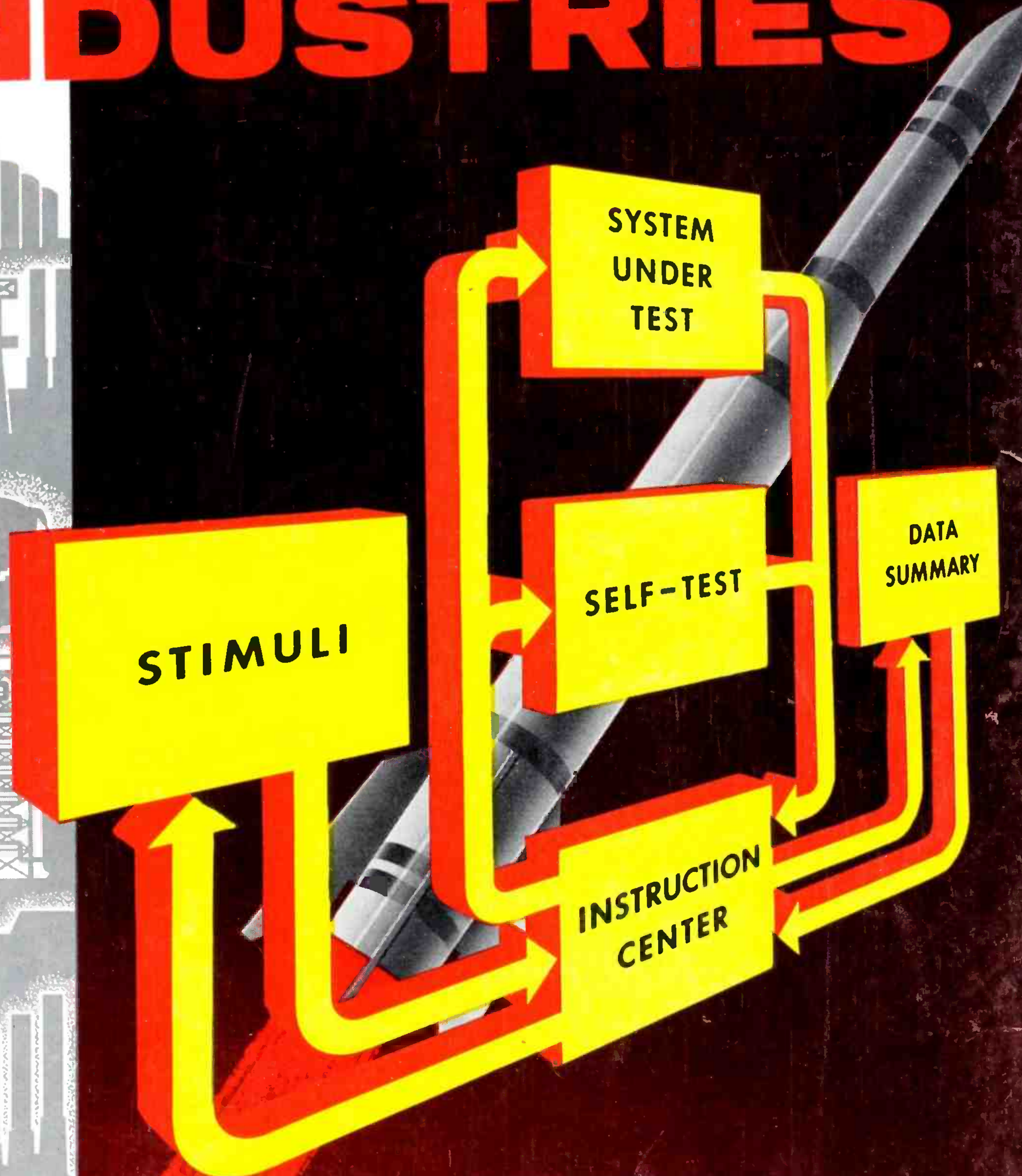
ELECTRONIC INDUSTRIES



AUTOMATIC CHECK-OUT...

for Weapons & Industrial Control Systems

/ Level DC-AC Conversion

nsistor Multiple Loop Feedback Amplifiers

April • 1958

Chilton Publication

Circle 52 on Inquiry Card, page 117

ELECTRONIC INDUSTRIES

Vl. 17, No. 4 April, 1958

MONTHLY NEWS ROUND-UP

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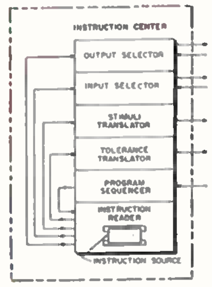
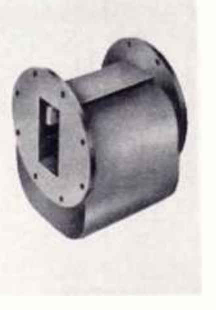


A look at the requirements of a check-out system for complex weapons and industrial control systems and the different types of equipment commercially available to do the job.

Multiple Feedback Loops 78

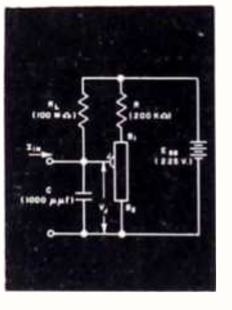
A criterion of stability is derived for calculating the stability margins of multiple loop structures. It is directly applicable to vacuum tubes, and to junction transistors in certain configurations.

Testing Ferrite Isolators 83



Low power tests of ferrite isolators does not adequately determine the optimum magnetic field for high power operation. A high power test has been developed.

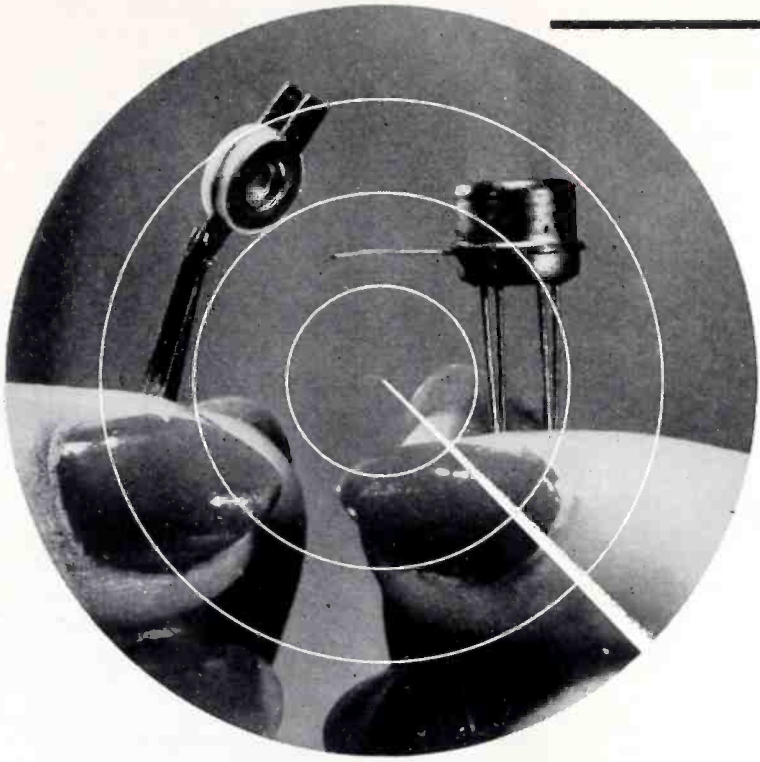
Reading Low-Level DC 86



By using high-quality silcon diodes in a ring-modulator circuit, DC signals as low as 10^{-10} amp can be measured. Output can be a logarithmic function of the input.

ELECTRONICS INDUSTRIES, April 1958, Vol. 17, No. 4. A monthly publication of Chilton Company, Executive, Editorial & Advertising offices at Chestnut & 56th Sts., Phila., Pa. Accepted as controlled circulation publication at Phila., Pa. 75¢ a copy; Directory issue (June), $3.00 a copy. Subscription rates U. S. and U. S. Possessions: 1 yr. $5.00; 2 yrs. $8.00. Canada 1 yr. 7.00; 2 yrs. $11.00. All other countries 1 yr. $18.00, 2 yrs. $30.00.

RADARSCOPE



TRANSISTOR-SIZE TUBE

The size of a shirt button, this new G.E. tube (l) operates at temperatures from 900° to 1500°F. Measuring ¼ x ⅛ in., it is constructed of layers of titanium and a special ceramic. Environment provides all the heat necessary; there is no heater.

COLOR TV shows signs of opening up slightly. Westinghouse announced last month that they had set their sights on 10% of the color TV market in 1958. Until now RCA has been carrying the color TV ball virtually by themselves, and a new name in the field should increase consumer interest considerably. New York, Los Angeles, Philadelphia, Indianapolis—in that order—lead the nation in color TV sales. RCA reports that color TV sales are 50% ahead of a year ago.

ELECTRONIC COMPUTERS are taking longer to pay for themselves than was originally estimated, according to delegates attending the annual electronics conference of the American Management Association in New York. Companies are reportedly taking a longer, harder look at the possibilities of immediate savings from electronic computers, before ordering the machines.

"TRIPLE TAKE" RADAR, using a frequency diversity technique and developed by Compagnie Generale de Telegraphie sans Fil (CSF) in France has been bought for evaluation by the Air Force Cambridge Research Center. Spokesman for Intercontinental Electronics Corp., (INTEC), U. S. representative for CSF said that the frequency diversity technique increases the radar range up to 35% and markedly improves the ability to detect targets.

TRANSISTOR EXPORTS to Europe can be expected to triple in 1958, according to the European representatives of Industro Transistor Corp. The increased business should result, they say, because of the greater use of transistors by European electronics producers, and the superiority of American-made transistors.

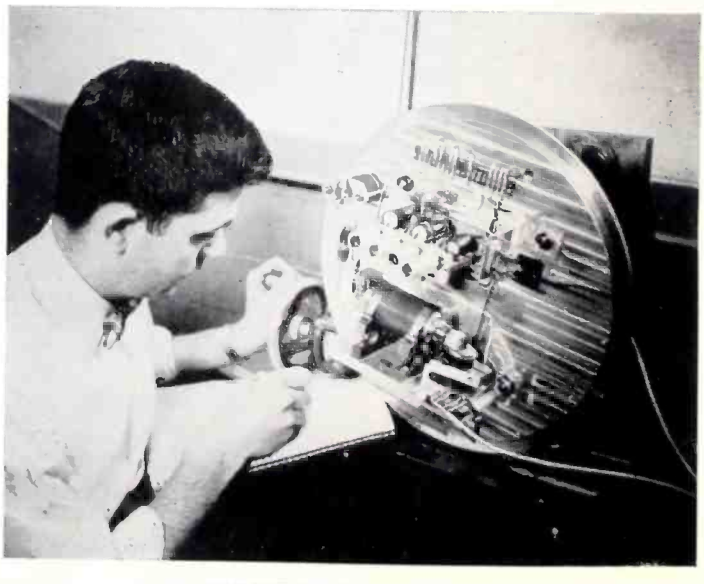
OPERATING TEMPERATURES for aircraft and missile materials in the next ten-year period will reach 2,500° F. for a few minutes and 4,000° F. for a few seconds, according to a survey made by the Aircraft Research and Testing Committee and Manufacturing Committee of the Aircraft Industries Association.

ENGINEERING COLLEGES are already doing engineering research valued at $100 million a year, and are looking for an additional $10 million of work. The American Society for Engineering Education is pointing out the important by-products—the professional development of the faculties, the new knowledge which results and the qualified students which the programs train.

LOOK FOR a string of repercussions from the current FCC hearings. With their sights zeroed on the radio-TV field the government can be expected to take pot shots at other phases of network and station operation as well. One prime target may be the dual ownership of radio and TV stations. Old argument that radio could not stand alone is hardly valid now that radio is back on its fiscal feet.

CHECKING ACCELEROMETERS

Special ultra-precision indexing platform at Sperry Gyroscope laboratory was created to measure accuracy of new integrating accelerometers at any point throughout full 360°. Master table automatically compares response in any position with correct answers.



Analyzing current developments and trends throughout the electronic industries that will shape tomorrow's research, manufacturing and operation

ANTI-RECESSION MOVE being seriously planned by the government would divert the bulk of defense spending into areas hardest hit by unemployment. This pattern of attack proved spectacularly successful in halting the minor recession of 1954, and many government officials are in favor of trying it again. But two outstanding figures in Washington are standing against it. Commerce Secretary Sinclair Weeks opposes the move because it greatly increases the powers of Labor Secretary James Mitchell, and Defense Secretary Neil McElroy opposes it because, though a great chunk of the government spending is for missiles, few if any missile plants are located in the affected areas.

MEXICAN PRODUCTION of TV and radio receivers and parts in 1957 increased substantially over 1956 leveis, but a slackening in consumer demand, beginning in June 1957, caused some retrenchment. As a result of a large volume of factory and dealer inventories held at the end of 1957, output is not expected to increase greatly, if at all, in 1958.

FIRST TESTS of a pictorial navigation device for helicopters will get underway in New York City in the near future. New York Airways pilots will see their position displayed on a map, scaled 850 ft. to the inch, mounted in the cockpit.

PRINTED CIRCUIT business is leveling off, according to the Institute of Printed Circuits. Sales during 1957 were about 10% over 1956, and the second half of 1957 ran only 6% ahead of the comparable months of 1956. The total market is estimated at $10.4 million. There are approximately 50 manufacturers "seriously in the printed circuit business." Last month Corning Glass Works entered the field with a new printed circuit process—Fotoceram—which offers high reliability and exceptional heat-resisting properties. Primary applications will be to military gear. Corning officials explained their jump into this rather small market by pointing out that their market research indicates a market of more than $30 million, rather than the $10.4 estimated by the IPC.

NUCLEAR POWER INDUSTRY may get a helping hand from the government in the form of lower atomic fuel costs to private and public utilities. The present high price of nuclear fuel is considered a principal factor in retarding the development of atomic power.

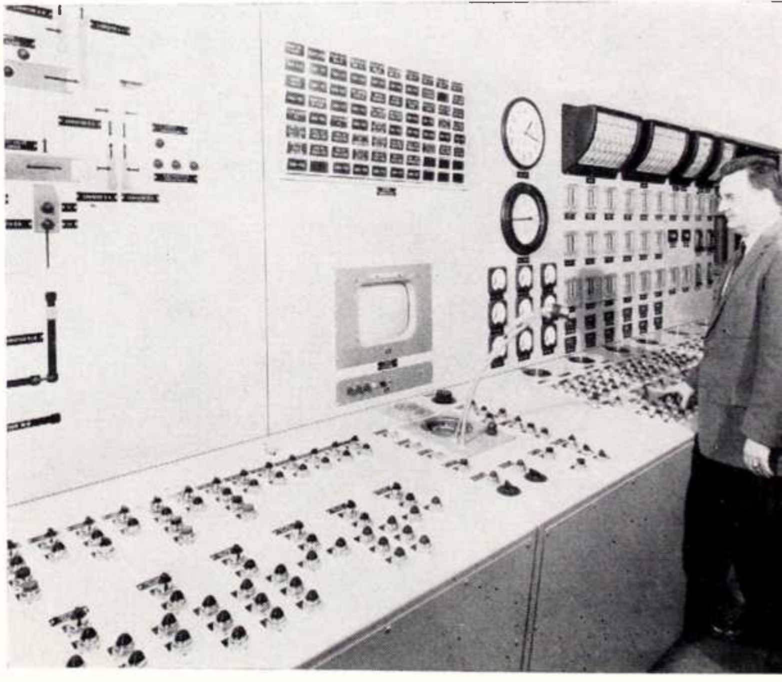
NEW METAL-TO-CERAMIC bonding technique developed for the Air Force by American Lava Corp. will speed up mass production of vacuum tubes, particularly those for high temperature applications. Formerly the metal material was put on the ceramic by hand. Now it is pressed on both ends of the vacuum tube cylinder structure by machine and ceramic material is impregnated with the metal powder. A single operation matures the ceramic, sinters the metal and develops the bond. The operation is called the "pressed powder technique."

TAPE STANDARDS have been established by the Record Industry Assoc. of America, Inc. A test tape has been circulated to all members and now filed in a temperature controlled vault. The Frequency Response Standards of the tape have been recommended as standard for the industry. William S. Bachman, chairman of the RIAA Engineering Committee states that RIAA has no objection to any tape manufacturer identifying his product as complying with RIAA standards so long as it shows the same characteristics as the standard tapes held by the association.

MICROWAVE INDUSTRY, looking to the future, has just completed a study which indicates that, engineering-wise, as many as 1458 microwave stations could be accommodated in an urban or equivalent small area, having 360° angular access and using R-F channels in the 900, 2,000, 6,000 and 11,000 MC bands. Over 700 stations could be accommodated in an area having a limited access of 180°. The study was made by the Operational Fixed Microwave Council and Microwave Services Inc.

AUTOMATIC PLANT CONTROL

This electronic control panel, complete with TV screen which gives the operator a continuous picture of the end product, is the nerve center of U. S. Steel's new sintering plant at Youngstown, O. The $60,000 panel went into operation last month. Dwight-Lloyd Div. of McDowell Co., Cleveland, is the designer.



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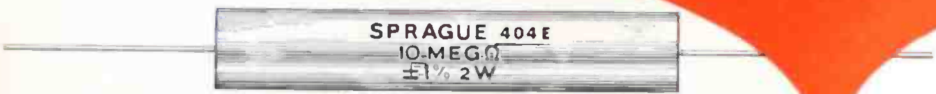

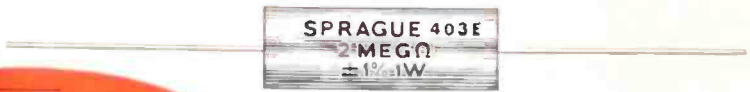

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Circle 1 on Inquiry Card, page 117

As We Go To Press . . .

Over-the-Horizon TV Proves Successful

The first use of "over-the-horizon tropospheric scatter links" for television transmission has proved successful in its initial operations between Miami, Fla. and Havana, Cuba. Details on the operation were delivered to the AIEE Winter General Meeting.

Engineers of AT&T and Radio Corp. of Cuba said that their experience showed that where terrain conditions call for single hops of the order of 200 miles, over-the-horizon systems offer significant advantages over other transmission methods.

The Miami-Havana transmission involves four links, two links of microwave equipment totaling 37 miles linking Miami to the over-the-horizon terminal equipment, a 185-mile "scatter" circuit terminating in Guanabo, Cuba, and a 14-mile microwave link carrying the signal into Havana.

The engineers concluded, "Scatter circuits are expected to be particularly advantageous for connecting islands, for crossing isolated regions with rugged intermediate terrain, and in areas where frequency congestion in the radio frequency bands between 500 and 2,000 MC is not severe."

Gen. Cook Appointed Chief of Signal R&D

Brig. Gen. Earle F. Cook, currently Commanding General of the U. S. Army Signal Engineering Laboratories, Ft. Monmouth, N. J., has been appointed Chief of the Research and Development Division in the Office of the Chief Signal Officer, Washington, D. C.

MISSILE TRACKER

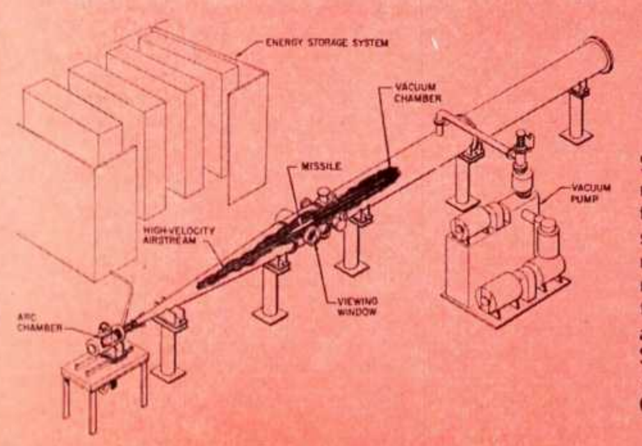
Higher than a 7-story building this giant 60-ft wide antenna built for ARDC by Radiation Inc. at Melbourne, Fla., is one of five that will pick up telemetering information from highflying-ballistic missiles.

3,000 Mile Range For New Army Radar Units

The Army has reportedly found a way to quadruple the power of existing radar devices and perhaps double their detection range.

The new 21,000,000-watt radar demonstrated last month by the Army is four to five times more powerful than the most potent existing equipment. It reportedly has a range of about 3,000 miles, and will considerably increase the warning time on supersonic enemy missiles. The time was previously estimated at 15-20 minutes before impact.

Cornell Aeronautical Laboratory, Buffalo, N. Y. developed the new radar.



"HOTSHOT" WIND TUNNEL

Speeds up to 15,000 mph and temperatures hotter than the sun's surface will be reproduced in this new 44-ft. long tunnel being built at Lockheed Missile Systems Div., research lab, Palo Alto, Calif.

"Framelok" Grids, New Tube Design

Latest news in the renaissance of the vacuum tube is Sylvania Electric Products' "Framelok" grid construction. In the new design, grid elements are formed by mounting the grid wires on flat, one-piece frames. The ladder-like grids can be more precisely formed than present spirally-wound grids.

Perfect alignment, and stability with electric and thermal cycling are vastly improved, according to company spokesmen. The heavy frame more readily dissipates heat, thus resulting in lower tube element temperatures.

Among the more important advantages of the new construction are: lowered failure rate, less variation of electrical characteristics among tubes of the same type, reduced occurrence of shorts, and less noise and microphonics.

Sylvania points out that producers of the tubes will welcome the simplified automatic manufacture possible with the new design.

Pilot production has been started on the 6FH6 beam power pentode, designed to supersede the 6DQ6 TV horizontal deflection tube. Sylvania is confident the new type of construction will be rapidly applied to all new tube types and will postpone the encroachment by transistors on the tube market.

TV set designers and servicemen will welcome the possibility of lower failure rates in horizontal deflection circuits, one of the more common causes of service calls on TV sets. The slightly greater cost of production volumes of the tubes should be more than offset by the increased reliability, Sylvania points out.

Low screen grid currents, and other differences in parameters will make necessary the modification of conventional circuits to make best use of the new tubes.

The new tube was exhibited at last month's IRE show, and the cost of the 6FH6 in small sample orders was estimated at about $1.75. Drastic reductions in price are expected with large volume production.

More News on Page 8

ELECTRONIC INDUSTRIES

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

Circle 3 on Inquiry Card, page 117

ELECTRONIC SHORTS

▶ One of two concerns seeking to install a pay television circuit in Los Angeles has withdrawn its request for a franchise because of a referendum scheduled on the issue. The other concern will abandon its efforts if the referendum measure is voted on at the June 3 primary instead of at the November general elections. International Telemeter Corp., allied with Fox West Theatres Corp., withdrew; Skatron TV, Inc. is the other concern. International gave up to avoid "the needless expenditure of public funds for a referendum that is now complicated by issues and forces unrelated to pay television."

▶ A highly-accurate pictorial navigation device for helicopters will be evaluated in the New York area on behalf of the Airways Modernization Board. Airborne Bendix-Decca equipment will be carried on scheduled helicopter flights of New York Airways. Helicopter position will be displayed on a pictorial map with relation to the established tracks for the NYA routes. Map scale will be as large as 850 ft. to the inch.

▶ TERRIER, a Navy guided missile development, has won for the Director of the Applied Physics Laboratory, Johns Hopkins Univ., and four members of his staff the Navy's highest public service award. Distinguished Public Service Awards were presented to Dr. Ralph E. Gibson, Director, Richard B. Kershner, Dr. Alexander Kossiakoff, Robert C. Morton, and Henry H. Porter.

▶ An engineering staff organization, known as C Stellarator Assoc. has been established by the Allis-Chalmers Mfg. Co. and RCA to design and build a facility at Princeton Univ. for advanced research into controlled thermonuclear reactions.

▶ Solid-electrolyte tantalum electrolytic capacitor prices were dropped approx. 25% by the Sprague Electric Co. Price reduction was ascribed to increased production volume and cost savings resulting from the opening of new facilities.

▶ The multi-million-dollar data processing phase of a super-radar system for the detection of intercontinental ballistic missiles will be performed by Sylvania Electric Products, Inc. Sylvania is a major subcontractor of the Radio Corporation of America which is charged with the overall development and production.

▶ The Army Map Service expects to reduce mapping errors to feet instead of miles by using the Explorer. Dr. John O'Keefe, AMS geodesist sees the satellite as a tool which will reduce errors in the Pacific region from ¾ mile to 300 ft. Formerly, AMS worked from place to place over the earth's surface in a narrow zone just above the surface much the same as a bug crawling on an apple. Now, by radio tracking the Explorer, information is gathered which permits standing off and taking a look at the earth, thus determining its exact shape.

▶ Nike Hercules missile systems will be operational in four selected areas by June. The defenses which will be the first to establish Hercules firing capabilities are New York, Washington-Baltimore, Chicago, and Philadelphia. The new systems will be located at converted Nike Ajax sites.

▶ The atomic "breather" reactor now under construction near Monroe, Michigan, will compete economically with conventional power plants within two and three generations. So said Robert W. Hartwell, its General Manager, at the University of Michigan. Mr. Hartwell described the plant as "the safest reactor that will ever be built."

▶ Descriptions of 58 patents owned by the U. S. Government and held by the Atomic Energy Commission have been released. The Commission will grant non-exclusive, royalty-free licenses on the listed patents, as part of its program to make non-secret technological information available for use by industry. Commission-held patents and patent applications released for licensing now total 1,327.

As We Go To Press (cont.)

Receiving Tube Mfrs. Ripped By Judge

A New York City judge ripped the receiving tube industry last month for permitting tube counterfeiters to swindle more than $5,000,000 from the industry and the public during the years from 1953 to 1957.

In passing sentence on ten persons and six corporations convicted of tube re-branding the judge said that tube manufacturers have long been aware that the practice existed, and in fact aided the swindle by giving credit on tubes whose code numbers they knew were falsified.

The General Electric Co. was singled out for credit in taking measures to detect the re-branding of defective tubes.

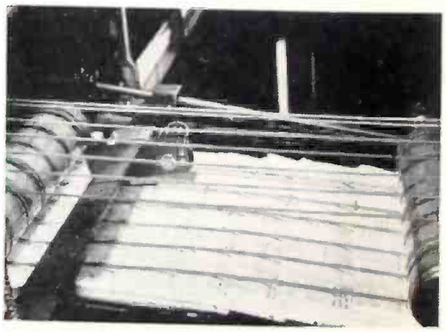
A total of 45 individuals and thirty-two corporations have been indicted since the investigation started in October 1956.

1st IGY Discovery—New Mountain Range

The first fruits of the massive effort going into the International Geophysical Year (IGY) are showing up. The first is a previously unknown mountain range, over 5,000 ft. high, on the floor of the Arctic Ocean.

