown. (Germany.)

The Design and Performance of Magnetic Tape Recording Heads. C. W. Ross. "J. BIRE." September 1958. 10 pp. Magnetic heads of the conventional ring type used for high quality sound recording and reproduction are discussed in detail. Factors governing their performance and design and the importance of various mechanical relationships are pointed out. The choice of operating conditions for optimum performance and the importance of correct mechanical adjustments is considered. (England.)

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Proc. AIRE. Proceedings of the Institution of Radio Engineers

CANADA

Can. Elec. Eng. Canadian Electronics Engineering
El. & Comm. Electronics and Communications

ENGLAND

ATE J. ATE Journal
BBC Mono. BBC Engineering Monographs
Brit. C.&E. British Communications & Electronics
E. & R. Eng. Electronic & Radio Engineer
El. Energy. Electrical Energy
GEC J. General Electric Co. Journal
J. BIRE. Journal of the British Institution of Radio Engineers
Proc. BIEE. Proceedings of Institution of Electrical Engineers
Tech. Comm. Technical Communications

FRANCE

Ann. de Radio. Annales de Radioelectricite
Bull. Fr. El. Bulletin de la Societe Francaise des Electriciens
Cab. & Trans. Cables & Transmission
Comp. Rend. Comptes Rendus Hebdomadaires des Seances
Onde. L'Onde Electrique
Rev. Tech. Revue Technique
Telonde. Telonde
Toute R. Toute la Radio
Vide. Le Vide

GERMANY

AEG Prog. AEG Progress
Arc. El Uber. Archiv der Elektrischen Uebertragung
El Rund. Electronische Rundschau
Freq. Frequenz
Hochfreq. Hochfrequenz-technik und Electroakustik
NTF. Nachrichtentechnische Fachberichte
Nach. Z. Nachrichtentechnische Zeitschrift
Rundfunk. Rundfunktechnische Mitteilungen
Vak. Tech. Vakuum-Technik

POLAND

Arch. Auto. i Tel. Archiwum Automatyki i Telemechaniki
Prace ITR. Prace Instytutu Tele-I Radiotechnicznego
Roz. Elek. Rozprawy Electrotechniczne

USA

Auto. Con. Automatic Control
Av. Age. Aviation Age
Av. Week. Aviation Week
Bell J. Bell Laboratories Journal
Comp. Computers and Automation
Con. Eng. Control Engineering
El. Electronics
El. Des. Electronic Design
El. Eq. Electronic Equipment
El. Ind. ELECTRONIC INDUSTRIES
El. Mfg. Electrical Manufacturing
IRE Trans. Transactions of IRE Prof. Groups
I. & A. Instruments & Automation
Insul. Insulation
M/R. Missiles and Rockets
NBS J. Journal of Research of the NBS
NRL. Report of NRL Progress
Proc. IRE. Proceedings of the Institute of Radio Engineers
Rev. Sci. Review of Scientific Instruments

USSR

Avto. i Tel. Avtomatika i Telemakhanika
Radio. Radio
Radiotek. Radiotekhnika
Rad. i Elek. Radiotekhnika i Elektronika
Iz. Acad. Bulletin of Academy of Sciences, USSR.

OTHER

Radio Rev. La Radio Revue (Belgium)
Kovo. Kovo Export (Czech)
J. ITE. Journal of the Institution of Telecommunication Engineers (India)
J. IECE. Journal of the Institute of Electrical Communication Engineers (Japan)
Phil. Tech. Philips Technical Review (Netherlands)
Eric. Rev. Ericsson Review (Sweden)
J. UIT. Journal of the International Telecommunication Union (Switzerland)

← Circle 77 on Inquiry Card, page 117

FREQUENCY STANDARDS

*3⅛" high
400 - 1000 cy.

PRECISION FORK UNIT
TYPE 50

Size 1" dia. x 3¾" H. Wght., 4 oz.*

Frequencies: 240 to 1000 cycles
Accuracies:—
Type 50 (±.02% at —65° to 85°C)
Type R50 (±.002% at 15° to 35°C)
Double triode and 5 pigtail parts required
Input, Tube heater voltage and B voltage
Output, approx. 5V into 200,000 ohms

FREQUENCY STANDARD
TYPE 50L

Size 3¾" x 4½" x 5½" High
Weight, 2 lbs.

Frequencies: 50, 60, 75 or 100 cycles
Accuracies:—
Type 50L (±.02% at —65° to 85°C)
Type R50L (±.002% at 15° to 35°C)
Output, 3V into 200,000 ohms
Input, 150 to 300V, B (6V at .6 amps.)

*3½" high
400 to 500 cy.
optional

PRECISION FORK UNIT
TYPE 2003

Size 1½" dia. x 4½" H. Wght. 8 oz.*

Frequencies: 200 to 4000 cycles
Accuracies:—
Type 2003 (±.02% at —65° to 85°C)
Type R2003 (±.002% at 15° to 35°C)
Type W2003 (±.005% at —65° to 85°C)
Double triode and 5 pigtail parts required
Input and output same as Type 50, above

FREQUENCY STANDARD
TYPE 2005

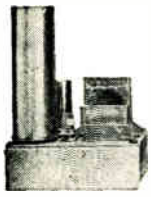
Size, 8" x 8" x 7¼" High
Weight, 14 lbs.

Frequencies: 50 to 400 cycles
(Specify)
Accuracy: ±.001% from 20° to 30°C
Output, 10 Watts at 115 Volts
Input, 115V. (50 to 400 cycles)

FREQUENCY STANDARD *NEW*
TYPE 2007-6
TRANSISTORIZED, Silicon Type
Size 1½" dia. x 3½" H. Wght. 7 ozs.
Frequencies: 400 — 500 or 1000 cycles
Accuracies:
2007-6 (± .02% at —50° to +85°C)
R2007-6 (±.002% at +15° to +35°C)
W2007-6 (±.005% at —65° to +125°C)
Input: 10 to 30 Volts, D. C., at 6 ma.
Output: Multitap, 75 to 100,000 ohms

FREQUENCY STANDARD
TYPE 2121A

Size
8¾" x 19" panel
Weight, 25 lbs.
Output: 115V
60 cycles, 10 Watt
Accuracy:
±.001% from 20° to 30°C
Input, 115V (50 to 400 cycles)



FREQUENCY STANDARD
TYPE 2001-2

Size 3¾" x 4½" x 6" H., Wght. 26 oz.

Frequencies: 200 to 3000 cycles
Accuracy: ±.001% at 20° to 30°C
Output: 5V. at 250,000 ohms
Input: Heater voltage, 6.3 - 12 - 28
B voltage, 100 to 300 V., at 5 to 10 ma.

FREQUENCY STANDARD
TYPE 2111C

Size, with cover
10" x 17" x 9" H.
Panel model
10" x 19" x 8¾" H.
Weight, 25 lbs.
Frequencies: 50 to 1000 cycles
Accuracy: (±.002% at 15° to 35°C)
Output: 115V, 75W. Input: 115V, 50 to 75 cycles.

ACCESSORY UNITS
for TYPE 2001-2

L—For low frequencies
multi-vibrator type, 40-200 cy.
D—For low frequencies
counter type, 40-200 cy.
H—For high freqs, up to 20 KC.
M—Power Amplifier, 2W output.
P—Power supply.

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Watch Master
Timing Systems

580 Fifth Ave., New York 36, N. Y.

A Survey of Performance Criteria and Design Considerations for High-Quality Monitoring Loudspeakers, D. E. L. Shorter. "Proc. BIEE." Nov. 1958. 17 pp. Loudspeakers used for monitoring purposes in broadcasting and recording studios are designed to give the nearest practicable approach to realistic reproduction. The paper discusses the various criteria which can be applied to the performance of such loudspeakers, together with the relationship between the measured free-field characteristics and the response as subjectively assessed in the working environment. While the degree of realism achieved in sound reproduction can only be judged aurally, even subjective assessments can be misleading unless carried out under controlled conditions and with clearly defined terms of reference; the precautions necessary in such tests are discussed. Some of the less obvious design considerations are reviewed and illustrated by examples. (England.)

IRE Standards on Audio Techniques: Definitions of Terms, 1958, 58 IRE 3.S1. "Proc. IRE." December 1958. 7 pp. (U. S. A.)

IRE Standards on Recording and Reproducing: Methods of Calibration of Mechanically-Recorded Lateral Frequency Records, 1958, 58 IRE 19.S1. "Proc. IRE." December 1958. 7 pp. (U.S.A.)

CIRCUITS

•Dividing Wide Frequency Bands, E. L. Laine. "El. Ind." Dec. 1958. 2 pp. A simple circuit for tubes or transistors divides a wide band of input frequencies by two. Self-starting, and not critically dependent on tube characteristics, it gives no output when input voltage is of the wrong frequency or amplitude. (U.S.A.)

Computing An Overdriven Vacuum-Tube Oscillator With A Complex Load, M. G. Margolin. "Radiotek." Nov. 1958. 10 pp. The paper presents a method for computing an overdriven vacuum-tube oscillator with a complex load. The analysis takes into account the effect of higher harmonics. The method of generalized load characteristics is used. (U.S.S.R.)

Computing A Potentiometer Circuit For Temperature Stabilization Of The Operating Point Of A Transistor, L. I. Rodinov. "Radiotek," Nov. 1958. 7 pp. The paper provides a mathematical analysis for temperature stabilization in a transistor triode as it applies to the design of a potentiometer circuit. It is shown that besides thermal stabilization, the circuit has the valuable property of eliminating the effect of current-gain spread on the position of the operating point. This feature can be used in order to expand the limits within which various transistor types are interchangeable. The circuit makes it possible for the transistor to work in a depletion ("egression") mode; this permits an appreciable increase in the working temperature (to above +100° C). The derived formulas are simple to use and agree closely with experimental results. (U.S.S.R.)

A Phase Discriminator, V. M. Viatkina, Z. A. Ivanova, A. P. Molchanov. "Radiotek," Nov. 1958. 6 pp. The design formulas are derived for a phase discriminator with highly stable balancing. A comparison is made between the transfer coefficient and the stability of the circuit under study and a bridge circuit with the same parameters. Experimental data is cited. (U.S.S.R.)

Matching Four Terminal Networks, U. Kirschner. "El. Rund." Oct. 1958. 4 pp. In practice it is often unavoidable to connect units with different input and output Z values. To overcome attenuations of reflexion matching four terminal networks have to be inserted. Design formulas of matching four terminal networks connected in pi and T are derived and the conditions for realization are dealt with. For the application in practice design parameters for relative matching conditions of the different attenuations may be derived from groups of curves. The minimum attenuations may be derived from groups of curves. The minimum attenuation for which the matching circuit is still realizable can also be obtained from this method. (Germany.)

The Reactance Conditions of Concentric Conducting Circuits with Interrupted Inside Conductors, Ch. Boden. "El Rund." Oct. 1958. 4 pp. The reactance condition as a function of magnitude of both circuit sections is thoroughly examined starting with the equation of the input resistance of a concentric conducting circuit the inside conductor of which is interrupted by a so-called splitting capacity. It is not possible to excite the conducting circuit in the gap at a certain length ratio. Various diagrams are given to design such special conducting circuits. Finally, the arrangement is examined for further self-frequencies. The higher self-frequencies are, normally, not harmonic to the basic frequency. (Germany.)

On the Distribution of Energy in Linear Networks and its Application to Negative Feedback Problems, J. Oswald. "Cab. & Trans." Oct. 1958. 22 pp. The scattering matrix, which makes it possible to study the properties of a linear network referred to its ports, has many advantages over other matrix types, such as the admittance, impedance or hybrid types generally used in network theory. After a short reminding of the definitions and main properties of this matrix, the author studies the general problem of the change of reference system, of which he indicates some immediate applications, and thereafter applies the theory to negative feedback problems. (France.)

Ladder Filters with a Maximum Number of Insertion Loss Undulations in Their Pass Band, J. E. Colin. "Cab. & Trans." Oct. 1958. 23 pp. Starting from the results of a former study by V. Fetzer on the same subject, the author gives general formulae for the calculation of the insertion loss of ladder filters with a maximum number of undulations in their pass band, and also for the determination of their structures. The known calculation method for the values of the elements is modified by the use of a representation of the angular frequency which was already classical in Zobel's image-parameter filter theory. (France.)

Synthesis of a Filter with a Given Insertion Loss, A. Fromageot. "Cab. & Trans." Oct. 1958. 22 pp. In his work published in 1939, Darlington proposed a method for determining the structure and the inductance and capacitance values of a four-terminal network providing a given attenuation when closed on pure resistances. The present paper is an account of the application of Darlington's method in one of the cases he already considered, that of filters having, outside their pass band, arbitrarily given attenuation. Symmetrical, antimetrical and dissymmetrical filters are successively dealt with. (France.)

Design of Detector Stages for Signals with Symmetrical or Asymmetrical Sidebands, A. Van Weel. "J. BIRE." Sept. 1958. 14 pp. The design of detector stages for signals with symmetrical-sideband components can be improved over conventional designs by properly using the long-established theory of such stages. For asymmetrical-sideband signals (i.e., television signals), an improved design is possible using the results of recent investigations. The conditions for the if. f. amplitude curve to fall by a factor of two at the carrier frequency and for the v. f. section of the detector stage to have a wide-band transfer impedance are shown to be unjustified. (England.)

Ultra-High-Frequency Power Amplifiers, J. Dain. "Proc. BIEE." Nov. 1958. 10 pp. The paper examines a few of the problems associated with the design and construction of power amplifiers operating in the frequency band 300-3,000 Mc/s. Various types of amplifier are considered in turn, and the advantages and disadvantages of each particular class are examined in some detail. (England.)

Thermally Compensated Crystal Oscillators, R. A. Spears. "J. BIRE." Oct. 1958. 8 pp. The paper describes a new approach to the problem of "frequency - versus - temperature" stability. The principle involved is particularly suitable for the special requirements of mobile and portable communications equipment. In contrast to oven-controlled crystal oscillators the technique requires neither the expenditure of power nor the use of thermostats in any form. Frequency stability is achieved by a temperature-sensitive phase-shifting network incorporated in the oscillator circuit. A stability approaching 1 part in 10^6 is obtained over a wide temperature range. (England.)

Amplitude-Modulated Transmitter Class-C Output Stage, C. G. Mayo and H. Page. "Proc. BIEE." Nov. 1958. 9 pp. The mode of operation of the amplitude-modulated transmitter class-C output stage is discussed, with particular reference to the case where the load impedance varies over the working frequency band; a typical example is that of a long-wave broadcasting transmitter. The impedance presented to the anode must be symmetrical with respect to the carrier frequency if non-linear distortion of the radiated signal is to be avoided. The carrier can be modulated fully at high audio frequencies if the impedance rises symmetrically (but not if it falls symmetrically) on each side of the carrier frequency. (England.)

Negatively-Biased Multivibrator, A. Bar-Lev. "E. & R. Eng." Nov. 1958. 5 pp. A multivibrator with its grid returned to a negative bias is described and its operation analyzed. The effects of the bias on frequency and waveshapes are discussed. It is shown that a linear relationship between the frequency and bias voltage, extending over a frequency ratio of more than five to one in the audio range, may be achieved. The frequency stability of a negatively-biased multivibrator is found to be high and so it may be used as a variable-frequency source, a source of special waveshapes or be frequency-modulated. (England.)

The Reduction of Low-Frequency Noise in Feedback Integrators, E. M. Dunstan. "Proc. BIEE." Nov. 1958. 13 pp. Two methods of designing a feedback integrator for use with repetitive inputs are described. Each results in a considerable improvement in signal/noise ratio compared with that of a conventional direct-coupled integrator. The first method uses an error amplifier containing a single CR coupling. In the second, phase correction is applied to the output from a low-accuracy direct-coupled integrator, increasing the accuracy but retaining the relatively high signal /noise ratio of the low-accuracy integrator. (England.)

Wide-Range RC Oscillator, C. G. Mayo and J. W. Head. "E. & R. Eng." Nov. 1958. 5 pp. A novel type of tone-source or oscillator is described; a frequency range of more than 1000:1 can be obtained in a single sweep. Elements are used which have continuously distributed series resistance and shunt capacitance, and behave like "Kelvin cables." These elements are easily made from standard high-stability resistors. The tone-source has a performance comparable with that of a beat-frequency tone-source, and also has the simplicity, cheapness, high frequency-stability and uniformity of scale associated with a resistance-capacitance oscillator. (England.)

Narrow-Band Magnetostrictive Filters, A. P. Thiele. "E. & R. Eng." Nov. 1958. 10 pp.

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Twenty filters, each with a 3-dB bandwidth of 7 c/s, were arranged with inputs in series and outputs isolated from one another. The design equations are stated, and construction described. The use of cobalt-substituted ferrite reduced temperature effects. Possible applications of both single resonators and arrays are considered. (England.)

General Power Relationships for Positive and Negative Nonlinear Resistive Elements, Richard H. Pantell. "Proc. IRE." December 1958. 4 pp. The method developed by Manley and Rowe for the treatment of nonlinear reactive elements is extended to include nonlinear resistors. General power relationships are derived which yield modulation efficiency, efficiency of harmonic generation, and stability criterion. (U.S.A.)

Pulse Amplifier with Nonlinear Feedback, Leon H. Dulberger. "El." November 7, 1958. 2 pp. Fast-acting nonlinear feedback through diodes controls gain of a transistorized pulse amplifier. Output is essentially constant over a 38-db range of input signals. Two circuits are presented; the second gives greater small-signal gain than the first, as well as improved feedback limiting action. (U.S.A.)

Designing a Transistor Audio Oscillator, M. A. Melehy. "El. Eq." November 1958. 3 pp. Junction transistors can be used in the design of an audio oscillator that has a wide frequency range and a reasonably constant output voltage. The lower and upper limits of the frequency range depend respectively on the capacitive interstage coupling and the transistor high frequency response. (U.S.A.)

COMMUNICATIONS

***Master Plan for Latin American Telecommunications,** Dr. W. J. Duschinsy. "El Ind Ops. Sec." Dec. 1958. 5 pp. In the overall plan to provide modern, efficient communications throughout the South American continent microwave, VHF and scatter radio relay links would replace the present radio telephone systems. Main trunk route would be a North-South link of scatter relays extending from Caracas to Buenos Aires. (U.S.A.)

The Reception of Pulse Signals by the Storage Method, M. K. Belkin, N. G. Gatkin. "Radiotek." Nov. 1958. 4 pp. The paper treats the possibility of receiving pulse signals by the storage method in single-channel and two-channel receivers. It is shown that in the latter case a certain advantage in noise stability is achieved. This is especially true for large averaging intervals. The results of the theoretical analysis are experimentally verified. (U.S.S.R.)

Power In Threshold Signal for Multichannel Radio Communication with Pulse-Phase Modulation, G. V. Dlugach. "Radiotek." Nov. 1958. 11 pp. The paper studies the problem of determining the probability of false operation for a demodulator. It is shown that the optimum position of the limiting level does not depend on the shape of the signal pulse and is determined by the average number of demodulator failures as a function of the signal power at the receiver input. A simple formula is derived for computing the threshold value of the pulse energy. An approximate computation is made for the power in the threshold signal. (U.S.S.R.)

On Back-to-Ground Telemetering of Variable Functions in Airborne Missiles, K. Zeilinger. "El Rund." Oct. 1958. 2 pp. The transmission of measuring values from airborne missiles to stationary or mobile ground receiving stations becomes more and more important. In this article such an air-to-ground telemetering equipment (license ONERA, design SFIM) which has many times been proved in practice is described. Measurement and recording as well as conventional data-evaluation and the limits of accuracy are also discussed. (Germany.)

The Introduction of Automatic Telephone Services in Internal Telephone Networks of Power Supply Organizations, J. Obermeier. "Nach Z." Oct. 1958. 6 pp. Special conditions of operation, particularly manual exchange operations on the "telecommunication switch board," determine the type of system to be chosen for the introduction of automatic telephone services in internal telephone networks of power supply companies. A new method of operation is described with the aid of a practically tested long distance dialing network within the communication network of "Bayernwerk A. G." The problems are emphasized by comparison with another possible alternative solution. (Germany.)