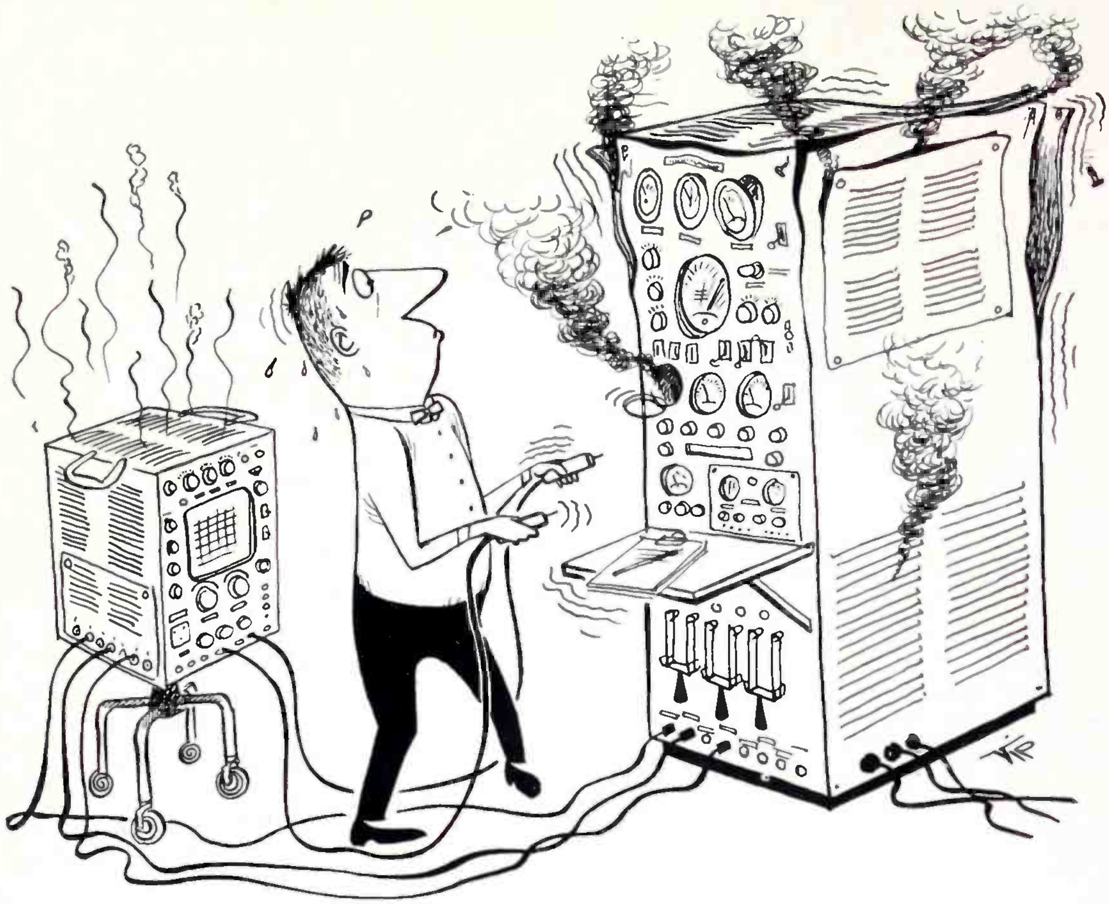
Dr. Michael Ference, member of the satellite instrumentation committee, said, "Location of this range may prove of inestimable value in charting ocean currents, and these currents also are responsible to a great degree for the weather we may have tomorrow, or next week, or even during the next six months."

TRANSISTORIZED COUNTER



New RCA counting system, shown here at The Detroit News, can total simultaneously the output of 40 different operations. Completely transistorized, it includes a memory system and counts up to 120,000 units/min.

How to Save Man Days in Research and Testing Involving Transients— **No. 6** *of a series*



PROBLEM: Transient Analysis—Economy in Testing Procedures

Using conventional oscilloscopes, careful analysis and study of nonrecurrent wave forms in complex and costly electronic equipment involves any number of tests and retests. While ferreting out spurious signals—caused by malfunctioning components, loose connections, pigtails of solder or other circuit troublemakers—fatigue and taxed patience result in a **waste of** both **time** and **money.**

SOLUTION: The Hughes MEMO-SCOPE® oscilloscope holds transient wave forms in place until they are intentionally erased. There is no more need for repetitious testing which oftentimes damages costly electronic equipment. A **storage type oscilloscope,** it allows careful study and analysis of wave forms until all desired information is obtained.

HUGHES MEMO-SCOPE OSCILLOSCOPE

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International Airport Station, Los Angeles 45, California

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Circle 4 on Inquiry Card, page 117

Coming Events

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

Apr. 2-4: Conf. on Automatic Optimization, AIEE, IRE, ISA, AIChE & ASME; Univ. of Delaware, Newark, Del.

Apr. 8-10: Symp. on Electronic Waveguides, IRE & Polytechnic Inst.; Engineering Societies Bldg., New York City.

Apr. 8-10: 6th National Conf. on Electromagnetic Relays; at Oklahoma State Univ., Stillwater, Okla.

Apr. 10-12: Regional Conf. & Electronics Show, by IRE; at Municipal Audit., San Antonio, Tex.

Apr. 12-13: 11th Regional Seminar, by NEDA & Electronic Industry Show Corp.; at Mark Hopkins Hotel, San Francisco, Calif.

Apr. 13-18: American Chemical Soc. National Mtg.; at San Francisco, Calif.

Apr. 14-16: Conf. on Automatic Techniques, by IRE, ASME & AIEE; at Statler Hotel, Detroit, Mich.

Apr. 14-17: 15th Annual Radio Component Show; Grosvenor House & Park Lane House, London, W. 1, England.

Apr. 14-17: Design Engineering Show, by ASME; at International Amphitheatre, Chicago, Ill.

Apr. 15-17: Annual Welding Show, by AWS; at Kiel Auditorium, St. Louis, Mo.

Apr. 16-25: Instruments, Electronics & Automation Exhibition; at Olympia Hall, London, England.

Apr. 17-18: 2nd Annual Mtg., Institute of Environmental Engineers; Hotel New Yorker, New York City.

Apr. 18-19: Spring Tech Conf. on TV and Transistors, by IRE; Engineering Soc. Bldg., Cincinnati, Ohio.

Apr. 20: Directors Mtg., National Alliance of TV & Electronics Service Ass'n.; Springfield, Mo.

Apr. 20-24: Annual Meeting of the Scientific Apparatus Makers Ass'n; at El Mirador Hotel, Palm Springs, Calif.

Apr. 21-25: 83rd Conv., SMPTE; at Ambassador Hotel, Los Angeles, Calif.

Apr. 22-24: Electronic Components Conference, IRE, WCEMA, AIEE, & EIA; at Ambassador Hotel, Los Angeles, Calif.

Apr. 23: Annual Meeting, PACE; Governor Clinton Hotel, New York City.

Apr. 24-26: URSI Spring Mtg., by IRE; at Willard Hotel, Washington, D. C.

Apr. 24-27: Conv. of American Women in Radio & TV; at San Francisco, Calif.

Apr. 27-May 1: Annual Conv. of NAB; at Biltmore & Statler Hotels, Los Angeles, Calif.

Apr. 27-May 1: Spring Mtg., by Electrochemical Society; at Statler Hotel, New York City.

Apr. 29: Annual Dinner Mtg., Broadcast Pioneers at Los Angeles, Calif.

Apr. 30-May 2: Tech. Conf. & Trade Show, IRE; Sacramento, Calif.

May 4-7: 4th National Flight Test Instrumentation Symp., ISA; Park Sheraton Hotel, New York City.

May 5-7: National Symp. on Microwave Theory & Techniques, IRE; at Stanford Univ., Stanford, Calif.

May 6-8: 1958 Western Joint Computer Conf., IRE, ACM & AIEE; at Ambassador Hotel, Los Angeles, Calif.

May 6-9: Spring Mtg., Acoustical Society of America; Washington, D. C.

May 7-17: 2nd U. S. World Trade Fair; at New York, N. Y.

May 12-14: National Aero & Navigational Electronic Conf., IRE; at Dayton, O.

May 12-14: National Midwestern Mtg. on Guided Missiles, IAS; at Hotel Chase, St. Louis, Mo.

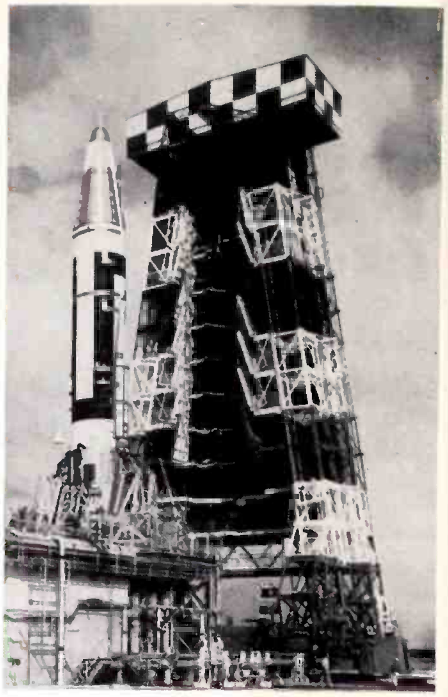
May 12-14: Symp. on Instrumental Methods of Analysis, ISA; Shamrock Hilton Hotel, Houston, Tex.

May 19-21: 1958 Electronic Parts Distributors Show: Conrad Hilton Hotel, Chicago 3, Ill.

Abbreviations:

ACM: Association for Computing Machinery
AIChe: American Institute of Chemical Engineers
AIEE: American Inst. of Electrical Engrs.
ASME: American Society of Mechanical Engineers
AWS: American Welding Society
EIA: Electronic Industries Assoc.
IAS: Inst. of Aeronautical Sciences
IRE: Institute of Radio Engineers
ISA: Instrument Society of America
NAB: National Association of Broadcasters
NEDA: National Electronic Distributors Association
PACE: Producers of Associated Components for Electronics
SMPTE: Soc. of Motion Picture & TV Engineers
WCEMA: West Coast Electronic Manufacturers Association

"BIRD" CAGE



Gantry tower used in readying the Atlas ICBM is rolled away from launch stand, leaving missile poised for flight, at the AFMTC, Cape Canaveral, Fla. Convair-Astronautics designed and built the Atlas.

NSIA Sets Up Missile Advisory Committee

The National Security Industrial Association, after consultation with Wm. M. Holaday, Dept. of Defense Director of Guided Missiles, has established a Missile Advisory Committee. The organization will be composed of leading figures of industry and will provide industrial advice and guidance to the government on problems related to the missile program.

The committee includes: Dr. Allen B. DuMont, DuMont Labs; Dr. Carl A. Frische, pres. of Sperry Gyroscope Co.; and RAdm L. B. Richardson, USN (Ret.), sr. vice-pres., General Dynamics Corp.

Merger Called Off

The proposed acquisition by Litton Industries Inc. of Aircraft Radio Corp. through an exchange of stock is off, both companies have announced.

The number of Aircraft Radio shares deposited for exchange was not equal to the 80% required by the date of termination of the offer. An official of ARC said that the total stock deposited came to 67% of the shares outstanding.

More News on Page 21

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NEW EECO "T-SERIES" *Germanium* TRANSISTOR PLUG-IN CIRCUITS

Actual size.

. . . A compatible series of LOW-COST EECO plug-in circuits that operate safely and reliably in $-45°C$ to $+65°C$ environment . . . permit you to concentrate on system design instead of routine circuit design.

SAVE TIME!
SAVE COST!
SAVE SPACE!

FEATURES

- Low Cost
- 250 kc circuits
- High Packing Density:
  1 square inch per container
  $2^{1}/_{4}$ cubic inches per container
  Multiple circuits per container
- All units compatible with all others
- Low power consumption (e.g., Flip-Flop: 60 mw)
- Repairable
- Long life and reliable operation (Design Criteria on request)
- Sealed
- Use standard hardware and standard punching
- Separate case and signal grounds
- Pin connections arranged for easy buss wiring of power, signal ground, and case ground.
- Diode Logic circuits contain Integral Emitter Followers to permit cascading. Any dc logic can drive any other dc logic. For example, "Or" circuits can drive "And" circuits and vice versa.
- Both NPN and PNP Emitter Followers

AVAILABLE CIRCUITS

- Flip-Flop, three types:
  - RST (Reset, Set, Trigger)
  - RS (Reset, Set)
  - T (Trigger)
- Squaring Amplifier
- One Shot
- Emitter Followers, PNP, single, dual, and triple
- Emitter Followers, NPN, single, dual, and triple
- DC "And" Gates
- DC "Or" Gates
- Reset Generator
- Pulse Inverting Amplifier, Dual
- Pulse Amplifier
- Pulse "And" Gates

ALSO AVAILABLE SOON

- Ring Counter
- Linear Amplifier
- Multivibrator
- Blocking Oscillator
- Crystal Oscillator
- Pulse "Or" Gates

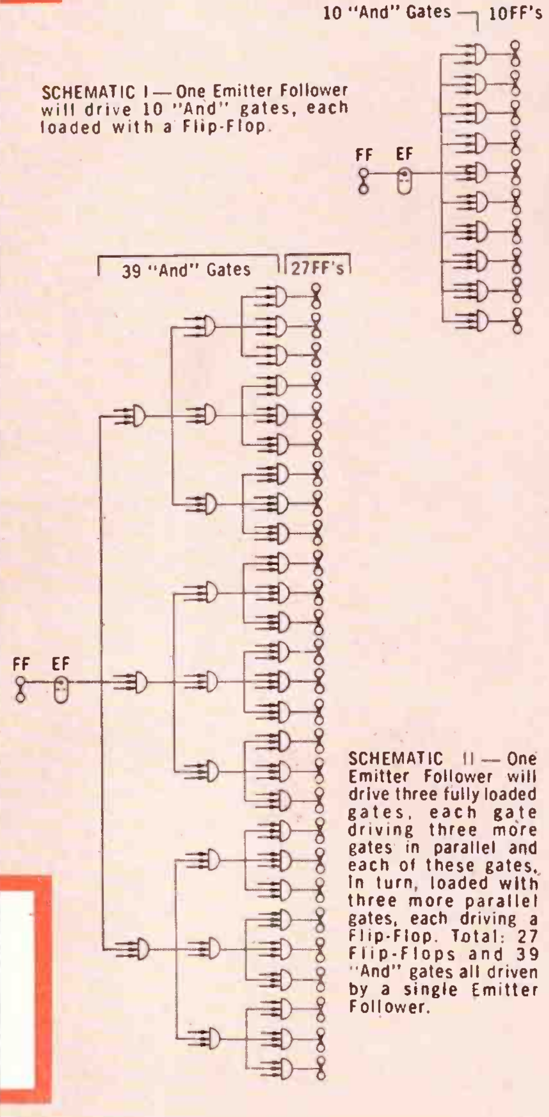
GUARANTEED SPECIFICATIONS

- Dimensions: Body $^{7}/_{8}$" diameter; seated height $2^{1}/_{4}$"; mount on 1" centers.
- Frequency Range: 0-250 kc.
- Temperature Range: $-45°C$ to $+65°C$.
- Power Requirements: -12 volts dc $\pm 10\%$. (If diode logic is used, a second voltage of $+12$ volts dc $\pm 10\%$ is also required.
- Signal Range: "0" is — 10 volts
  "1" is — 3 volts
- Rise Time: (Positive-going output) 0.8 μs or better
  (Negative-going output) 2.0 μs nominal
- Emitter Followers: One Emitter Follower will drive 10 "And" gates, each loaded with a Flip-Flop (see Schematic I); OR will drive three fully loaded gate legs. (See Schematic II for example of three gates fully loaded. Note that this totals 27 Flip-Flops and 39 "And" gates all driven by a single Emitter Follower.)

DESIGN CRITERIA

EECO Germanium Transistor Plug-In Circuits safely and dependably meet the guaranteed specifications because of the conservative design approach that has been consistently observed in developing them. No selection of transistors or other parts has been permitted. Circuit design is based on saturated transistor operation. Units are typically designed for 50% greater frequency range than rated in specifications.

Detailed design criteria are available on request to aid the systems engineer in properly evaluating the circuits from an engineering standpoint.



SCHEMATIC I — One Emitter Follower will drive 10 "And" gates, each loaded with a Flip-Flop.

SCHEMATIC II — One Emitter Follower will drive three fully loaded gates, each gate driving three more gates in parallel and each of these gates, in turn, loaded with three more parallel gates, each driving a Flip-Flop. Total: 27 Flip-Flops and 39 "And" gates all driven by a single Emitter Follower.


51 Plug-In Circuits mounted on a 19" x $3^{1}/_{2}$" panel.

WRITE FOR FULL INFORMATION AND PRICE LIST

WE CAN PACKAGE YOUR SPECIAL OR CUSTOM CIRCUITS, BOTH QUICKLY AND AT LOW COST. WRITE FOR DETAILS.

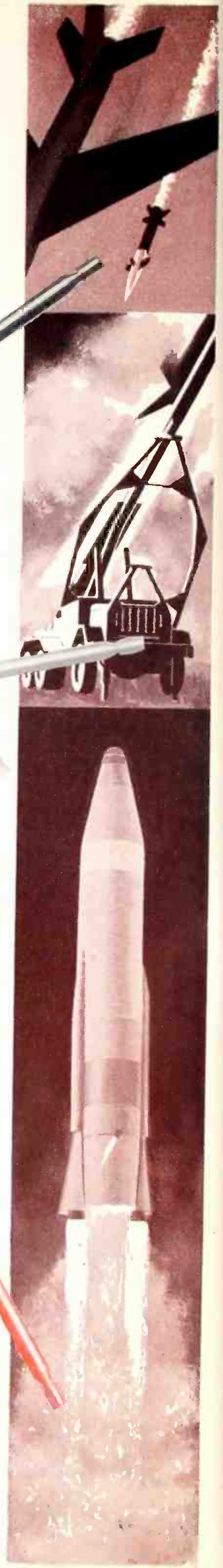
ENGINEERED ELECTRONICS Company

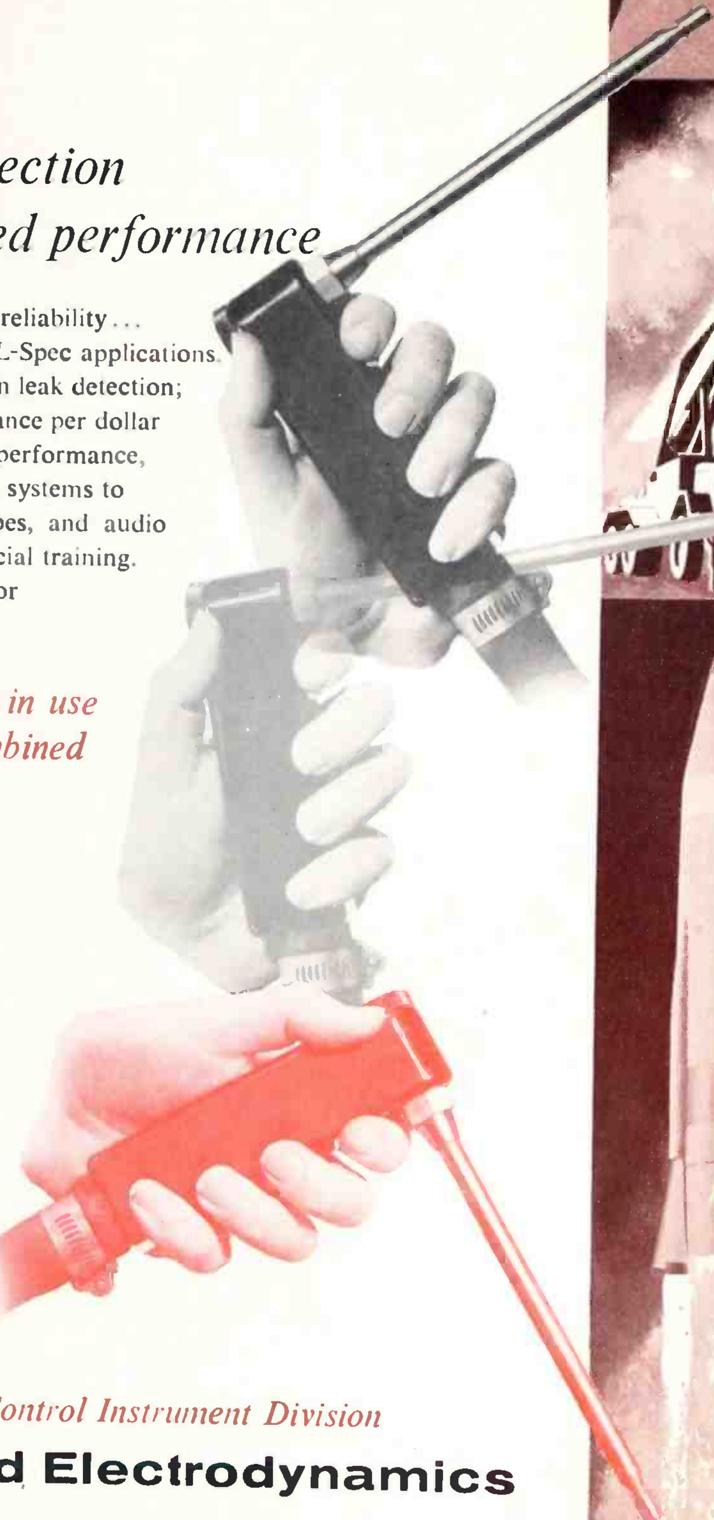
ENGINEERED ELECTRONICS COMPANY
(a subsidiary of Electronic Engineering Company of California)

506 East First Street • Santa Ana, California

Circle 7 on Inquiry Card, page 117

Don't gamble with MIL Specs





...get positive leak detection with CEC's unsurpassed performance

Consolidated Leak Detectors set the standard for reliability... quickly pay for themselves in all types of critical MIL-Spec applications. CEC offers two models: one provides the ultimate in leak detection; the other, a low cost unit, gives the highest performance per dollar invested. Ruggedly designed for long-life precision performance, CEC Leak Detectors feature stainless-steel vacuum systems to minimize contamination, adjustable "sniffer" probes, and audio alarms. Easy, convenient operation requires no special training. Contact your nearest CEC Field Office, or write for the Bulletins indicated below.

More CEC Leak Detectors are in use today than all other makes combined

24-110...Ultra-sensitive. Recommended for large, complex systems and high-vacuum products. Detects at least 1 x 10^{-10} atm cc/sec of air. Weighs 470 lbs. Operates on 115 volts, 60 or 50 cycles. Ask for Bulletin CEC 1838-X17.

24-210...Low cost. Portable with no sacrifice of reliability. Detects at least 1 x 10^{-9} atm cc/sec of air. Weighs 145 lbs. Available with mobile workstand. Operates on 115 volts, 60 or 50 cycles. Bulletin CEC 1830-X32.

Analytical and Control Instrument Division

Consolidated Electrodynamics

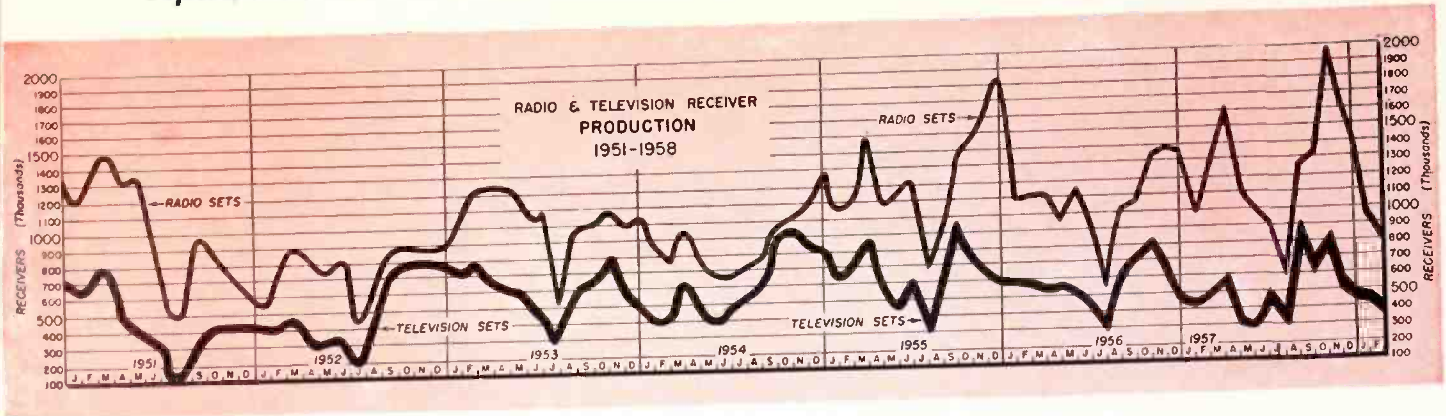
CEC *300 North Sierra Madre Villa, Pasadena, California*

OFFICES IN PRINCIPAL CITIES THROUGHOUT THE WORLD

Facts and Figures Round-up
April, 1958

ELECTRONIC INDUSTRIES

TOTALS



ESTIMATES & PROJECTIONS OF B.S.E.E. DEGREE, 1940-1964

Year	All Eng's Degrees	Electrical Degrees	Year	All Eng's Degrees	Electrical Degrees
1940	15,100	2,880	1956	28,000	6,600
1945	8,500	1,540	1957	30,000	7,600
1948	31,000	6,716	1958	37,000	8,300
1949	47,000	11,042	1959	37,000	8,300
1950	52,000	13,270	1960	38,000	8,500
1951	42,000	9,488	1961	39,000	8,750
1952	30,000	6,453	1962	39,000	8,750
1953	24,000	4,899	1963	40,000	9,000
1954	22,000	4,485	1964	43,000	9,700
1955	23,000	4,900	1965	43,000	9,700

—Basic data obtained from U. S. Office of Education

RANGE OF MONTHLY STARTING SALARIES (1958)

Field	No. Companies Reporting	Average Bottom of Range	Average Top of Range	Average Spread
Engineering	151	$451	$496	$45
Accounting	116	$402	$437	$35
Sales	97	$398	$435	$37
General Business Trainees	106	$393	$428	$35
Other Fields	52	$410	$449	$39

—From a report by Frank S. Endicott, Director of Placement, Northwestern University

TOTAL RADIO SALES FOR 1957

	Auto Set Output	Radio Production	Radio Sales*
January	521,624	1,085,529	563,363
February	522,859	1,264,765	525,029
March (5 wks)	597,532	1,609,073	730,584
April	380,452	1,115,813	543,092
May	396,151	1,023,771	547,480
June (5 wks)	416,058	1,088,343	729,421
July	256,279	612,588	597,484
August	301,971	965,724	710,553
September (5 wks)	446,419	1,610,748	893,366
October	522,746	1,569,180	923,849
November	563,066	1,688,868	925,620
December (5 wks)	570,617	1,793,336	2,031,444
TOTAL	5,495,774	15,427,738	9,721,285

*These figures do not show sales to auto manufacturers.

—Electronic Industries Association

SELECTED COMMUNICATION EQUIPMENT PRODUCTION, 1957

Product	Unit of measure	Production (quantity) Total	1st quarter	2nd quarter	3rd quarter	4th quarter
Telephone sets	Sets	8,073,472	2,306,126	2,118,440	1,583,652	2,065,254
Dial central office equipment	Lines	4,669,699	1,260,729	1,287,174	995,293	1,126,503
Manual central office equipment	Positions	6,720	1,941	1,888	1,419	1,472
Manual PBX equipment	Positions	16,401	5,052	4,277	3,577	3,495
Dial PBX equipment	Lines	537,546	142,372	148,470	126,751	119,953

—U. S. Department of Commerce

GOVERNMENT ELECTRONIC CONTRACT AWARDS

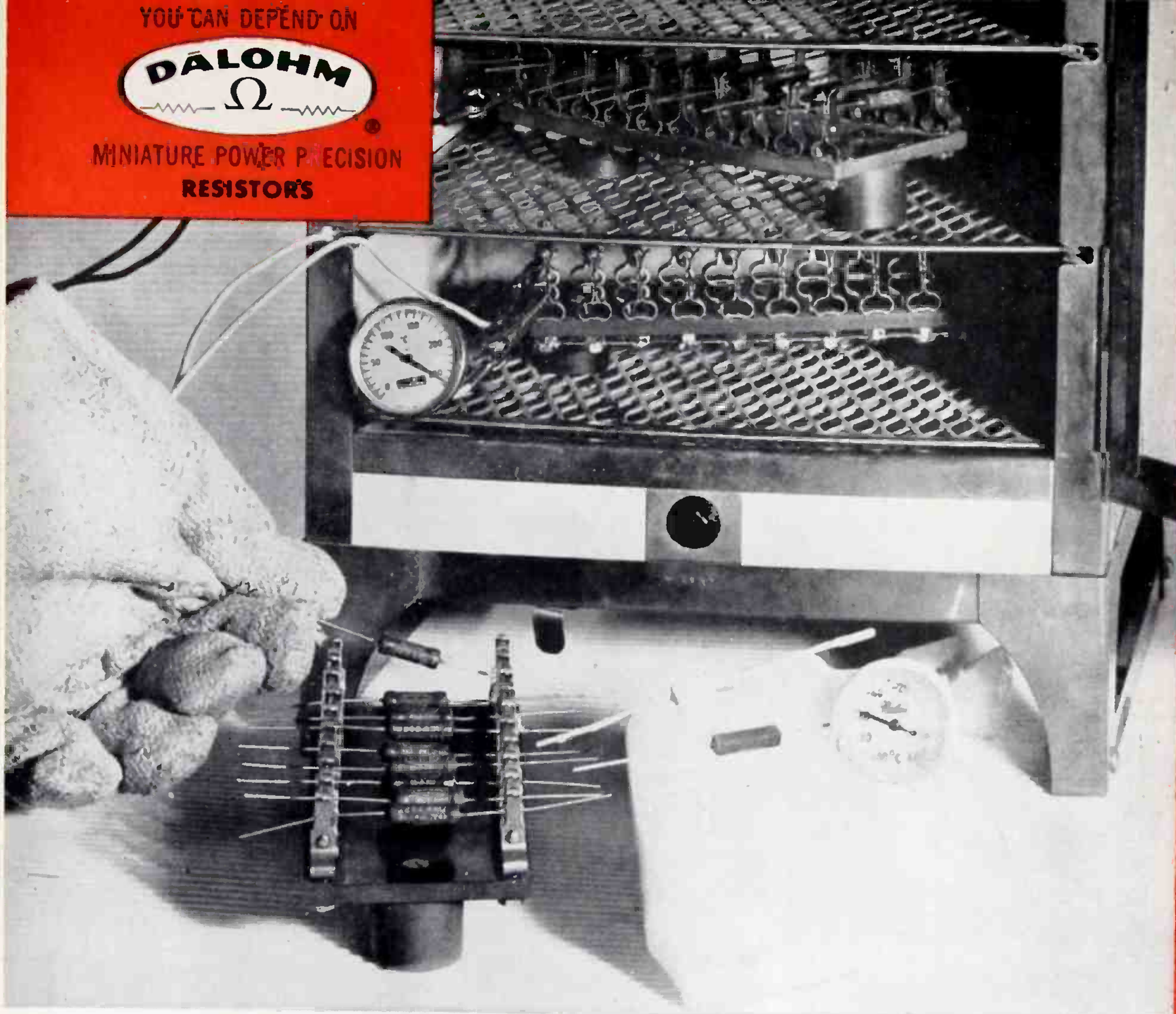
This list classifies and gives the value of electronic equipment selected from contracts awarded by government agencies in February 1958.