Observations of Multi-path Propagation on the Short-Wave Link Osaka—Frankfurt a. Main, B. Beckmann and K. Vogt. "Nach Z." Oct. 1958. 5 pp. The amplitudes and delays on propagation paths of pulse transmission from the short-wave station Osaka are measured on the direct way and on the backward way and the backward scatter of the pulse transmitter London (Rugby) has been investigated. The results have been evaluated with a view to ionospheric conditions. (Germany.)

VF-Telegraphy Systems for Use on Shortwave Telephone Links FM-WTK 3/6, H. J. Neumann. "Nach Z." Oct. 1958. 5 pp. A new VF-telegraphy system for shortwave links is described. This system employs frequency modulation and permits a transmission of telegraph signals with a step velocity of up to 200 Baud for high standards of freedom from distortion. Three channels can operate simultaneously in the frequency band 300 to 3000 c/s. Each channel can be loaded with a 4-channel time-multiple system, thus resulting in a higher channel concentration. (Germany.)

Methods and Equipment for Meteorite Scatter Propagation, E. Roessler. "Nach Z." Oct. 1958. 7 pp. Meteorite scatter propagation is not only a completely new type of propagation now used for electro-magnetic waves, but also the methods and equipments required for this type of transmission differ in principle from previous knowledge, although conventional components are used. The reason for this lies in the fact that in the case of such methods it is not a continuous communication which is to be expected, but, on the contrary, a communication which is operative only for fractions of the total time. (Germany.)

Automatic Power Supply Equipment for Telephone Selector Systems, E. Schroeter. "AEG Prog." No. 1. 1958. 4 pp. Power supply equipment developed in recent years for telephone selector systems operates with magnetically controlled semi-conductor rectifiers, the notable characteristics being reliability and accurate response. The circuit with divided battery permits simultaneous working of the exchange and charging of the battery. (Germany, in English.)

Simultaneous Variation of Amplitude and Phase of Gaussian Noise, with Applications to Ionospheric Forward-Scatter Signals, T. Hagfors and B. Landmark. "Proc. BIEE." Nov. 1958. 5 pp. (England.)

Tropospheric Scatter System Evaluation, M. Telford. "J. BIRE." September 1958. 13 pp. A study of the mode of propagation and changes in attenuation found along typical paths forms the basis for the evaluation of signal strength requirements in the design of communication systems employing tropospheric scatter. A chart is presented to enable performance and/or equipment parameters to be determined for a wide range of conditions. (England.)

Electronics in Railway Signaling, B. K. Cooper. "Brit. C. & E." Nov. 1958. 4 pp. Automatic train control assumes considerable importance in the big program of electrification under the Modernization and Re-equipment Plan for British Railways. This article reviews the history of railway signaling and then considers the extent to which various electronic systems can be used to improve the safety of railways. (England.)

Performance of Some Radio Systems in the Presence of Thermal and Atmospheric Noise, A. D. Watt, et al. "Proc. IRE." December 1958. 10 pp. The performance of several basic types of communication systems are determined experimentally, and in some cases theoretically, under typical conditions with steady or fading carriers, and in the presence of thermal or atmospheric noise. The relative efficiency of various carriers and the interference factor of various types of noise are found to be dependent upon the characteristics of the particular communication system as well as the characteristics of the carrier and noise themselves. (U.S.A.)

Using Markerless Pulse Trains to Communicate, M. Davidson, et al. "El." November 21, 1958. 3 pp. Three types of markerless pulse train modulation are compared. Circuitry for demodulating a markerless pulse train, containing low frequency audio information as a time interval variation between pulses, is described. (U.S.A.)

COMPONENTS

***Wire—In the Electronic Industry.** "El Ind." Dec. 1958. 8 pp. For the electronic design engineer here is a presentation of significant wire information. Included are: ASA & ASTM wire gauge standards; a general summary of Mil Specs; a graphical summary of MIL-W-76A; color coding for hook-up and component interconnection wire; aircraft wiring code designations; and a flexible wire chart for consumer electronic equipment and appliances per Underwriters' Labs. (U.S.A.)

***Hermaphroditic Connectors,** H. E. Ruehlemann. "El Ind." Dec. 1958. 5 pp. This new type of connector is "sexless"—there are no male or female members; both are exactly alike at their mating faces. Provisions have been made to maintain correct polarity, hot lead protection, sealing and coupling. Interconnecting cables may be run without worry about having the correct connector on the right end. They can also be very easily mated in total darkness. (U.S.A.)

***Extreme Environmental Testing Determined Capabilities of Coaxial Cable, Part 2,** E. T. Pfund, Jr., P. S. Klasky, and B. Suverkrop. "El Ind." Dec. 1958. 3 pp. As a part of an Air Force sponsored world-wide survey of potentially high-temperature-resistant 50 ohm coaxial cable, six different types have been tested. The extensive tests, which were conducted impartially, exceeded the manufacturers' specifications in an attempt to find rugged coax cable. Some of the findings are enlightening. (U.S.A.)

Thermistor Thermometers with Linear Scale, S. Topinski. "Roz. Elek." Vol. 4, No. 2. 13 pp. Thermometric circuits with a thermistor have a disadvantageous feature, which is the nonlinear dependence of current upon temperature, giving in effect an uneven scale of the instrument. The above feature confines the applications of that type of thermometers. (Poland.)

The Life of Ballasts for Gas-Discharge Lamps, I. Transformers, and Chokes, T. Hehenkamp. "Phil. Tech." Oct. 23, 1958. 10 pp. The

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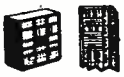
life of a transformer is determined by the "reserve" of insulating strength initially present and by the rate at which this reserve decreases. The reserve depends on the quality, quantity and processing of the insulating materials. In the case of transformers and chokes of ballasts for gas-discharge lamps, the aging rate is primarily determined by the temperature of the insulation. Life tests can be accelerated by performing them at higher temperatures. The temperature range should be such that the shortest life amounts to a few days and the longest to a few years. (Netherlands, in English.)

Self-Starting Miniature Synchronous Motors, W. Renelt. "AEG Prog." No. 1, 1958. 2 pp. An inevitable consequence of the present trend towards rationalization and, where possible, automation in manufacturing processes in all branches of industry is the demand for improved or new apparatus for control, regulation and measurement. The miniature synchronous motor, predominately used as a driving unit wherever time is a factor, is thus attaining ever increasing importance. (Germany, in English.)

Optimum Wattage Absorption without Forced Cooling, F. R. MacDonald. "El. Eq." Nov. 1958. 2 pp. The design of housings for electronic components can be simplified by using this method for determining the optimum configuration for heat dissipation by natural convection. The problem of whether a blower or some other means of forced cooling will be necessary is solved by simple calculations. (U.S.A.)

Oscilloscopic Analysis of Relay Performance, Charles F. Cameron and D. D. Lingelbach. "Auto. Con." Nov. 1958. 2 pp. (U.S.A.)



COMPUTERS

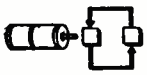
***Maintaining an Analog Computing System,** R D. Horwitz. "El Ind. Ops. Sec." Dec. 1958. 3 pp. Large analog computing facilities require constant maintenance by qualified specialists. This maintenance is broken into three types; preventive, routine and emergency. The types of tests and checks required are enumerated along with other helpful maintenance information. (U.S.A.)

A Magnetic-Drum Store for Analogue Computing, J. L. Douce and J. C. West. "Proc. BIEE." Nov. 1958. 4 pp. The paper discusses how a conventional magnetic drum may be used in an analogue computer. The magnetic drum becomes a versatile element in this computer, giving a large storage capacity combined with a relatively short access time. Several of the important facilities obtainable by this technique are discussed. (England.)

A Train Performance Computer, E. Bradshaw, et al. "Proc. BIEE." Nov. 1958. 9 pp. The computer employs a 50 c/s computing circuit, with induction-type energy meters as integrators, and gives automatic prediction of speeds, running times, energy consumption and r.m.s. motor current. Typical studies of train performance are illustrated. (England.)

Latching Counters, Part 2 — Non-Binary Counters and Transistor Circuits, W. P. Anderson, and N. A. Godel. "E. & R. Eng." Nov. 1958. 12 pp. (England.)

Tones Find Data in High-Speed Tape Systems, Reuben Wasserman and Paul Hurney. "El." November 21, 1958. 4 pp. Companion digital timing generator and magnetic-tape search unit give automatic, high-speed access to selected data from multichannel magnetic-tape instrumentation systems. Tone modulated recording and signal integration recovery techniques permit reliable operation regardless of tape defects. (U.S.A.)



CONTROLS

The Automatic Electric Follow-up Control System of the Largest German Radio Telescope, H. Kleissmann. "AEG Prog." No. 1, 1958. 3 pp. In addition to a description of the design and method of operation of the radio telescope, the electrical control system of the driving motors for the antenna is explained in general terms. (Germany, in English.)

Transductor Voltage Regulation of Transformers with Tap Changers, A. Lang, and W. Steuer. "AEG Prog." No. 1, 1958. 5 pp. For the automatic voltage regulation of transformers with on-load tap changers magnetic amplifiers may be employed in place of contact amplifiers in the regulator, motor drive and transfer switch. A new transductor-type automatic voltage regulator without contacts and a motor drive without contactors are described. (Germany, in English.)

Current Limiting by Means of Transductors, P. Kratz and A. Lang. "AEG Prog." No. 1, 1958. 5 pp. Magnetic amplifiers (transductors), of which extensive use is now made in regulation and control techniques, are employed mainly in voltage-controlling circuits since the power gain is about a hundred-times that possible with current-controlling circuits for the same time response. The current-controlling circuit may be used with advantage in certain cases, for which this natural characteristic is appropriate. These include current limiting and transforming, and the maintaining of constant currents. (Germany, in English.)

Tungsten Filament Lamps as Limiters for Servo-Motor Supplies, H. A. Dell. "Brit. C. & E." Nov. 1958. 4 pp. An account is given of an investigation that has been carried out on the current stabilizing properties of metal filament lamps. The conclusion is that such lamps, incorporated in the armature circuit of Velodyne motors, give a better performance than ohmic resistors. (England.)

The Simulation of Distributed - Parameter Systems, With Particular Reference to Process Control Problems, J. F. Meredith and E. A. Freeman. "Proc. BIEE." Nov. 1958. 8 pp. Simulator techniques for solving certain partial differential equations, generally occurring in process-control engineering (e.g. heat exchangers), are investigated. Limitations associated with the method of dividing a distributed-parameter system into a series of elements which may be represented by lumped-constant electrical networks are discussed, and an alternative method of simulation is suggested which overcomes these limitations. (England.)

Methods of Arbitrary Function Generation, Part Two, Barbara Silverberg. "Auto. Con." November 1958. 3 pp. Last month, the author covered diode function generators and two types of photo electric function generators: the McNee Photoformer and one utilizing magnetic type deflection. This part continues the discussion of photoelectric function generators. (U.S.A.)

How User Needs Influence Design of Electronic Process Pressure Transmitters, W. E. Belcher, Jr. "Auto. Con." November 1958. 5 pp. The degree of utility which can be achieved with any control device depends primarily on the designer's relative awareness of the end user's special problems. With this fact in mind, the author of this article describes the step-by-step procedure which was followed in the development of a new two-wire control system for the processing industries. (U.S.A.)

GENERAL

***1959 Coming Events Calendar.** "El Ind." Dec. 1958. 8 pp. Portraying important electronic events for the year ahead. (U.S.A.)

***Wall Street Looks at the Electronic Industry . . .,** C. M. Bower. "El. Ind." Dec. 1958. 4 pp. What yardsticks does the security analyst use to measure financial health of a company? How do electronic firms differ from other industries? In changing jobs what are the significant items in a firm's financial statement that best indicate the quality of management? How much R&D is "healthy"? (U.S.A.)

A General Survey, K. S. Knol. "Phil. Tech." October 23, 1958. 8 pp. The article substantially reproduces the address delivered by the author on the occasion of his inauguration as Professor of electronics at the Technische Hogeschool, Eindhoven. A survey is given of the phenomena, collectively termed "noise" which cause interference in radio and television reception. After touching briefly on the noise and secondary-emission noise, the noise appearing at very low frequencies and the noise phenomena at very high frequencies (quantum noise and transit-time effects). (Netherlands, in English.)

Science and Industry, H. B. G. Casimir. "Phil. Tech." October 30, 1958. 4 pp. In this lecture, delivered at the 50th Anniversary International Symposium at Oklahoma City, June 17, 1957, the author puts forth and illustrates three statements: 1) In an industrial research laboratory it is impossible to relate research projects budget wise to industrial and commercial projects. 2) Although industry is for its future dependent on fundamental research, very few fundamental results have come, will come or should come out of industrial research laboratories. 3) It is wrong to regard education and research as two distinct and separate tasks of a University. (Netherlands, in English.)

On Design of Average Value Scales in Applied Radioactivity, J. Low. "El. Rund." Nov. 1958. 6 pp. After the explanation of the Poisson distribution and of the average statistic error the accuracy of single measurement is elucidated. The relation of attenuation of scale and time constant of the unit to pulse density and measuring precision is dealt with and represented in a diagram. How the counter tube dead-period determines the attenuation constant and the suppression point is described, and shown in a diagram. An example shows the application of the diagram. (Germany.)

Microwave Generators with Closed Operating Space for Dielectric Heating of Victuals and Industrial Products, W. Schmidt. "El Rund." Nov. 1958. 4 pp. The first part of the article describes the construction and operation of microwave generator (magnetron) with closed operating space for dielectric heating. The general design of feed systems is described. (Germany).

Gamma-Spectroscopy, H. Mahnau. "El. Rund." Nov. 1958. 3 pp. The radiative power of isotopes being characteristic of their atomic nuclei, it is possible to identify isotopes by determining their energy. With the aid of a scintillation counter electrical impulses are derived, the amplitude of which is proportional to the gamma radiation. The pulse train, varying in amplitude, is fed to an analyzer. The present article deals with the principle and operation of a scintillation counter for spectroscopy, and of a 25 channel pulse analyzer. (Germany).

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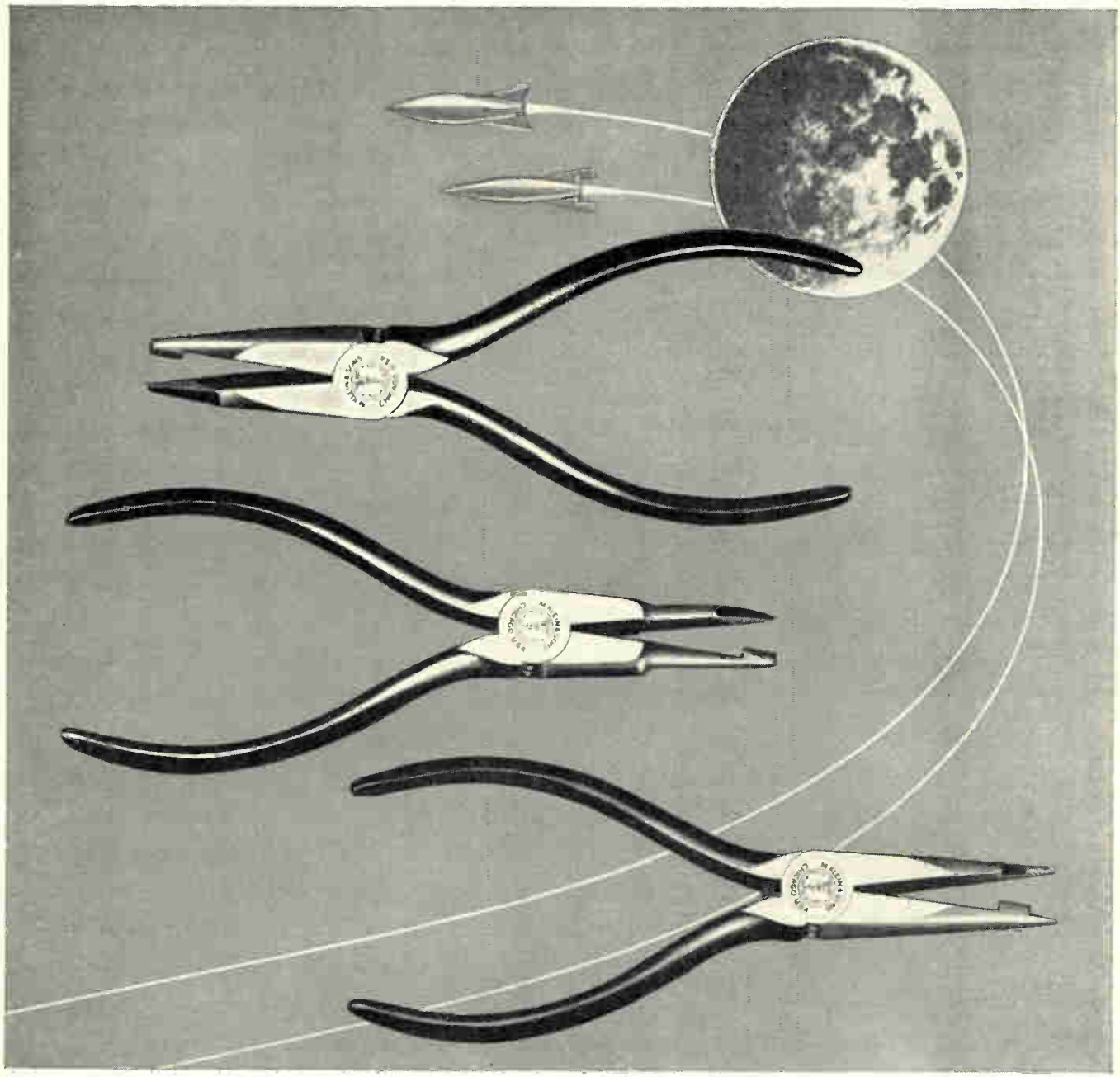

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Spectrochemical Applications of Electronics in Soil Research, A. M. Ure. "Brit. C.&E." Nov. 1958. 4 pp. Many of the problems which arise in the field of soil research are dependent for their solution on sensitive methods of chemical analysis, and it is here that spectrochemical methods find a ready application. Spectheir colution on sensitive methods of chemitrographic techniques are both sensitive and rapid, and they have made a considerable contribution to the knowledge of trace element deficiencies in soil, plant and animal. The application of electronic and photoelectric methods is helping to meet the requirement for yet greater speed of analysis. (England.)

Electronic High-Speed Motion Pictures, Harold E. Edgerton. "El. Eq." November 1958. 5 pp. Principles involved in design of a high-speed electronic flash unit having an exposure time of a few microseconds and capable of speeds up to 10,000 frames per second and peak light up to 300,000 candle power. Performance data include flash duration, light output, and running time. (U.S.A.)

Engineers Can Sell, William D. Bell. "El. Des." November 12, 1958. 2 pp. Often engineers are called upon to help their company's sales effort. This gives an engineer the opportunity to add to his own job stature. But he must know how to effectively deal with customers. This article shows how. (U.S.A.)

Integrated Design Considerations, R. A. Keppel. "El. Eq." November 1958. 3 pp. A modern approach to subsystem design philosophy from inception all the way through the methods of field application and maintenance is outlined. Environmental factors such as reliability, operability, producibility, and maintainability are given consideraton from the beginning of the design. (U.S.A.)

Electronics and the American Automobile, William E. Bushor. "El." November 21, 1958. 7 pp. Current development programs directed towards the use of electronics to improve safety, performance, reliability and sales appeal of cars promise big, new market. Devices and systems discussed here represent results to date. (U.S.A.)

Two-Transistor Amplifier Corrects Heart Block, G. H. Vanderschmidt. "El." Nov. 21, 1958. 2 pp. Pulse amplifier reestablishes proper circulation of blood in heart-block patients by driving ventricle at beat rate dictated by auricle. (U.S.A.)

INDUSTRIAL ELECTRONICS

Theoretical and Experimental Analysis of the Automatic Control System of the Mine Winder With Asynchronous Driving Motor, T. Puchalka. "Roz. Elek." Vol. 4, No. 2. 67 pp. The present article gives a conception and short description of the operation of the laboratory model of the regulator of riding with amplidyne intended for the work in mine winder with asynchronous a.c. driving motor. The new regulator is of static type operated in a system of continuous, single, and program control. (Poland.)