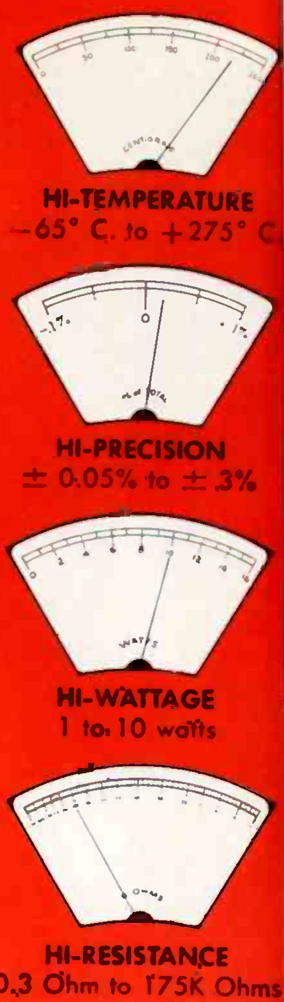
Accelerometers	43,125
Amplifiers	217,878
Antennas	350,833
Batteries, dry	946,206
Batteries, storage	183,360
Battery packs	73,010
Cable assemblies	36,852
Capacitors	59,841
Circuit breakers	75,915
Communication systems	2,000,000
Computers & Accessories	82,176
Connectors	28,956
Generators, signal	27,862
Headsets	37,225
Indicators	2,978,089
Infrared equipment	583,820
Isolators	31,500
Meter, frequency power	175,222
Oscillographs	28,240
Patching racks, video	54,000
Power supplies	74,251
Radar Equipment	2,066,625
Radiac Equipment	45,750
Radio direction finders	149,487
Radio equipment	39,700
Radio receivers	63,457
Radio sets	3,364,250
Radomes	44,782
Reactors	36,478
Recorders & accessories	86,835
Recorders-reproducers	80,221
Relays	78,312
Resistors	335,955
Semiconductor diodes	64,090
Switches	239,378
Syncro signal amplifiers	108,477
Tape, recording	92,225
Television equipment	34,025
Test sets	116,677
Test sets, radio	124,909
Transformers	70,660
Tubes, electron	3,338,727
Ultrasonic equipment	25,419
Wire & cable	2,908,389

YOU CAN DEPEND ON

DALOHM Ω ®

MINIATURE POWER PRECISION RESISTORS





RS Resistors take severest THERMAL SHOCK . . . yet retain 100% reliability!

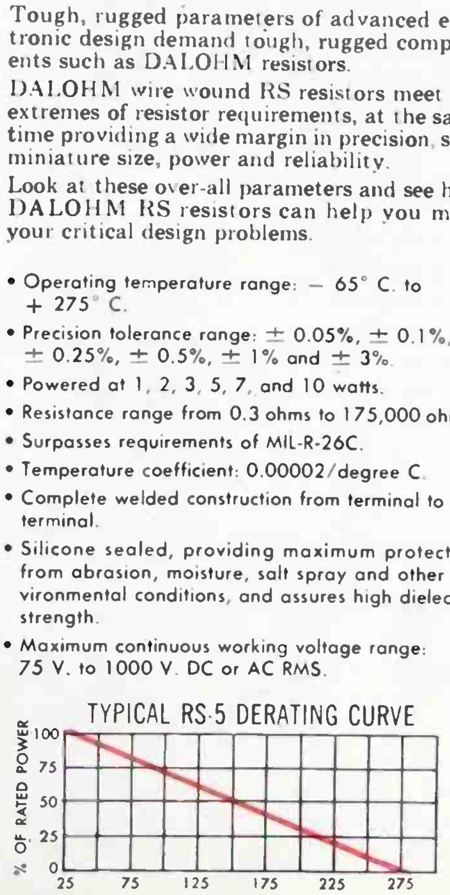
Tough, rugged parameters of advanced electronic design demand tough, rugged components such as DALOHM resistors.

DALOHM wire wound RS resistors meet the extremes of resistor requirements, at the same time providing a wide margin in precision, subminiature size, power and reliability.

Look at these over-all parameters and see how DALOHM RS resistors can help you meet your critical design problems.

- Operating temperature range: − 65° C. to + 275° C.
- Precision tolerance range: ± 0.05%, ± 0.1%, ± 0.25%, ± 0.5%, ± 1% and ± 3%.
- Powered at 1, 2, 3, 5, 7, and 10 watts.
- Resistance range from 0.3 ohms to 175,000 ohms.
- Surpasses requirements of MIL-R-26C.
- Temperature coefficient: 0.00002/degree C.
- Complete welded construction from terminal to terminal.
- Silicone sealed, providing maximum protection from abrasion, moisture, salt spray and other environmental conditions, and assures high dielectric strength.
- Maximum continuous working voltage range: 75 V. to 1000 V. DC or AC RMS.

TYPICAL RS-5 DERATING CURVE



TWO NEW SUPER-MINIATURE SIZES for TRANSISTORIZED CIRCUITRY

RS-1A 13/32 x 3/32
1 watt to 25° C., derating to 0 at 275° C.; .05 ohm to 30K ohms; tolerance: see left; Max. working voltage: 75 volts.

RS-1B 17/32 x 3/32
1 watt to 50° C., derating to 0 at 275° C., 1 ohm to 10K ohms; tolerance: see left; Max. working voltage: 100 volts.

COMPLETE RANGE OF WIRE WOUND POWER RESISTORS

RS-2A 13/16 x 3/16
2 watts to 125° C., derating to 0 at 275° C.; .5 ohm to 28K ohms; tolerance: see left; Max. working voltage: 200 volts.

RS-2B 9/16 x 3/16
3 watts to 25° C., derating to 0 at 275° C.; .5 ohm to 20K ohms; tolerance: see left; Max. working voltage: 150 volts.

RS-2 5/8 x 1/4
3 watts to 25° C., derating to 0 at 275° C.; .05 ohm to 30K ohms; tolerance: see left; Max. working voltage: 200 volts.

RS-5 7/8 x 5/16
5 watts to 25° C., derating to 0 at 275° C.; .1 ohm to 60K ohms; tolerance: see left; Max. working voltage: 400 volts.

RS-7 1-7/32 x 5/16
7 watts to 25° C., derating to 0 at 275° C.; .1 ohm to 90K ohms; tolerance: see left; Max. working voltage: 600 volts.

RS-10 1-25/32 x 3/8
10 watts to 25° C., derating to 0 at 275° C.; .3 ohm to 175K ohms; tolerance: see left; Max. working voltage: 1000 volts.

Request Bulletin R-23 for complete specifications

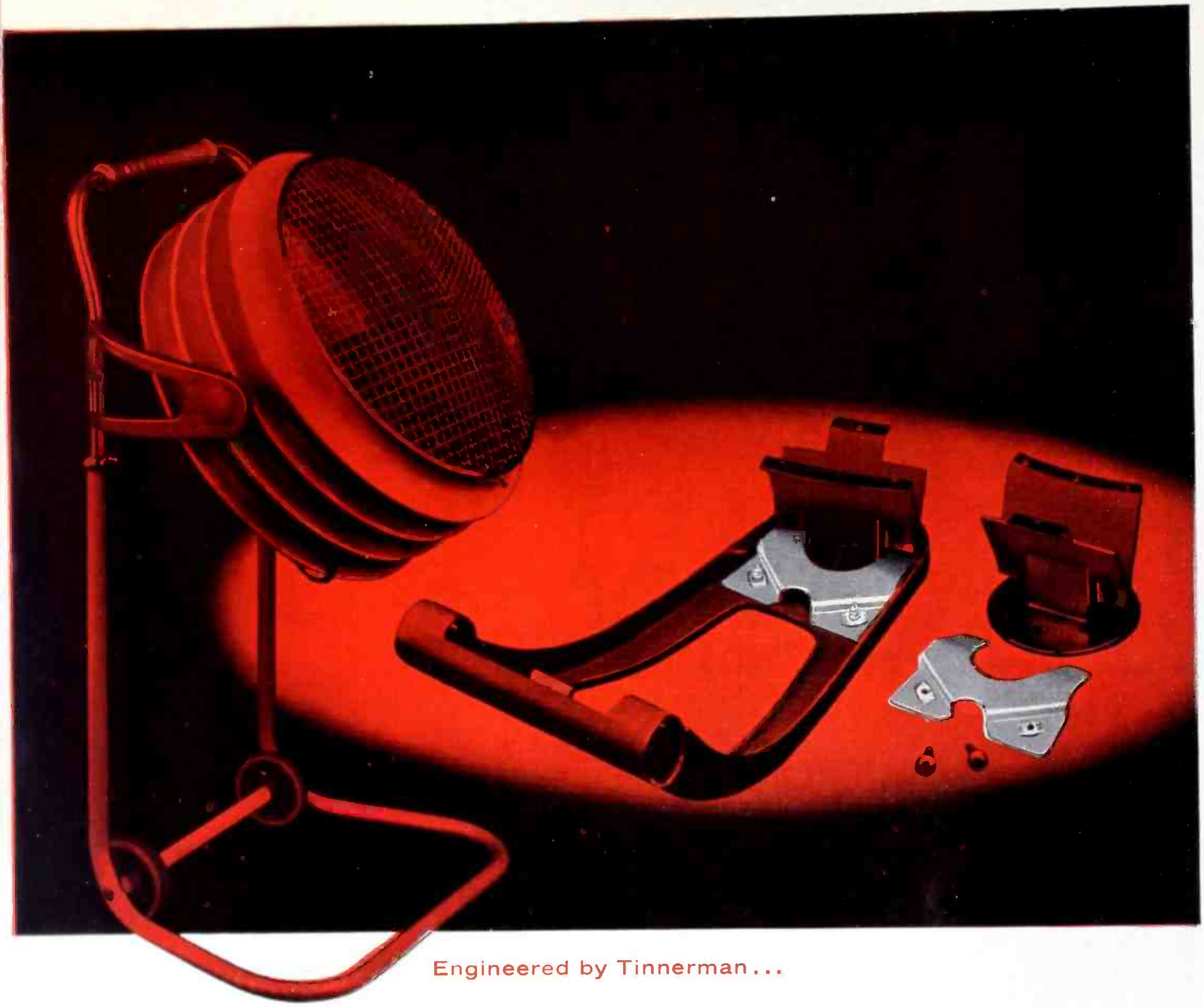
JUST ASK US

DALOHM line includes a complete selection of precision wire wound, power and precision deposited carbon resistors. Also trimmer potentiometers, precision wire wound and deposited carbon; and collet fitting knobs. Write for free catalog.

If none of DALOHM standard line meets your need, our engineering department is ready to help solve your problem in the realm of development, engineering, design and production. Just outline your specific situation.

DALE PRODUCTS, INC.
1304 28th Ave.
Columbus, Nebr., U.S.A.

Circle 9 on Inquiry Card, page 117



Engineered by Tinnerman . . .

It's a fastener . . . It's a friction-lock . . .
It's a Tinnerman **SPEED NUT**® doing double-duty

Turn this Westinghouse Mobilaire® Fan to any angle . . . and it *stays* angled. The Tinnerman SPEED NUT Brand Fastener that holds the fan trunnions tight to the housing also supplies live spring-tension to keep the fan positioned at any angle you choose.

These SPEED NUT fasteners, developed by joint efforts of Tinnerman and Westinghouse designers, eliminate special adjusting thumb-screws. Only 2 SPEED NUT parts serve the purpose of several stampings and ordinary fasteners. Material and assembly costs are lower than with ordinary fastening methods. And the consumer gets a better fan that's easier to adjust.

Chances are that Tinnerman designers can develop SPEED NUT parts for your product to cut costs, speed production, improve that product.

Call your local SPEED NUT representative now . . . if he's not in your Yellow Pages Directory under "Fasteners", write to:

TINNERMAN PRODUCTS, INC.
Dept. 12 • P. O. Box 6688 • Cleveland 1, Ohio

TINNERMAN
Speed Nuts®

FASTEST THING IN FASTENINGS®

CANADA: Dominion Fasteners Ltd., Hamilton, Ontario. GREAT BRITAIN: Simmonds Aerocessories Ltd., Treforest, Wales. FRANCE: Simmonds S. A., 3 rue Salomon de Rothschild, Suresnes (Seine). GERMANY: Mecano-Bundy GmbH, Heidelberg.

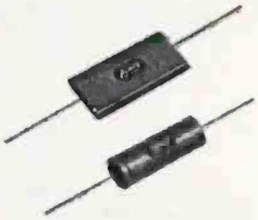
Circle 10 on Inquiry Card, page 117

ASTRON'S *New* reliable sub-miniature capacitors

ENGINEERING BULLETIN
RM-325

ASTRON *Capacitors*

FLAT AND ROUND MINIATURE MYLAR* DIELECTRIC CAPACITORS



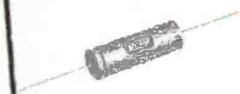
ASTRON TYPES XPR & XPF capacitors use "Mylar"* polyester film as a dielectric. A new series of non-metallic cased units, employ a plastic thermosetting resin end seal to provide a secure bond between leads and case. Series XPR and XPF are for use in applications requiring minimum size, high insulation resistance and exceptional capacitance stability.
For added flexibility in design, they are supplied in both flat and round case styles as listed.

PERFORMANCE CHARACTERISTICS AND TEST SPECIFICATIONS

ENGINEERING BULLETIN
RM-375

ASTRON *Capacitors*

METALLIZED MYLAR* CAPACITORS



ASTRON TYPE RLR metallized Mylar capacitors combine the advantage of metallized units with good insulation resistance, smaller size, less capacitance change and low power factor.

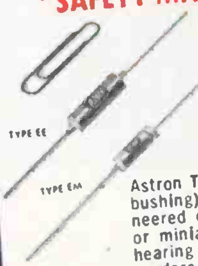
Because the RLR is an uncased unit, sealed with epoxy resin, and wrapped in Mylar tape, its size is further decreased and a reduction in price is effected, compared to conventional style — metallized capacitors.

PERFORMANCE CHARACTERISTICS AND TEST SPECIFICATIONS

ENGINEERING BULLETIN
TE-250

ASTRON *Capacitors*

"SAFETY MARGIN" ELECTROLYTIC CAPACITORS for miniaturized low voltage D.C. equipment

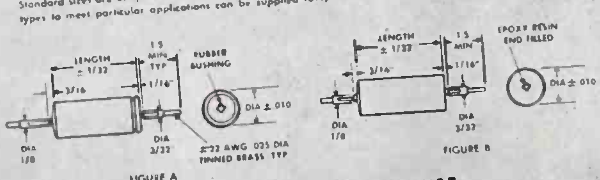


- Smallest hermetically sealed electrolytic capacitors (from 3/16" x ½" to ¼" x ¾")
- Very low leakage characteristics for minimum battery drain
- Long shelf and operating life
- Reliable performance at reasonable price

Astron Types EE (epoxy end fill) and EM (spun end with rubber bushing) sub-miniaturized electrolytic capacitors were engineered especially for transistorized circuits and other compact or miniaturized low voltage E. C. equipment — applications in hearing aids, transistorized pocket radios, miniaturized recorders. The most important features are extremely small physical size and exceptionally low leakage coupled with reliable operation.
Astron's "Safety Margin" construction provides reliable performance even under adverse conditions — your guarantee for equipment reliability.

PERFORMANCE CHARACTERISTICS AND TEST SPECIFICATIONS

I. PHYSICAL CHARACTERISTICS:
Standard sizes are as specified in the catalog listings. Special sizes and types to meet particular applications can be supplied to specification.



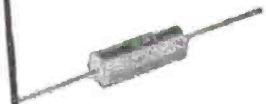
II. STANDARD OPERATING TEMPERATURE RANGE:
-20 to +85 C

ASTRON CORPORATION
255 GRANT AVENUE • EAST NEWARK, NEW JERSEY, U. S. A.

ENGINEERING BULLETIN
RM-300

ASTRON *Capacitors*

MYLAR* METALLIZED CAPACITORS



ASTRON TYPE RQL combines in a miniature hermetically sealed case the outstanding attributes of reliability at high temperatures — 125°C without derating — with significant savings of space. They will find their main applications in military reliability equipment and in critical industrial circuits . . . meet specification of MIL-C-18312. Astron's Safety Margin construction is your guarantee of performance under the most difficult conditions.

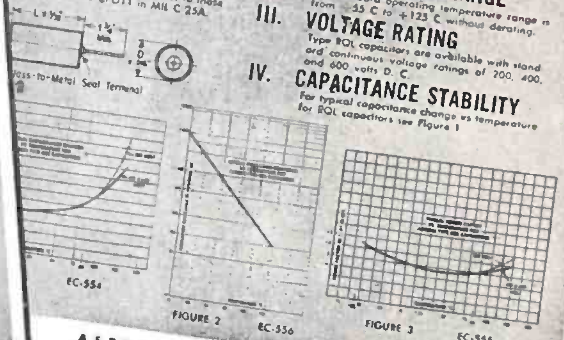
PERFORMANCE CHARACTERISTICS AND TEST SPECIFICATIONS

PHYSICAL
RQL standard sizes are as specified in catalog listings. Other case styles and construction variations are available similar to those type CPO4 thru CPO11 in MIL C 25A.

II. TEMPERATURE RANGE
The standard operating temperature range is from -55 C to +125 C without derating.

III. VOLTAGE RATING
Type RQL capacitors are available with standard continuous voltage ratings of 200, 400, and 600 volts D. C.

IV. CAPACITANCE STABILITY
For typical capacitance change vs temperature for RQL capacitors see Figure 1



ASTRON CORPORATION
255 GRANT AVENUE • EAST NEWARK, NEW JERSEY, U. S. A.

*Reg. DuPont Trademark

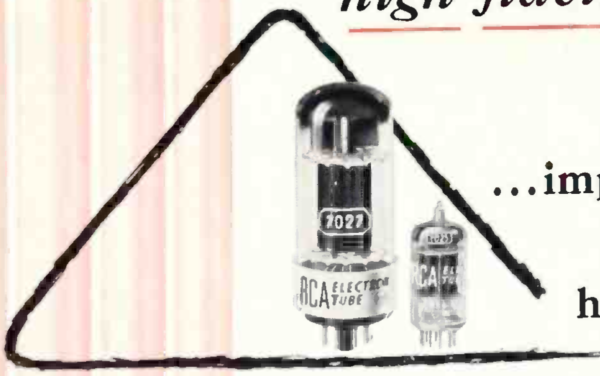
Write today for complete technical information by Bulletin Number.

ASTRON CORPORATION

255 GRANT AVENUE
EAST NEWARK, N. J.

West Coast Warehouse: I. R. Stern Co., 4109 Burbank Blvd., Burbank, Calif.—Export Division: Rocke International Corp., 13 East 40th St., N. Y., N. Y.—In Canada: Charles W. Pointon, 6 Alcina Ave., Toronto, Ontario.

Two new RCA tubes offer outstanding performance for your most critical high-fidelity audio designs



...important contributions to designers of high-quality audio amplifiers

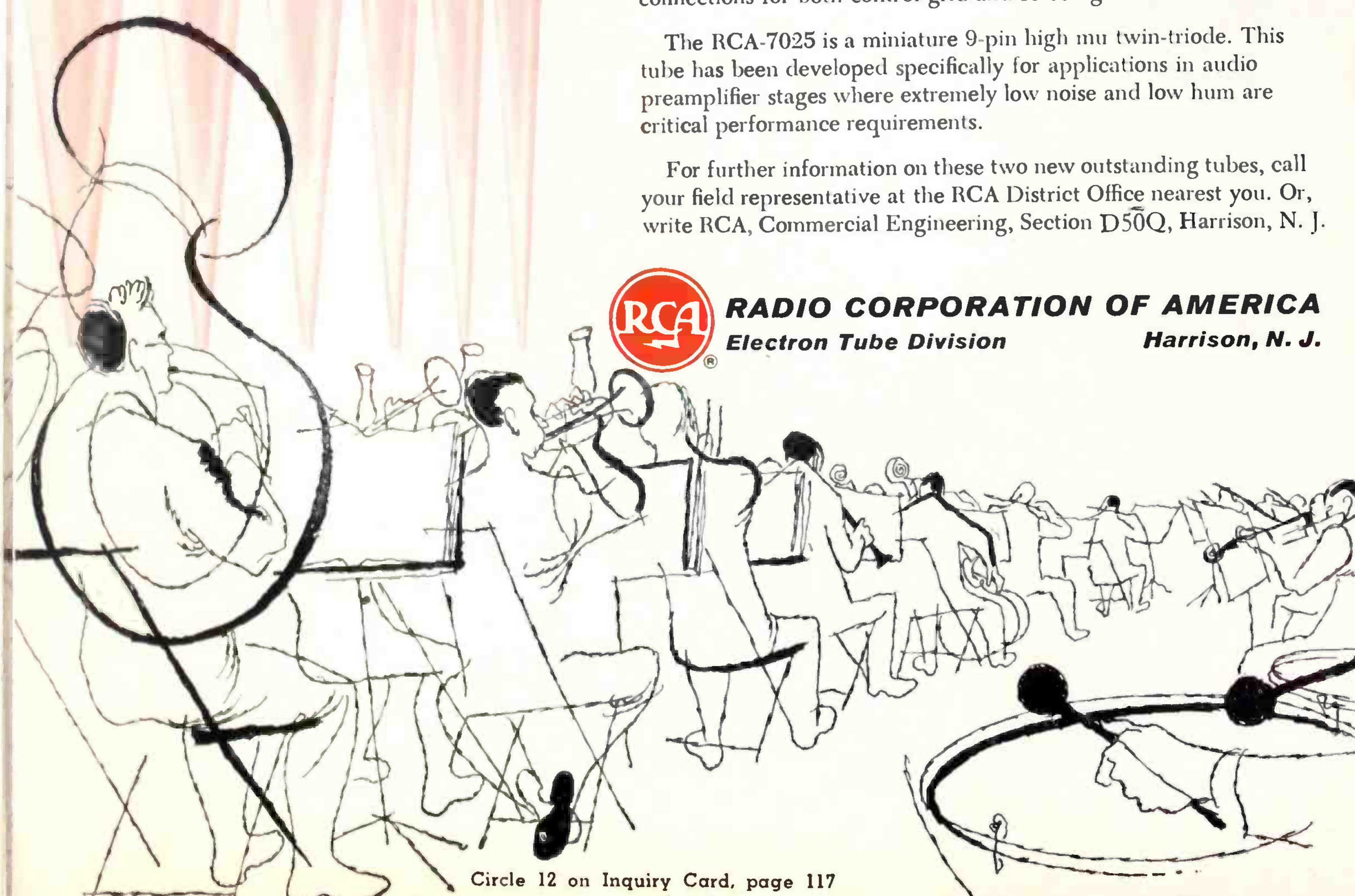
The organ hurls its thunderous tones! The piano strikes an answering chord! A triangle sparkles its crisp note and an orchestra expands to full forte! These are the exciting, timbre-rich sounds which require full realism in reproduction and make extraordinary demands on the performance capabilities of your audio amplifier designs. The RCA-7025 and -7027 have been developed specifically for such performance requirements in high-quality high-fidelity audio amplifiers.

The RCA-7027 is a glass-octal type beam power tube. Two 7027's in class AB, push-pull service *with only 450 volts on the plate* can handle up to *50 watts of audio power* with only *1.5 percent distortion*. Structural features contributing to the exceptionally high plate dissipation (25 watts) of this compact tube are: metal base collar, heavy stem leads having high heat conductivity, heavy plate material, radiating fins on control grid, and double base-pin connections for both control grid and screen grid.

The RCA-7025 is a miniature 9-pin high mu twin-triode. This tube has been developed specifically for applications in audio preamplifier stages where extremely low noise and low hum are critical performance requirements.

For further information on these two new outstanding tubes, call your field representative at the RCA District Office nearest you. Or, write RCA, Commercial Engineering, Section D50Q, Harrison, N. J.

RADIO CORPORATION OF AMERICA
Electron Tube Division — ***Harrison, N. J.***



Circle 12 on Inquiry Card, page 117

Electronic Industries' News Briefs

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

EAST

AIRBORNE ACCESSORIES CORP. has added a one-story, brick concrete building to its present facilities. It will be utilized fully as a tool and engineering model shop.

LIBRASCOPE, INC., has been awarded a $17-million contract with the U. S. Navy for digital computers to be used in the ASROC system.

AEROJET-GENERAL CORP. has moved its Northeastern District Office to 821 Franklin Ave., Garden City, N. Y. J. M. Beauchamp is District Manager.

CORONA ENGINEERING SERVICE, Elmhurst, N. Y., reveals development of a new relay, known as "RotoRelay," which includes from one to four mercury switching tubes.

STRETCH WIRE CORP. has been organized to serve the electronic industries with extensible cables. Sales Office: P. O. Box 893, New Rochelle, N. Y.

EPSCO, INC., has signed a sales agreement with the Pacific Div., Bendix Aviation Co. Under the agreement Bendix will have exclusive sales representation of the Epsco FM/FM telemetry line of equipments.

GENERAL PRODUCTS CORP. has just completed an extensive plant expansion program which more than doubles their floor space. The new area will house sales and engineering staff, general offices, additional production areas and a new laboratory.

TECHNOGRAPH PRINTED ELECTRONICS, INC., have moved from Tarrytown, N. Y., to 920 Northwest Blvd., Winston-Salem, N. C.

NARDA MICROWAVE CORP. has recently received orders for coaxial direction couplers, terminations, and standard gain horns. This microwave equipment is being supplied for use in the USAF Ballistic Missile Program.

BURROUGHS CORP. RESEARCH CENTER, Paoli, Pa., now has in service two 65-ft. towers housing radar equipment capable of detecting approaching aircraft at long range. Equipment will be used primarily to carry on simulated field tests of equipment developed and built for the Air Force SAGE System.

BELL AIRCRAFT CORP. has established an autonomous operating unit, Bell's Niagara Frontier Div., which will operate all Buffalo and Niagara Frontier defense products activities.

BURNDY CORP. has just completed and occupied a new and modern central warehouse located at the company's headquarters plant in Norwalk, Conn.

KEARFOTT CO., INC., has organized an Astronautics Laboratory within the company's Navigation Projects Dept.

STAVID ENGINEERING, INC., has received a multi-million dollar contract to produce additional guidance systems for the submarine-launched Regulus missile.

HAYDON INSTRUMENT CO. has been organized to design and manufacture new proprietary electro-mechanical devices. Headquarters are at 156 W. Liberty St., Waterbury 20, Conn.

GULTON INDUSTRIES has established an Advanced Development and Systems Div. Bernard Bernstein will be the General Manager.

CORNING GLASS WORKS will build a new plant at Bradford, Pa., for the manufacture of electronic components.

CURTISS-WRIGHT CORP. has consolidated sales and service responsibilities in the U. S. for Canadian Curtiss-Wright, Ltd., formerly Isotope Products, Ltd., and for the Electronics Div. under the Electronics Div. at Carlstadt, N. J.

MID-WEST

COMPUTER ENGINEERING ASSOCIATES of Pasadena have installed a quarter-million dollar computer, "DAEAC," at Lockheed Aircraft's Marietta, Ga., plant. The computer will analyze complex stress and flutter problems at the higher mach supersonic speeds, faster and more economically than conventional wind tunnel tests.

AVCO's CROSLEY DIV. has been awarded a $1-million USAF contract. The high priority contract embodies a service test quantity of closed-circuit TV sighting link adaptations for aircraft weapons systems.

SHURE BROS., INC., is looking for the industry to adopt a compatible system for 4-channel tape recording. Consumers will quickly welcome such a system that will produce monaural and stereo tapes on the regular ¼ inch tape.

COLLINS RADIO CO. has just received a USAF contract for airborne high frequency communications system costing an estimated $10.5-million.

FOREIGN

HIGH VOLTAGE ENGINEERING CORP. plans to double existing overseas facilities for installation and service of its Van de Graaff particle accelerators. First step in the program was the acquisition of 51% of the stock in High Voltage Servicing Co., Ltd., London.

HOLTZER-CABOT MOTOR DIV., NATIONAL PNEUMATIC CO., INC., has signed an agreement with Elliott Bros. (London) Ltd., of Lewisham, England, for the manufacture of many of the H-C instrument motors.

COMPUTING DEVICES OF CANADA LTD. has been appointed sales agent to handle the transistor line manufactured by the Red Bank Div. of Bendix Aviation Corp. The Canadian company is a Bendix affiliate located in Ottawa.

INTERNATIONAL ELECTRONIC RESEARCH CORP. has set up licensing arrangements with Pierre Simon, New York representative for Inter-Technique, Paris, France, for the sale of IERC Heat-dissipating electron tube shields in Europe.

SEALECTRO CORP. has appointed Belram Electronics, Brussels, Belgium, as representatives for Belgium and Yugoslavian markets to handle sales of the firm's Teflon terminals.

WEST

RYAN AERONAUTICAL CO. has been awarded a $6¼-million contract for advanced model KDA-4 Firebee jet drone missiles by the U. S. Navy.

SERVOMECHANISMS, INC., was awarded a USAF contract for the manufacture of Central Air Data Computers, Type MG-3 amounting to more than $1-million.

PACIFIC DIV., BENDIX AVIATION CORP., has developed a beyond-the-line-of-sight navigational system, accurate to within 20 ft. on or above a battleground, for land and air units of the field army of the future.

LOCKHEED MISSILE SYSTEMS has begun construction on a special Navy-owned Polaris Test Facility on 271 acres at its 4000-acre remote test site in the Santa Cruz mountains. The multi-million-dollar facility comprises a complex of huge concrete and steel missile test stands and special related buildings.

ANDREW CORP. has expanded its West Coast factory. The added plant area has increased production capacity and added engineering facilities.

WESTERN GEAR CORP. will concentrate all its San Francisco Bay operations at its Belmont Works to accommodate a program of continued growth and expansion.

HUGHES AIRCRAFT CO. will grant master of science fellowships to 150 college graduates to help them pursue advanced studies in science and engineering. Fellows will be selected from applicants with outstanding scholastic records from universities throughout the nation.

SPACE TECHNOLOGY LABORATORIES, a division of The Ramo-Wooldridge Corp., has increased effectiveness of its digital and analog computers in simulating missile flights by the addition of a new multi-channel computer link. The "Addaverter" was built by Epsco, Inc., links the two types of computers and makes their languages compatible.

AERONAUTICAL AND INSTRUMENT DIV., Robertshaw-Fulton Controls Co., has been awarded a supplementary contract in excess of $250,000 by Convair Div. for development of a damper amplifier for the supersonic F-106A all-weather interceptor.

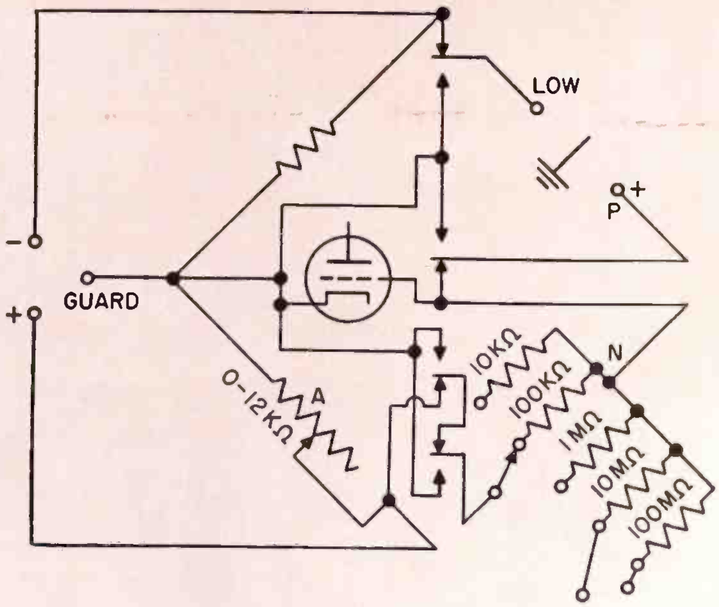
SYLVANIA ELECTRIC PRODUCTS INC. has purchased approx. 26 acres of land in Santa Cruz for eventual expansion of its computer component manufacturing operations.

BECKMAN INSTRUMENTS INC. is completing a $250,000 program to supply improved power-monitoring instrumentation for the Strategic Air Command's B-47 long-range jet bombers.

NON-LINEAR SYSTEMS, INC., has announced a new oscillogram trace reader and computer. It is designated the Model 12 OTRAC.

HYCOR DIV., INTERNATIONAL RESISTANCE CO. is now in full production of a redesigned series of magnetic clutches and brakes.

NOW! Reduce semiconductor rejects with B&A's new "Electronic-Grade" Solvents



... QUALITY CONTROLLED BY RESISTIVITY MEASUREMENTS!

Reducing rejects is a major problem for everyone engaged in the manufacture of transistors, diodes and other semiconductor devices. One way is to eliminate possible contaminants in the solvents used for washing and drying crystals.

A new quality control technique

Responding to this industry need, Baker & Adamson—America's foremost producer of high purity chemicals—has developed a new method of quality control for its "Electronic Grade" Solvents. Quality is controlled by using resistivity measurement to determine trace impurities.

Resistivity "specs" on label

With these analytical techniques it is now possible to offer solvents whose purity surpasses all previous standards! For the guidance of your production and quality control departments, *B&A provides Resistivity Specifications on the label of each "Electronic-Grade" Solvent.*

Here is still another example of how B&A works with the electronics industry to supply chemicals made especially to your exacting requirements.

For full information, write or phone Baker & Adamson Products, General Chemical Division, Allied Chemical & Dye Corporation, 40 Rector Street, New York 6, N. Y.

The following resistivity-tested "Electronic-Grade" Solvents are presently available:

Acetone
Alcohol Propyl, Iso
Alcohol Methyl, Absolute (Methanol) "Acetone Free"
Carbon Tetrachloride
Ether, Anhydrous
Trichloroethylene

B & A® "Electronic-Grade" Chemicals

Allied Chemical

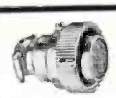
GENERAL CHEMICAL DIVISION
40 Rector Street, New York 6, N.Y.

Offices: Albany • Atlanta • Baltimore • Birmingham • Boston • Bridgeport • Buffalo • Charlotte • Chicago • Cleveland (Miss.) • Cleveland (Ohio) • Denver Detroit • Houston • Jacksonville • Kalamazoo • Los Angeles • Milwaukee • Minneapolis • New York • Philadelphia • Pittsburgh • Portland (Ore.) • Providence San Francisco • St. Louis • Seattle • Kennewick, Vancouver and Yakima (Wash.) In Canada: The Nichols Chemical Co., Ltd. • Montreal • Toronto • Vancouver

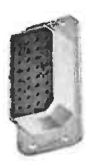
are you fighting SPACE?

No need to suffer from engineering claustrophobia, if you design with CANNON PLUGS in mind!

Coaxials. Screw-type coupling Low VSWR. for 50-, 70-, 93-ohm cable



K miniatures 3 to 50 contacts 13 different arrangements



DP Type Rack-Panel-chassis style 2 to 57 contacts

MC Sub-Miniatures 3, 6, 12 contacts Built for rugged use

D Sub-Miniatures 9 to 50 contacts Same space . . . same weight!

Cannon Miniature and Sub-Miniature Plugs are rugged, easy mating, unusually versatile, neat and compact.

When you design with Cannon Miniatures in mind you'll get complete electrical circuit dependability in a very small space. Up to 50 contacts in ½ or ⅓ the area taken by standard multi-contact connectors!

Rectangular and circular types. Hermetically sealed, vibration and moisture resistant, and general purpose designs. Contacts for 5, 10, 15, 25 amps . . . and miniature coaxial connectors. Practically all five ampere contacts are gold plated. High dielectric insulation in phenolics, resilient materials, glass seals, Zytel, Diallyl Phthalate and Melamine. Aluminum alloy or steel shells, depending upon application.

Miniature lines include: DPA, DPX, DPM, DPG, K, MM, MR and Diamond MB and SM Coaxial connectors. **Sub-miniatures:** D, MC, and Diamond DIC Coaxial connectors.

Write TODAY for new 32-page 2-color Miniatures Bulletin HMC-2. Also, write for Bulletin SM-1, "Soldering Small Contacts."

For an interesting discussion of the broad subject of "Reliability," write for Cannon Bulletin R-1.

CANNON PLUGS

WHERE RELIABILITY IS THE 5TH DIMENSION

AWARENESS OF PROBLEM — INTEGRITY OF INTENT — DESIGN EFFORT — MANUFACTURING CONTROL

Please refer to Dept. 201

CANNON ELECTRIC CO., 3208 Humboldt Street, Los Angeles 31, California. Factories in Los Angeles; Salem, Massachusetts; Toronto, Canada; Melbourne, Australia; London, England. Manufacturing licensees in Paris and Tokyo. Representatives and distributors in all principal cities. See your Telephone Yellow Book.

Circle 14 on Inquiry Card, page 117

Tele-Tips

"MAYDAY, SOS" calls were picked up by FCC engineers in the Seattle area, signed by a novice amateur call. Investigators find that the dual calls for help were transmitted by a 15-year-old "ham" when his stepfather threatened his mother. The boy felt that "the circumstances warranted the transmission." The FCC warned the lad that "emergencies" do not include domestic trouble.

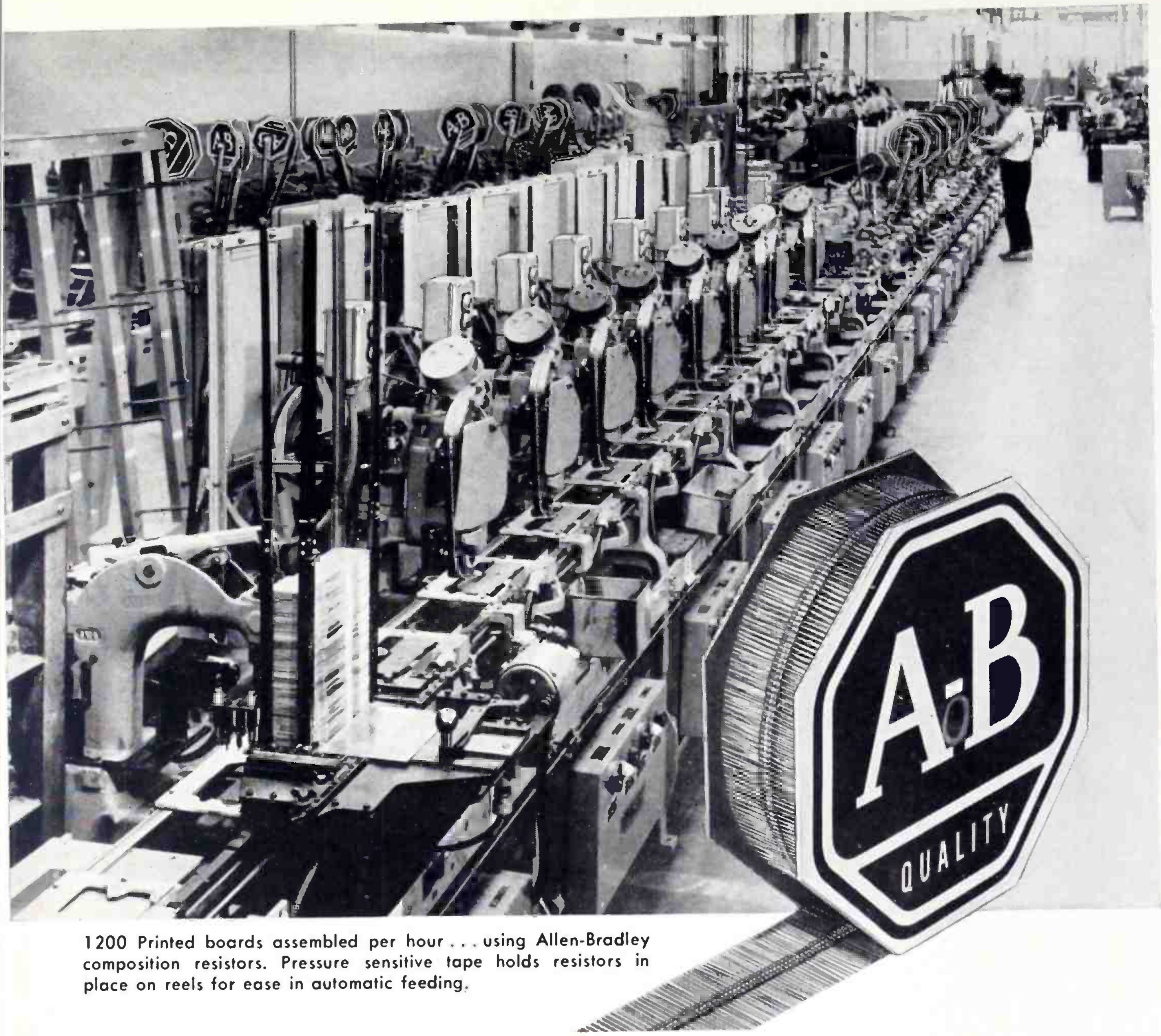
NEW PLANET discovered in 1953 has been christened NORC, for the Naval Ordnance Research Calculator which has provided a vast amount of computation of orbits of other minor planets.

ELECTRONIC - AGE SENATOR. Congressman Stuyvesant Wainwright (Rep., Long Island, N. Y.) one of the 259 lawyers serving in the U. S. House of Representatives, has embarked on a one-man, do - it - yourself, basic education course in electronics in order to vote with fuller understanding on forthcoming missile legislation. His first stop was Amperex Electronic Corp., Hicksville, N. Y.

ELECTRONIC LETTER SORTING will be facilitated by having electrical conductors printed into the gum on the back of the stamp. Recognition signals will be "imprinted" on the conductors to speed sorting in automatic machines.

ELECTRONIC GUIDANCE to get the family car into the garage without knocking over the lawnmower has been developed by Dr. D. Lawrence Jaffe, pres. of Polarad. Patented last month, the system uses the car radio, with an extra antenna and two transmitters in the garage. The extra antenna is placed at the front of the car on its center line, and the garage transmitters are at each side. When the car is directly on course the driver hears no sound. If he is too far to the right he hears one tone, and another tone if he is too far to the left.

(Continued on page 26)



1200 Printed boards assembled per hour . . . using Allen-Bradley composition resistors. Pressure sensitive tape holds resistors in place on reels for ease in automatic feeding.

Physical uniformity of ALLEN-BRADLEY resistors permits high-speed mechanized assembly

Allen-Bradley's exclusive process used in making its solid molded resistors assures dimensional uniformity that is astounding. Consequently, their use in mechanized assembly virtually eliminates costly shutdowns to clear jammed stations resulting from "off-size" units. The clean, tough surface of A-B molded resistors will withstand mechanized handling without chipping or cracking. Since wax is *not* used to provide moisture resistance, this source of trouble is also eliminated. Differentially tempered leads permit bending without wire breakage.

Electrically, Allen-Bradley resistors are universally recognized for their conservative ratings and stable characteristics. To realize the maximum output from your high-speed assembly process, specify Allen-Bradley *quality* resistors. Write for technical data, today.

A-B fixed resistors are available in 1/10, 1/4, 1/2, 1, and 2-watt sizes, in all RETMA values. Also carton packed for manual assembly.

Allen-Bradley Co., 1342 S. Second St., Milwaukee 4, Wis.
In Canada—Allen-Bradley Canada Ltd., Galt, Ont.

ALLEN-BRADLEY

RADIO, ELECTRONICS, AND TELEVISION COMPONENTS

Tele-Tips

(*Continued from page* 24)

SEVERE INTERFERENCE was complained of by the Pennsylvania, North Carolina and Wyoming state police radio systems. Bearings obtained by FCC direction finders led overseas to a Berlin, Germany radio station. The angle of the Berlin station's directional antenna was accommodatingly changed, but it appeared to be a transitory prank due to high sunspot activity. Likewise, passing interference to certain domestic radio communication channels has been caused by wayward video signals from British TV channels 1 and 2 in the 40 MC band.

FCC ENGINEERS came across this odd case. Induced voltage from a nearby high - powered broadcast station affected loading cranes on docks at Oakland, Calif. The r-f voltage proved so disconcerting to stevedores touching the hooks of these "passive reflectors" that cargo handling was discontinued until night when the 10 kw daytime AM station was off the air.

COMPANY PRESIDENT is certainly a worthwhile goal, but from a financial viewpoint it isn't what it's cracked up to be. Dun's Review recently completed a survey of 109 company presidents, most of them heads of the country's largest firms, and turned up the fact that though the average top official earns $111,500 a year he has less than $20,000 left for investment or other voluntary spending after he has paid his taxes and living expenses. In fact, if he saved 20% of his average compensation every year it would take him about 45 years (without interest) to accumulate $1 million. As far as other official's pay is concerned, the presidents think that their executive vice president should be paid 72% of their own pay; the top marketing executive, 56%; top financial executive, 55%; top production executive, 52%; and top industrial relations executive, 38%.

NEW—Raytheon Amplitron

Now—peak power 800 kw, bandwidths of 10% with efficiencies of 50-70% over entire band

QK520 Amplitron
Typical Operation (Pulsed)

Anode Voltage	40 kV
Anode Current	35 amps
Peak Power Output	800 kw
Average Power Output	1200 watts
Efficiency	55%
Operating Band (±1 db)	1225-1350 Mc
Peak Power Input	80 kw
Phase Stability with Anode Current	1°/amp

The Amplitron is a new type of tube capable of power amplification at microwave frequencies. Amplification is obtained over a broad range of frequencies without need of mechanical or electrical adjustments. The Amplitron is a derivative of the magnetron and retains many of its advantages—high operating efficiency, simple construction, small size, light weight, low operating voltage.

The Amplitron uses crossed electric and magnetic fields, a reentrant beam produced by a magnetron-type cathode, and a non-reentrant broadband circuit matched at either end to external circuits.

Variations in anode current or voltage have little effect upon the total phase shift. This results in very low phase pushing and excellent reproduction of the input spectrum even under pulse conditions with slow rise time and ripple. Because of low insertion loss, duplexing may be accomplished at the input rather than the output of the final rf amplifier.

A limited quantity of preliminary literature is now available. To be sure of your copy, write now. *Amplitrons in other frequency bands are currently in development. Inquiries are invited.*

RAYTHEON MANUFACTURING COMPANY

RAYTHEON
Excellence in Electronics

Microwave and Power Tube Operations, Section PT-51
Waltham 54, Massachusetts

Regional Sales Offices: 9501 W. Grand Avenue, Franklin Park, Illinois. 5236 Santa Monica Blvd., Los Angeles 29, California
Raytheon makes: Magnetrons and Klystrons, Backward Wave Oscillators, Traveling Wave Tubes, Storage Tubes, Power Tubes, Miniature and Sub-Miniature Tubes, Semiconductor Products, Ceramics and Ceramic Assemblies

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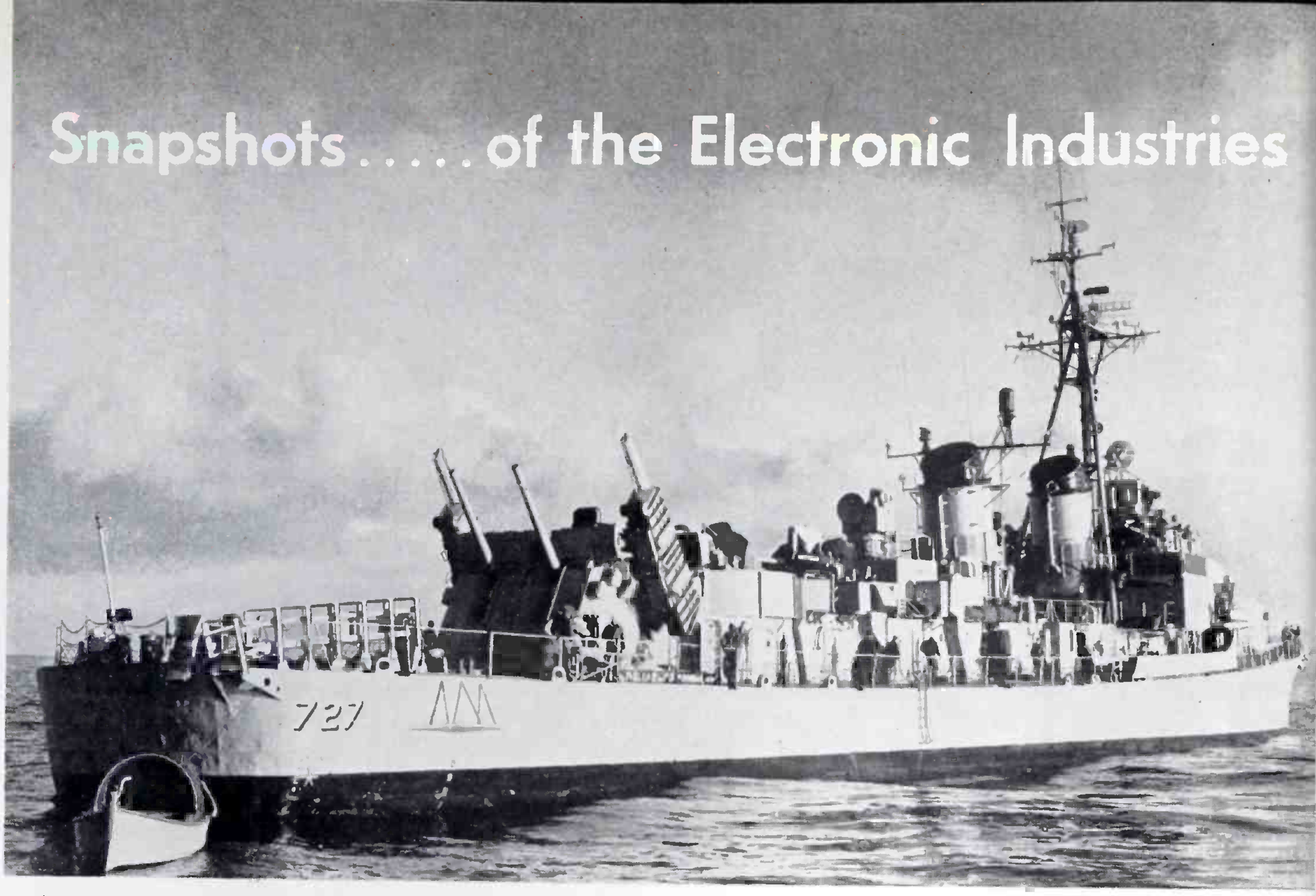
Snapshots ..... of the Electronic Industries



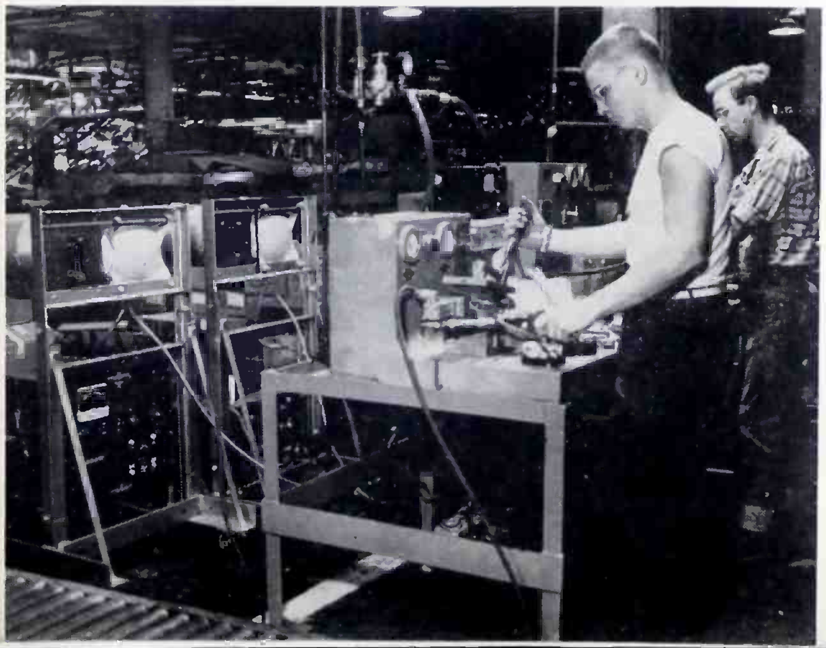
Launcher for RAT, Navy's new rocket-propelled, anti-submarine weapons system, is shown mounted on destroyer's aft 5-in. gun turret.

LIGHT ON FLIGHT

Uniform light and controlled brightness ratios feature the new line of flight instruments by Sperry Gyroscope Co. System combines the functions of 6 conventional indicators in new jet airliners.

NEW DISPLAY SYSTEM

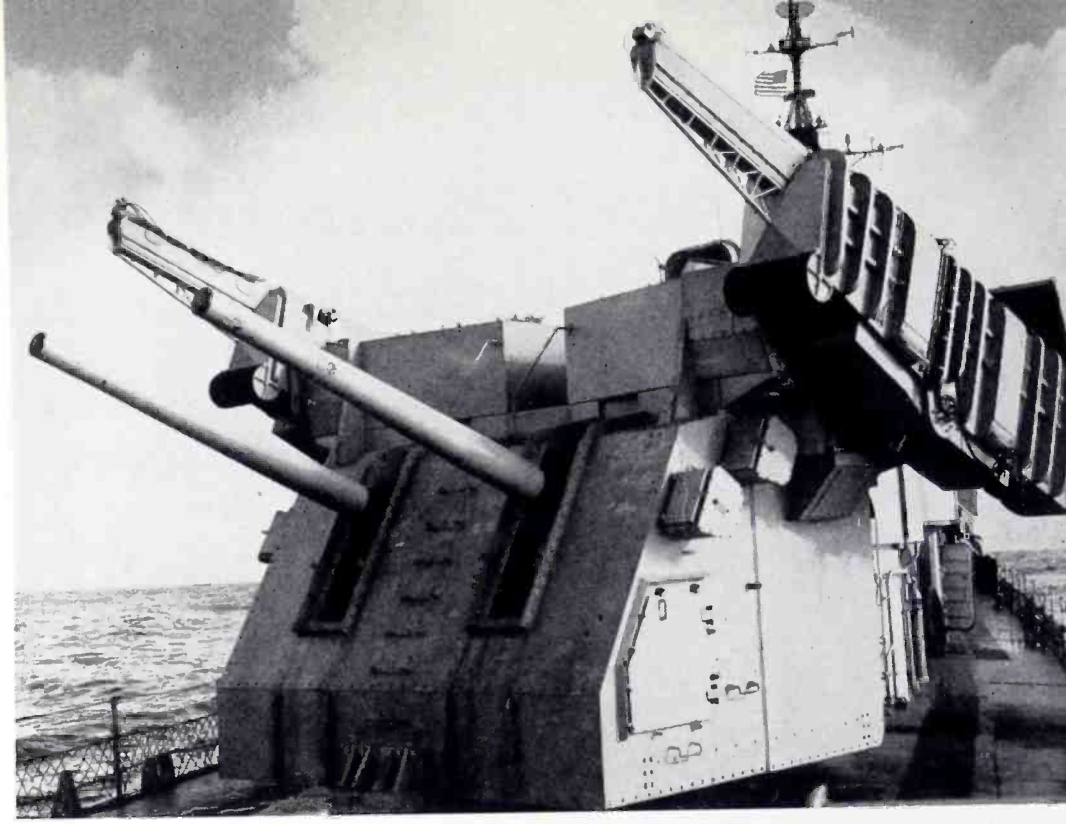
Glowing electroluminescent panels glow with letters and figures in a new display system developed by Westinghouse Research Labs. Panels are bright enough for daylight viewing.