Brazing in Vacuum, F. Von Bernhard, and H. Bumm. "Vak. Tech." Oct. 1958. 6 pp. Brazing of small parts either in a protective atmosphere or in high vacuum is quite a common practice in laboratories and in industrial production, in particular in valve production. Here machined parts or whole systems of magnetrons, klystrons and of x-ray tubes are mounted in vacuum chambers made of metal or quartz, and while heated by induction the components are being predegassed and afterwards hard soldered. (Germany.)

Timing Units and Switches for Industrial Electronics, A. Gericke. "AEG Prog." No. 1, 1958. 5 pp. For control and supervision of manufacturing processes electrical and electronic auxiliary apparatus is necessary. The construction and method of operation of a new series of AEG timing units are described. Special regard has been paid to such features of importance to the machine designer as layout, simple, robust and compact construction, reliability and a wide range of application. (Germany, in English).

A New Molecular Pump, W. Von Becker. "Vak. Tech." Oct. 1958. 4 pp. The operation and performance of a new molecular pump is described. The new design, resembling that of a turbine, shows an airgap of 1 mm, which is much more than the usual gap of only a few hundredth of a millimeter. The wide airgap ensures extreme reliability in operation. Another advantage of the new design is the high pumping speed which bas been achieved by paralleling a large number of suction channels. In spite of the high pumping speed the compression ratio for air is as high as 5×10^7. The ultimate vacuum is practically determined by the leakage of the vacuum system and the outgassing of the walls. The performance of the pump depending on backing pressure and nature of the gas is shown in various diagrams. Finally the potential applications of the pump are being discussed. (Germany.)

Electronic Control Equipment for Automatic Arc-welding Machines, O. Becken, and E. Rietsch. "AEG Prog." No. 1, 1958. 4 pp. An electronic control equipment for obtaining clean and uniform arc-welded seams is described. The motor driving the feed rollers of the automatic welding machine is controlled by means of thyratrons so that the welding wire contacts the work-piece to strike the arc and is then withdrawn. The automatic control equipment maintains a constant length of arc throughout the welding operation. (Germany, in English.)

Register Control Equipment for Multi-Colour Rotary Printing Machines, W. Hackel and F. Lentze. "AEG Prog." No. 1, 1958. 5 pp. An automatic register controller applied to multicolour rotary printing machines ensures accurate superposition of the individual colours. The plant characteristics, the methods of measuring, the error in registration and the various control systems are described. (Germany, in English.)

MATERIALS

Arrangement of Boundary Surfaces Between Dielectric or Ferromagnetic, K. Funk. "El Rund." Oct. 1958. 2 pp. In this article boundary surfaces are understood by plates, coatings or any electrodes of condensers, those of ferromagnetic bodies, however, are understood by surfaces which are passed through by current going over to objects of different properties. The fact is demonstrated that arrangements of boundary surfaces intentionally set up are more advantageous than arbitrary or conventionally parallel and plain arrangements. In spite of remaining peak efficiency or field concentration real gains of selective specific magnitudes of carriers of electric or magnetic fields arise. A specific capacity higher by 25% of granulated layer condenser and higher quality of optimal ferrite pressed dust cores have been measured. (Germany.)

Mixed Dielectrics, W. Pajewski. "Prace. ITR." Vol. 2, No. 2. (5). 14 pp. The paper brings results of research work on mixed dielectric materials composed of ferroelectric substances and linear dielectrics, organic as well as anorganic. The objective of the work referred to was to fill up the gap between ferroelectric materials of high dielectric constant and linear dielectric materials of a dielectric constant not exeeding 100. It was also aimed at lowering the temperature of sintering of ferroelectric materials which in most cases is in excess of 1350°C. It has been stated that in case of resins the temperature of sintering does not exceed 200°C and may be even lower; as regards different kinds of glass, good dielectric materials may be obtained at sintering temperatures of some 1100 . . . 1200°C which is accompanied by a reduction in dielectric losses and some flattening out of the maxima of dielectric constant. (Poland.)

MEASURE & TESTING

Measurement of the Parameters of Magneto-Dielectrics and Unmagnetized Ferrites Using a Rectangular H_{10}-Wave Resonator, E. B. Zal'tsman. "Radiotek." Nov. 1958. 5 pp. The paper computes a rectangular H_{10}-wave resonator containing a magnetodielectric specimen with small losses. (U.S.S.R.)

An Experimental Pyrometer Using a Phototransistor and Designed for Radio-tube Inspection, F. H. R. Almer and P. G. van Zanten. "Phil. Tech." Oct. 30, 1958. 5 pp. The radiation-sensitive element in the pyrometer described here is a phototransistor (Phillips type OCP 71), the radiation sensitivity of which has a maximum at a wavelength of 1.55. A lens projects an image of the same size as the object on to a diaphragm mounted in front of the transistor. The opening in the diaphragm has a diameter of only 0.6 mm, thus permitting very localized measurements of the temperature at points on the object. (Netherlands, in English.)

On the State of Oscilloscope Technique, C. Heindl. "El Rund." Nov. 1958. 6 pp. In a survey of modern oscilloscope technique examples are shown of amplifier circuits including delay networks, time-deflection circuits, modern oscilloscope tubes and their high-voltage supply. Further properties of modern oscilloscopes are also given. This first part of the article is concerned exclusively with amplifier circuits. (Germany.)

The Relationship between Fieldstrength and Limitations of the Transmission Frequency Band (LUF, MUF), B. Beckman. "Nach Z." Oct. 1958. 6 pp. The relationship between fieldstrength and the limitations of the transmission frequency band (LUF, MUF) is discussed with the aid of measurements and observations. Initially, the effect of the MUF* (MUF extended due to scattering) is included emperically into the calculation with the formula which is used for the calculation of the LUF and which takes non-selective absorption into account. The resulting simple formula permits an estimate of the fieldstrength over the whole transmission frequency band (increasing fieldstrength in the band LUF-FOT: decreasing fieldstrength in the band FOT-MUF) on the basis of known LUF, MUF or FOT data which can be derived from radio forecasts, measurements or observations. Fieldstrength measurements carried out so far for the purpose of comparison have shown a fairly good agreement. (Germany.)

Application of Mass-Spectrometry in Vacuum-Technology, H. Von Hintenberger and E. Dornenburg. "Vak. Tech." Oct. 1958. 13 pp. Mass-spectrometer methods applied to investigations of vacuum problems show the remarkable advantage not only of being very sensitive, so that very small gas or vapor pressures are indicated, but furthermore these methods provide complete information about the various components which make up the

residual quantites of gas or vapor still present in the volume. In spite of the rather bulky experimental requirements the advantage is such that mass-spectrometer methods are frequently being preferred to simpler methods, when problems in the field of vacuum technology have to be investigated. (Germany.)

A Simple 3cm Q-Meter. A. E. Barrington. "Proc. BIEE." Nov. 1958. 2 pp. Following a brief review of existing reflectometer methods for the measurement of Q-factors of microwave cavities, a simplified system is described in which the complexity and cost of components are reduced appreciably. (England.)

Measurements on Gas-Discharge Noise Sources at Centimetre Wavelengths, A. C. Gordon-Smith and J. A. Lane. "Proc. BIEE." Nov. 1958. 3 pp. Measurements are described in which the effective noise temperature of the type CV1881 argon discharge tube is determined by comparison with both a thermal noise source and a continuous-wave signal, at a wavelength of 3.2 cm. (frequency, 9.4G/cs, The results obtained were 10590 $\pm$ 500°K and 11050 $\pm$ 1350°K, respectively. The results are compared with data previously given for argon noise sources. (England.)

A Novel, High Accuracy Circuit for the Measurement of Impedance in the A.F., R.F. and V.H.F. Ranges, D. Karo. "Proc. BIEE." Nov. 1958. 6 pp. The paper describes a high-accuracy measuring circuit suitable for frequencies from 50 c/s to vhf. There are two branches in the circuit, one of which contains the unknown impedance. The two branches are fed in phase opposition from the secondaries of two mutual inductors or two transformers. (England.)

Measuring Microwave Interference, Robert Saul. "El. Des." Nov. 12, 1958. 4 pp. In the first part, a procedure for measuring interference in the 1,000 mc to 10,000 mc range was discussed. This concluding part describes interference generated by microwave equipment. It suggests a means of controlling such interference •1) at the source of generation, (2) along the transmission path, and (3) in the suspectible instrument. (U. S. A.)

Primary Frequency Standard Using Resonant Cesium, W. A. Mainberger. "El." Nov. 7, 1958. 6 pp. Cesium atoms in a sealed beam tube comprise the heart of a primary frequency standard. A crystal oscillator is monitored by the natural resonance frequency of cesium. (U. S. A.)

Balloon Gear Monitors Cosmic Radiation, L. E. Peterson, et al. "El." Nov. 7, 1958. 4 pp. One field of investigation for the International Geophysical Year is the correlation of cosmic radiation intensity with other ionospheric and geomagnetic phenomena. Plastic balloons carrying sensitive recording and telemetering equipment are ideal vehicles for this purpose. This article describes the instrumentation and transistor circuits employed. (U. S. A.)

RADAR, NAVIGATION

The Effect of Asymmetry in a Radio Direction Finder on Its Operating Characteristics, Iu. A. Erukhimovich. "Radiotek." Nov. 1958. 12 pp. The paper studies the instrument errors and the spreading of the minimums which occur in multiple-mast radio direction finders with diversity antennas when amplitude and phase asymmetry are present. General laws are derived for the operation of such a unit, and graphs are given for the variation of the quantities indicated above when asymmetry is evidenced by one pair of antennas or by the entire direction finder as a whole. The paper shows that it is possible to compensate the instrument errors by artificial means. A practical method for doing so is described. The resulting relationships make it possible to perform a simple computation of the limiting errors and the limiting spreading of the minima, as well as the corresponding asymmetry values. (U.S.S.R.)

Staggered Rep Rate Fills Radar Blind Spots, S. E. Perlman. "El." Nov. 21, 1958. 4 pp. Blind speeds in a moving target indicator are relocated by staggering the pulse repetition frequency. Limitations of a moving-target-indicator radar system are investigated and a staggered prf circuit described. (U. S. A.)

Designing Safety into Automatic Pilot Systems, C. W. Williams. "El." Nov. 7, 1958. 3 pp. Systems can be monitored by protection circuits that give alarm or shut equipment off when either control or safety circuit breaks down. Typical torque limiting and modulating circuits for control surfaces are cited. (U. S. A.)

SEMICONDUCTORS

The Future with Solid State Devices, Part 1. J. B. Brauer. "El. Ind." Dec. 1958. 4 pp. Rapid, reliable, high quality communications; long distance, high resolution detection and identification; long distance ultra-precise navigation. These are the objectives of the USAF Ground Electronic Program. (U. S. A.)

For Certain Audio Transistors Low Frequencies Vary T-Parameters, G. N. Kambouris. "El. Ind." Dec. 1958. 3 pp. At low frequencies, equivalent impedances have been approximated by pure resistances. Data presented here reveal that the magnitude of equivalent T-parameters changes radically. Measured characteristic impedances start to change near 50 cps. (U. S. A.)

Nomograph Computation on the High-Frequency Parameters of Transistors Using Transient Responses, G. P. Sherov-Ignat'ev. "Radiotek." Nov. 1958. 6 pp. The paper presents a method of determining the parameters of the approximating function for the transient responses of the transistors. In order to compute the limiting frequency, the phase shift at the limiting frequency, and the high-frequency parameters of the equivalent transistor circuits from the resulting parameters, special nomograms are given. As an illustration, results are cited for the application of the method to the study of standard transistors. (U.S.S.R.)

Computing the Reverse Sawtooth Current in a Transistor Oscillator, G. I. Oliferenko. "Radiotek." Nov. 1958. 6 pp. The paper is devoted to a method for computing the sawtooth reverse current in a transistor oscillator. The behavior of the oscillator is described by a second-order nonlinear differential equation. The solution of the equation is performed graphically. A relationship is established between the parameters of the sawtooth and the parameters of the circuit elements. Recommendations are made concerning the selection of transistors. (U.S.S.R.)

Effective Conductivity and Permittivity of Polycrystalline Semiconductors — Application to Ferrites, P. M. Prache and J. Rozes. "Cab. & Trans." Oct. 1958. 11 pp. After a reminding of the previous theoretical studies relating to condensers with a heterogeneous dielectric, it is shown that the behavior of such condensers can be studied in a simple way by introducing the concept of complex elastivity. The so-obtained results can be extended to granular structures and make it possible to explain why the apparent permittivity of some of them assumes very high values at low frequencies. (France.)

The Stabilization of DC Voltages with Switched Transistors, G. Meyer-Brotz. "El Rund." Oct. 1958. 3 pp. Favorable switching features of surface transistors enable reduction of power dissipation and improvement of the degree of efficiency in stabilizing units for dc voltages by use of transistors as two-point controller or as control rectifiers in place of the usual constant controllers. Application possibilities are pointed out and the properties are compared. The circuits demonstrated can be very easily understood, but they do not represent the best possible solution, particularly not, if very high outputs are required. (Germany.)

New Developments in Silicon Photovoltaic Devices, M. B. Prince. "J. HIRE." Oct. 1958. 13 pp. The requirements which silicon photovoltaic devices have to meet in various applications are so widely different that it was necessary to develop three distinct types of devices: (1) A device which is operated in the forward biased condition, useful at very low light to high light levels, known as a solar cell. (2) A device which is operated in the forward biased condition, useful at very low light levels, known as a low level cell. (3) A device operated in the reverse biased direction at low to high light levels, known as a photodiode. All three types are p-n junction devices, prepared by solid state diffusion methods, with each type designed to yield special characteristics. The spectral response, transient response, and temperature dependance of these devices are considered. (England.)

Structure-Determined Gain-Band Product of Junction Triode Transistor, J. M. Early. "Proc. IRE." Dec. 1958. 4 pp. This paper discusses some fundamental frequency limitations of the junction triode. It also describes briefly practical accomplishments with germanium diffused base transistors of the type reported by Lee. Finally, the frequency limitations of the junction triode are compared with those of the field effect transistor and the analogue transistor. (U. S. A.)

Designing Transistor Circuits — Sequential Logic, Richard B. Hurley. "El. Eq." Nov. 1958. 6 pp. Sequential logic problems involve time, storage, and transfer as well as combinational processes. Use of binary arithmetic, truth tables and Veitch diagrams is discussed. A logical diagram is developed for a five-count system that employs flip-flops. (U. S. A.)

High Power Transistor Switches, Joseph L. Nelson. "El. Des." Nov. 12, 1958. 4 pp. The availability of germanium and silicon power transistors has stimulated interest in using these units as switches to handle moderately large amounts of power. This article analyzes the operation of the transistor switching circuit and develops a design procedure. (U. S. A.)

Boosting Power Transistor Efficiency, John W. Caldwell and T. C. Gordon Wagner. "El." Nov. 21, 1958. 3 pp. Precise control of transistor instantaneous voltage and current produces operating efficiencies that approach the ideal. Since peak power dissipation in a single transistor occurs in the middle of a transition between on and off stages, transition is kept small. (U. S. A.)

Graphical Design of Transistor Bias Circuits, G. V. Woodley. "El. Des." Nov. 26, 1958. 4 pp. Graphical shortcuts can make the design of transistor circuits easier. (U. S. A.)

TELEVISION

Gradation Correction in Color Television, J. Kaashoek. "Nach Z." Oct. 1958. 4 pp. The gamma correction method used in black-and-white television can be applied to color tele-

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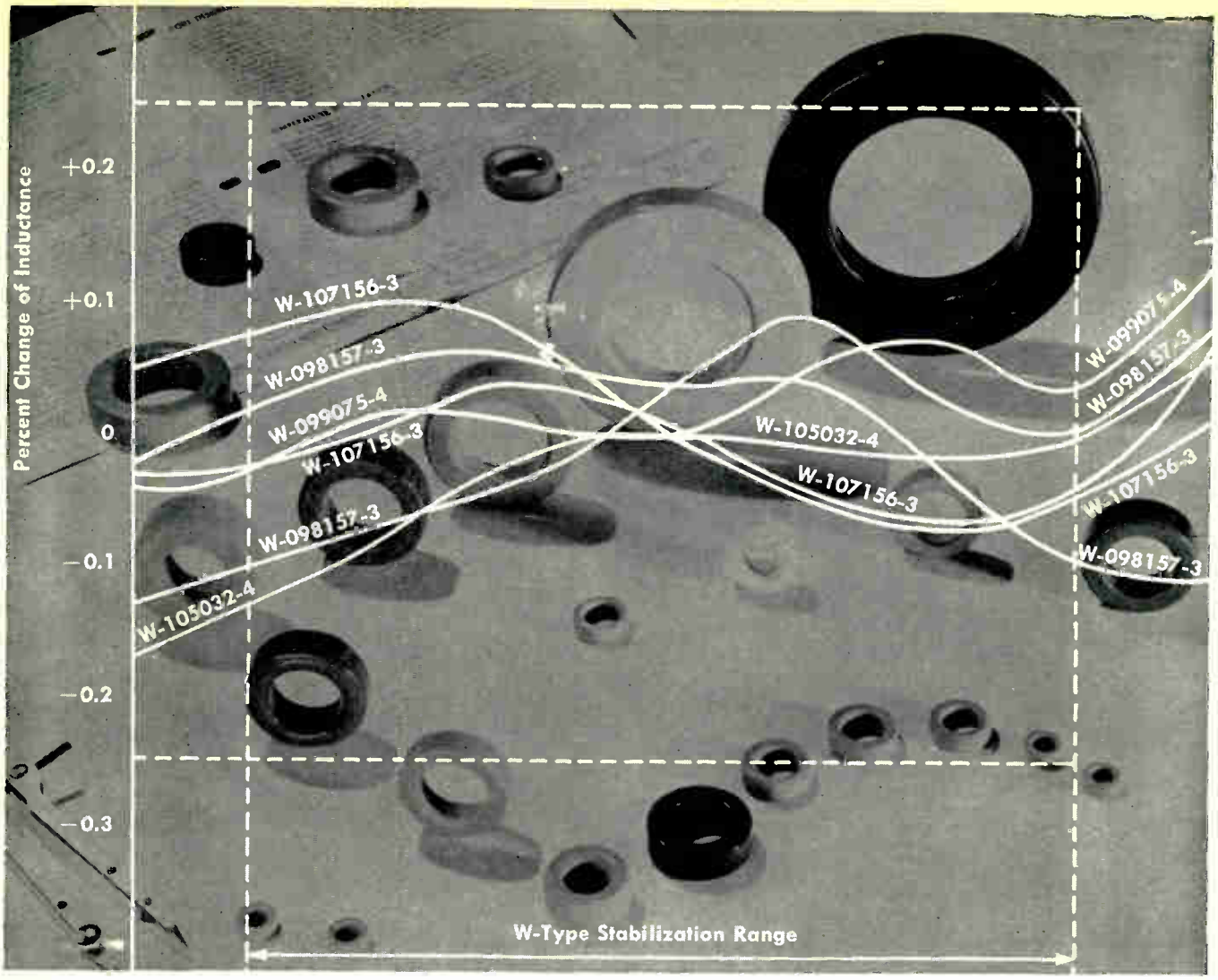

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vision only for the purpose of obtaining a linear transmission but not for gamma adjustments because color distortions will occure in this case. A new circuit is described for obtaining variable gamma corrections which depend on luminance and are free from color distortion. Any gamma value between 1 and 0.4 can be chosen for the overall system transfer characteristic. The correction can be chosen to be also dependent on color thus producing a greater relative increase in brightness for picture areas of a chosen color without any color change. (Germany.)

A New Cathode-Ray Tube for Monochrome and Color Television. D. Gabor, et al. "Proc. BIEE." Nov. 1958. 26 pp. A flat, thin television cathode-ray tube for monochrome or color, whose thickness is only about one-quarter of its creen diagonal, has been developed by the authors to the point at which the feasibility of its essentially novel features could be tested singly, and partly in combination. In the flat tube the electron beam—and in the case of a color tube, three beams—issuing from the same gun is launched vertically downwards. A line-deflection system imparts to it a pendulating motion in a vertical plane, and a reversing lens turns this plane by 180°, increasing the deflection angle by a factor of about 4. (England.)