CHECK NEW AUTOS

Perkin - Elmer leak detectors are here used to check component parts of 1958 auto air suspension systems.

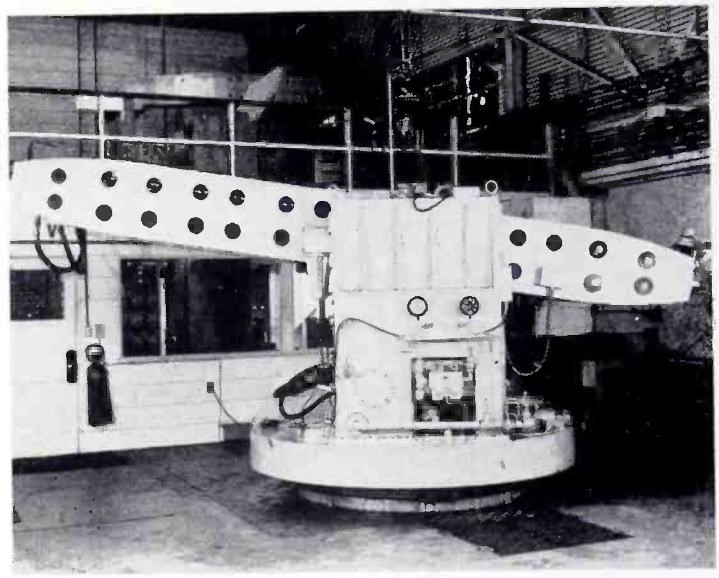
lose-up of launcher. RAT is rocket thrown, ien dropped by parachute to water surface.



RAT—

Rocket-Assisted Torpedo

RAT is propelled by rockets to sub's general area, and dropped by parachute. Underwater homing device guides RAT to the sub itself.



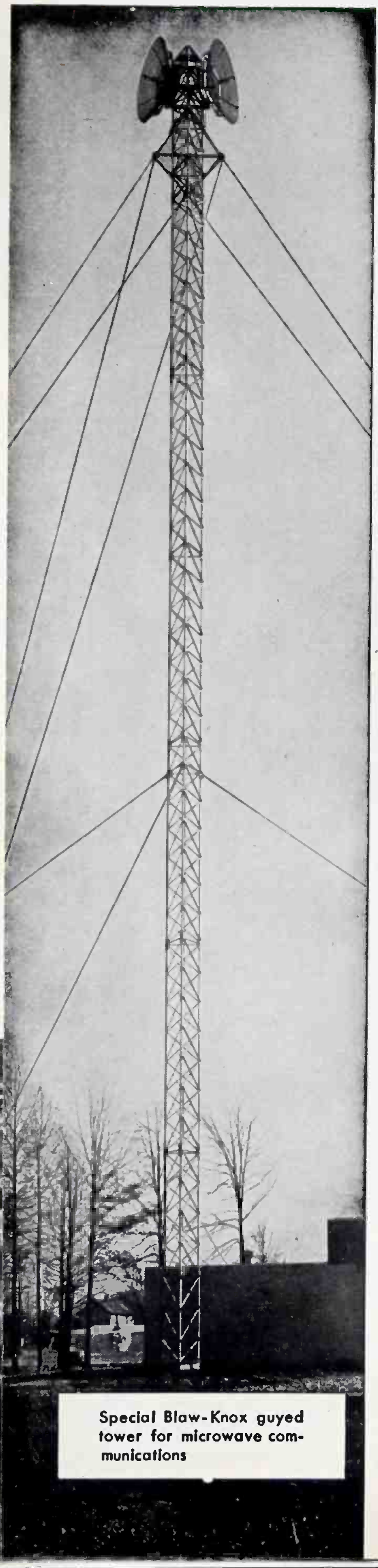
(Above) Hydrodynamic Simulator at Naval Ordnance Test Station, Pasadena, Calif., tests torpedoes under simulated sea environment.

(Right) Thompson Aeroballistic Lab, at NOTS, China Lake, Calif., where inert models and full-scale ordnance rounds are fired.

(Below) Variable Angle Launcher is used to study water entry and underwater trajectories of full scale missiles.

Planning better communications?

Microwave may be the answer ...and Blaw-Knox has the towers



Special Blaw-Knox guyed tower for microwave communications

Improved service, reduced maintenance, and economy records of pioneer microwave installations are responsible for many companies planning new communications paths through the sky. Quite possibly, microwave can best answer your growth problems, and Blaw-Knox can best answer your tower questions.

Blaw-Knox Microwave Tower designs are based on more than 40 years of experience in building towers. For example:

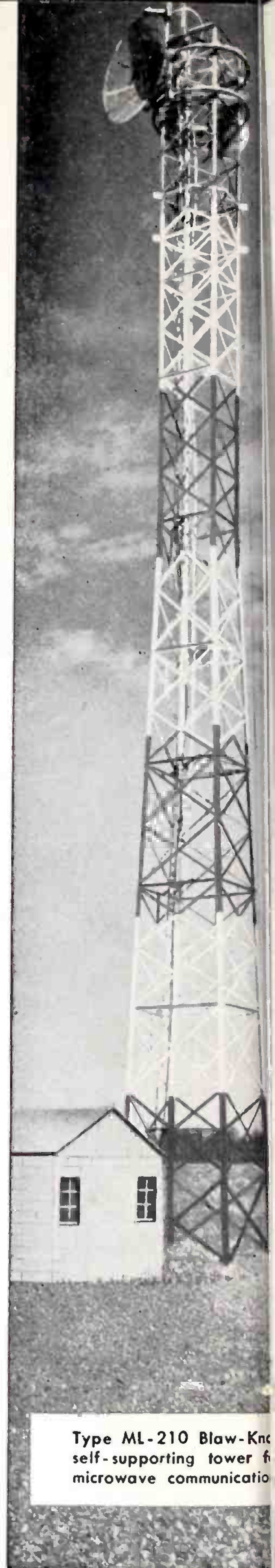
- The first Blaw-Knox Towers, four 300′ self-supporting towers erected over 40 years ago in Alaska, still stand in good service.

- The world's first atom bomb was supported by a Blaw-Knox Tower, ushering in the Atomic Age at Alamogordo, New Mexico, in 1945.

- First electronic contact was made with outer space by a radar signal to the moon, beamed from a Blaw-Knox Tower.

From such varied experience as this, Blaw-Knox engineers are well qualified to design and engineer the type of tower system that will best meet your present and future requirements. Blaw-Knox Microwave Towers meet or surpass government standards and recommendations of the Radio-Electronics-Television Manufacturers Association for safety, wind loading and quality of construction.

Get the full story of Blaw-Knox Tower design, engineering and fabrication services. Write today for your free copy of new Bulletin 2538.



Type ML-210 Blaw-Knc self-supporting tower f microwave communicatio

BLAW-KNOX

BLAW-KNOX COMPANY
Equipment Division
Pittsburgh 38, Pennsylvania

MICROWAVE TOWERS
Guyed and self-supporting Microwave Towers, custom-built for each installation ...and Transmission Towers ...Antenna Towers—guyed and self-supporting for AM-FM-TV, Radar ... parabolic antennas and other special structures

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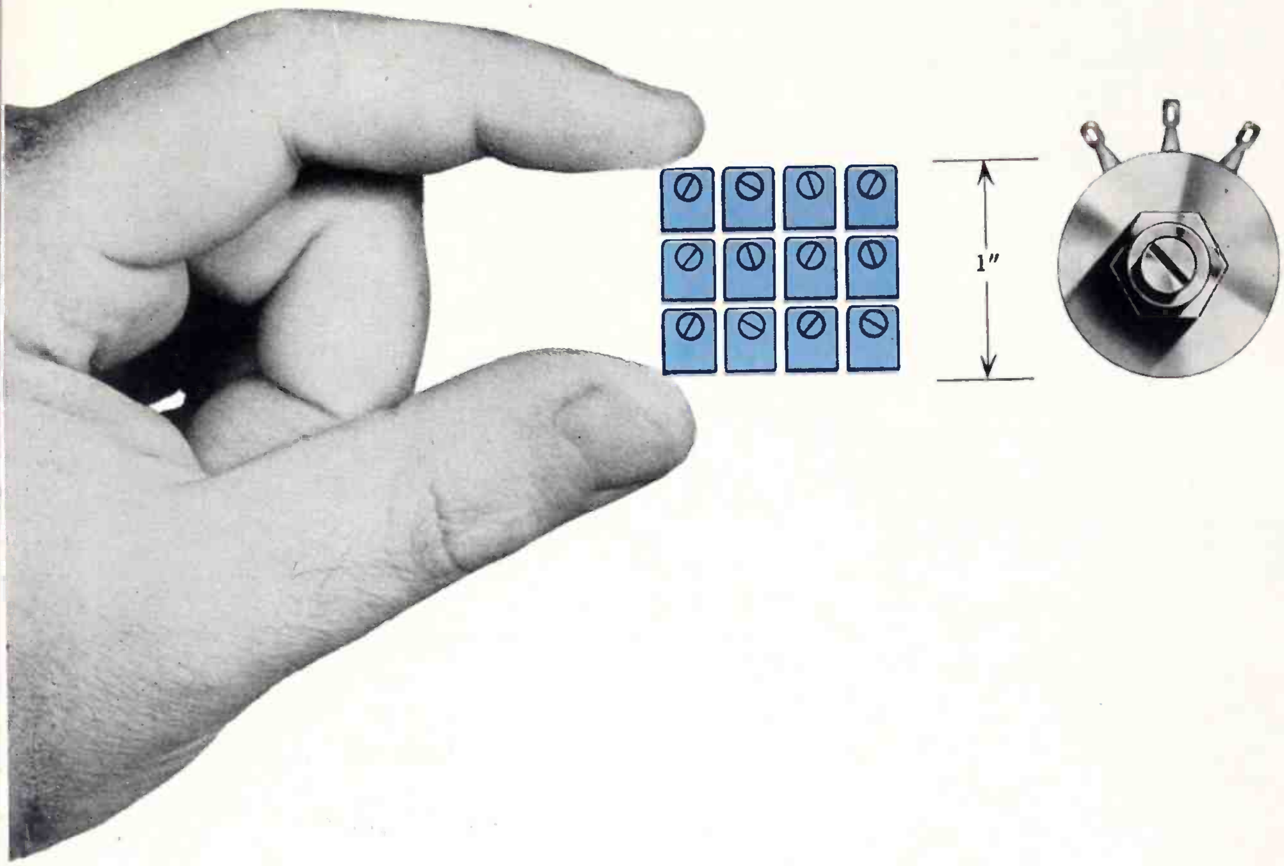


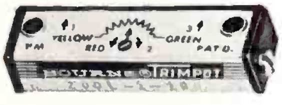
FIT 12 OF THESE RECTANGULAR POTENTIOMETERS IN A PANEL AREA OF 1 SQUARE INCH!

You can pack 12 Bourns TRIMPOT® potentiometers in the 1-square-inch area occupied by the average single-turn rotary.

Fit the TRIMPOT into corners—between components—flat against a chassis or printed circuit board. Mount them individually or in stacked assemblies. Any way you use them—Bourns potentiometers save space!

You can adjust Bourns potentiometers more accurately, too. The 25-turn screw-actuated mechanism gives you 9000° of rotation instead of 270°. Circuit balancing and adjusting is easier, faster. Repeatability is assured every time. Furthermore, adjustments are self-locking—shock, vibration and acceleration have no effect!

Write for new Model Summary Brochure



BOURNS
Laboratories, Inc.

P. O. Box 2112-A • Riverside, California

ORIGINATORS OF TRIMPOT® AND TRIMIT®
PIONEERS IN POTENTIOMETER TRANSDUCERS FOR POSITION, PRESSURE AND ACCELERATION

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Books

Marine Electrical Practice

By G. O. Watson. Published 1957 by Philosophical Library, Inc., 15 E. 40th St., New York 16. 335 pages. Price $12.00.

This book is intended to fill the gap which confronts the Marine engineer when he has mastered fundamental formulae and elementary principals and begins to apply himself to practical problems. It will be of great assistance to engineers, and a practical help to electrical draftsmen, seagoing engineers or electricians, and engineers employed on installation, maintenance or operation of Marine electrical equipment.

Analytical Design of Linear Feedback Controls

By G. C. Newton, Jr., L. A. Gould, and J. F. Kaiser. Published 1957 by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16. 430 pages. Price $12.00

In this book, the phrase, analytical design, is identified as the design of control systems by application of the methods of mathematical analysis to idealized models which represent physical equipment. Taking as their starting point the systems specifications, the authors include descriptions of the input, the disturbances, and the desired response. They also include a statement of the basis of which the system performance will be judged; this statement is in the form of a performance index. The design objective is to minimize (or maximize) the chosen performance index. Analytical design theory, the authors show, is a presentation of the ways and means for accomplishing this objective.

Mathematics and Computers

By George R. Stibitz and Jules A. Larrivee. Published 1957 by McGraw-Hill Book Co., 330 W. 42nd St., New York 36.

Engineers and scientists can gain a better idea of the relationships between pure and applied mathematics and the growing use of automatic computers from this book. It surveys the work of the applied mathematician, the problems he studies, methods he uses, especially computation methods, and the computing devices that help him in the application of mathematics to problems in science, engineering, and business.

Computing devices and their components are described, especially the automatic digital computer, the way it works, and its capabilities and limitations. Non-digital computing devices also are covered. A treatment of the use of randomness in computation, and typical applications of the computing devices in technology and business are covered.

(*Continued on page* 38)

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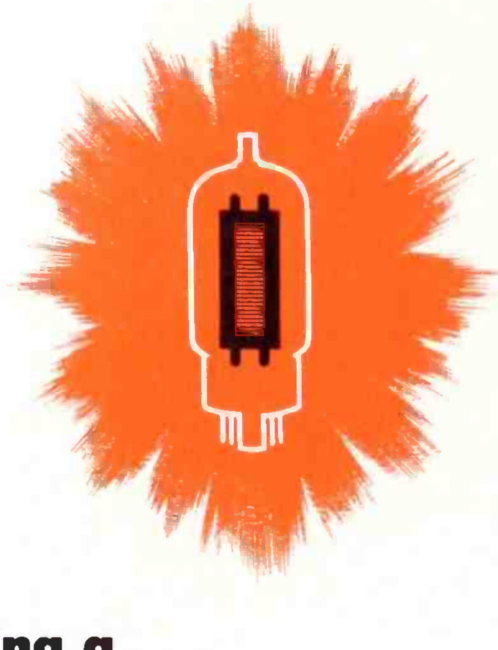
Circle 22 on Inquiry Card, page 117 →

Electron Tube News
– from SYLVANIA

Announcing the Sylvania Framelok Grid



. . . Introducing a

New Receiving Tube Era

Sylvania's revolutionary Framelok construction marks the era of mass produced "Frame Grid" Tubes

Frame grid history is a Sylvania history

Beginning with its earliest handmade frame grid, Sylvania has concentrated engineering effort on frame grid design and development. From this experience, comes the Framelok Grid, a revolutionary design which makes it possible to mass produce frame grid tubes for the first time.

First tube to incorporate the Framelok Grid is the Sylvania Type 6FH6—a beam power pentode designed for Horizontal TV Deflection.

Framelok Grid is self-aligning

In the Framelok Type 6FH6, grid alignment is accomplished with unprecedented ease and precision. Sylvania's unique construction draws grid laterals taut; grid wires are arranged in a ladder sequence, normal to the axis of the grid. Precise frame construction and close mica tolerances make perfect alignment automatic.

Higher Plate-to-Screen Current Ratios

Framelok tubes are more efficient as a result of precise grid alignment. Plate-to-screen current ratios substantially greater than those of present types can be achieved—requiring less screen power for optimum performance. Thus improved horizontal scan performance can be realized.

Higher Dissipation

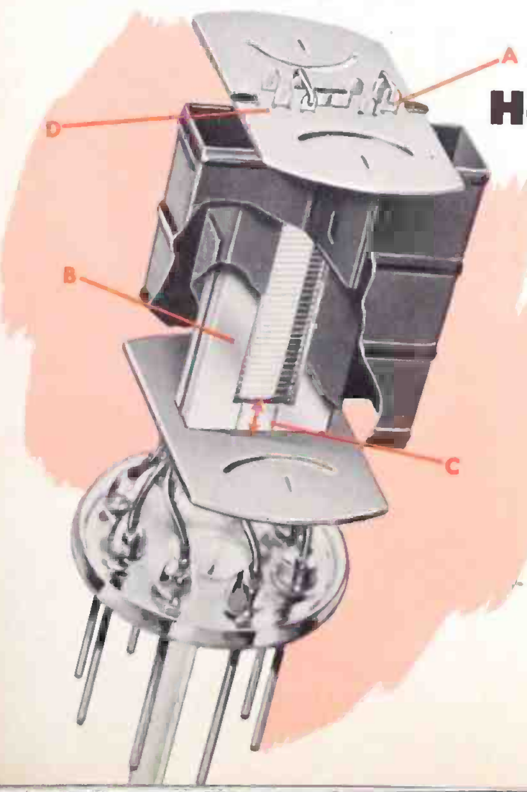
Less required screen grid power for a given plate power automatically reduces the dissipation requirements of the Framelok Grid. And since the Framelok Grid has greater mass it is more capable of dissipating heat. These factors, contributing to inherently lower grid emission, make it possible to achieve higher peak plate currents before dissipation becomes a limiting factor.

Mount is more rugged

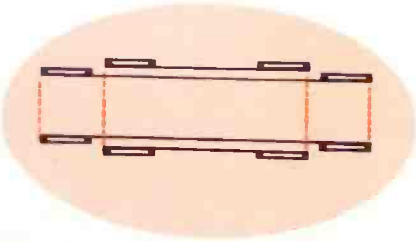
Unlike ordinary grids, strength of the Framelok Grid comes from its rigid frame and is independent of the grid wires. This rigidity is transferred to the mount assembly, reducing life failures resulting from grid warping or bowing.

More uniform transfer characteristics

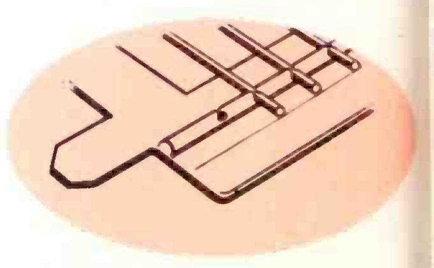
More precise grid construction, more uniform element spacings, and more rugged mount assembly,



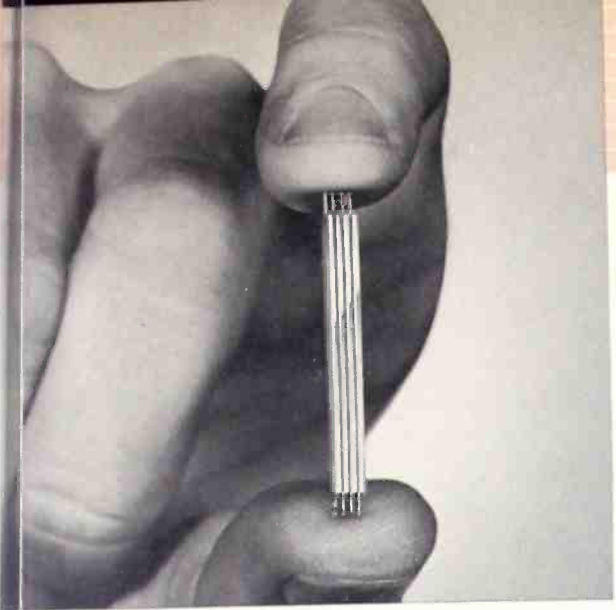
Here are a few highlights of the mechanica

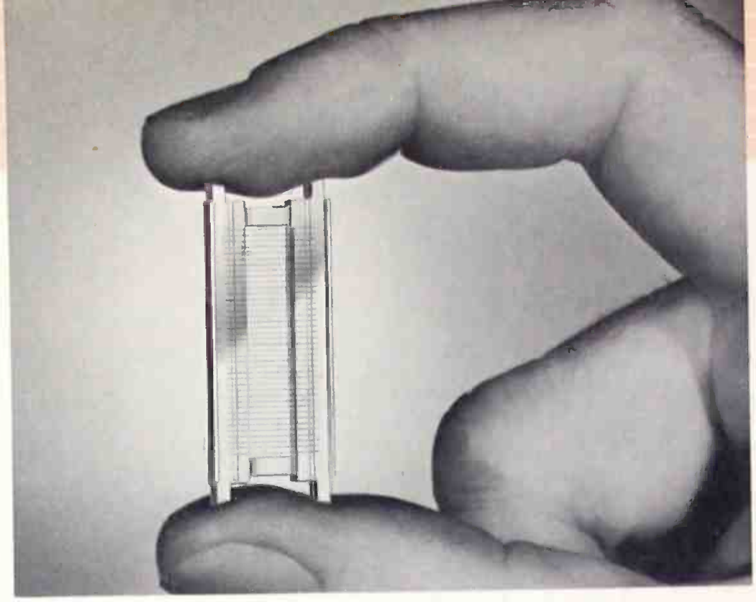


A Straight line geometry of grid side-rods in present grids is considerably weaker than the double-box configuration formed by frame grids. Distortion due to mount "twist" is virtually nonexistent in the frame grid structure.



B Sylvania's new Framelok construc tion eliminates brazing and adapts th frame grid to automatic production. Grid halves are perfectly flat—free from ther mal strains.





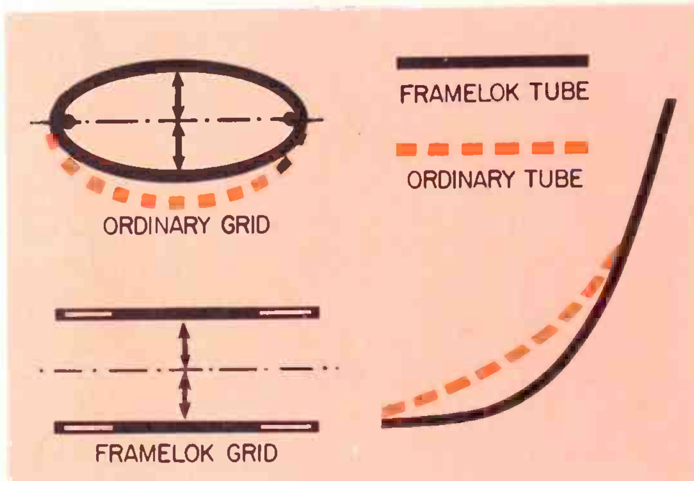
Many grids look like one! The inherent alignment capabilities of Sylvania's Framelok Grid are demonstrated by the ease with which the laterals of any number of separate grid halves can be lined up. Perfect alignment means higher efficiency—greater flexibility in the selection of grid wire diameters for optimum performance.

...ip to closer control over tube transfer characteristics. Narrower control of limits of course means less ...ital circuitry, and a more stable and reliable ...rmance in the end product.

Application potentials are wide

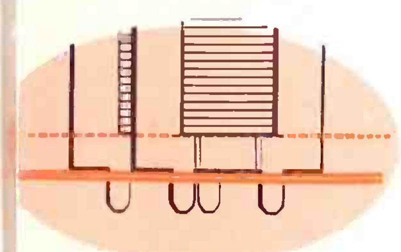
...o meet the heavy operational requirements of ...rizontal deflection tubes, the first Framelok tube ...e announced is the Horizontal Deflection Type ...F16.

...he adaptability of this grid is such that applica...on of Framelok tubes should quickly extend to ...erical TV deflection, video, audio, and a wide ...ange of low and medium power uses in the frequency ...ange below UHF.

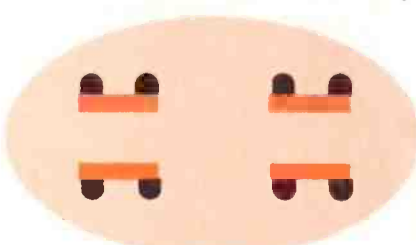


Uniform transfer characteristics of the Framelok Grid tube result largely from greater control of both major and minor dimensions of the grid. Above is a graphic representation of variations in characteristics which result from distortion of the minor dimensions in wound grids. Since both major and minor are fixed in the rigid frame grid, these variations are virtually eliminated.

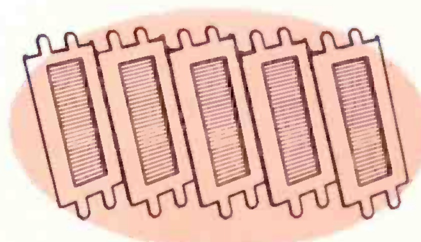
...periority of the Framelok Tube



...Self-alignment is accomplished in ...he Framelok Grid through precise con...ro of the distance between the mica ...n the first grid lateral wire. These ...olerances in the frame grid are held in ...he order of one tenth of one thousandth ...of an inch—considerably tighter than ...rdinary grid tolerances.



D Mica slots are designed with flat alignment surface and channel index to position grids with much greater precision. Closer element spacings are possible where extra Gm is required.



Sylvania's unique technique of frame grid construction makes it possible to duplicate grid after grid. More uniform spacings produce a more uniform electrostatic field in the tube.

The SYLVANIA

FRAMELOK

TYPE 6FH6

Highly efficient horizontal deflection tube

Proved in pilot and now being planned for mass production, the Framelok Type 6FH6 is the most efficient tube ever designed for horizontal deflection service.

It provides design engineers with a new flexibility in circuit design because of the high zero-bias plate-to-screen current ratio. This permits the tube to be driven harder at a lower screen dissipation.

The 6FH6 supplies increased power output because plate voltage can swing to a very low value without encountering unduly high screen grid currents. Higher screen voltages can be maintained at lower dissipation levels resulting in higher output peak current and power.

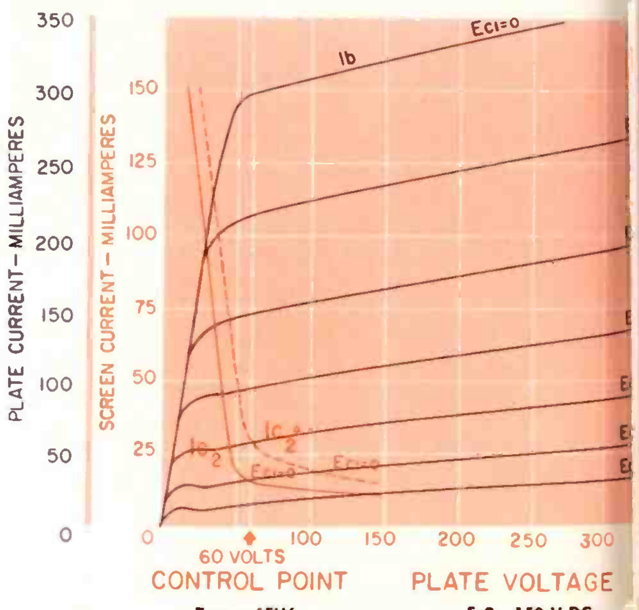
TYPE 6FH6
DESIGN MAXIMUM RATINGS

Maximum D. C. plate supply voltage (boost + DC power supply)	770	volts
Maximum peak positive plate voltage	6000	volts
Maximum peak negative plate voltage	1500	volts
Maximum plate dissipation	17	watts
Maximum D.C. grid #2 voltage	220	volts
Maximum peak negative grid #1 voltage	300	volts
Maximum grid #2 dissipation	3.6	watts
Maximum average cathode current	155	ma
Maximum peak cathode current	500	ma
Maximum grid #1 circuit resistance Self-bias	1.0	megohm
Maximum bulb temperature (hottest spot)	240	°C

AVERAGE CHARACTERISTICS

Pentode operation with Eb=250 V; Ec2=150 V; Ec1= −22.5 V;		
Plate current	75	ma
Grid #2 current	1.7	ma
Transconductance	6000	umhos
Plate resistance	12,000	ohms
Zero Bias with Eb=60 V; Ec2=150 V; Ec1=0; (Instantaneous values)		
Plate current	300	ma
Grid #2 current	15	ma
Cutoff: For Ib=1.0 ma with Eb=250 V; Ec2=150 V.		
Grid #1 voltage (approx.)	-53	volts
Triode Amplification Factor with Eb=Ec2=150 V and Ec1= −22.5 V	4.1	

Framelok type 6FH6 plate-to-screen current ratios are compared to those of comparable existing tubes.



Type=6FH6
Avg. Plate Characteristics
Ef=Rated Voltage

Ec2=150 V DC
I_{c2}=6FH6 Framelok Structure
I_{c2}*=Conventional Structure

For additional information on Framelok Tubes and the Type 6FH6 mail this coupon to:

Sylvania Electric Products Inc.
1740 Broadway
New York 17, N. Y.

Name__________

Company__________

Title__________

Street__________

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SYLVANIA

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DOW CORNING CORPORATION

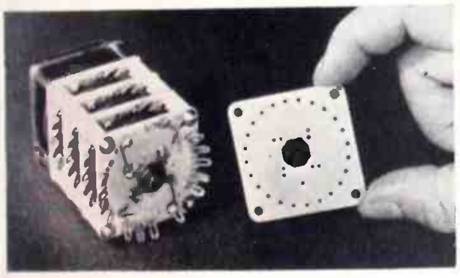
Silicone Dielectrics

ELECTRICAL AND ELECTRONIC NEWS No. 17

Rotary Switches More Reliable With Silicone-Glass Laminates

Combining unique dielectric and physical properties, silicone-glass laminates can be used to improve the performance of electrical and electronic devices involving extreme heat or moisture. An unusually good illustration is provided by Shallcross Manufacturing Company, Collingdale, Pennsylvania.

Shallcross' new line of 24-position electrical rotary switches features decks stamped from glass cloth laminate bonded with a Dow Corning silicone resin. The heat-stable silicone-glass decks keep terminals locked securely in place despite heat of soldering. More important, the silicone-glass construction of these 1500 V, 1 to 6 deck rotary switches assures reliable operation in hot, cold or humid climates where other insulating materials would fail.

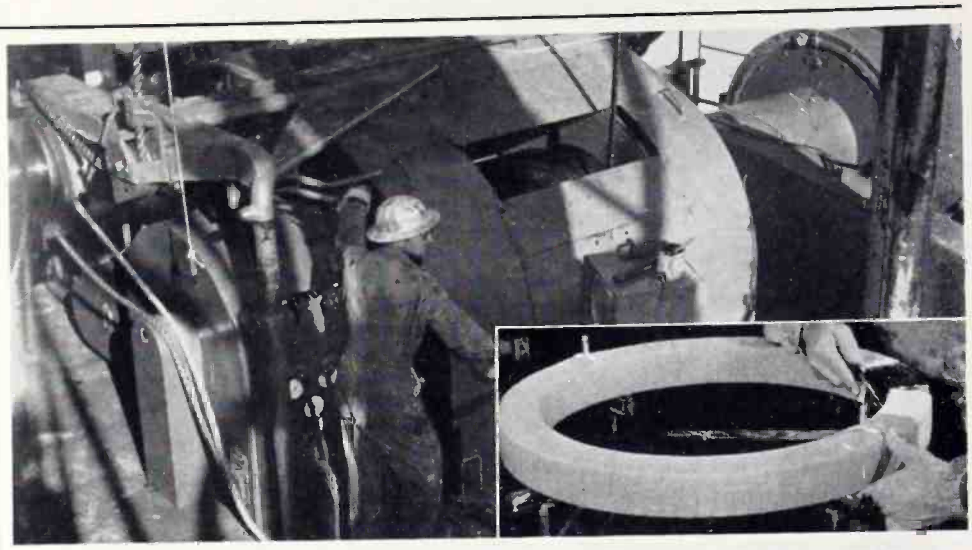


According to Shallcross, silicone-glass laminate was chosen because of these outstanding properties:

1. Low moisture absorption.
2. Thermal stability which not only permits service in varying climates, but prevents terminals loosening during soldering.
3. Good surface resistivity.
4. Low dielectric loss for increased RF efficiency.

The silicone-glass laminate used in these switches is "Phenolite G-7-830," produced and sold by National Vulcanized Fibre Company. National fabricates the plates maintaining a tolerance of ±.005 inch in the punched holes. *No. 66*

Pressure-sensitive silicone tapes— that stick to wet or dry surfaces; form good bonds; have high dielectric strength; repel moisture; are not affected by corrosive chemicals—are described in a new folder designed to help you choose the tape best suited to your application. *No. 67*



REPLACEMENT COSTS SLASHED

Increasing the reliability of magnetic brakes and couplings by insulating them with silicone dielectrics has paid handsome dividends to the Baylor Company, Houston. Result: greater customer satisfaction plus improved maintenance-free performance for their product.

Unconditionally guaranteed for a full year, Baylor Elmagco brakes and couplings are used in oil drilling to dissipate the tremendous energy developed while lowering drill strings. Three years ago Baylor started insulating this equipment with Dow Corning silicone insulation.

The heat-stable silicone insulation so drastically reduced Baylor's replacement costs during the one year warranty period that savings far exceeded the higher initial cost of using silicone insulation. Coil replacements dropped from 30% of total output to a mere 0.55%, only one-fiftieth of the previous rate.

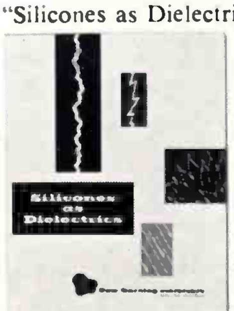
While the brakes are designed to dissipate energy up to 5000 hp, actual rates are frequently much higher. The silicone insulated brakes operate efficiently despite temporary overloads that would quickly burn out any other type of insulation. *No. 65*

Now Available—A Complete Guide To Silicone Dielectrics for Designers

Here's the most comprehensive guide to Dow Corning silicone insulating materials ever published for electrical and electronic design engineers.

A well-illustrated 12-page booklet, "Silicones as Dielectrics" will help you select the silicone material offering the best combination of mechanical and dielectric properties for any specific application.

It covers the latest application data and general properties of silicone rubbers, fluids, resins, varnishes, enamels plus compounds for filling, sealing and molding. In addition, "Silicones as Dielectrics" provides a handy reference to all the popular uses of these silicone materials for coating, bonding, impregnating, sealing, encapsulating and molding. To obtain your personal copy, circle . . *No. 68*



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Books

(*Continued from page 32*)

Industrial Electronics Circuits

By R. Kretzmann. Published 1957 by Philosophical Library, Inc., 15 E. 40th St., New York 16. 198 pages. Price $10.00.

This book is a sequel to Industrial Electronics handbook. It deals with the circuitry of industrial electronics apparatus, and includes nearly 200 carefully chosen circuits.

The functions of the various circuit elements are described, and comprehensive information is also supplied on the actual component values.

Instructive examples are given of photo electric controlled devices, counting circuits for various purposes, stabilizing circuits, switching and control circuits, amplifiers and oscillators, rectifying circuits and motor controls. Numerous photographs are used to illustrate the design of the apparatus.

Synthesis of Passive Networks

By Ernst A. Guillemin. Published 1957 by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16. 759 pages. Price $15.00.

Here is a logical, comprehensive approach to linear passive network synthesis. The author avoids so-called "short-cuts" in this treatment. He covers both the approximation problem and the realization techniques, the two essential parts of synthesis procedure. The coverage is sufficiently detailed so that the reader who digests this material will be able to work independently in this field. Included are numerous illustrative and practice problems. A good understanding of essential mathematics and basic circuit analysis is considered prerequisite to the use of this volume.

Passive Network Synthesis

By James E. Stoyer. Published 1957 by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36. 329 pages. Price $8.50.

Here is a concise treatment of network synthesis which covers modern developments in the field, available in text form for the first time. This is a survey of network synthesis, rather than a reference. Almost without exception, every synthesis procedure has been illustrated with one or more numerical examples. These are of such character that the reader can follow the arithmetic without resorting to the use of a slide rule.

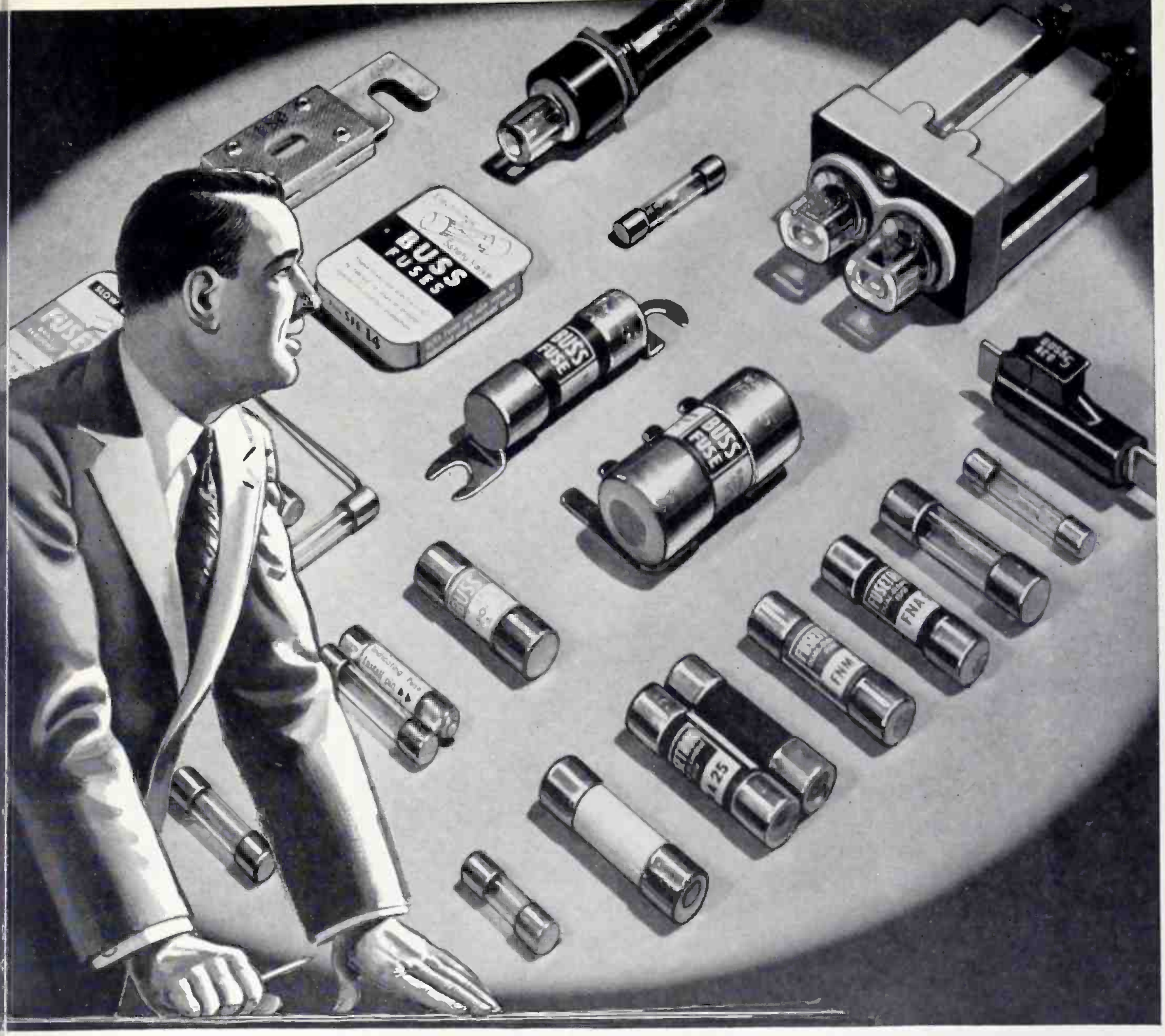
Books Received

Handbook of Tri-Plate Microwave Components

Published 1956 by Sanders Associates, Inc., Nashua, N. H. 152 pages.

Compiled as a scientific report of developments under two government contracts (1952 and 1954), this volume contains basic technical information on the design, production, and performance of "flat-strip" microwave components fabricated with printed circuit techniques.

(*Continued on page 40*)



BUSS Fuses provide Maximum Protection *against damage due to electrical faults*

When an electrical fault occurs, BUSS fuses quickly clear the circuit. By preventing useless damage, BUSS fuses help to get your equipment back in operation sooner. Users of your equipment are safeguarded against the expense of unnecessary repair bills.

BUSS fuse dependability also prevents needless blows that 'knock' equipment out-of-service without cause. Users are protected against irritating and often costly shutdowns due to faulty fuses blowing when trouble does not exist.

Electronic Testing Assures Dependability in BUSS Fuses

Every BUSS fuse is tested in a sensitive electronic device that automatically rejects any fuse not correctly calibrated, properly constructed and right in all physical dimensions.

By specifying BUSS fuses, you are providing the finest electrical protection possible, — and you are helping to safeguard the reputation of your product for quality and reliability. To meet your needs, the BUSS fuse line is most complete.

If you have an unusual or difficult protection problem . . . let the BUSS fuse engineers work with you and save you engineering time. If possible, they will suggest a fuse already available in local wholesalers' stocks, so that your device can easily be serviced.

For more information on 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.

Circle 25 on Inquiry Card, page 117

Books

(*Continued from page* 38)

System Engineering

By Harry H. Goode and Robert E. Machol. Published 1957 by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36. 551 pages Price $10.00.

This over-view of the relatively new "system design" approach to the problem of designing engineering equipment presupposes a mathematical background of elementary calculus.

The book shows how a number of very important fields such as statistics, computers, game theory, information theory, servomechanisms and control are put together by a group of system engineers to attack large scale problems in engineering, e.g., a development of radar systems, telephone systems, or guided missile systems.

Books Received

Electrical Discharges in Gases

By F. M. Penning. Published 1958 by The MacMillan Co., 60 Fifth Ave., New York 11, N. Y. 83 pages. Price $3.00.

Installing Electronic Data Processing Systems

By Richard G. Canning. Published 1957 by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. 206 pages. Price $6.00.

Care and Repair of Hi-Fi

By Leonard Feldman. Published 1958 by Cowan Publishing Corp., 300 W. 43rd St., New York 36, N. Y. 156 pages, paper bound. Price $2.50.

Techniques of Magnetic Recording

By Joel Tall. Published 1958 by The MacMillan Co., 60 Fifth Ave., New York 11, N. Y. 495 pages. Price $7.95.

Ceramic Fabrication Processes

Edited by W. D. Kingery. Published 1958 by The Technology Press, Massachusetts Institute of Technology and John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. 246 pages. Price $9.50.

Transistor Circuits and Applications

Edited by John M. Carroll. Published 1957 by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y. 294 pages. Price $7.50.

Numerical Control Systems for Machine Tools, Proceedings of the EIA Symposium

Published by Engineering Publishers, Div. of the AC Book Co., Inc., GPO Box 1151, New York 1, N. Y. 106 pages, paper bound.

Bulletin of the Academy of Sciences of the USSR, Volume 20, Nos. 11 and 12B, Physical Series

Published 1957 by Columbia Technical Translations, 5 Vermont Ave., White Plains, N. Y. Single issues $20.00.

Selection and Application of Metallic Rectifiers

By S. P. Jackson. Published 1957 by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y. 340 pages. Price $8.00.

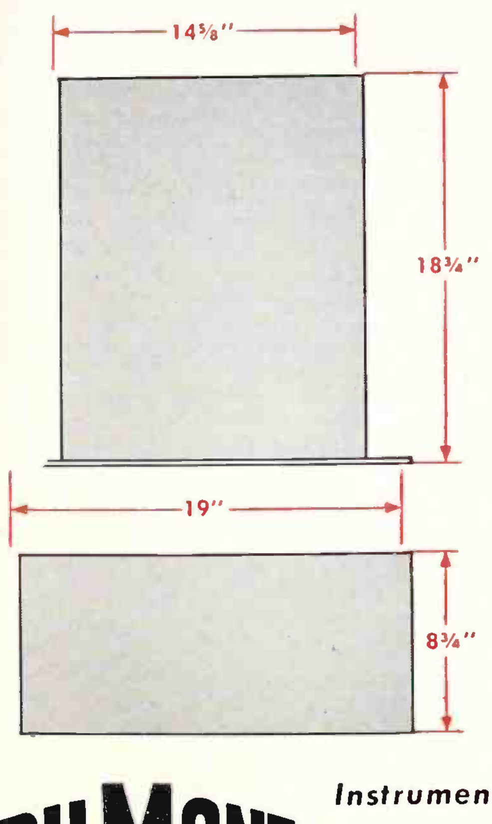
JUST AS GREAT IN EITHER SHAPE

One of the 400 Series

the same big benefits you get in the Type 401 Bench Model are in rack-mounting form

Du Mont 401-R Rack-Mounted Oscilloscope

Identical in every electrical respect to its industry standard counterpart, the 401-R is physically rearranged for insertion into standard 19" relay racks. For quantitative and qualitative studies within the dc to 100 kc bandwidth, the 401-R offers important advantages in an easy-to-use configuration for panel operation. Some of these features... not available in other rack mountable units... are:



- X and Y amplifiers *identical* in all respects.
- Less than 3° phase shift between amplifiers at 100 kc. Even less phase shift at lower frequencies.
- Complete flexibility of sync control. Will sync from either positive or negative signals.
- Driven or recurrent sweeps available from front panel.
- Fast sweep — down to 10 us/inch.
- *Specified* linearity — any 10% increment of on-screen display is within 10% of any other increment.
- 5ADP cathode-ray tube for maximum light output at its 3 kv accelerating potential. No spot "blooming" with increases in brightness intensity.
- Direct access to deflection plates by terminals brought out at rear.
- Only 110 watt power consumption.
- "Channelized" controls. No doubled-up sweep ond amplifier controls.

PRICE $495.00

Write for complete details...

DU MONT *Instrument Division*

ALLEN B. DU MONT LABORATORIES INC., CLIFTON, N. J., U. S. A.

Circle 27 on Inquiry Card, page 117

A report to engineers and scientists from Lockheed Missile Systems — where expanding missile programs insure more promising careers

COMPUTER "FLIES" MISSILE DESIGNS, SPEEDS POLARIS DEVELOPMENT

A new analog computer is today speeding early development of the Polaris ballistic missile by virtually "flying" missile designs right off the drawing board.

These "test flights" eliminate design flaws and come up with a workable form without wasting time and money building and flying proposed missile shapes.

Two Univac Scientifics are also included in the division's computer facilities — already among the most extensive in the west.

Advanced facilities like our computer installation have been developed through expansion in a variety of missile programs. These missile projects—including Polaris, X-7 and Q-5—have earned Lockheed leadership in missile technology.

More advanced projects we cannot talk about are under way. This means engineers and scientists who join Lockheed Missile Systems now, can enjoy opportunities to grow rapidly in the years ahead.

Positions are open for qualified people in: **Information Processing, Telecommunications, Reliability-Producibility, Ground Support, Guidance, Flight Controls, Aerodynamics, Thermodynamics.**

Write or send résumé to M. W. Peterson, Research and Development Staff, Sunnyvale 5, California.

Lockheed **MISSILE SYSTEMS**

A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

SUNNYVALE • PALO ALTO • VAN NUYS • SANTA CRUZ • CALIFORNIA

Group leader Robert Turner, right, discusses results of a problem with Math Analyst Richard Hayes.

Circle 501 on "Opportunities" Card, page 117

ONE-MAN COMMUNICATION CENTER

With the portable, lightweight Kleinschmidt field teletypewriter, remote positions keep in two-way printed communication with distant headquarters.

Quickly set up for transmission and reception of information, the Kleinschmidt teletypewriter instantly establishes accurate, printed communications between outlying areas and headquarters. With this unit, developed in cooperation with the U. S. Army Signal Corps, two-way teleprinted communications can be established in minutes. Identical printed originals are in the hands of sender and recipient simultaneously.

Since the early 1900's, Kleinschmidt has devoted its efforts to the constant development and wider utilization of teleprinted communications equipment. Credited with an imposing list of "firsts," Kleinschmidt—now a member of the Smith-Corona organization—continues its never-ending research to broaden the scope of teleprinted communications in every field.

Pioneer in teleprinted communications equipment

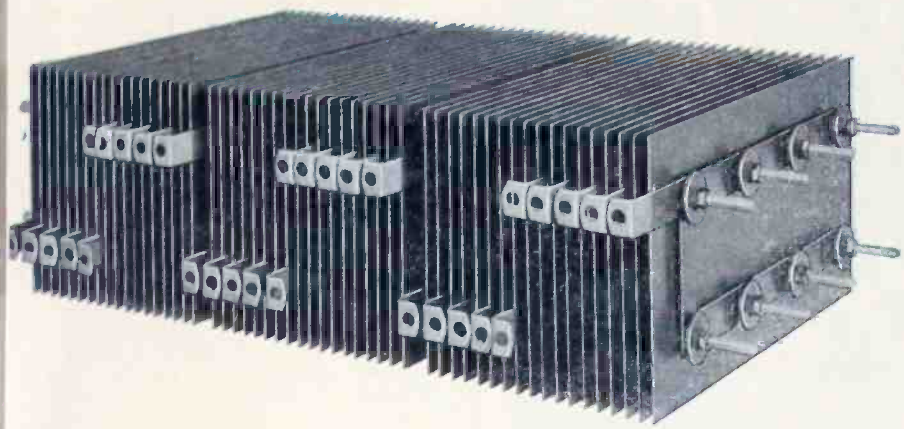
KLEINSCHMIDT LABORATORIES, INC.

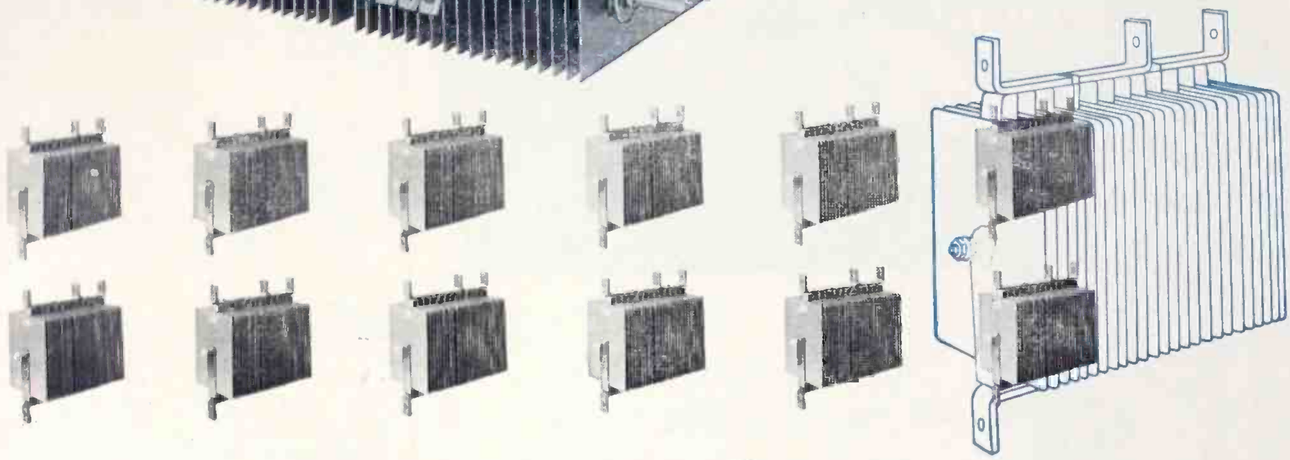
A subsidiary of Smith-Corona Inc • Deerfield, Illinois

Circle 29 on Inquiry Card, page 117

Single New Rectifier Outperforms

12 full size conventional stacks!





Radio Receptor HCD* Petti-Sel

**High current density*

Industrial Type Selenium Rectifiers

Produced by the improved new vacuum process developed by Siemens of West Germany and now manufactured exclusively by Radio Receptor in the U.S.

Smaller cell sizes

Lower voltage drop

No artificial barrier

Negligible aging with an estimated life of 100,000 hours!

Because the exclusive Siemens vacuum process eliminates the need of an artificial barrier layer, it is possible for Radio Receptor to offer smaller cell sizes operating at high current density, yet with lower voltage drop. In actual dimensions this means that just *one* RRco. HCD rectifier measuring 8" x 16" x 25", rated at 26V AC, 4500 amps DC, replaces *twelve* usual stacks 6" x 7¼" x 10".

RRco. Petti-Sel rectifiers do far more than save space. They reduce assembly time, require fewer connections and cost less per ampere. Their dependability has been proved for years in European circuits and the outstanding electrical characteristics are not even approached by other standard cells available today. For further information please write today to Section T-4R.

Radio and Electronic Products Since 1922

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Radio Receptor products for Industry and Government:
Germanium and Silicon Diodes, Selenium Rectifiers, Thermatron Dielectric Heating Generators and Presses, Communications, Radar and Navigation Equipment

Circle 31 on Inquiry Card, page 117

News of Reps

Reps Wanted

A manufacturer of **automatic component test equipment** desires representation in several territories for their complete line. (R4-1, Editor, Electronic Industries).

A well known manufacturer desires reps for their complete line of **communication equipment, amplifiers, control devices, capacitors, and filters.** The territories to be covered are Michigan, Minnesota, Wisconsin, North and South Dakota, Ohio, Tennessee, Alabama, Mississippi, Virginia, North and South Carolina, Georgia, Florida, Colorado, and Utah. (R4-2, Editor, Electronic Industries).

The Electronic Tube Corp. has appointed **Tower Engineering Co., Lawrence C. Freeman & Assoc., Eastern Assoc., Inc.,** and **Adams Engineering Ltd.** to handle their line of oscilloscopes and cathode-ray tubes.

John E. Sweeny, Jr. has been named to represent Synthane Corp. in Western Pennsylvania, Northwestern Maryland, Eastern Ohio and Northern West Virginia. He will handle their complete line of industrial laminated plastics.

William N. Rider, Jr. and **Dudley B. Bishop** have been appointed Wyle Assoc. reps in Dallas, Texas and Dayton, Ohio respectively.

R. G. Sidnal and Co., 1229 Westlake Ave., Cleveland, Ohio has been appointed sales rep in Ohio and Western Pennsylvania for Clevite Transistor Products.

Johnson Assoc., 521 Elwell St., Orlando, Fla. now represent the Bliley Electric Co. in the state of Florida.

The Electronic Div. of Waldorf Instrument Co. has appointed **Frank Bradley Assoc.**, New York City, **Gerald B. Miller Co.**, Hollywood, Calif., **Mury E. Bettis Co.**, Kansas City, Mo., and **John P. Brogan Assoc.**, Westbury, N. Y. as reps in their respective areas.

Benz Sales Co., P. O. Box 178, North Miami Beach 62, Fla. is now sales reps in Florida, Cuba and Puerto Rico, for the Chicago Telephone Supply Corp.

At the recent annual RMS sales meeting at Grossingers, N. Y. which was attended by all reps, **Al Levine, Ed Martin, Jim Chilcote, Gask Goss** and **Jack Rosen** were presented awards as top reps of the year.

(*Continued on page* 48)

PZT-4 ©

NEW

Piezoelectric* Material

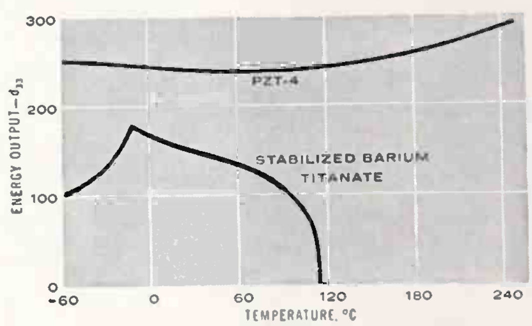
Surpasses barium titanate . . . performs remarkably independent of temperature . . . Curie point above 572°F . . . suggests new fields of application—maybe yours

A newly-developed polycrystalline ceramic, Clevite PZT-4, can greatly increase the reliability and operating range of missile devices, sonar transducers, ultrasonic cleaning equipment and other systems now using "grown" crystals or barium titanate elements.