TRANSMISSION

A Method for the Approximate Computation of Waveguides with Triangular and Trapezoidal Cross-Sections, A. Ia. Iashkin. "Radiotek." Nov. 1958. 6 pp. The paper describes a new method for the approximate computation of the lowest critical wave in triangular and trapezoidal waveguides. The computed data are given graphically for waveguides with cross-sections shaped in the form of right triangles and isosceles triangles, as well as for cross-sections shaped in the form of rectangular and isosceles trapezoids. Certain of the computed data are compared with experimental results. (U.S.S.R.)

Evaluating the Error in the Approximate Theory of Inhomogeneous Transmission Lines, S. I. Orlov. "Radiotek." Nov. 1958. 5 pp. The paper describes the similarity conditions for inhomogeneous lines operating at various wavelengths. Simple expressions are derived for evaluating the limiting error in computing the reflection coefficient at the input of a lossless inhomogeneous line. (U.S.S.R.)

Dynamics of Gases in Telecommunication Cables with a View to Pneumatic Protection of Trunk Cables, H. Larsen. "Nach Z." Oct. 1958. 7 pp. The dynamics of gases in telecommunciation cables is calculated with certain simplifications and by means of the differential equations for diffusion. The following practical cases have been treated: Filling and emptying of cables of finite length and those of practically infinite length, a gas leak at any point and of any size on a section of cable. Statements are made concerning the quantity of protective gas required and the choice of an advantageous spacing between pressure gauges with signal contacts. The determination of the relevant pneumatic constants of manufactured cable sections are discussed and comparisons between theory and measurements on a sample section are reported. (Germany.)

Electromagnetic Wave Propagation in Cylindrical Waveguides Containing Gyromagnetic Media, R. A. Waldron. "J. BIRE." Oct. 1958. 16 pp. A comprehensive treatment of the subject is given, with a large number of computed results of cut-off points and phase constants for the case of a guide containing a concentric ferrite rod of arbitrary radius. The wave equation for the ferrite is derived in cylindrical co-ordinates, and solved. The wave equation for the isotropic medium surrounding the ferrite is also solved. The boundary conditions are then applied and the characteristic equations obtained for the case of the filled guide, the partly filled guide, and the guide filled with dielectric. (England.)

Reflectionless Bead for Symmetrical Strip Transmission Line, K. S. Packard. "El. Des." Nov. 26, 1958. 2 pp. The design of a reflectionless bead for supporting the center conductor of a strip transmission line is described. The design and fabrication are simple and the SWR is extremely low over the full useful frequency range of most practical symmetrical strip transmission lines. (U.S.A.)

TUBES

***Stabilize Tube Heater Voltages,** P. L. Toback. "El. Ind." Dec. 1958. 3 pp. Zener diodes are now being used to regulate tube heater voltages. With regulated heater voltages, the tube plate voltage remains quite stable with large input voltage changes. Heater regulation also greatly increases tube life. Typical applications of the regulators are given. (U. S. A.)

An Experimental Induction-Heating Generator Using Hydrogen Thyratrons, H. L. van der Horst and P. H. G. van Vlodrop. "Phil. Tech." Oct. 30, 1958. 7 pp. With a circuit similar in principle to the spark-gap oscillator used in the early days of radio-telegraphy, but in which the spark-gap is replaced by a hydrogen thyratron, damped oscillations can be generated with a frequency of up to 10 kc/s. Such frequencies are suitable for induction heating. The power can be controlled by varying the repetition frequency of the pulses that ignite the thyratron. A description is given of a control circuit for generating these pulses and for automatically varying the frequency and power. (Netherlands, in English.)

A Noise Diode for Ultra-High Frequencies, H. Groendijk. "Phil. Tech." Oct. 30, 1958. 3 pp. For examining the noise of amplifiers and similar apparatus at frequencies up to 1000Mc/s, a noise diode (laboratory designation 10 P) of extremely small dimensions and having lead-in wires of very low self-inductance has been developed. The valve operates at an anode voltage of 100V, the permissible anode dissipation being 2 W. (Netherlands, in English.)

Industrial Thyratrons for Very High Output, R. Huber. "El Rund." Nov. 1958. 1 p. The thyratron has had its place in electrical engineering for several years. Its high output limit and its good degree of efficiency as well as the relatively uncomplicated and worthless control conduce to using this control element in frequently used high tension units. A new especially powerful thyratron with advantageous features e.g. mixture filling produced on the basis of a special filling procedure, short, temperature independent heating time, relatively high reverse voltage and peak current is discussed. (Germany.)

Application of Gas Discharge Tubes as Noise Sources in the 1700-2300 M/cs Band, M. Kollanyi. "J. BIRE." Sept. 1958. 8 pp. The paper gives the design aspects, description and performance of a gas discharge helix-coupled noise source for the 1700-2300 Mc/s band. A minimum coupling of 15 db is maintained throughout the band. Satisfactory matching is obtained in both the struck and unstruck state, thus facilitating easy noise figure measurements with an accuracy of 0.2 db. (England.)

PATENTS

Complete copies of the selected patents described below may be obtained for $.25 each from the Commisaioner of Patents, Washington 25, D. C.

Electron Tube for Generating High Frequency Oscillations, #2,855,532. Inv. J. S. A. Tomneer and S. G. Gustafsson. Assigned Telefonaktiebolaget L. M. Ericsson. Issued October 7, 1958. The discharge space of the tube is permeated by a magnetic field. The electrons are accelerated in an electrostatic field parallel to the magnetic field and exchange energy with a h.f. electric field while oscillating to and fro. The tube comprises a cathode, an anode, a cylindrical reflector and a collector. The relative angular position of the tube can be adjusted with respect to the magnetic field, whereby the oscillation frequency of the electrons can be varied without change in the electrode potentials.

Method of and System for Operating Gaseous-Discharge Devices, #2,855,544. Inv. K. J. Germeshausen. Assigned Edgerton, Germeshausen & Grier, Inc. Issued October 7, 1958. A voltage, rendering the tube conductive, is impressed on the non-oscillatory circuit containing the tube. Part of the current flowing in the circuit is extracted, its direction of flow is reversed to reverse the impressed voltage at a predetermined time after the rendering conductive of the tube in order to render it non-conductive.

Dielectric Matching Devices, #2,856,497. Inv. H. G. Rudenberg. Assigned Raytheon Manufacturing Company. Issued October 14, 1958. Material having a high water content haa r.f. energy coupled thereto through an opening in a waveguide by a tapered block of insulating material containing a titanate positioned within the waveguide at the opening in the waveguide wall.

Automatic Signal Frequency Tracker, with Search and Hold-During Fade Provisions, #2,856,519. J. W. Gray, E. G. Newsom and R. Crane, Jr. Assigned General Precision Laboratory, Inc. Issued October 14, 1958. The beat frequency signal from the variable-frequency received wave and the adjustable-frequency oscillator is discriminated and controls the local oscillator frequency. The discriminator output further controls the speed of a motor which operates a generator producing an output signal having an amplitude proportional to the motor speed. The input signal-to-noise ratio interrupts the connection between the discriminator and the motor when the ratio drops below a predetermined value, while the motor speed is maintained at its last adjustment.

Traveling Wave Tube, #2,856,555. Inv. M. Kenmoku. Assigned International Standard Electric Corporation. Issued October 14, 1958. The output coupler arrangement for the tube comprises a coupling element connected to one end of the retardation line and capacitively coupled to the target electrode. The output waveguide has one wall aligned with the end of the target electrode and carries a choke flange extending coaxially over and coupled to the target electrode.

Light-Controlled Waveguide Attenuator, #2,856,589. Inv. B. Kazan. Assigned Radio Corporation of America. Issued October 14, 1958. Photoconductive material is supported between two opposed walls of a waveguide. One of the opposed walls contains an aperture positioned to permit light from a source to fall upon the photoconductive material so that the material attenuates the radio frequency energy propagated through the waveguide in accordance with the light impinging on the photoconductive material.

PATENTS

Complete copies of the selected patents described below may be obtained for $.25 each from the Commissioner of Patents, Washington 25, D. C.

Oscillating Electrical Circuits, #2,829,306. Inv. M. S. Glass and L. R. Walker. Assigned Bell Telephone Laboratories, Inc. Issued April 1, 1958. The output coupling in one of the circularly arranged cavities of a magnetron introduces an asymmetry and introduces a traveling wave. The effect of this asymmetry with respect to a π-mode is cancelled out by the arrangement of compensating asymmetries in a plurality of other cavities producing other traveling waves. It is required that the summation of the magnitudes of all said waves times the cosine of twice their angular position from the output coupling is substantially zero.

Storage Type Electron Tube Systems, #2,830,111. Inv. Ph. T. R. Farnsworth. Assigned International Telephone and Telegraph Corp. Issued April 8, 1958. Individual storage devices for each color signal are provided and the different received color signals are successively applied to their respected storage device. Information is continuously extracted from all storage devices simultaneously with the application of any of the signals to its respective storage device. The extracted information are effectively combined to reproduce the original pattern on a display screen.

Amplitude-to-Position Modulation Converter, #2,830,113. Inv. S. W. Levine. Assigned Fairchild Camera and Instrument Corp. Issued April 8, 1958. The facsimile system contains an electro-optical cathode-ray transducer, the sweep frequency being the same as the frequency of the intelligence carrier so that a position-modulated optical signal is developed on the screen. A pulsed gating signal, also of the carrier frequency, restricts operation of the transducer to predetermined portions of each cycle. A tone-control mask is interposed between the screen and an optically coupled image reproducing system, which mask modifies the optical intelligence signal in accordance with a preselected functional pattern to vary the optical illusion and interpretability of the reproduced image as compared to the original image.

Public Address System, #2,830,117. Inv. A. W. Blow. Assigned General Dynamics Corp. Issued April 8, 1958. The coupling between the line and the amplifier may selectively assume a high and a low level of coupling, and the input transducer may selectively be connected to the line. A circuit is provided which automatically causes the coupling to selectively assume its high level of coupling when the transducer is connected to the line.

Phase Inverting Translating Circuit, #2,830,133. Inv. J. E. Ranks. Assigned General Elec-Co. Issued April 8, 1958. Two electron tubes are serially connected, the first having a cathode impedance and the second a plate impedance. An undulating input potential is applied between the cathode and grid of the first tube, while the grid of the second tube derives its input from an impedance extending between the cathode of the first tube and the plate of the second tube. The inverted output is taken from the plate of the second tube.

Direct Coupling Two-Stage Transistor Amplifier, #2,830,134. Inv. Jean-Marie Moulon. Issued April 8, 1958. A direct connection extends between the collector electrode of the first transistor and the emitter electrode of the second transistor. The utilization circuit in series with a d.c. biasing source is connected between the collector electrode of the second transistor and the base electrode of the first resistor. A resistor connected between the respective base electrodes is preferably of the same order of magnitude as the internal dynamic collector-base electrode resistance of the second transistor.

Pulse Generating Circuits, #2,830,199. Inv. J. Mofenson. Assigned Raytheon Manufacturing Co. Issued April 8, 1958. A source of triggering voltage is connected across the input of a normally nonconducting transistor. A delay line and a first impedance in shunt therewith are connected across the output of the transistor and a second impedance having a value substantially equal to the characteristic impedance of the delay line is in series with the delay line.

Traveling-Wave Tube, #2,830,219. Inv. S. E. Webber. Assigned General Electric Co. Issued April 8, 1958. The only attenuator in the tube is arranged to be spaced not more than two wavelength from the input of the helix and to be spaced from the output terminal of the helix by a much greater distance. Thus substantially more attenuation is present in the input half of the helix than in the output half thereof.

Traveling Wave Tubes, #2,830,221. Inv. W. J. Doods. Assigned Radio Corporation of America. Issued April 8, 1958. A helical beam of electrons having substantially axial translational movement only sweeps a helical conductive structure. The pitch of the beam is different from the pitch of the conductive structure.

Electronic Device, #2,830,226. Inv. W. R. Aiken. Assigned Kaiser Industries Corp. Issued April 8, 1958. The beam switching tube comprises a plurality of coplanaro electrodes, a pencil electron beam progressing along a path parallel to and adjacent the target electrodes, and a plurality of deflection electrodes in adjacent spaced relation to the beam path. The deflection electrodes effect deflection of the point end of the beam into registration successively with each of the target electrodes; each target electrode is electrically coupled with an associated deflection electrode.

Automatic Focus Adjuster, #2,831,057. Inv. R. K. Orthuber. Assigned International Telephone and Telegraph Corp. Issued April 15, 1958. Two signals, the amplitudes of which are, respectively, functions of the degree of optical focus of the light image of a scene to be televised on planes closer to and further removed from the scene than the plane of the television camera lens are derived. The relative amplitudes of these two signals are compared and the resulting corrective signal simultaneously controls the focusing system for the television camera and the two images of the scene to be televised.

Television Distribution System, #2,831,105. Inv. L. W. Parker. Issued April 15, 1958. One master receiver of comparatively good selectivity for each of the channels to be received rebroadcasts the respective video and sound signals so that at least some of the channels are more widely spaced than the original channels and that the ratio of sound to picture components is higher than in the original channels. The rebroadcast signals are received by a plurality of local receivers of comparatively poor selectivity.

Waveform Modifying Device, #2,831,109. Inv. R. F. Casey. Assigned Allen B. DuMont Laboratories. Issued April 15, 1958. The input signal applied to the quadrature grid of a gated beam tube of the 6BN6 type to flip from one stable state to the other. The same terminal simultaneously acts as the output terminal from which rectangular pulses are derived.

Anti-Distortion Means for Cathode-Ray Tube Displays, #2,831,145. Inv. M. P. Albert and G. L. Scott. Assigned International Business Machines Corporation. Issued April 15, 1958. The circuit is designed to correct cubid distortion in a C.R.-Tube display. An electric analog computer develops a correction signal as a function of the third power of the variation in a variable-amplitude input. The computer output is applied to the deflection circuit in an amount appropriate to render the observed deflection a linear function of the driver signal variations.

Electrical Device, #2,831,149. Inv. Noel C. Jamison. Assigned North American Philips Company, Inc. Issued April 15, 1958. The anode of an electron discharge device comprises a selenium barrier layer cell arranged for electron bombardment from a cathode; a control electrode is also provided.

Magnetic Amplifier, #2,831,159. Inv. F. G. H. Guth. Assigned Thompson Products, Inc. Issued April 15, 1958. The magnetic amplifier has reduced time-delay characteristics and comprises directly coupled cascaded stages. The control winding and the power windings maintain a magnetic push-pull relation, a rectifier being in series with each of the power windings which connect to one of two oppositely wound control windings of a second stage. Each of the power windings of the second stage includes a rectifier oriented oppositely to that in the first stage.

Information Handling Equipment, #2,831,179. Inv. E. Ph. Goodwin, D. A. Weir and J. Rice. Assigned International Standard Electric Corp. Issued April 15, 1958. Information can be supplied to any one of a plurality of storage devices, adapted for recycling the contained information, in succession at a first speed. A converter designed to convert the received information to a form suitable for subsequent recording is alternately switched to one of the storage devices, the converter receiving the information at each recycling thereof, whereby the information is transferred at a speed less than the first speed. The converter output is switched to a plurality of recorders.

Hazard Computer Device for Motor Vehicles, #2,831,182. Inv. M. Kamins. Assigned Studebaker-Packard Corp. Issued April 15, 1958. A velocity voltage proportional to the vehicle velocity and a range voltage proportional to the distance between the vehicle and a leading vehicle are generated. From the velocity voltage a composite voltage proportional to the minimum safe following distance is derived, which composite voltage is compared to the range voltage to obtain a warning signal when the minimum safe following distance equals the distance separating the vehicle from the leading vehicle.

Semiconductor Trigger Circuit, #2,831,986. Inv. E. E. Sumner. Assigned Bell Telephone Laboratories, Inc. Issued April 22, 1958. To provide a cut-off bias for one transistor when the other transistor is in conducting condition, a semi-conductor threshold diode couples the base electrode of each transistor with the collector electrode of the other transistor. These diodes are of the type having little or no conduction unless a potential exceeding a predetermined minimum amplitude is applied thereacross.

Single-Carrier Color Television Systems, #2,831,916. Inv. R. B. Dome. Assigned General Electric Company. Issued April 22, 1958. The three high-frequency color components of a three-color television signal and one of the low-frequency bands are modulated onto the carrier wave with a first type of modulation. The carrier wave is further modulated with a different type of modulation with a signal alternately corresponding to the two low-frequency color bands.

Color Image Reproducing Apparatus, #2,831,918. Inv. R. B. Dome. Assigned General Electric Company. Issued April 22, 1958. One color component signal is coupled to a first electron gun of a C.R. tube and the two other color component signals are alternately coupled to a second electron gun of the same tube. The target structure of the tube comprises a grid having two groups of interleaved conductors parallel to a plurality of phosphor lines, the relative potentials of the groups of conductors are being changed in synchronism with the alternate coupling of the two color component signals to the second electron gun.

Low-Frequency Oscillators and the Measuring of the Amplitude of Low Frequency Oscillations, #2,831,975. Inv. R. Catherall. Assigned The Solartron Electronic Group Limited. Issued April 22, 1958. A regenerative loop containing a phase-shifting network connects the output of at least two cascade-coupled amplifier stages to the input. An amplitude-stabilizing loop containing a wave-form squaring circuit embraces at least one stage of the amplifier.