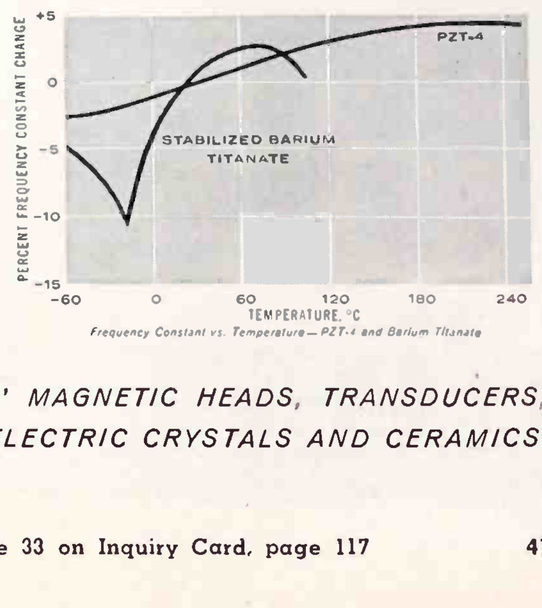
PZT-4's resonant frequency and piezoelectric coefficients are virtually independent of temperature . . . dielectric constant compatible with barium titanate—substitute PZT-4, extending your operating temperature range. PZT-4 substantially increases voltage output and power handling capacity of transducers.

Commercial quantities of PZT-4 are now available in electromechanical specifications to meet your needs. With skilled facilities, knowledge and experience in this highly specialized field, Clevite's Electronic Components Division is also prepared to manufacture complete assemblies — such as transducers — for your needs. Send for PZT-4 technical data, or discuss your application with one of our specialists.

*Piezoelectric—"pressure" electricity. Press or squeeze certain crystalline materials and they generate electricity. Conversely, charge them electrically and they change in width, in length or in thickness.



Energy Output vs. Temperature—PZT-4 and Barium Titanate



Frequency Constant vs. Temperature—PZT-4 and Barium Titanate

CLEVITE ELECTRONIC COMPONENTS

3311 Perkins Avenue, Cleveland 14, Ohio

DIVISION OF CLEVITE CORPORATION

'BRUSH' MAGNETIC HEADS, TRANSDUCERS, PIEZOELECTRIC CRYSTALS AND CERAMICS

Circle 33 on Inquiry Card, page 117

News of Reps

The Nylok Corp. has appointed five new rep firms. They are: **Russell Associates**, Brightwaters, N. Y., **Northeast Sales Engineering**, Hamden, Conn., **Factors, Inc.**, Seattle, Wash., **The Monroe Co.**, Cincinnati, Ohio, and **Strother & Assoc., Inc.**, St. Louis, Mo.

Radionics, Ltd., 8230 Mayrand St., Montreal, Canada is now Eastern Canadian representative for Baird-Atomic, Inc.

Harry W. Gebhard Co. has been appointed to represent the Electro Tec Corp.

R. G. Bowen Co., Denver, Colo. are now reps in the Rocky Mountain area for Bud Radio, Inc.

Winfield Electronic Sales Co. are presenting Anchor Products Co. in the state of Florida.

Houser Associates, Perth Amboy, N. J. are sales reps for the Vacuum Tube Products Co. in the Southeastern states from Pennsylvania to Florida.

Ernest F. Whittaker of Arnprior, Ontario is now Canadian rep for the Electronics Div. of Gudebrod Bros. Silk Co.

Jack Berman Co., Inc. of Los Angeles, Calif. has been named West Coast technical sales rep by Tri-Point Plastics, Inc.

S. Forrest Brooks has been named rep in Arizona and New Mexico for the San Fernando Electric Mfg. Co.

Andrew L. Polich, Inc. is now a rep in Oregon, Washington, Montana and Idaho for the Electro-Span digital supervisory control systems. This equipment is manufactured by the Pacific Div. of Bendix Aviation Corp.

Frank Malley Co. of Albuquerque, N. M. has been named sales reps in Idaho, Wyoming, Montana, Utah and Colorado for the Sealectro Corp.

Alabama, Florida, Georgia, Mississippi, North Carolina, South Carolina and Tennessee territories are now being covered by **Stanley K. Wallace Assoc., Inc.**, Lutz, Fla. for the Victoreen Instrument Co.

B. B. Taylor Corp. have been named reps in New York City and New Jersey for the Pulse Engineering, Inc.

Carl G. Chafin Co. of San Diego has been appointed by WYCO Metal Products to represent them in San Diego and the Imperial counties.

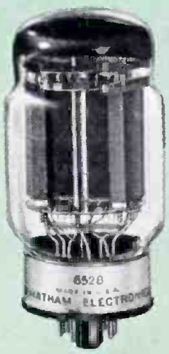
(*Continued on page* 50)

Specialists in special purpose tubes

THYRATRONS—An extensive line of thyratrons for use as grid control rectifiers, relays and noise generators. Inverse voltage ranges from 100 to 5,000 volts. Sizes from subminiatures to ST 16 bulbs. Filamentary as well as hot and cold cathode types are available.

RECTIFIERS—Both vacuum and gas filled tubes with peak inverse voltage ratings from 200 to 15,000 volts. Included are tubes with special features such as fast warm-up, cold cathodes, clipper service ratings and rugged construction.

VOLTAGE REGULATOR AND REFERENCE TUBES—Gas filled tubes designed to specific voltages for regulating small currents. Also used to make available stable reference voltages for high current supplies. Sizes from subminiatures to bantams, including many reliable, ruggedized types.



TWIN POWER TRIODES—The most complete line of high current twin power triodes developed especially for regulated power supply usage. Current and power ranges up to 800 milliamperes and 60 watts respectively. Included are rugged types in both low and medium mu construction.

TELEPHONE TYPES — A highly specialized line of vacuum and gas filled types in both the 300 and 400 series.

HYDROGEN THYRATRONS—Used primarily as switching tubes in line type radar modulators, these tubes permit accurate control of high energy pulses. Sizes from miniatures to the VC 1257. Peak pulse power ranges from 10 kilowatts to 33 megawatts.

Chatham research and development has produced many new tube types that have become industry standards. If you have a special purpose tube problem, Chatham experience can help you find the solution.

CHATHAM

CHATHAM ELECTRONICS Division of **TUNG-SOL ELECTRIC INC.**

General Office and Plant: Livingston, New Jersey

SALES OFFICES: CHICAGO, DALLAS, LIVINGSTON, LOS ANGELES

News of Reps

Shamp Scientific Supply Co., Washington, D. C. has been appointed technical sales reps in that area for Control Electronics Co., Inc.

Martin Mann Assoc., reps in Southern California and Arizona have moved into their new and larger quarters at 14751 Keswick St., Van Nuys, Calif.

Electromechanical Products of Agincourt, Ont. are now reps in the Dominion of Canada for Radiation Counter Laboratories, Inc.

The Southern Sales Co., Angola, Ind. are now sales reps in Northern Indiana for the Electronics Div. of Elgin National Watch Co. They will handle the Advance Relay line.

Ad. Auriema, Inc. are representing the Engineered Electronics Co. on a world-wide basis exclusive of the United States, its possessions, and Canada.

Robert Pflieger Co., San Carlos, Calif. are now sales reps for Hermetic-Pacific Corp. on the West Coast.

Ernest L. Wilks Co., 1212 Camp St., Dallas 2, Tex., are exclusive reps in Texas, Oklahoma, Louisiana and Arkansas for Peerless Products Industries.

Don H. Burcham Co., 510 N. W. 19th Ave., Portland 8, Ore. are now Northwestern sales reps for International Telephone and Telegraph's semiconductor products.

Martin-Rettger, Inc., 3477 Fairmount Blvd., Cleveland Heights 18, Ohio are now sales reps in Northern Ohio for the Ward Leonard Electric Co.

G. S. Marshall Co., San Marino, Calif., have been reps for Electro-Physics Labs. and Industrial Electronics Engineers in California, Arizona, and Nevada.

William Logan has formed a new rep firm covering Northern California and Northern Nevada. The firm has warehouse facilities available.

Ralph J. Haffey Co. are exclusive sales rep in Indiana, Ohio, Michigan, and Kentucky for Minco Products, Inc. Their main headquarters are in Ft. Wayne, Ind.

Engineering Services Co., 4550 Main St., Kansas City. Mo., have been named reps in Missouri, Kansas, Nebraska, Iowa, and Southern Illinois for Century Industrial Instruments.

New!

Brush

Mark II

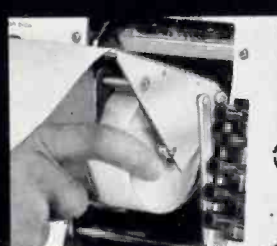
plug it in . . . put it in writing . . . anywhere!

Recording with the new Brush Mark II is remarkably simple.

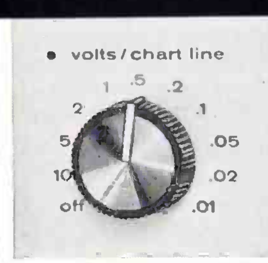
Operation is foolproof, with push-button chart speed selection . . . fast paper loading . . . self-cleaning, self-priming pens. . . built-in, permanently calibrated amplifiers.

Recordings are accurate . . . easy to interpret . . . easy to reproduce. Mark II operates over a wide amplitude and frequency range (d.c. to 100 cps), provides high stability, extreme sensitivity with an input range of 10 millivolts to 400 volts.

See how Mark II can speed your work, help you obtain data — the Brush way.



Convenient operation: fast paper loading without threading, pushbutton controls for 4 convenient chart speeds.



Complete recorder with built-in, permanently calibrated amplifiers. Ten millivolt input signal gives a deflection of one chart line.

Trouble-free writing system features self-cleaning, self-priming, rugged pens and extra-large ink reservoir.

brush INSTRUMENTS

DIVISION OF

3405 PERKINS AVENUE **CLEVITE** CORPORATION CLEVELAND 14, OHIO

Truly sub-miniature, these capacitors were devised especially for printed circuits and automatic assembly. Since they retain all the properties of larger, pig-tail capacitors, they are well suited to general circuitry as well.

Now—Corning Fixed Glass Capacitors in new sub-miniature size

Packing up to 1,000 uuf at 300 V. and 125°C. into 0.010 cubic inches, these new capacitors are designed for use on printed circuit boards and all applications requiring high-quality components. Advantages include fixed temperature coefficient, high insulation resistance, low dielectric absorption, the ability to operate under high humidity and high temperature conditions, plus the added advantage of increased miniaturization.

You can now up-grade your specs for miniature capacitors used on printed circuits.

These new capacitors measure only $\frac{9}{32}$ x $\frac{19}{64}$ x .115, yet have capacitances up to 1000 uuf at a full 300 V. rating at 125°C. Such exceptional thinness makes these capacitors particularly well suited for vertical mounting in small, high-rated units.

The capacitors have high temperature soldered leads which allow direct connection to circuit boards. The leads are .100 inches long, fitting most circuit board thicknesses and eliminating any trimming.

Reliable · Since the new construction is extremely simple, reliability is correspondingly high.

Rugged · These capacitors, when mounted, successfully withstand a standard five-hour vibration cycling test at 10 to 55 cycles, 15G Max.

Known as WL-4 capacitors, these units are in mass production. Your inquiries concerning data and prices are welcome.

FEATURES

1. to MIL C-11272A except smaller
2. 1 to 1,000 uuf
3. 300 volts
4. 125°C. full rating
5. .010 cubic inches

Corning means research in Glass

CORNING GLASS WORKS, 95-4 Crystal St., Corning, N. Y.

Electronic Components Department

Now PRECISION MEASUREMENTS with

Lavoie ROCK-STABLE SPECTRUM ANALYZER

covers 10 mc

to 21,000 mc

with only

"one head"

From Lavoie comes one of the most useful laboratory instruments in a decade. Spectrum analyzers have long been considered a "go-no-go" type of instrument . . . but with the Lavoie LA18A Spectrum Analyzer you get a rock stable precision instrument that is Klystron-free giving you dependable quantitative data. Single head construction and a simplified band switch arrangement permits coverage of the entire 10-21,000 mc range.

This unit minimizes down-time due to its rugged construction and militarized design . . . and should the need for maintenance occur, it can be done quickly and easily because of "Lavoie Unitized Subassemblies."

Other features are triple shielding, which has permitted use of the Spectrum Analyzer in fields where 4 megawatts were exceeded without spurious responses . . . and human-engineering . . . the essential feature of base line elimination allows the unit to be used for long hours without eye strain.

The Lavoie Spectrum Analyzer is an everyday lab and shop tool that gives you the versatility and stability of a luxury-type unit.

Write today for complete specifications. You can also see the LA18A Spectrum Analyzer and the new Extended Range Analyzer at the Lavoie IRE Show Booth

Users requiring an extended range analyzer!

The Lavoie Extended Range Analyzer LA18B covers up to 44 Kmc.

Write for full details!

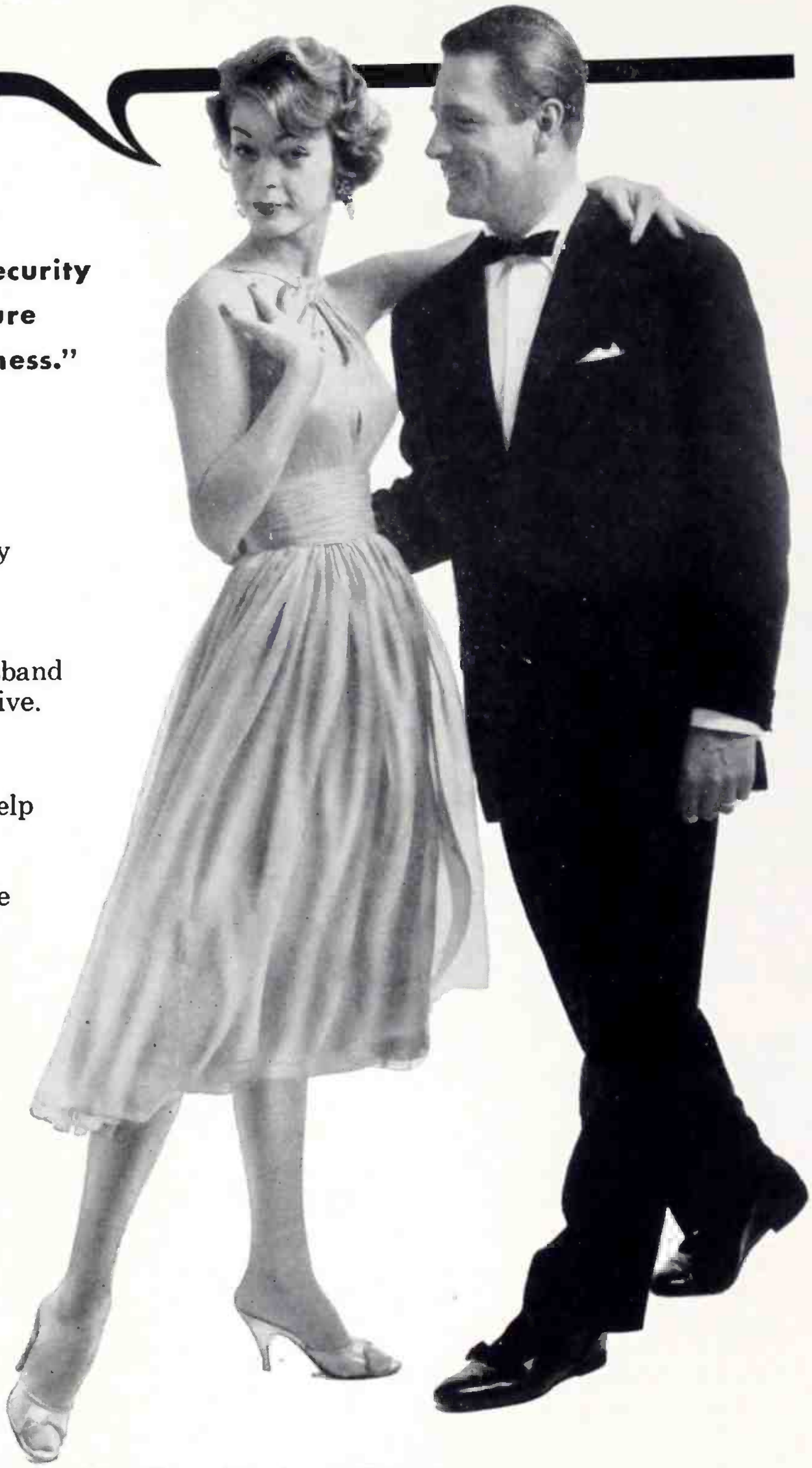
Lavoie Laboratories, Inc.

MORGANVILLE, NEW JERSEY

GN

Circle 77 on Inquiry Card, page 117

Why SHOULDN'T I be interested in business life insurance?



"My family's future security depends upon the future of my husband's business."

death can shake the very foundation of any usiness and cause serious financial problems) the families which rely on it.

'hat's why business life insurance important to every woman, whether her husband an owner, partner, stockholder or key executive. 'he future of the firm often depends n business life insurance.

Etna Life's Business Planning Service can help our attorneys for efficient transfer of our business estate and increase its dollar ffectiveness. Thoroughly trained Ætna Life epresentatives in 91 agencies from oast to coast are ready to offer you his unequaled service in planning your usiness life insurance.

ETNA BUSINESS LIFE INSURANCE 'LANS ARE SPECIALLY DESIGNED . . .

- To preserve PARTNERSHIP value when death comes to any partner.
- To preserve SOLE PROPRIETORSHIPS for heirs or selected employees.
- To preserve ownership values when death comes to any stockholder in a CLOSE CORPORATION.
- To indemnify any firm for the death of a KEY MAN.

Add Life to your Business with Ætna Business Life Insurance

ÆTNA LIFE
INSURANCE COMPANY

Affiliates:

ÆTNA CASUALTY AND SURETY COMPANY
STANDARD FIRE INSURANCE COMPANY
Hartford, Conn.

Ætna Life Insurance Company
Hartford 15, Connecticut

Gentlemen:

Please send me a copy of your new business life insurance booklet "Will This Man Take Your Business With Him When He Dies?"

Name______________________________

Address______________________________

____

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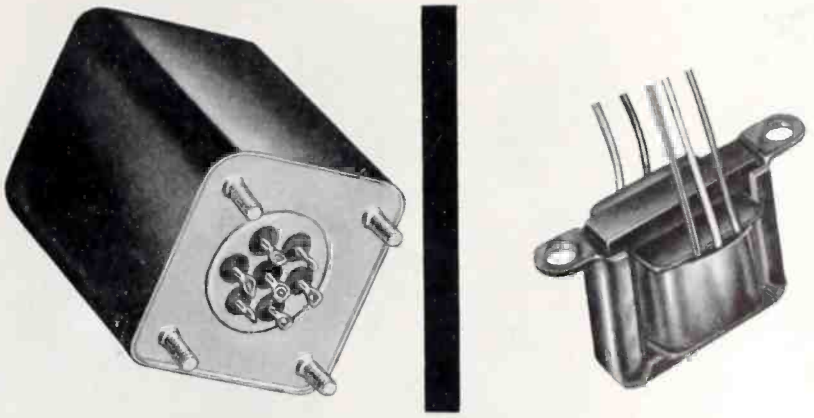


As We Go To Press . . .

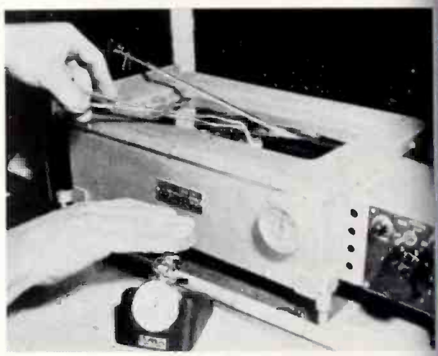
Yield Pay-TV Rights

The two holders of pay television franchises in Los Angeles have asked the city to take them back. The move would eliminate the need for a referendum planned to authorize the licenses.

A spokesman for International Telemeter Corp. said, "Because of our faith in the inevitability of pay television, we relinquish our franchise rather than burden the city with a needless expenditure of public funds for a referendum that is now complicated by issues and forces unrelated to pay television."

Skiatron TV Inc., the other Los Angeles pay TV operator, also made a move to turn back its franchise.

NEW CLAD LAMINATE



GE has developed a new copper clad glass expoxy laminate, Textolite 11558, reportedly capable of passing any dip solder specification in the industry. Here new laminate is tested in solder pot at 500° F.

30% of Top College Youths Choose Science

The Science Manpower Project at Columbia University recently released a preliminary report on the attitudes of a representative sample of New Jersey public high school students toward science and scientific courses.

30% of the boys in the upper quarter of intelligence named a career in science or engineering as their first choice. They further stated that *it is possible for them to prepare for that career.* (A followup study is now—six months later—in the design stage to determine how many of these carried out these plans by college enrollment.)

It is interesting to note that only 1 in 10 of all seniors felt that science is a man's world with little room for women. Only 1 senior in 10 believed that girls have little

(*Continued on page* 58)

(*Continued from page* 56)

mechanical aptitude and should not consider scientific or engineering courses.

However, over a third felt that friends often discourage girls from taking high school science courses and that the average home discourages girls from scientific or engineering careers.

Contrary to many recent reports, less than 10% of the seniors held stereotype of scientists as "long hairs", "egg heads", or "an odd lot". Less than 10% thought of a scientist as a "shy and lonely individual". However, of these that have an opinion:

23% felt that scientists are too narrow in their views.

32% felt that scientists might aptly be described as "non-conformists".

76% felt that scientists display an unnatural attachment to their work.

About half of the group viewed scientists as normal persons who stand high in popular prestige.

Radar Development Aids ICBM Detection

A new achievement, expected to contribute significantly to the development and perfection of ICBM detection apparatus, has been announced by the Department of the Army.

Radar-like signals many more times powerful than believed possible previously have been transmitted by the Cornell Aeronautical

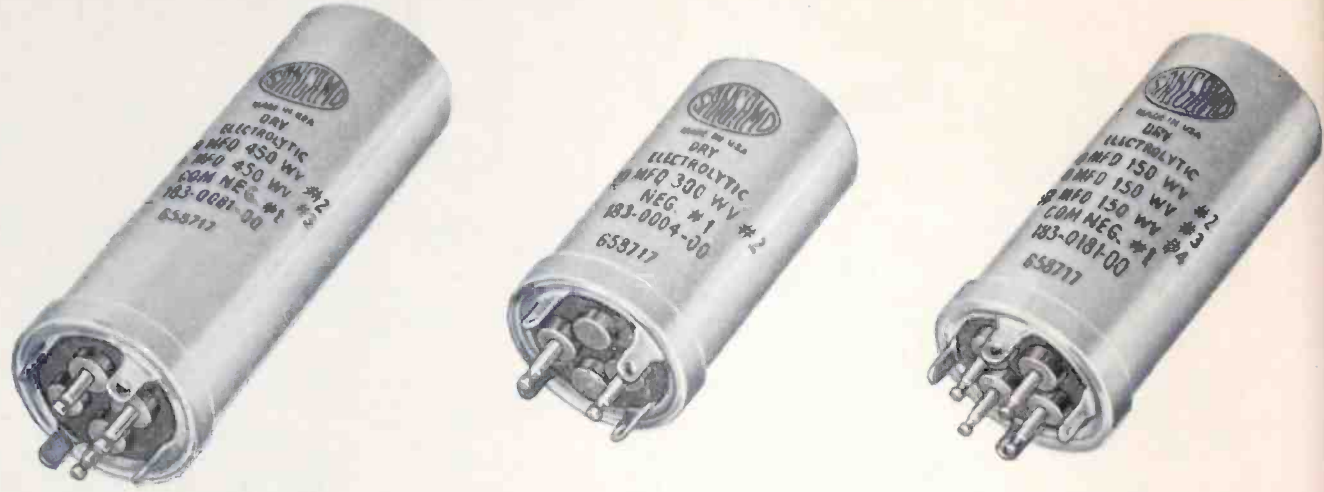
(*Continued on page* 64)

NEW COMPUTER

The "APAC" computer developed by Nortronics Div., Northrop Aircraft, is designed for airborne applications and features full transistorization. APAC (Airborne Parabolic Arc Computer) is packaged into 1½ cu. ft., has magnetic memory drum.

Circle 43 on Inquiry Card, page 117

NEW HIGH RELIABILITY



IN ELECTROLYTIC CAPACITORS

These new dry electrolytic capacitors are especially built for applications that require an extremely high level of reliability over long periods of time.

Sangamo Type TR capacitors are designed to operate in a temperature range from —20°C to +85°C.

The Type TR is well suited for use in communication systems; in all types of electronic industrial controls, laboratory test instruments, computer equipments, and in many other similar applications. Type TR capacitors are available in ratings from 3 to 450 volts D.C.

Sangamo Type TR

TWIST-TAB ELECTROLYTICS

have a life expectancy of at least 10 years when operated within their ratings These high reliability dry electrolytics are designed with safety factors to pass high ripple currents.

The use of high purity aluminum foil assures lower leakage current, and a highly effective end seal gives these capacitors unusually long operating life provided they are operated within their ratings.

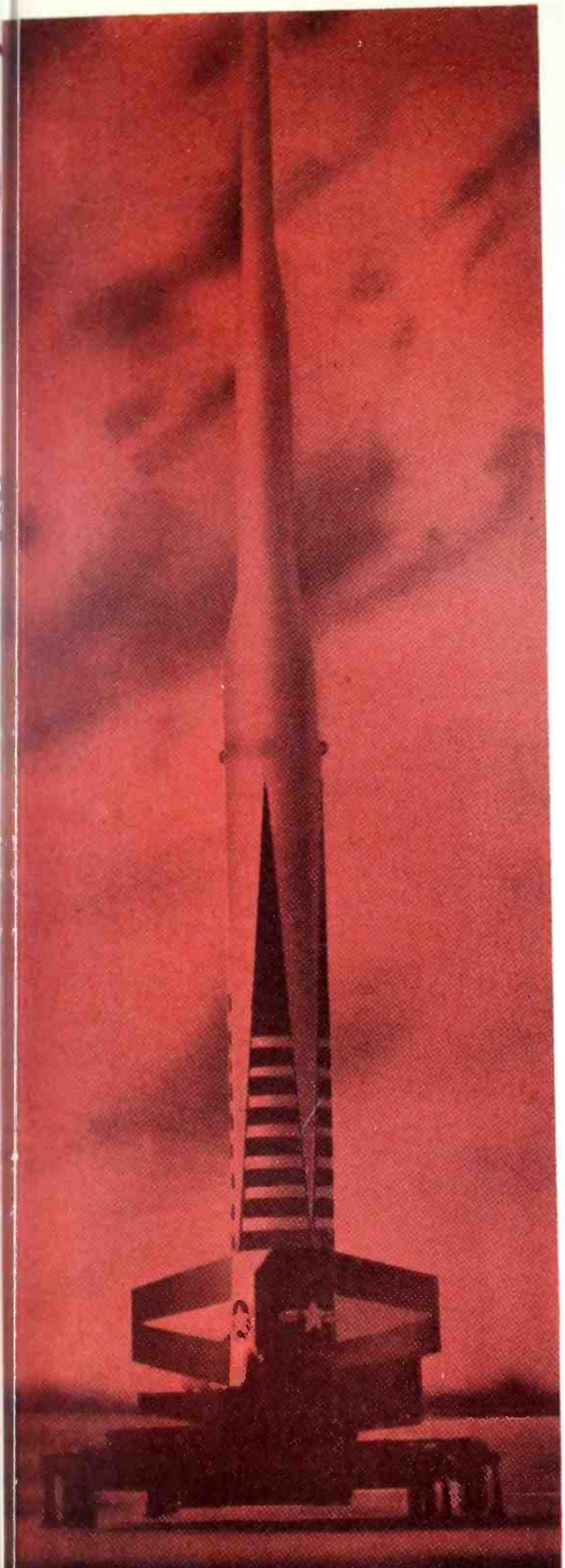
Engineering Bulletin TSC 119 gives full information.