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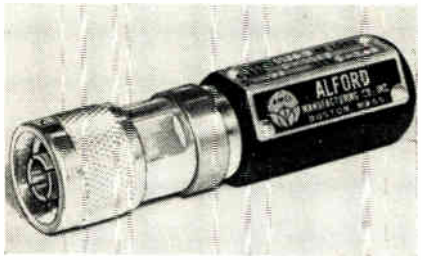

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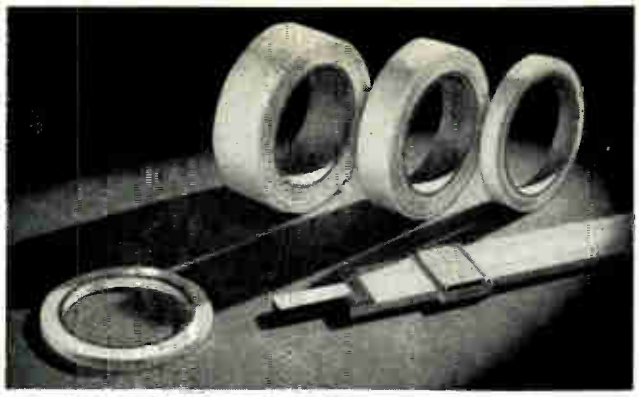

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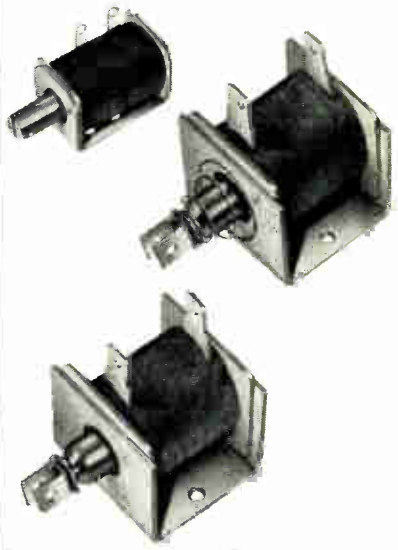

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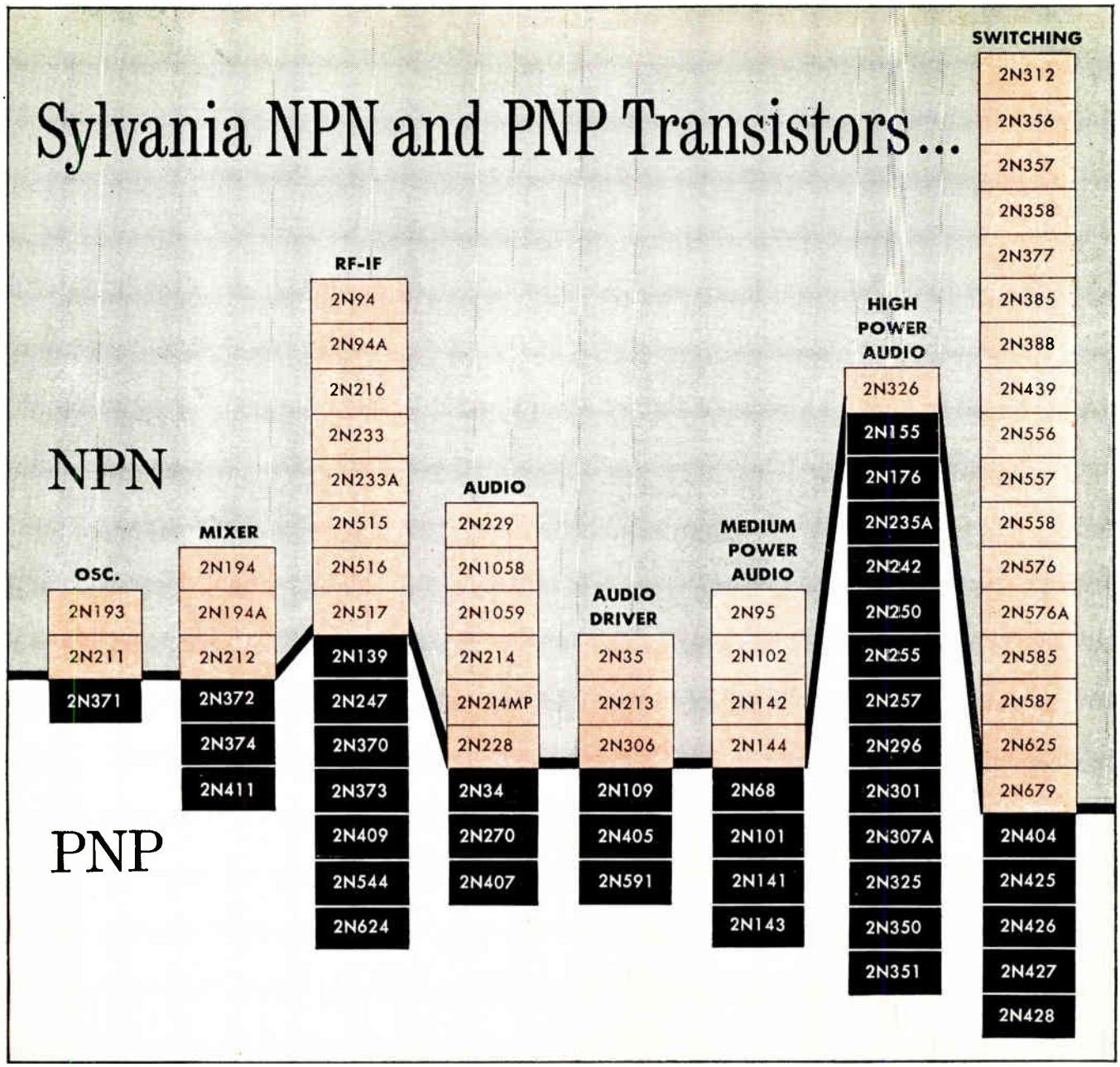

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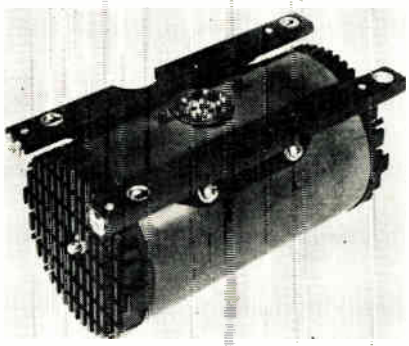
POWER SUPPLIES

Transistorized power supplies for communications and navigation applications provide built-in protection against the spikes and transients disturbing system voltages in air-ground

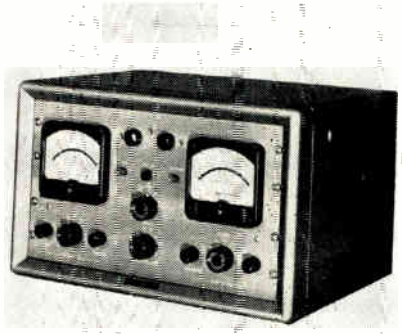


systems as described in MIL-E-7894A. Model #6073 features protection against input polarity reversal and short circuits as well as control of over-voltage. Operating efficiency 87%. Size 6¼ x 3½ in. in dia. Weight 2 lb. 12 oz. It produces 300 v and 100 v from 27 vdc input. It operates in temperatures from −40°C to +80°C. Other models available have inputs from 6-110 vdc and outputs to 2000 w. Universal Transistor Products Corp., 17 Brooklyn Ave., Westbury, L.I., New York.

Circle 231 on Inquiry Card, page 117

MEGOHMMETER

Portable "Megatrometer," designed for 14 K to 5 x 10^{15} ohms measurements features transistorized power supply and built-in calibration standard. It is designed primarily for measurement of insulation resistance in laboratory work, materials research, engineering development, and production testing, and has an accuracy of 3% at resistance measurements as



high as 100 million megohms. Operational safety has been provided within the test voltage range of 3 to 1000 v. Mid-Eastern Electronics, Inc., 32A Commerce St., Springfield, N. J.

Circle 232 on Inquiry Card, page 117

High-Precision Balances

(*Continued from page* 61)

"on scale" range of the balance; and this permits the use of larger—and hence more accurate—sensitivity weights. This disadvantage of high-speed operation is that it ordinarily results in losses of readability and deflection sensitivity. However, the high reading sensitivity of the present instrument more than compensates for these losses.

Basic Design

The basic design of the reader is fairly straightforward (Fig. 1). A narrow beam of light is sent towards the balance and is reflected by a mirror on the balance beam back to the slit at the front of a photocell. Besides swinging with the motion of the balance, the light beam has a small 60 CPS vibration of its own (amplitude about 1 minute of arc). This facilitates the design of a servo loop to maintain the photocell slit centered on the light beam. When light beam and slit are not in line, an "error signal" is generated, and this controls a two-phase motor that turns the lead screw on which the photocell is mounted. By suitable design and adjustment of the components, the photocell is made to follow the swinging light beam to within about 0.0002 in., corresponding to 4 x 10^{-5} degrees in the angular position of the balance arm.

The position of the balance beam is thus repre-

(*Continued on page* 151)

ANALYZER

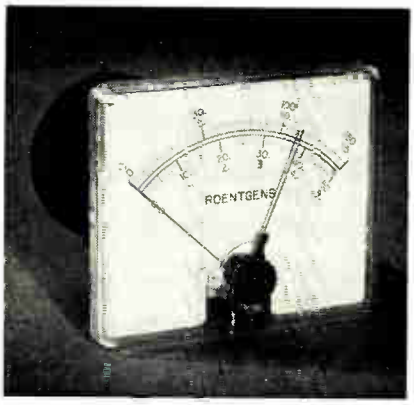
Increased range and ruggedness in a smaller size are features of the Mark II Analyzer, a volt-ohm-milliammeter. The Model 980 provides for a wide range of test measurement

applications. It has a dc sensitivity of 20,000 ohms/v, and an ac sensitivity of 1000 ohms/v. Accuracy is within 2% full scale dc and 3% ac. Range and function-switching is simplified by a single dial control. Ranges provided are: dc volts: 1.6, 8, 40, 160, 400, 800, 4000, at 20,000 ohms/v; ac v: 1.6, 8, 40, 160, 400, 1600, at 1000 ohms/v; db range: −15 db to +54 db (in six ranges); dc microamperes 80; dc amperes 8. Weston Instruments Div. of Daystrom Inc., 614 Frelinghuysen Ave., Newark, N. J.

Circle 233 on Inquiry Card, page 117

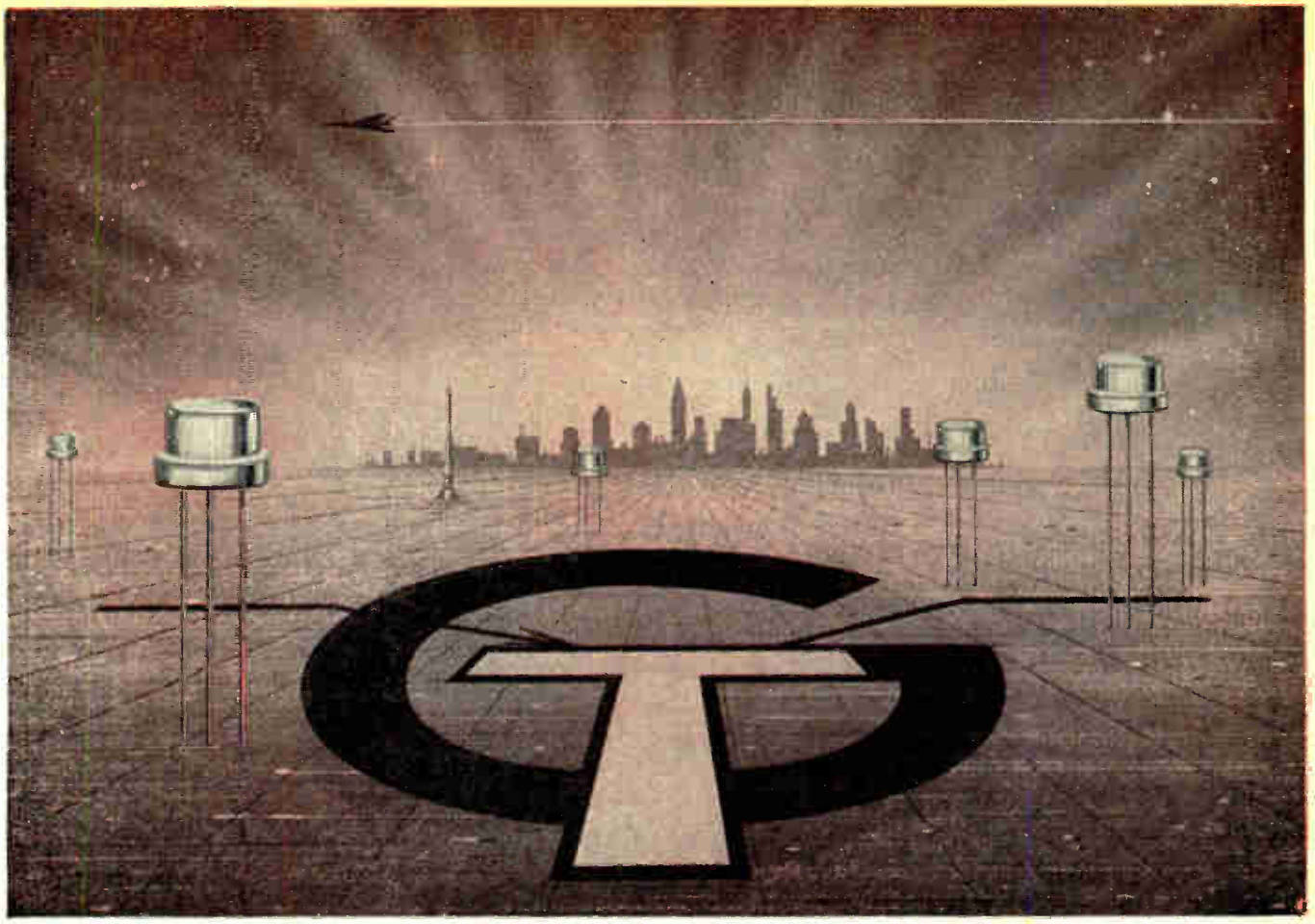
MINIATURIZED CONTROL

This control provides continual signal indication, triggers control action, and occupies the same panel space as a standard 4½ in. indicating meter. For manual reset, the new control may be used with 4½ in. API meter-relays of any sensitivity, and ranges from 0 to 5 μa and 0 to 5 mv. In such controls, it is rated at 2 a. One manual reset circuit is available with a ruggedized meter-relay. For simple automatic operation, maximum sensi-



tivity is approximately 200 μa. Rating in automatic circuits is 1 a. Available with either conventional terminals or plug-in pins. Assembly Products, Inc., Chesterland, Ohio.

Circle 234 on Inquiry Card, page 117



BROADEN DESIGN HORIZONS

with new pnp drift transistors

TYPICAL APPLICATIONS

- TV CIRCUITS
- FM RADIOS
- SHORT WAVE RADIOS
- HIGH FREQUENCY OSCILLATORS
- VERY HIGH SPEED SWITCHING DEVICES

SEVEN NEW DRIFT TRANSISTORS FOR HIGH SPEED SWITCHING AND HIGH FREQUENCY AMPLIFIER APPLICATIONS

General Transistor's new 2N602, 2N603, 2N604 provide the design engineer with guaranteed switching parameters such as gain-bandwidth and DC current gain, while the 2N605, 2N606, 2N607 and 2N608 provide guaranteed power gains at high frequencies.
In addition to the great speed advantages offered by the drift transistor at no sacrifice of gain, such additional features as higher voltages and lower capacity are available. Thus one can now drive higher impedance loads with no sacrifice of speed or pulse power.
The complete control of G. T.'s Drift Transistor assures longer life and maximum performance while possessing complete reliability.
Other features include: high input-circuit efficiency, excellent high-frequency operating stability, good signal-to-noise ratio, good automatic-gain-control capabilities and the rugged mechanical construction of a positive hermetically sealed JETEC 30 case.

WRITE TODAY FOR BULLETIN G-180 INCLUDING COMPLETE MECHANICAL AND ELECTRICAL SPECIFICATIONS, DIMENSIONAL DRAWINGS, GRAPHS AND ENGINEERING DATA.

ALL TRANSISTORS CAN NOW BE SUPPLIED IN FULL COMPLIANCE WITH MIL-T-19500A.

	DC Current Gain h_{FE}		Gain X Bandwidth		Power Gain K_p		
2N602 2N603 2N604	$V_{CE} = 1$ v $I_B = 0.5$ ma	* 25-100	$V_{CB} = 5$ v $I_C = 5$ ma	10-30 mc 30-50 50-70	2N605 2N606 2N607 2N608	$V_{CE} = 7.5$ v $I_C = 1$ ma f = 2 mc	20-25 db 25-30 db 30-35 db 35-40 db

* REPRESENTS RANGE VALUE FOR COMPLETE TRANSISTOR FAMILY AND NOT FOR ONE PARTICULAR TRANSISTOR.

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CORPORATION

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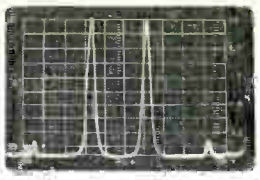
quicker set-up . . . greater accuracy in SSB (single side band) transmitter spectrum analysis at minimum cost

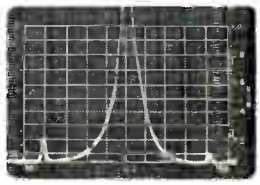
TWO TONE TEST

3rd order IM products clearly shown down 37db from tone sidebands 1.5kc and 2.1kc from off-screen carrier, using SB-12a's preset 2kc sweep width.



HUM TEST

Indication of one sideband in above photo increased 20db. Sweep width set to 150cps pinpoints hum sidebands down 54db and 60db.



PANORAMIC'S new...compact... SB-12a PANALYZOR

Versatility, reliability, easy operation . . . that's what you've looked for in an SSB Spectrum Analyzer. Panoramic's SB-12a gives you all these . . . plus *important economy!* More automatic features, fewer operating controls speed up all these critical investigations:

● standard two-tone test for non-linearities such as IM and harmonic distortion ● hum and other low frequency modulations ● residual carrier and suppressed sideband levels ● dynamic transmission band occupancy ● out-of-band radiations such as RF harmonics, parasitics, etc.

The SB-12a analyzes RF signals up to 1000mc by heteradyning in the input stage converter, using an external VFO. Extremely stable variable and preset sweep widths, resolution capability of 10cps, and full 60db dynamic range mean rapid, accurate visual analyses.

FULL 60db DYNAMIC RANGE . . . for FINER measurement

- detect & measure in-band (odd order) intermodulation products precisely down to —60db
- improved selectivity allows measuring 60 cps hum sidebands down —60db
- 0-40db vertical calibration expandable by 20db switch to read from —20db to —60db

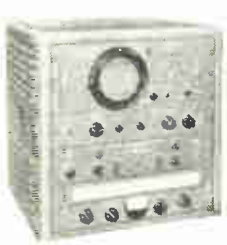
FEWER SETTINGS TO MAKE . . . for FASTER set-up

- designed for easy operation by non skilled personnel
- 5 preset operating modes — 150 and 500cps, 2kc, 10kc, and 30kc sweep widths, with automatically optimized resolution . . . plus
- continuously variable sweep width, resolution and scan rate
- precision broad band RF input attenuator-down to —65db in 5db steps
- "quick look" button: speeds signal location and set-up for highly resolved 10 sec. sweeps
- internal markers and other self-checking features
- 5" high persistence CRT with illuminated scale and camera mount facilities

dependable **CERTIFIED SPECIFICATIONS** *for accurate data*

now! in ONE PACKAGE

• complete • compact • convenient **PANORAMIC'S SSB-3**



Everything you need to set up . . . adjust . . . monitor . . . trouble shoot SSB&AM transmissions

- all the outstanding accuracy and convenience of the SB-12a . . . plus
- built-in stable tuning head (2-40mc) easily tuned . . . direct frequency reading
- 2-ton audio generator—with low harmonic and IM distortion
- completely self-checking—by internal transmitter simulator
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540 So. Fulton Ave., Mount Vernon, N. Y.
Phone: OWens 9-4600
Cables: Panoramic, Mount Vernon, New York State

Circle 102 on Inquiry Card, page 117

High Temperature Wire

(*Continued from page 57*)

additional operations are sometimes necessary to accomplish the designed function.

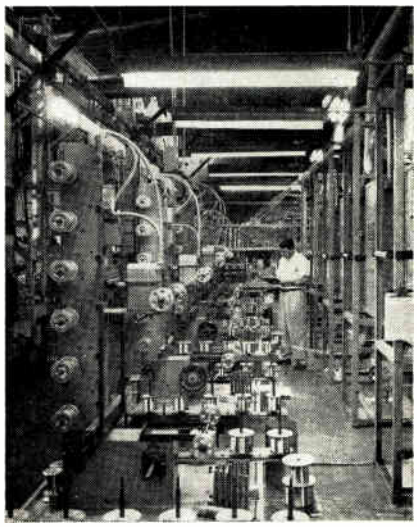
Almost all secondary operations on wire fall into one or more of the following: shielding, cabling and jacketing.

Shielding

In the electrical sense a shield is a conducting or semi-conducting covering over the insulation of a wire, or over a group of insulated wires. The functions of the shield are:

1. To confine the electrical field of a conductor to the insulation of the conductor:
2. To prevent the inductance of electromotive forces with the conductor by external circuits or signals:
3. In the case of coaxial cable. the shield, in conjunction with the inner conductor diameter, dielectric material and dielectric thickness, determines the electrical characteristics of the cable. This results in impedance matching for minimum power loss of transmitted signals or r-f energy.
4. In the case of power cables, the shield gives symmetrical stress distribution in the insulation and minimizes surface discharges.

Fig. 9: Magnet wire is being manufactured.



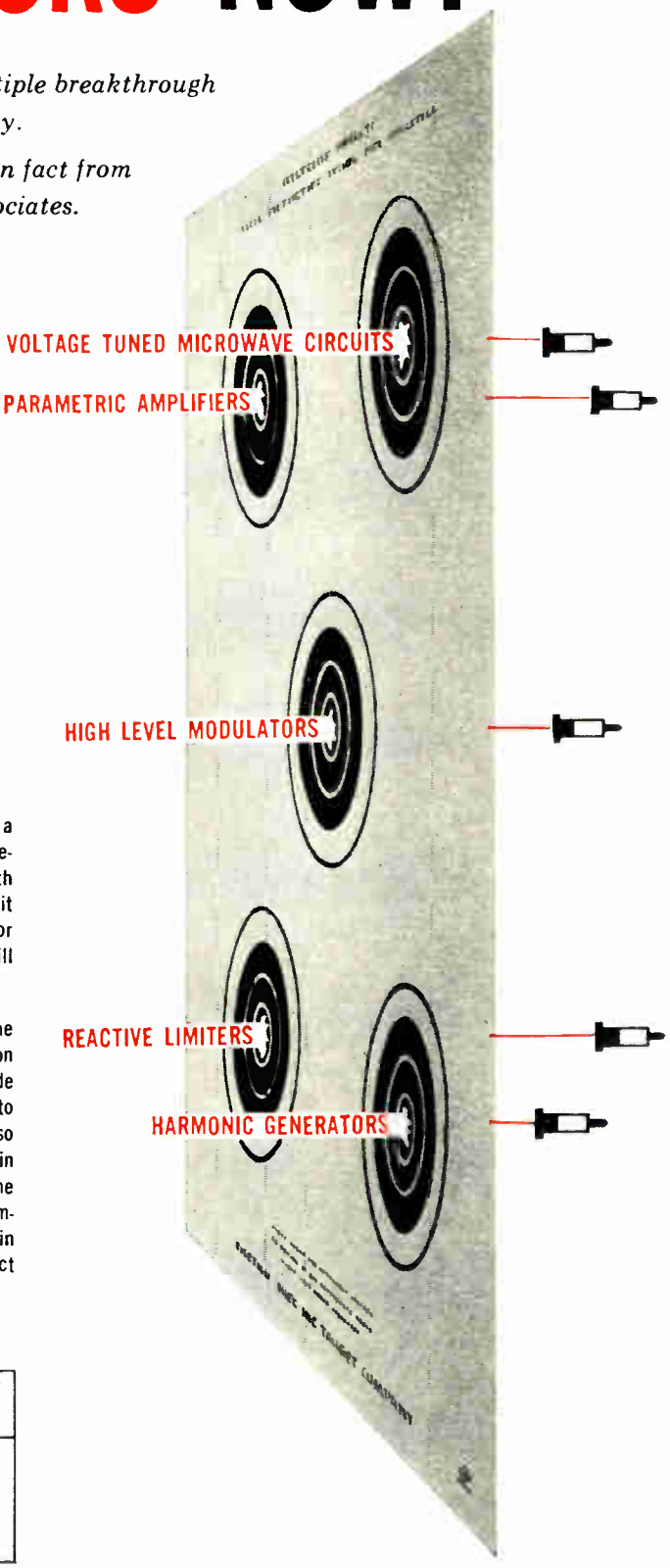
Shielding normally consists of a non-magnetic metallic covering in the form of a braid, serving or tape.

(*Continued next month*)

VARACTORS NOW!

YESTERDAY . . . *a multiple breakthrough in the laboratory.*

TODAY . . . *a production fact from Microwave Associates.*



This Microwave Associates varactor is a diffused silicon PN junction diode designed to be a variable capacitance with low loss at high frequencies. The unit complies with MIL-E-1 outline 7-1 for cartridge type crystal rectifiers and will fit most standard crystal holders.

In the standard form, the pin end of the diode is connected to P-type material on the top of a small "mesa" and the N-side of the silicon element is connected to the base. Reverse polarity units are also available. Mechanically reversible units in both polarities may be ordered but the single-ended units are generally recommended because they insure placement in holders with the proper end in contact with a heat sink.

TYPE	CUT OFF FREQUENCY (kMc)	CAPACITY AT ZERO BIAS ($\mu\mu$f)
MA-460A	20	8
MA-460B	30	6
MA-460C	40	4
MA-460D	50	4
MA-460E	60	3

VOLTAGE TUNED MICROWAVE CIRCUITS

The high Q of the varactor at microwave frequencies and its voltage variable capacitance provide excellent qualities for use in circuits as AFC, voltage variable filter networks, tuned microwave oscillators.

PARAMETRIC AMPLIFIERS

The varactor used in very simple circuits requiring no refrigeration has demonstrated low noise, high gain performance from 1 to 6000 mc. Noise figures of approximately 1 db at UHF and 5 db at 6000 mc. are typical. We believe the varactor will be the component of choice for receiver inputs from 30 to 6000 mc.

HIGH-LEVEL MODULATORS

For the difficult problem of imposing VHF and UHF intelligence on a microwave carrier, the varactor is a top performer. The varactor accomplishes the mixing function with signal gain in the side bands as opposed to present low efficiency techniques.

REACTIVE LIMITERS

The varactor has been used as a passive reactive limiter at UHF frequencies. It is believed that the varactor will be an ideal "receiver protector" as an adjunct to present UHF radar duplexing systems.

HARMONIC GENERATORS

The unique properties of the varactor provide highly efficient harmonic generation. Useful harmonics have been generated up to 100 kMc. With inputs at HF, VHF, UHF and lower microwave frequencies, conversion losses of considerably less than 1 db per harmonic have been observed. The varactor driven by transistor or tube oscillators appears very promising as a signal source in the microwave region.

Send for catalog 59V

MICROWAVE ASSOCIATES, INC.

BURLINGTON, MASSACHUSETTS • Telephone: Browning 2-3000

Circle 104 on Inquiry Card, page 117

PROBLEM CLINIC
Test Set For Pulsed Doppler Radar

A West Coast manufacturer needs field test equipment for a pulsed doppler radar. As far as is known the unit required does not exist.

The test set must be capable of measuring subclutter visibility. The radar frequency is 2,000 to 3,000 MC with a pulse repetition of 7,000 pps. For testing the radar system, the test equipment would have to generate signals which would simulate moving and fixed targets.

The mfr. would supply either 115v or 208v power at 400 cps for which you would have to furnish within your equipment the appropriate regulation.

The mfr. will send detail specifications and information on the quantities required if you are interested in preparing a proposal.

EI welcomes the appartunity ta bring ta the attentian af aur readers needs far specific engineering equipment ar campanents. Firms ar individuals interested in supplying this equipment shauld write: Prablem Clinic, Electranic Industries, 56th & Chestnut Sts., Phila. 39, Pa.

MINIATURE MOTOR

The model 2PP1, miniature motor, is rated at 1/100 HP at 1100 RPM. It has been qualified to MIL-M-8609 specifications. The 26.5 vdc motor is 1.18 inches in diameter, 1.9 inches long and weighs 3½ ounces. Life is 500 hours without a change of brushes. Electro Products Division Western Gear Corporation, P. O. Box 182, Lynwood, California.

Circle 239 on Inquiry Card. page 117

HIGH-POWER TRANSISTORS

Silicon transistors (WX1015 and WX1016), for switching and amplifier applications, can switch power up to 1 kw. Rated at 2 and 5 a, collector-to-emitter voltage range is 30 to 300 volts. Of n-p-n construction, their high voltage and current ratings and low saturation resistances (max 0.7 and 0.5 ohms for the 2 and 5 a units), enable either to handle high switching power with minimum losses. They are characterized by case-to-junction temperatures up to 150°C and are hermetically sealed and designed for mounting on an external heat sink by a threaded stud. Dimensions are: Dia. 1¼ in.; heights 1 7/64 in. Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa.

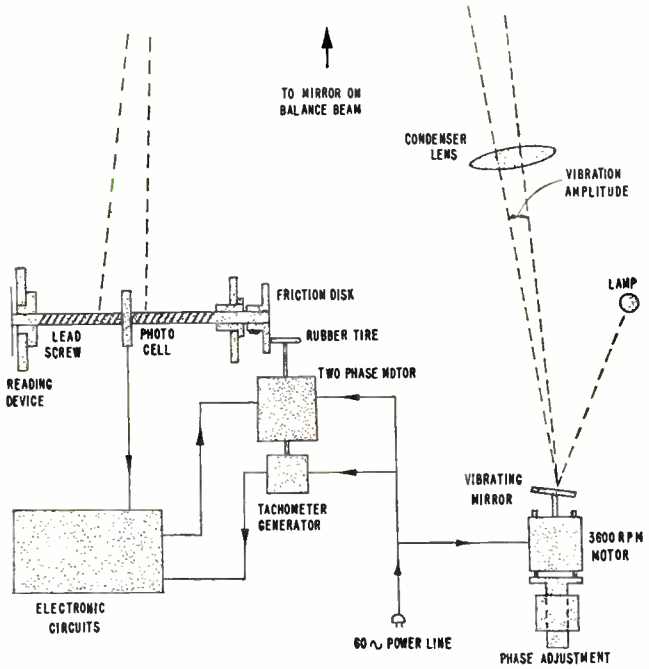
Circle 240 on Inquiry Card. page 117

High-Precision Balances

(Continued from page 143)

sented by the angle turned through by the lead screw. The latter drives a dial which has a single turn of free play so that when the direction of the lead screw reverses (i.e., at a turning point) the dial remains motionless for one revolution of the screw. To obtain a voltage proportional to the position of the balance beam, the lead screw is mechanically coupled to the pickoff arm of a precision potentiometer.

Fig. 2: Reader is on table in foreground; balance is manipulated by the long rods



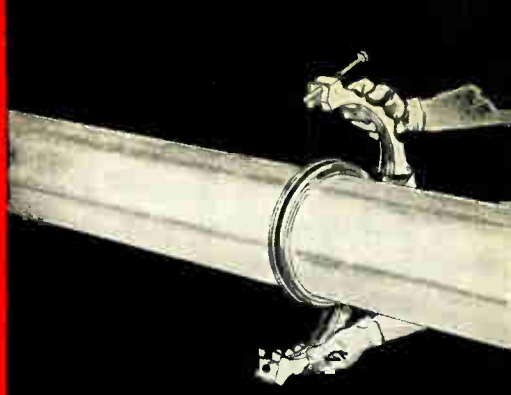
Design and construction of the apparatus are due primarily to L. B. Macurdy and H. A. Bowman. Consultation was provided by M. L. Greenough and T. R. Young, also of the Bureau staff; and the instrument was fabricated largely in the Bureau's instrument shop.

[1] Further technical details are given in the paper, *The observation and control of errors due to changing ambient conditions during high-precision weighing experiments*, by L. B. Macurdy, H. A. Bowman, and H. E. Almer, delivered December 30, 1958 at the Washington meeting of the AAAS, session on "Precision Measurements" conducted by the ISA.

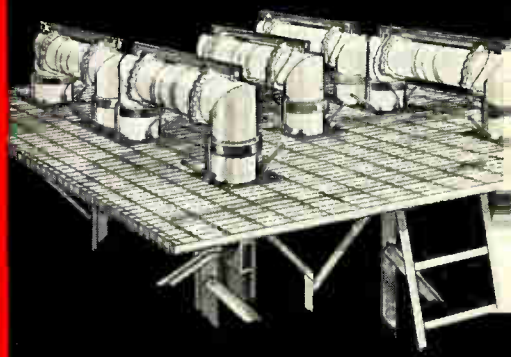
ANDREW

ANTENNAS • ANTENNA SYSTEMS
TRANSMISSION LINES

Space Surveillance Calls For New High Power



9" TRANSMISSION LINE
WITH SINGLE BOLT FLANGE CLAMP



PATCH BAY FOR SWITCHING 9" LINE

21" ALUMINUM WAVEGUIDE
WITH BRANCHING SWITCH

ANDREW CORPORATION offers a wealth of engineering experience in the field of super power RF transmission devices. A broad line of standard equipment is offered and ANDREW facilities for the development and production of special equipment are without equal.

Available on a production basis is antenna equipment in all of the new, very large waveguide and transmission line sizes, including high power coaxial lines designed with specially shaped inner conductors and insulators to substantially increase voltage ratings.

Typical too, of this equipment are patch panels such as the 9" line model shown above, used for occasional rearrangement of antenna and transmitter connections.

For high speed circuit switching, ANDREW has developed peak reliability, non-contacting waveguide switches such as the 21" model above. Similar switches are also supplied with transitions for use with coaxial line.

Of definite advantage to you is the completeness of the ANDREW line which permits a systems approach with integrated equipment for best performance of the overall system.

Our newly expanded production facilities assure prompt deliveries.

We would welcome your inquiries for product information and engineering assistance on:
Antennas • Feed Horns • Switches • Patch Panels • Duplexers • Power Dividers • Filters • Coaxial Line • Waveguide • Transitions • Adaptors • Bends • Hangers • Dehydrators

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PROFESSIONAL OPPORTUNITIES

Reporting late developments affecting the employment picture in the Electronic Industries

Design Engineers • Development Engineers • Administrative Engineers • Engineering Writers
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Battle Simulator Trains Navy Brass

Naval officers can "play" war games and evaluate new weapons and systems with the one block long, three story high, Navy Electronic Warfare Simulator (NEWS) that presents realistic reproductions of actual combat tactical situations. It gives them an opportunity to exercise their own judgment and professional experience under realistic conditions formerly possible only with costly mock fleet exercises.

All information normally available to the officers under combat conditions is available to them, and they can control all the forces in the action. Umpires, in a separate room, observe the action. Rapid calculation of results and evaluation of the officer's decisions enable the battle to progress at any rate of speed. It can also be stopped at any point to permit a detailed anlysis of the situation.

Veteran Teachers Study TV as Classroom Aid

Veteran teachers are being shown the potentials, the limitations, and the special techniques of TV teaching in a special course at Teachers College, Columbia University. The students operate the TV cameras, direct practice programs and observe the results on monitors.

Two complete camera chains featuring Model 103 cameras and all necessary control, monitoring, and lighting equipment have been made available for student use by the Dage Television Division, Thompson Ramo Wooldridge, Inc., Michigan City, Ind.

FOR MORE INFORMATION . . . on positions described in this section fill out the convenient inquiry card, page 85.

What to Do/Not Do For Tech Writers

How to make an oral presentation, how to prepare visual aids, and information on the preparation of manuscript for submission to the editors of technical society publications are some features of a manual, "Technical Societies Guide—$3.00," published by the Industrial Publicity Assoc., Room 1616, 41 E. 42nd St., New York, N. Y.

The manual was compiled in cooperation with 36 leading technical societies to serve as a reference for both the industrial publicist and the engineer. It contains data on: membership structure, number of members, principal meeting dates, subjects of interest, paper requirements, mechanics of contribution, policies on preprints and reprints, restrictions and rights to papers and data, and each society's publication and publicity policy.

Night Courses Feature Electronic Technology

Electronic technology courses, ranging from "Elements of Electrical Theory" to "U.H.F. and Microwave Communication Systems," will be offered as evening courses by the New York University's Division of General Education. The non-credit courses will be given during the spring semester beginning in February.

How to Bring Up Creative Engineers

Industrial environment is a major factor in the creativity of scientists and engineers — it is also the most neglected consideration. The factors that determine the proper climate for creativity are discussed in a new study by Deutsch and Shea, Inc., industrial manpower consultants, called "Company Climate and Creativity", published last month by Industrial Relations News, 230 West 41st St., New York, N. Y. Cost is $10.00.

Midwest Corp. To Invest in Small Firms

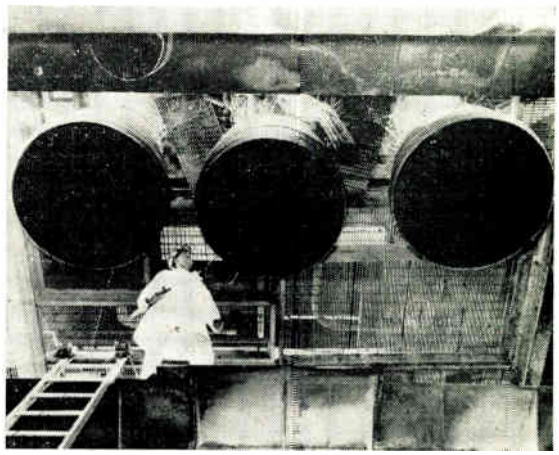
A recently organized corporation, Midwest Technical Development Corp., plans to invest in small, successful technical companies whose potential can be increased by added capital.

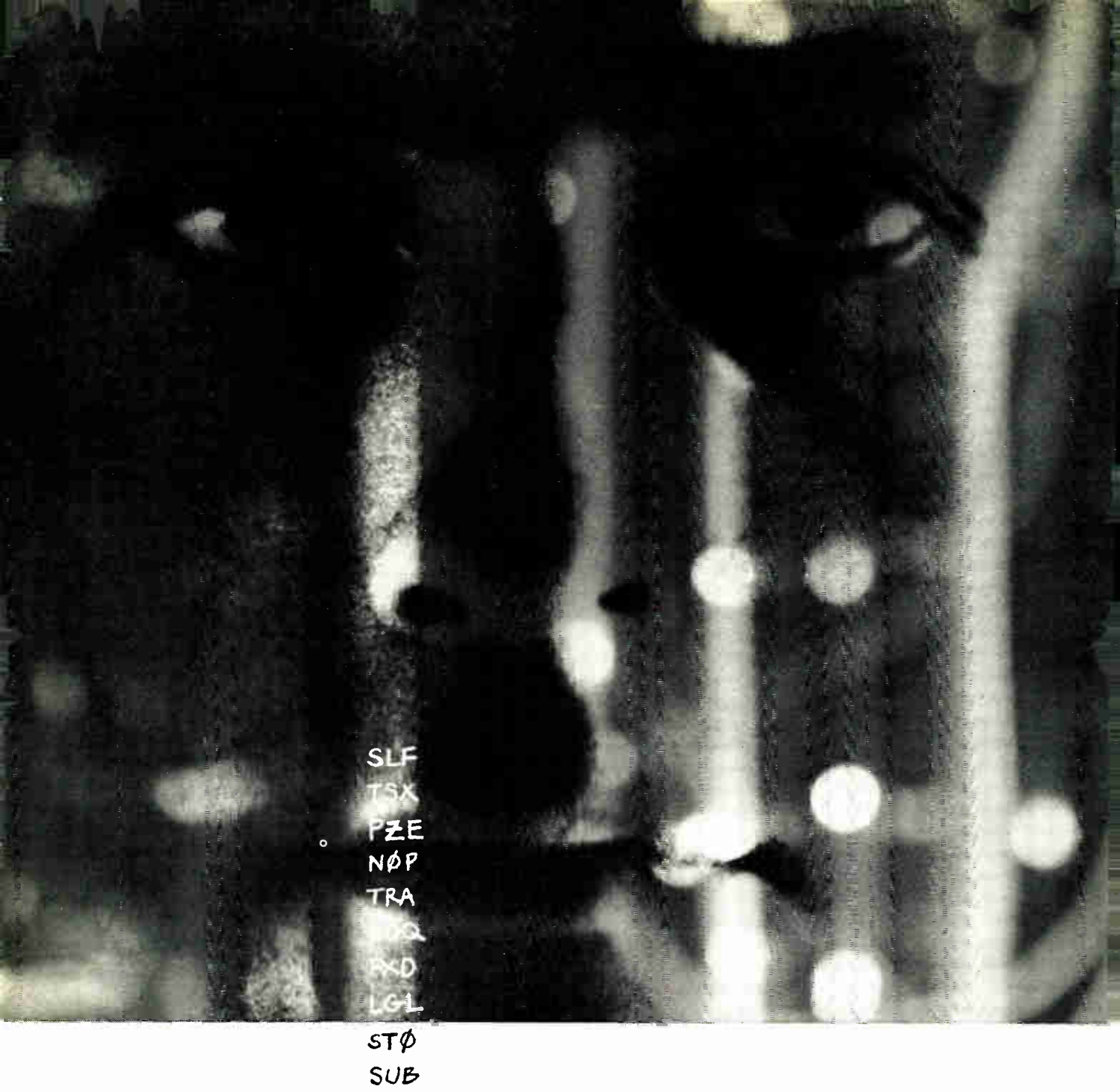
A wholly-owned subsidiary, Technical Management Services Corp., is being formed to provide such companies with specialized management consulting services in the areas of finance, product planning and marketing.

The parent corporation's address is: 1404 Northwestern Bank Building, Minneapolis, Minn.

BIG THRUST

This cluster of rocket engines, the most powerful in the free world, comprise the propulsion package for the AF's Atlas ICBM. Made by Rocketdyne, div. of North American Aviation, Inc., the units are twin-chambered boosters (l and r) and sustainer (c).





Man-Machine Relationships a Growing Field for **OPERATIONS RESEARCH**

Mathematicians, Physicists and Engineers with experience or strong interest in Operations Research on large-scale automated systems will be interested in the major expansion program at System Development Corporation.

SDC's projects are concerned primarily with man-machine relationships in automated systems in a number of fields, including air operations. The application of new and advanced digital computer techniques is particularly important in optimizing these man-machine relationships. SDC activities constitute one of the largest Operations Research efforts in the history of this growing field.

Senior positions are among those open. Areas of activity include: Mathematics, Systems Analysis, Forecasts, Cost Analysis, Operational Gaming, Design Analysis, Performance Evaluation.

Those who have professional questions or desire additional information are invited to write Dr. William Karush, Head of the SDC Operations Research Group. Address System Development Corporation, 2428 Colorado Avenue, Santa Monica, California

"A Theorem in Convex Programming." A paper by Dr. Karush is available upon request. Address inquiries to Dr. William Karush at System Development Corporation.

SDC

SYSTEM DEVELOPMENT CORPORATION
Santa Monica, California

An independent nonprofit organization

Circle 501 on "Opportunities" Inquiry Card, page 119

Wall Street Looks At The Electronic Industry . . .

What yardsticks does the security analyst use to measure financial health of a company? How do electronic firms differ from other industries? In changing jobs what are the significant items in a firm's financial statement that best indicate the quality of management? How much R&D is "healthy"?

By CASPER M. BOWER,

Investment Analyst,
Utilities & Industries Management Corp.
425 Park Ave.,
New York 22, N. Y.

Part Two of Two Parts

YOUR industry, as measured by its individual company equities, is today an arena of equity value dispute—the likes of which have not been presented for years. And why! For a host of debatable reasons which I now plan to review.

The present price earnings ratios of the majority of electronic company shares are from twenty to thirty times current earnings. Yet, the equities of long-established companies, with sizeable working capital, unbroken dividend records, seasoned managements, broad and established product lines sold to a diversified consumer market and with still further growth, may be bought at price earnings ratios of fifteen to twenty times earnings.

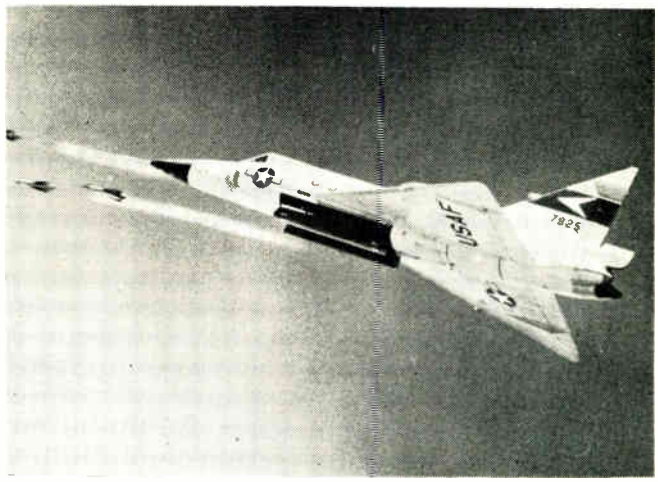
By contrast, a majority of the electronic companies for their survival are heavily dependent on military contracts, which when completed, are subject to profit renegotiation, even though the net profit reported by the contractor after taxes may be only 4% or 5%. In the coming year it is estimated that about 55% of all electronic work will be for government account. Only a few electronic companies are well-heeled with working capital, and as many of you know, bidding on government contracts, without even the assurance of winning one, is expensive in engineering hours.

Many managements are relatively new and in many cases are dominated by single entrenched presidents who have become paper-rich overnight because the public seems to believe the shares of these companies, which in the past year have risen enormously, are keys to Fort Knox.

The technology of astronautics, astrophysics, infrared, maser, doppler, cryogenics, microwave, troposcatter, nuclear energy cosmology, and others, is without doubt mystifying to the investor and perhaps also to many in the field of electronics.

While these are exciting in terms of potential research, development, and perhaps, production contracts worthy of measurable profits, in the process of completion are they not likely to impose financial and engineering strains on many an electronic company.

I read the *New York Times* business opportunity section each Sunday and thereby follow the engineering activities and contract awards of many electronic companies. Frequently, I read of a company obtaining a substantial research and development award and a week or so later, that same company runs a quarter or a half page ad looking for engineering skills to fulfill each technical level required of the contract.

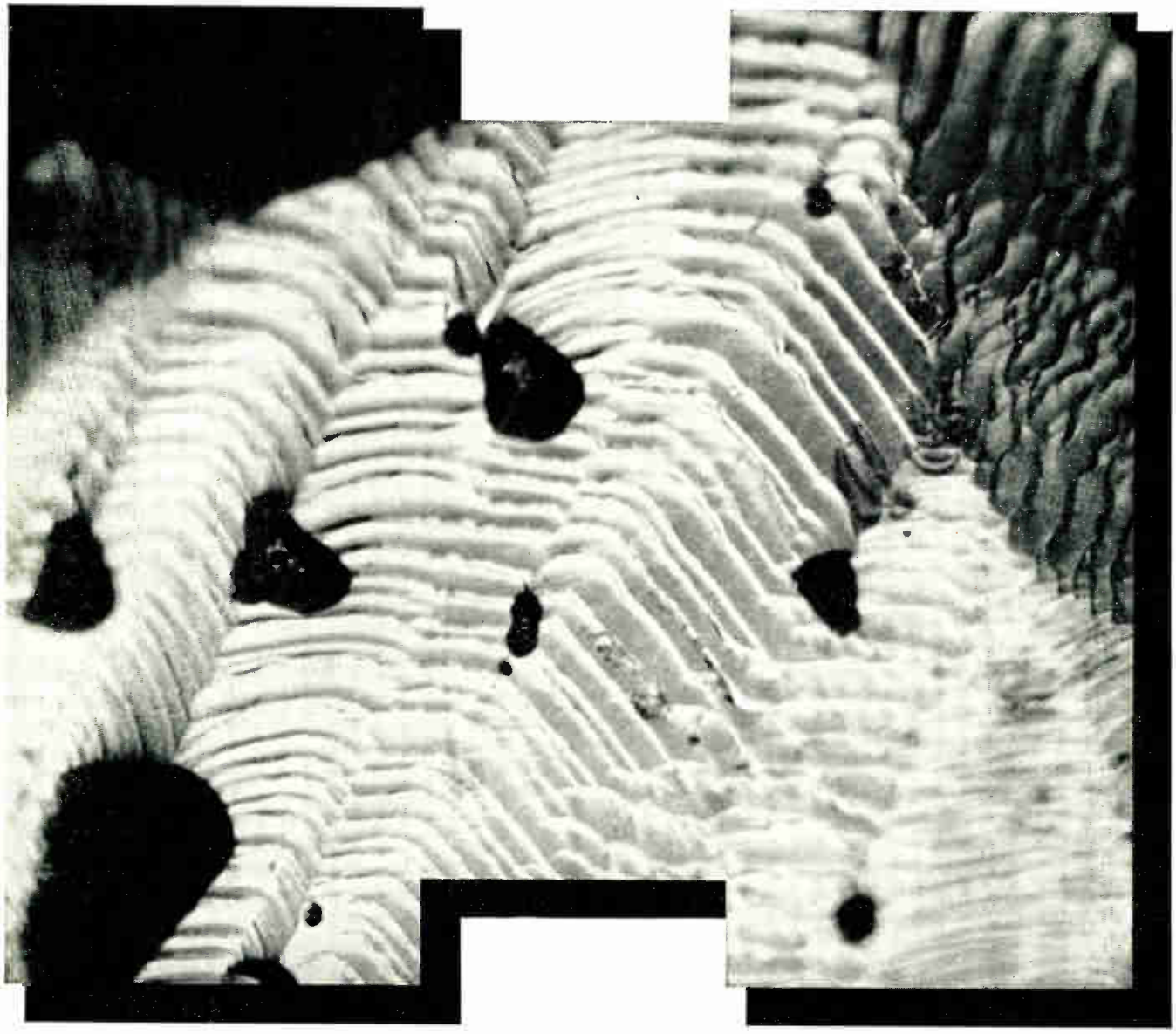


Military weapons systems involve many sub-contractors. The security analyst must evaluate the present optimism against defense cutbacks.

These ads state applicants must have minimum two to five years of prior experience in these fields of science—many of which are still inchoate or unexplored. These ads, therefore, must be considered "engineering talent raids." This poses questions, as one for example—suppose the new contractor cannot obtain his minimum of engineering skills to fulfill the basic research and development essential to con-

(*Continued on page* 158)

The industry that



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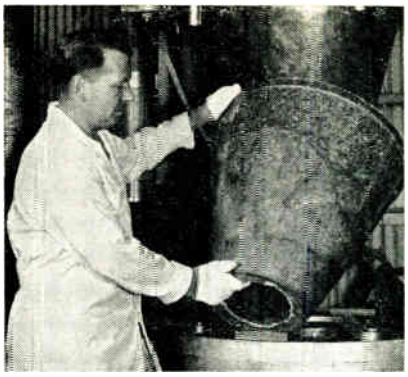


***Exit cones** capable of withstanding temperatures of 6000° F, represent one example of advanced engineering being performed by the Hughes Plastics Laboratory.*

This photomicrograph (at left) of an etched silicon crystal is used in the study of semiconductor materials. Impurities introduced into crystals such as this form junctions for semiconductor devices.

In the fast-growing semiconductor industry, Hughes Products, the commercial activity of Hughes, is leading the field. Its programs include basic research on semiconductor surfaces; alloying and diffusion techniques; and materials characterization studies to determine the electrical effects of imperfections and impurities.

In addition, Hughes Products is developing new semiconductor devices such as parametric amplifiers, high frequency performance diodes, and improved types of silicon transistors. New techniques are being devised for casting silicon into various configurations. Also underway is the development of new intermetallic compounds for use in semiconductor devices.

Other activities of Hughes provide similarly stimulating outlets for creative engineering. The Hughes Research & Development Laboratories are conducting studies in Advanced Airborne Electronics Systems, Space Vehicles, Plastics, Nuclear Electronics, Global and Spatial Communications Systems, Ballistic Missiles... and many more. Hughes in Fullerton is developing radar antennas which position beams in space by electronic rather than mechanical means.

The diversity and advanced nature of Hughes projects provides an ideal environment for the engineer or physicist interested in advancing his professional status.

Newly instituted programs at Hughes have created immediate openings for engineers experienced in the following areas:

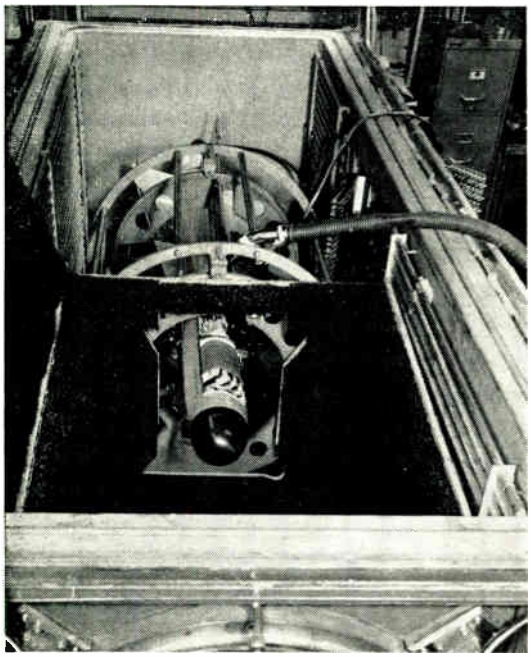
Semiconductors	Communications
Microwave & Storage Tubes	Circuit Design
Field Engineering	Systems Analysis
Microwaves	Reliability Engineering
Digital Computer Engr.	Radar

Write in confidence, to Mr. Phil N. Scheid, Hughes General Offices, Bldg. 6-C1, Culver City, California.

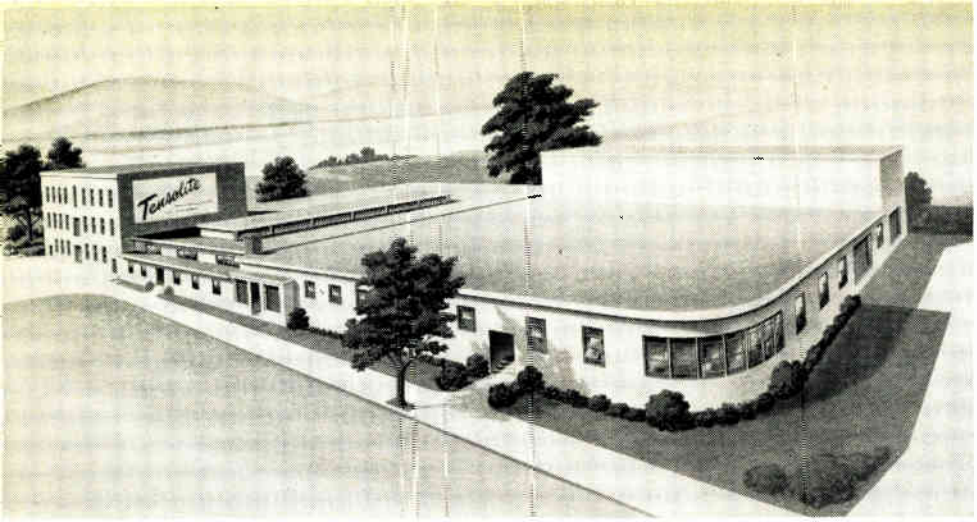
The West's leader in advanced ELECTRONICS

HUGHES

HUGHES AIRCRAFT COMPANY
Culver City, El Segundo,
Fullerton and Los Angeles, California
Tucson, Arizona



***Falcon air-to-air guided missiles,** shown in an environmental strato chamber are being developed and manufactured by Hughes engineers in Tucson, Arizona.*



Tensolite Inc. is expanding its plant to supply more high-temperature wire.

Wall Street . . .

(*Continued from page* 155)

tract completion?

Another—what happens to the engineering team broken up by key men weaned away by raiding companies? These are but two, and I am sure, you can think of many others.

Are these some of the basic reasons for the "inefficiency" which seems to plague the industry and may also explain General E. R. Quesada's recent remarks that the competitive drive, and I quote: " . . . is now increasingly directed toward drafting and peddling of gaudy sales proposals and toward staying alive through getting development contracts for weapons, regardless of their ability or the ability of the contractor to deliver what he promises."

The recent trend toward joint-venture concepts, which seemingly has the Department of Defense blessings, may lessen the opportunity for smaller electronic contractors to obtain their proportionate share of this year's $40-billion defense budget. The joint-venture concept seemingly relieves the Department of Defense of the problem of dealing with large numbers of prime and sub-contractors, with the attendant headaches of coordinating their activities. Thus, unless you are elected to a team, getting worthwhile defense contracts, either research and development, or production, may be difficult to come by.

Further warnings with respect to government concern over the Gordian Knot of defense needs versus economy are found in further remarks of General E. R. Quesada who observed: "Some present contractors are almost certain to disappear; others are apt to live in a most precarious existence;—others will prosper."

Each of the foregoing topics—and others I have not mentioned—is a detectable, feedback, hot-spot area of possible corporate and industry financial trouble. Yet, facing us here is an anomaly of investors willing to pay, and obviously paying, higher and higher prices for estimated future electronic earnings — which may not develop to the extent now enthusiastically believed — than for the surer future earnings of a broad range of established industrial companies less burdened with government interference or dependence, and where corporate efficiency policies—measured by earnings and divided payout—are in the hands of seasoned professional management.

The obvious question is—What is the basis for this irrelevancy? Is the public paying these premium prices because, beguiled by the aura of mystery of new sciences and terminology, they are abandoning basic and established investment principles?

Or—Are these pristine sciences actually opening the door for substantial near and longer term earnings which may minimize any threats from the eco-political factors briefly touched on;

Or — stimulated by imaginative newspaper and magazine feature articles, and electronic management statements of unlimited business horizons, are security analysts themselves, becoming infected with a virus of electronic euphoria, thereby tossing caution and historic rules of evaluation to the winds. Let me endeavor to explain this last point.

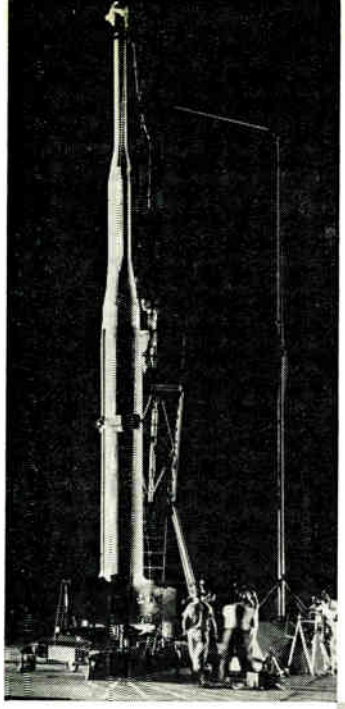
Too Much Optimism

Some officials of electronic companies in public statements have obviously been too optimistic about their present or anticipated government business which may consist largely of low profit margin research and development contracts with only modest production.

Two examples come to mind; one electronic company executive in February, 1957, said that his company which grossed $29.4 million for its 1956 fiscal year would chalk up $40 million for the 1957 fiscal period. He also anticipated company sales would climb to $100 million by 1960 and added that he foresaw annual sales growth at 25%—40% to be maintained for the next five years.

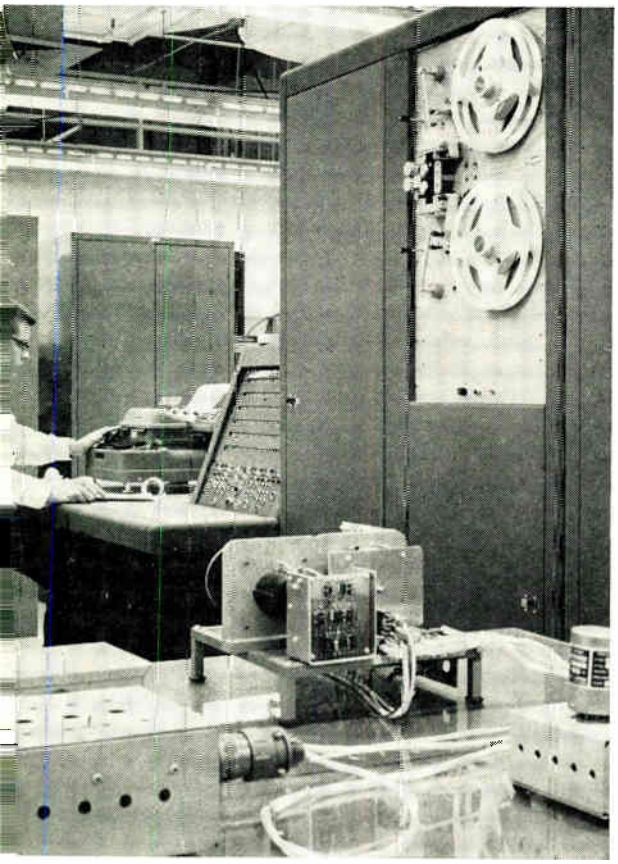
(*Continued on page* 160)

Is expansion well planned and backed with adequate capital, as with Stromberg-Carlson's new San Diego, Calif., plant, or is the company reaching too far?

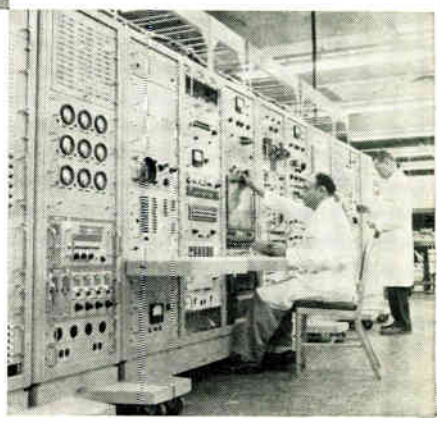


(left) Lockheed X-17. Lockheed-designed checkout computers are already proving their effectiveness in service.

(below) Another Lockheed-designed automatic missile check-out for quick determination of flight readiness.



(left) Automatic Checkout and Readiness Equipment (ACRE)—a Lockheed product—automatically performs pre-program missile checkouts and runs diagnostic routines to localize trouble.



EXPANDING THE FRONTIERS OF SPACE TECHNOLOGY

Lockheed's capability in the design and development of computers is contributing to the advancement of the state of the art. Research is being conducted in the building of machines capable of reading 5,000 characters a minute; in the development of high-speed digital plotters which will operate up to 5,000 points a second from magnetic tape input; in the improvement of library reference systems for the storing and retrieval of information; and in the study of self-organizing machines using variable threshold neurons that will operate essentially without programming.

The ACRE system developed by Lockheed combines outstanding performance at the lowest cost in the industry, and has broad applications to a number of other missile and space projects.

Scientists and engineers of outstanding talent and inquiring mind are invited to join us in the nation's most interesting and challenging basic research and development programs. Write: Research and Development Staff, Dept. A-48, 962 W. El Camino Real, Sunnyvale, California, or 7701 Woodley Ave., Van Nuys, California. For the convenience of those living in the East and Midwest, offices are maintained at Suite 745, 405 Lexington Ave., New York 17, and Suite 300, 840 No. Michigan Ave., Chicago 11.

"The organization that contributed most in the past year to the advancement of the art of missiles and astronautics."
NATIONAL MISSILE INDUSTRY CONFERENCE AWARD

Lockheed / MISSILE SYSTEMS DIVISION / SUNNYVALE, PALO ALTO, VAN NUYS, SANTA CRUZ, SANTA MARIA, CALIFORNIA
CAPE CANAVERAL, FLORIDA
ALAMOGORDO, NEW MEXICO

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Wall Street . . .

(*Continued from page* 158)

Here is how this company actually performed: for 1957, sales were $38 million and for 1958, sales rose slightly to $39.8 million.

This executive, at the time of this public address said that 1957 earnings would probably exceed the $1.36 per share reported in 1956 and that an annual increase could be expected for several years. Here is the actual earnings performance as reported. Earnings for 1957 were $0.16 per share and for fiscal 1958, the company lost approximately $946,000. Now, and only after major managerial shifts, the company may be back again on the profits road.

This retrospection is not intended as a criticism—rather, it is submitted to emphasize the dangers inherent in many young companies and managements relatively inexperienced to the complexities of sudden corporate bigness.

This ineptitude in fiscal management is not necessarily a disease of the newer electronic companies. One of the longer established, with many fine divisions, reported 1957 earnings of over $3.3 million or $3.03 per share of common stock. Yet, by June, 1958—or six months later—its earnings shrunk to an almost vanishing point of $180,000 or $0.16 per share.

These are but two—there were many others. Of course, there are substantially more doing an excellent job for the Department of Defense, their employees, and their stockholders.

Concerning the latter I must point out that historically the shares of young growth companies sell at price earnings ratios which bear little or no relationship to actual or near-term earnings—a reflection of the public's willingness to bet on the future in any form.

Sooner or later, however, the public's appetite or enthusiasm is watered down by earnings results which do not measure up to anticipated totals. Or, the period of actual earnings is deferred from year to year by unexpected "non-recurring" expenses or other unforeseen events. And many temporary investors fatigue quite easily if the

market price for these chosen shares fails to maintain the speedy ascent which prompted their purchases in the first place.

Seasoned investors on the other "growth" company equities until management has demonstrated its hand usually shy away from many capabilities to cope with the stresses of sudden prosperity and adversity.

Under the weight of these depressing forces, "growth shares" tend to drift downward and begin to establish price earnings ratio patterns more in keeping with the business characteristics of the industry. For example, finance company shares may sell at 10 to 12 times earnings, chemicals — 25 times, rails—10 times, utilities — 15 times, steels—10 to 12 times, and so forth. Each industry ratio reflects years of investor experience and evaluation of the earnings susceptibility of the particular industry to periods of good and bad business.

Not to be overlooked either as potent factors in altering the historic pattern of price earnings ratios are the impact of technological, style, or evolutionary strides within each industry which may strike powerful blows at its survival, or boost its growth enormously.

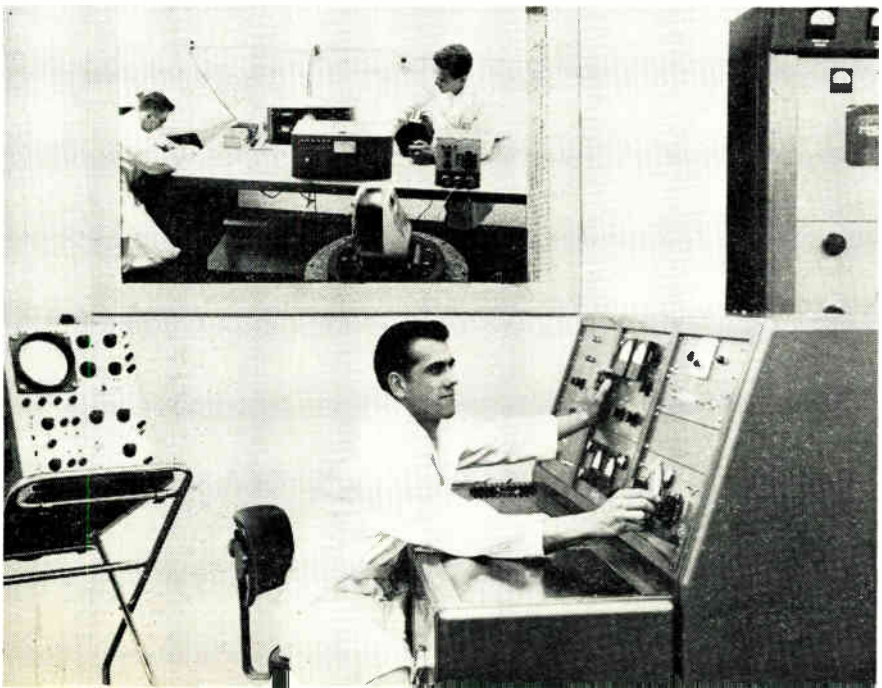
For the electronic industry, it is still too early to say whether this ratio will settle down to 15—20—25 or 30 times. Were the government to decide to establish a type of surtax on defense production in order to help pay for mounting defense appropriations, on conceive other types of profit restrictions designed especially for defense contractors, a sharp decline would occur in this pattern of price earnings ratios. Another possible price depressing factor would be that of government "economy scares" accompanied by contract stretch-outs, slowed down progress payments, and R & D profit limitations, and still others which legislators can conceive if it becomes politically popular to tax defense industries.

If investors come to believe these forces will hang over the electronic industry like Damocles' sword, it would be conceivable, and, in fact, most likely that electronic shares would sell at perhaps 15 to 20 times present, or near-term earnings—a considerable drop from present inflated investor regard.

We analysts, as you can see, therefore must separate the wheat from the chaff and our evaluating tools are, without question, extremely useful yardsticks—despite the implications to the contrary. But every competent analyst will quickly agree that they are not final measurements. They might be considered barometers of management performance which lead to the delicate subject of management and its evaluation.

A corporation legally is a paper entity. But its life, its growth, its strength, its diseases, and even its death are the images and actions of men—an appraisal often overlooked. Thus, the luster of its health or the depth of its sickness

Leach Corp. facility pre-tests components for severe environmental operation.



depends on the men or women who control and operate this paper entity.

To investment analysts, management appraisal is by far one of the most important yardsticks, and under ordinary conditions is difficult to measure. Top electronic executives represent a phalanx of new forces in management. Many are scientists and skilled engineers—and temperamental—a characteristic of the profession.

But few possess the balanced managerial training necessary to cope tactfully with the singular organizational and personnel problems inherent in electronic companies. Thus electronic management appraisal seemingly calls for a set of additional measurement standards. This viewpoint finds support in the contradiction of the analyst's management evaluation tools by two leading electronic executives.

One key official of an electronic company, in placing himself in the role of a securities analyst of electronic companies, commented on management's importance as follows, and I quote:

"Even more hazardous as an investment is a company whose success is dependent upon, or which is dominated by one or two or three individuals. The indispensable man is the greatest weakness that a company can possibly have. We have seen company after company grow to a certain point and then stagger and fall back. . . ."

Now compare this with the observation of another electronic president:

"Besides assuming the responsibility of president and general manager, I personally direct the company's over-all engineering program. We expect that some day one of our own engineers will naturally develop into this position."

Here are two views, gentlemen, as irreconcilable as the North and South Poles, and yet we are face to face with it in trying to determine which in your industry is the sounder investment view.

I leave the matter of management evaluation now and turn to the next topic which, I believe, contributes substantially to the public's current enthusiasm for electronic shares. This is the ticklish subject of R & D.

I have noted in the past year or so that many electronic companies have been calling attention to the amount of their research and development expenditures in relation to sales. This is borrowing a leaf from the book of the highly successful pharmaceuticals, drugs and chemical companies which, over the course of many years, have spent vast sums of their own funds for research. In fact, about $0.08 out of every chemical sales dollar is reinvested in research. But here is where the comparison ends. These companies sell domestically to a broad market of 175 million people —not including foreign consumption—whereas in the instance of electronic companies, the government is the largest single politically fickle customer, taking some 55% of all electronic production.

R & D expenditures seemingly point to many new products and in time lots of profits. But people are unaware of the trials and tribulations of research, the real costs, the failures, the time consumed between the breadboard, the prototype, the production model, and finally the acid test of marketing; very few indeed, because failures are skeletons in a closet and managements are not too keen to reveal these factors to their stockholders.

Management views differ widely on methods to evaluate the efficiency and productivity of their R & D programs. Last year, for example, the Massachusetts Institute of Technology conducted a survey to ascertain how companies, seriously concerned with their R & D expenditures, evaluated these efforts. Some twenty-nine companies replied to M.I.T.'s questionnaire and the results, while not necessarily all inclusive, were quite revealing. For example, nineteen companies related R & D to sales volume or revenues; twenty-eight to the time and cost of the technical solution; seventeen to the effect on savings in materials, labor and other costs; and thirteen related it to the effect on profits.

Considering this survey was conducted by a competent institute, it certainly does reveal that managements disagree widely on methods to evaluate the increasing sums which must be spent annually on this vital activity.

(*Continued from page* 163)

These different management approaches to R & D studies should also serve as a warning buzzer that unless definitive controls of some sort are exercised, R & D could readily affect a company's earnings adversely and even its financial stability.

A recent example involving a publicly-owned electronic company will suffice to drive this point home. I quote from an annual report just released.

"The first half losses of $85,000 compared to earnings of $222.389 for the same period of 1957 were attributed to 'writing off increased engineering costs due to a build-up in research and development.'"

For the various points now referred to, electronic R & D expenditures both government paid for and company sponsored should obviously become a high priority in investment appraisal.

With respect to past R & D expenditures and forward budget planning, rather than suggest procedures for disclosure, I offer instead for management consideration a number of specific questions. If these are answered with frankness to the degree permitted by competition and government security regulations, they would contribute substantially to a thorough investment appraisal.

Here they are; as applied to government R & D.

What percentage of the past year's R & D expenditures was for government account?

What percentage was company financed?

What are these percentages for the current year's budgeted expenditures?

What percentage of government contracts is cost plus fixed fee?

What percentage is fixed price?

What are the percentage fees for each category? Do any contracts contain incentive fees coupled with penalties?

For example, one company recently obtained a $23 million cpff contract which provides for fees ranging from 5% to 7% of estimated cost. Target cost has been set at $22 million and target fee at 6%—or $1.3 million. Therefore, approximately $0.20 of each dollar of actual cost below target will

be added to the fee. But, $0.20 could be subtracted from the $1.3 million fee for each dollar by which the target cost is exceeded.

Maximum and minimum limits have been set at $1.5 million to $1.1 million—or a difference in net earnings before taxes of $400,000 throughout the life of the contracts. As is apparent, it is important also to know the target date for completion.

Do the R & D contracts provide for any production? If so, what is the estimated volume?

Do any of these R & D contracts now in progress have foreseeable commercial use or application? If so, what does your marketing research department estimate these to be in terms of sales?

Questions I pose to explore and evaluate commercial R & D expenditures would be these:

Are R & D expenditures budgeted and tied, as a percentage, to past year's sales and present year's sales forecast or, are they single product allocations?

What fiscal, or management reporting procedures are employed to assay the productivity of your R & D groups?

What interim controls, if any, are established to regulate actual expended project engineering hours, target progress, and allocated funds to the target hours, rate of progress and funds initially allotted for each project?

What new products have been brought to the market within the past or present year attributable to R & D outlays.

What amount of sales volume has been developed by these new products and finally;

Have your R & D efforts directed at cutting production costs for your existing product line—as for example, simplified operational controls, miniaturization of components, and improved internal and external design and packaging—permitted you to maintain or even increase your share of the market by list price adjustment without profit margin penalty?

Were managements to provide answers to these probes, the analyst would then be fortified with a clearer knowledge of the productivity of these critical R & D expenditures * * *

ELECTRONIC Advertisers —

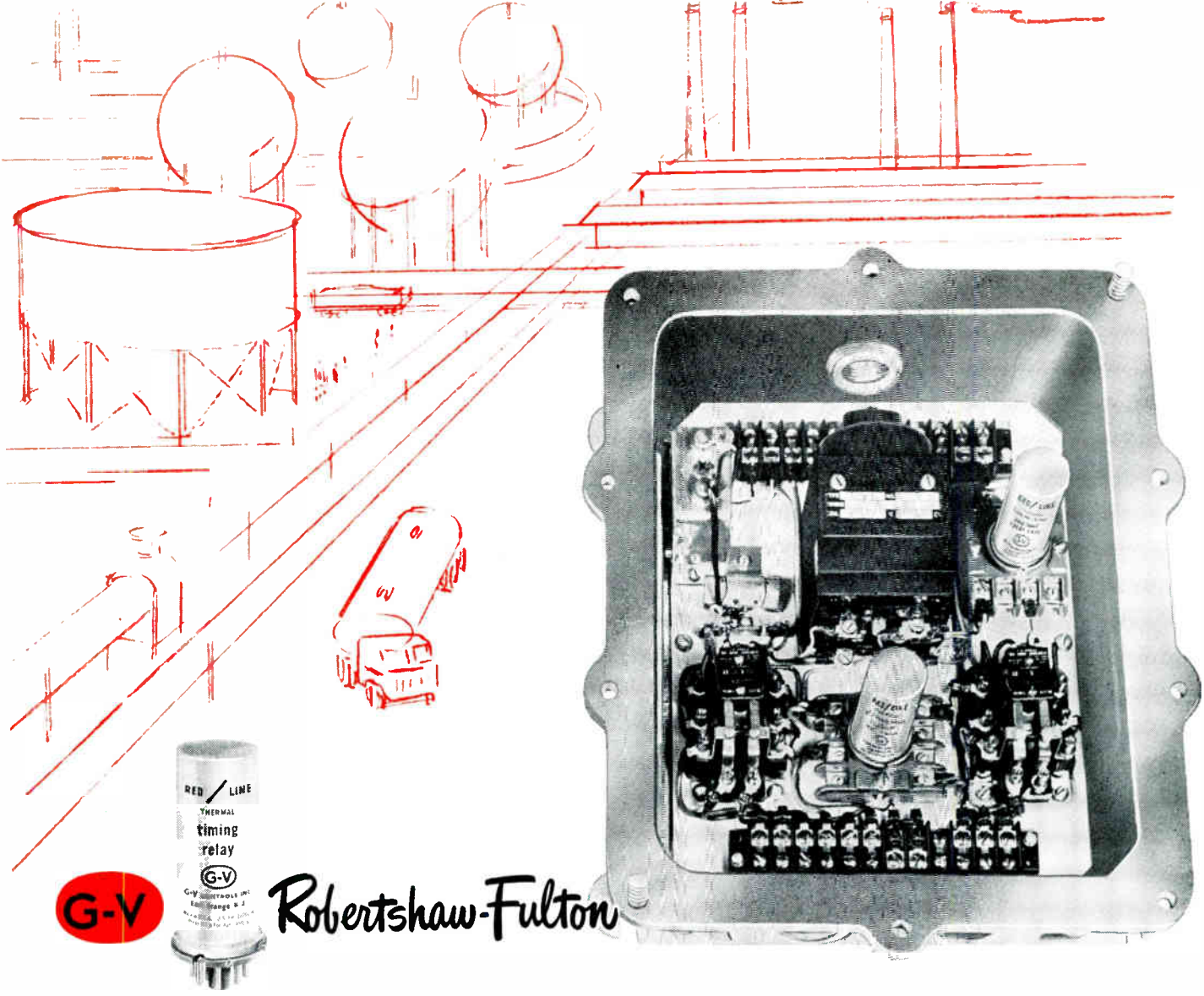
INDUSTRIES
January 1959

Circle 511 on "Opportunities" Inquiry Card, page 119

ELECTRONIC INDUSTRIES Advertisers January 1959

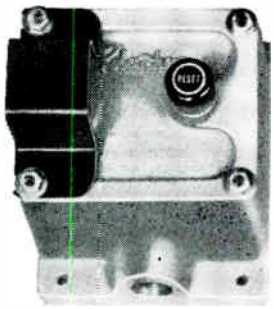
* In Operation Edition Only.

While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.



G-V Robertshaw-Fulton

G-V stands guard with Robertshaw to detect harmful vibration...



Abnormal and persistent vibration in rotating equipment usually means costly trouble. Robertshaw-Fulton's Vibraswitch Detectors and Model 651 control units detect vibration and shut down valuable equipment before damaging trouble develops.

Two G-V Red Line Thermal Time Delay Relays are used in each control unit. One blocks out the vibration detector while the protected equipment is starting up. The second times the duration of vibration and permits shut-down only if trouble persists.

Absolute reliability of every component is vital in a protective system of this sort. G-V Red Line Delay Relays meet this requirement for reliability... at surprisingly low cost. Apply them in your equipment and be safe.

Write for Publication 131.

G-V CONTROLS INC.
Livingston, New Jersey

G-V

Circle 2 on Inquiry Card, page 117

90 Watts CW Input (ICAS) up to 60 Mc
60 Watts CW Input (ICAS) at 175 Mc

The beam power tube that takes the

"SHOCKS 'N SHAKES"

New, rugged RCA-7212 Beam Power Tube is an outstanding performer in equipment subjected to severe vibration and shock

Completely new from the ground up—yet electrically equivalent to the well-known RCA-6146—the RCA-7212 is the answer for equipment designers who require a small and husky beam power tube that can STAND UP in almost any "rough and tumble" communication or industrial application.

Is Tube Shock your Problem? RCA-7212 is designed to withstand an impact acceleration of 500 g in four different positions (per MIL-E-1C*, par. 4.9.20.5).

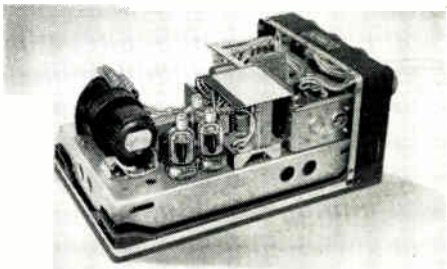
Is Tube Fatigue your Problem? RCA-7212 is designed to withstand vibrational acceleration of 2.5 g at 25 cps for 32 hours—in each of three positions (per MIL-E-1C*, par. 4.9.20.6).

Is Tube Vibration your Problem? RCA-7212 is designed to withstand low-frequency vibration of 25 cps with a fixed amplitude of 0.040 inch (per MIL-E-1C*, par. 4.9.19.1)—variable-frequency vibration at the same fixed amplitude in each of three positions through the frequency range from 10 to 50 cps and back to 10 cps (per MIL-E-1C*, par. 4.9.20.3)—and variable-frequency vibration in each of three positions through the frequency range from 50 to 120 cps at a fixed acceleration of 10 g.

If you are designing equipment for service under conditions involving severe mechanical shock and vibration, solve your problem with the RCA-7212. For long-term operating reliability and economy, nothing beats it in its class. RCA-7212 takes 90 watts CW input up to 60 Mc, and 60 watts CW input at 175 Mc (ICAS). Plate dissipation is 25 watts maximum (ICAS).

Ask for a technical bulletin on the RCA-7212 from RCA Commercial Engineering, Section A-50-Q, Harrison, N. J.

*Military Specification, Electron Tubes and Crystal Rectifiers 3 October 1955.



RCA-7212's are used in the closed-loop TV link of one of the most advanced airborne fire-control systems.

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RADIO CORPORATION OF AMERICA
Electron Tube Division ***Harrison, N. J.***