SANGAMO

Electric Company

SPRINGFIELD, ILLINOIS

SC58-1



ALL SET FOR A . .

Hot ride

Thanks to Extensive RF Testing In a Shielding, Inc. Enclosure

No room for errors, now . . . "countdown" is over . . . and the success of a missile's mission greatly depends on the ability of its electronic guidance system to deliver its payload on target.

Proper functioning of critical missile electronic gear demands exhaustive pretesting in the laboratory, on the production line and at the launching site. One very important pre-testing procedure is analyzing the performance of electronic components, sub-systems and systems in an area completely free of RF interference.

Shielding, Inc. is proud to say that it has been a supplier of RF shielding enclosures for use in both Thor and Atlas programs. As a designer and producer of RF shielding enclosures from the largest ever built to standard, modular rooms, Shielding has the experience and abilities to fill these most critical RF shielding requirements — with either a standard or custom-designed enclosure.

It's not by chance that Shielding has been consistently selected as a supplier to many of our nation's most vital missile and communication projects. Missile manufacturers and government officials know from experience that Shielding enclosures offer the highest RF shielding effectiveness available for construction material used . . . incorporate extra mechanical design features and installation versatility not found in conventional enclosures.

Whatever your RF interference needs, Shielding can deliver an enclosure to your specifications. Write or wire Shielding outlining your problems in these highly technical areas. You'll receive a prompt appraisal.

TYPICAL SHIELDING "UNIVERSAL" RF SHIELDING ENCLOSURE

SHIELDING, INC.

63 N. READE AVE., RIVERTON, N. J.

CHICAGO — R. EDWARD STEMM
DENVER — WILLIAMS & ASSOCIATES
LOS ANGELES — CARL A. STONE ASSOCIATES, INC.
FORT WORTH — MITCHELL SPEARS COMPANY
SEATTLE — G. M. GILLETT COMPANY
CANADA —
STARK ELECTRONICS SALES LTD., AJAX, ONTARIO

Circle 45 on Inquiry Card, page 117

Personals

Richard P. Gifford has been na[med] Manager of Engineering for Gene[ral] Electric Company's Communicat[ions] Products Dept. He succeeds C. Heiden who has joined GE's Resea[rch] Lab.

Dr. Hans E. Hollmann and **D[r.] Frederick F. Liu** have joined Dress[er] Dynamics, Inc., Northridge, Calif., new subsidiary of Dresser Industri[es] Dallas, Tex., in the capacities of V[ice] Presidents in charge of basic and a[p]plied research, respectively. Dr. Ho[ll]mann was formerly the Director [of] Research of the National Aircra[ft] Corp. and Dr. Liu's former affiliati[on] was with Rocketdyne.

Dr. H. E. Hollmann

Dr. F. F. Liu

Clevite Transistor Products of Wa[l]than, Mass., have made four additio[ns] to their engineering staff. The fo[ur] new members all of whom receiv[ed] their educations at colleges in Eng[]land, are **William Dingsdale, John Hi[]**, **William L. Quine** and **David [] Roberts.**

D. M. Heller and **R. E. Whiffen** ha[ve] been appointed Assistant Gener[al] Managers and **W. P. Bollinger** h[as] been named Director of Engineerin[g] of the Products Div. of Bendix Avi[a]tion Corp.

Kenneth G. Bucklin is now Mana[]ger, Engineering, Receiving Tube Op[]erations, RCA Electron Tube Div Harrison, N. J. He was formerly Man[]ager, Market Planning, Entertainmen[t] Receiving Tube activity.

Louis De Lalio is now Chief Re[]search and Development Enginee[r] with Filtors, Inc.

Andrew C. Bayle has been appointe[d] Director of Engineering of the Wa[l]tham Precision Instrument Co. (for[]merly the Waltham Watch Co.).

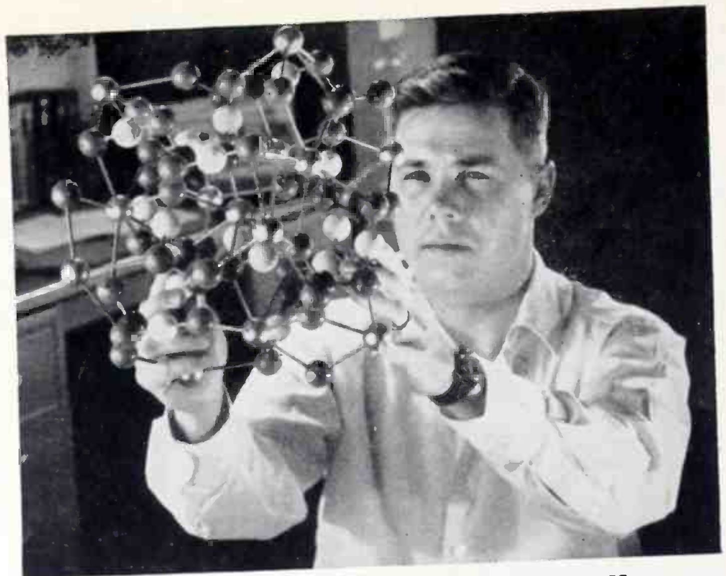
Roger Bowen has been appointed t[o] the Central Staff as Director of Engi[]neering of the Cannon Electric Co. I[n] this post he will direct and control th[e] over-all engineering activities of th[e] company.

SYMBOL

OF A POWERFUL FORCE

'he question mark symbolizes man's inquiring pirit. And nowhere is this spirit cultivated with nore enthusiasm than at Bell Telephone Laboratories vhere, through vigorous research and development, t constantly works to improve electrical communi- :ations and also to help national defense in essential nilitary programs.

More than 3000 professional scientists and engineers at Bell Telephone Laboratories are exploring, inventing and developing in many fields: chemistry, mathematics and physics, metallurgy, mechanical engineering, electronics and others. You see the successful results achieved by this organization of inquisitive and highly trained minds in the nationwide telephone system that serves you.



Dr. Walter Brown, physics graduate of Duke and Harvard Universities, bombards crystalline solids with one-million-volt electrons to study the nature of simple defects in crystals. Objective: new knowledge which may help improve transistors and other solid state devices for new and better telephone and military systems.

Peter Sandsmark, from Polytechnic Institute of Brooklyn, and his fellow electrical engineers develop a new microwave radio relay system able to transmit three times as much information as any existing system. Objective: more and better coast-to-coast transmission for telephone conversations and network television.

Bill Whidden, from Polytechnic Institute of Brooklyn, and George Porter, from Georgetown College, study new experimental telephone instruments designed to explore customer interest and demand. Objective: to make your future telephone ever more convenient and useful.

BELL TELEPHONE LABORATORIES

WORLD CENTER OF COMMUNICATIONS RESEARCH AND DEVELOPMENT

(Continued from page 58)

Laboratory, Buffalo, New Yor under an Army Ordnance researc contract applicable to U. S. Arm missiles systems.

A power peak of 21,000,00 watts, believed to be the large peak power ever radiated, wa reached by use of an especial micr wave generator.

Because of its extreme speed an unusual configuration, an ICBM i difficult to detect with present da radar equipment. Consequently, an radar which is contemplated for us against missiles must have a grea deal more power than a correspond ing radar used for the detection o aircraft.

Any development increasing th peak power which can be emitted b a radar is viewed as significant i the development of future detectio equipment.

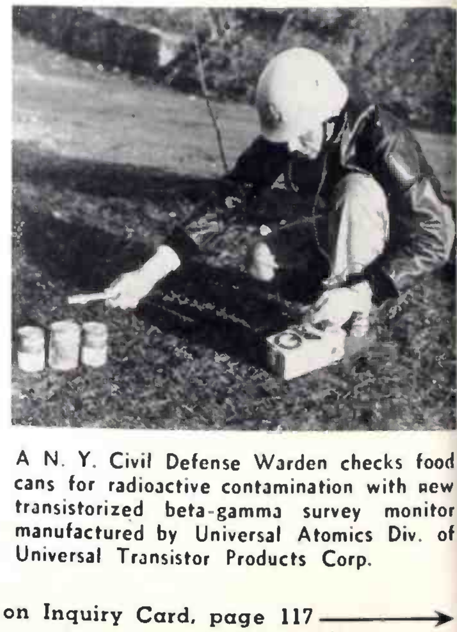
Bank Bookkeeping Goes Electronic

Burroughs Corp. and the First Pennsylvania Banking and Trust Co. of Philadelphia last month jointly demonstrated the first application of electronics to the task of bank bookkeeping.

While 13 operators toiled at a battery of mechanical bookkeeping machines 5 of their counterparts did the same amount of work effortlessly on new Burroughs Sensitronic units.

The new system has account number and balance information ingeniously registered on three magnetic strips down the back of the master journal. Only two entries need be posted by the operator.

CHECKING CONTAMINATION

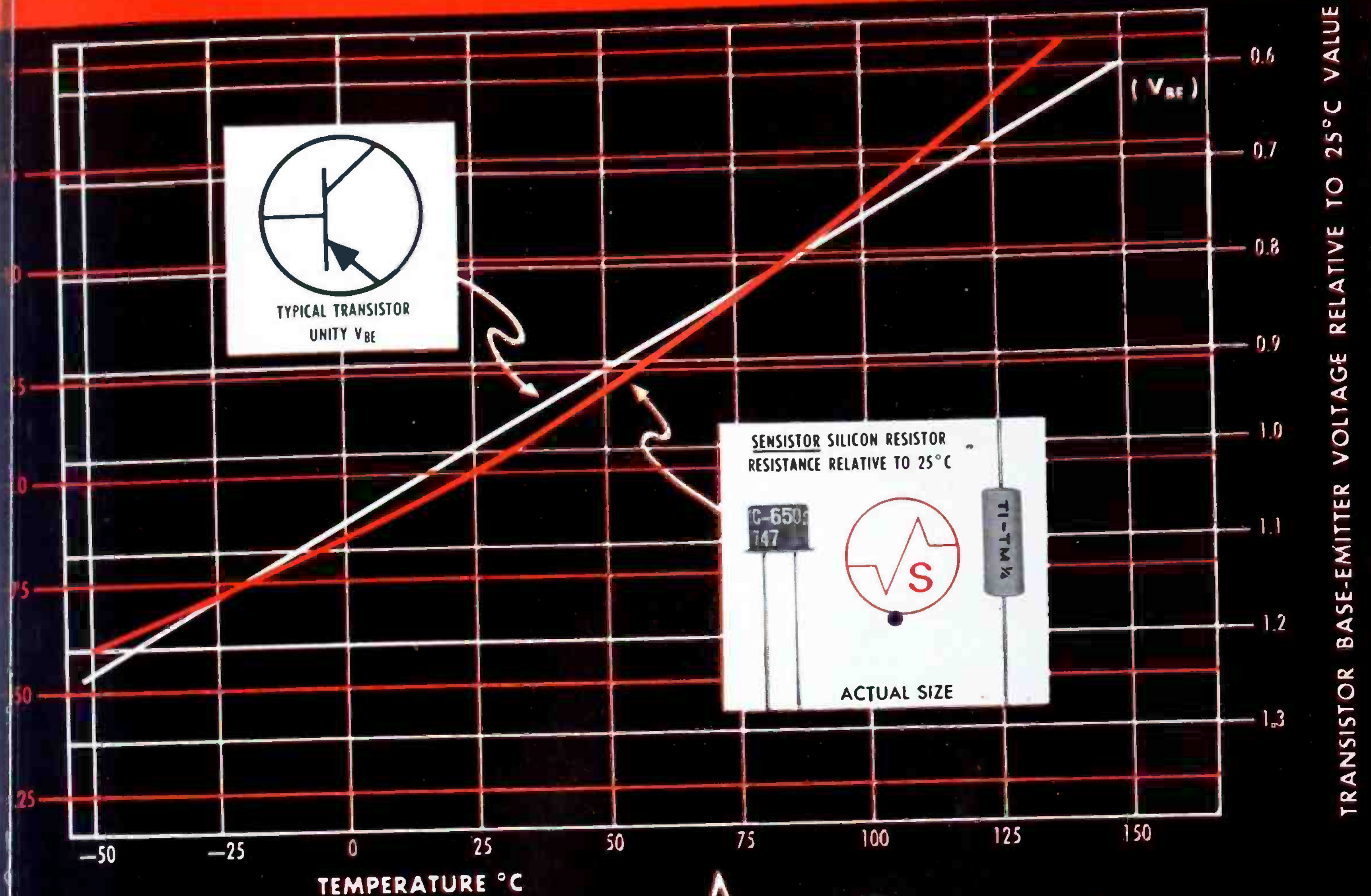


A N. Y. Civil Defense Warden checks food cans for radioactive contamination with new transistorized beta-gamma survey monitor manufactured by Universal Atomics Div. of Universal Transistor Products Corp.

Circle 48 on Inquiry Card, page 117

Circle 49 on Inquiry Card, page 117 →

NEW SOLID STATE DEVICE from TEXAS INSTRUMENTS



sensistor*

SILICON RESISTOR

...itive temperature coefficient of resistance (+0.7%/°C) plus a constant rate of change

...s or silicon resistors further stabilize temperature-induced variations in ...rstor characteristics . . . compensate for base-emitter bias voltage vs. ...rature characteristics of transistors.

...or silicon resistors are ideally suited for your temperature sensing and ...nperature compensating type applications in amplifiers . . . computer ...ming circuits . . . servos . . . power supplies.

...our next temperature compensating or sensing requirement, specify a ...or silicon resistor, *the resistor with a positive temperature coefficient of resis- ...plus a constant rate of change.*

STANDARD AVAILABLE RESISTANCES** AT 25°C: 100, 120, 150, 180, 220, 270, 330, 390, 470, 500, 560, 680, 820, and 1000 ohms.

electrical specifications	TM ¼	TC ⅛	UNITS
wattage rating	¼	⅛	W
average temperature coefficient	+0.7	+0.7	%/°C
resistance tolerance	10	10	%

**Other resistance values and tolerances available on special order.

...ailable now! Ask your nearest TI sales office for Bulletin DL-C 860

*Trademark of Texas Instruments Incorporated

...S INSTRUMENTS SALES OFFICES
• NEW YORK • CHICAGO • LOS ANGELES
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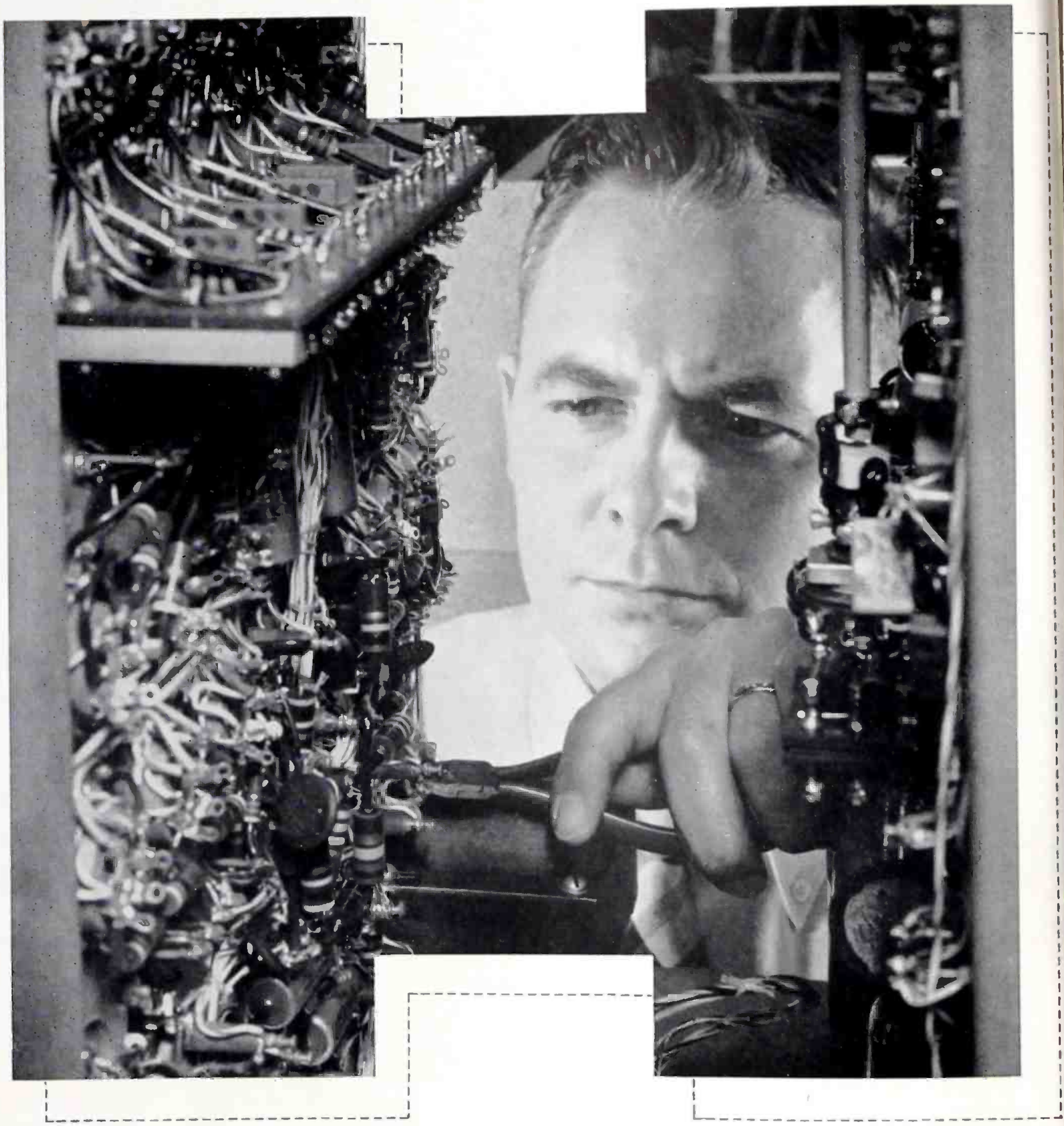
TEXAS INSTRUMENTS
INCORPORATED
SEMICONDUCTOR-COMPONENTS DIVISION
POST OFFICE BOX 312 • DALLAS, TEXAS

The job he holds



...ever existed before

It takes a wizard to test a wizard

...s Electronic Systems are so advanced that ...qually advanced test equipment can insure ...perational reliability.

...velop and build these test "wizards" calls ...iew kind of electronic engineer.

...ust act as a connecting link between the- ...d application. To do this, he gathers all per- ... information concerning the capabilities ...ed into the system.

...e same time, he accumulates an intimate ...ledge of the system's performance in the ...d

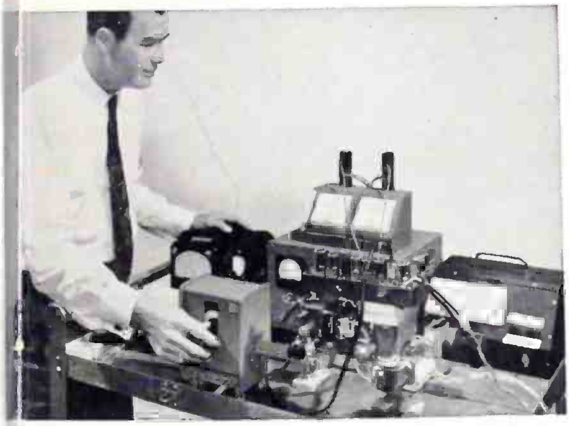
...is way the Test Development Engineer ...erfect complex equipment—like the test ...e at left—which insures "built-in reliability."

This kind of close liaison between Research, Development, Manufacture and Field Evaluation is typical of all Hughes activities. You'll find it in the development and manufacture of radar warning systems . . . in guided missiles and commercial electronics products. The diversity of activity assures prospective employees the opportunity to build a rewarding career.

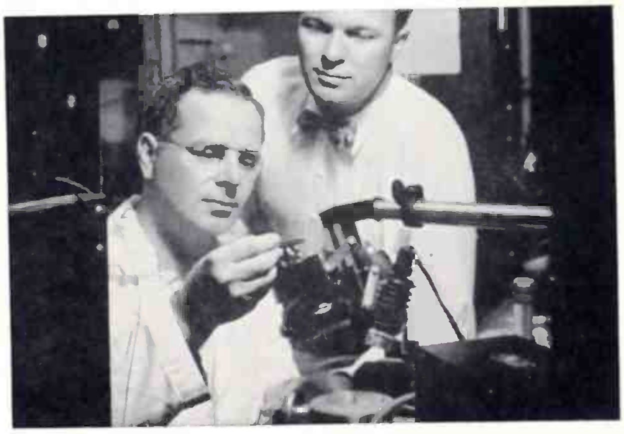
New commercial and military contracts have created an immediate need for engineers in the following areas:

Circuit Design	Systems Analysis
Reliability	Field Engineering
Communications	Semiconductor Applications
Microwaves	Semiconductor Sales

Write, briefly outlining your experience, to Mr. Phil N. Scheid, Hughes General Offices, Bldg. 17-Q, Culver City, California.



...aterials research in the Semiconductor Division of Hughes ...cts opens wide new areas of applications. Other areas of this ...ercial electronics activity include electron tubes and industrial ...s and controls.



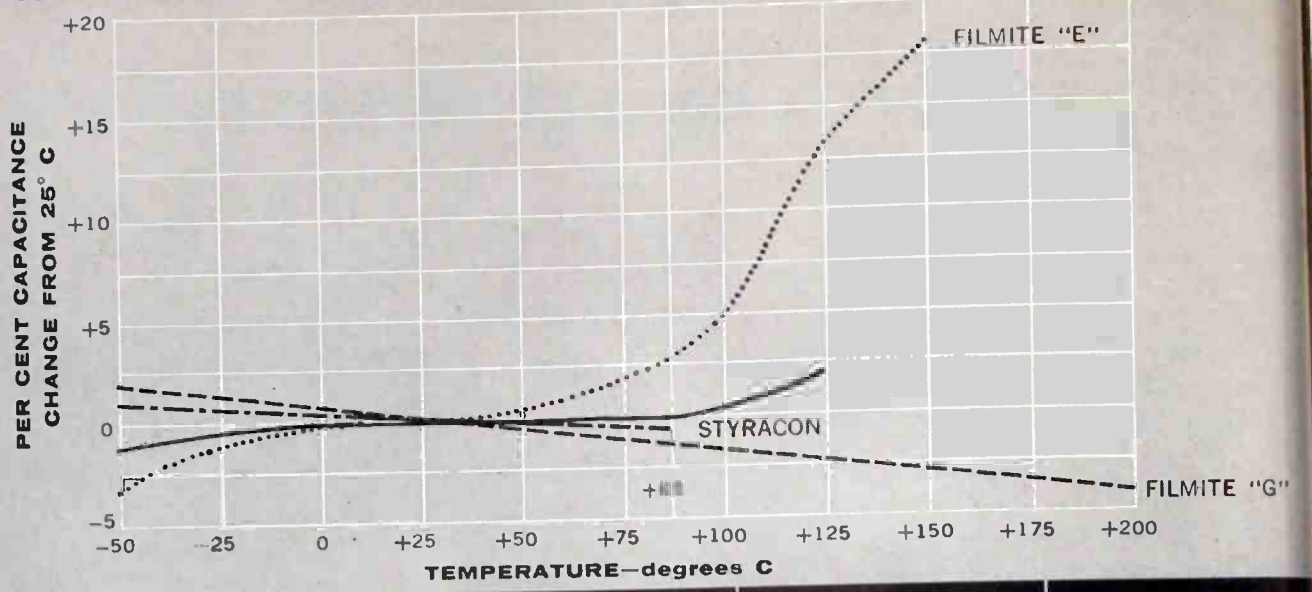
Research & Development of complex Hughes electronics armament systems is performed by the R&D Laboratories in Culver City. Embracing every advanced phase of electronics, this activity is pre-eminent in establishing new electronics frontiers.

...g a new world with ELECTRONICS

HUGHES

HUGHES AIRCRAFT COMPANY
Culver City, El Segundo,
Fullerton, Los Angeles, California
Tucson, Arizona

TYPICAL CAPACITANCE vs TEMPERATURE CHARACTERISTICS at 1000~



	STYRACON (85°C)	FILMITE "E" (150°C)	FILMITE "F" (125°C)	FILMITE "G" (200°C)
RATINGS	.001 to 1.00 μF 50 to 600 WVDC	.001 to 1.00 μF 200 to 2500 WVDC	.001 to 1.00 μF 200 to 600 WVDC	.001 to 1.00 μF 200 to 600 WVDC
STYLES	tubular metal cases screw-neck cases drawn metal cases	tubular metal cases screw-neck cases	tubular metal cases screw-neck cases "bathtub" cases	tubular metal cases screw-neck cases drawn oval cases
WRITE FOR TECHNICAL DATA	Engineering Bulletin No. 2510	Engineering Bulletin No. 2410	Engineering Bulletin No. 2560	Engineering Bulletin No. 2610

4 kinds of film dielectric capacitors

for specialized applications

Here are four plastic-film dielectric capacitors now in regular production at Sprague:

STYRACON CAPACITORS find wide application in laboratory equipment and in industrial controls where their low dielectric hysteresis (low "soak"), high insulation resistance, high "Q", low and linear temperature coefficient of capacitance are of great value.

FILMITE "E" CAPACITORS are general-purpose capacitors for use up to 150°C where capacitance stability with temperature is of secondary importance. They are also used at lower temperatures where very high insulation resistance is a prime requirement.

FILMITE "F" CAPACITORS are intended for use in circuits where the absolute minimum in capacitance change with temperature is a must and relatively large capacitance values are used. These capacitors typically will be within .05% of their 25°C value from −10°C to +85°C. They may be used up to 125°C where greater capacitance excursion is tolerable.

FILMITE "G" CAPACITORS have the highest temperature rating of any organic dielectric. They may be used up to 200°C! All units are nickel-plated to withstand high temperature corrosion. They also have the highest insulation resistance, the lowest dielectric hysteresis, and the lowest dissipation factor of any capacitor made so that they are often used at lower temperatures which are above the 85°C limit of the lower-cost Styracon Capacitors.

CAPACITANCE VS. TEMPERATU CHARACTERISTICS of all four typ of film capacitors are compared the chart above for the benefit the circuit designer.

ALL SPRAGUE FILM CAPACITO are designed to have positi electrical contact between lea and electrodes, even at low op ating voltages.

WRITE FOR ENGINEERING BU LETINS on the Sprague plastic-fi capacitors in which you're int ested. Address your letter Sprague Electric Co., Techni Literature Section, 233 Marsh Street, North Adams, Mass.

SPRAGUE

the mark of reliability

SPRAGUE COMPONENTS:

CAPACITORS • RESISTORS • MAGNETIC COMPONENTS • TRANSISTORS • INTERFEREN FILTERS • PULSE NETWORKS • HIGH TEMPERATURE MAGNET WIRE • PRINTED CIRCUI

ELECTRONIC INDUSTRIES

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

Western Safari

Last month we were invited to participate in an editorial safari to the Hughes Aircraft Company in Los Angeles, Calif. A chartered TWA Jetstream picked up the press representatives from the many interested newspaper and industrial publications in New York City, Washington and Chicago and then flew on to the Los Angeles International Airport. Editorial safaris are rare, but not uncommon. They are created by manufacturers when they feel that there is an important story to tell and that the most advantageous way to present the material is on the company's home grounds. The trip to the Hughes' Los Angeles plants was unusual because, to the best of our knowledge, this marked the first time that such an undertaking in the electronic field was initiated by a Western manufacturer.

For the next two days we were oriented and received information on a three years research and development program that had been carried on by the Industrial Systems and Controls Division. The result is a new "Digitape Controls" system.

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The development of this "Digitape-controlled" machining system is a truly remarkable and significant achievement. It is remarkable because it illustrates dramatically how the products of the electronic industries can be employed to increase production, improve accuracy, and reduce costs in the manufacturing techniques now employed by other industries. It is significant because it practically illustrates the marketing possibilities that can be achieved in developing new proprietary items. Such items are sorely needed in our industry to help overcome the balance that we now have dollar-wise in gross national product between military vs. consumer and industrial products. It is significant too that this forward step has been taken by a Western manufacturer who in the past has been primarily involved in making military electronic items. Finally, the recent Western safari indicates that the West Coast should no longer be regarded as an "isolated" area having relatively small impact on electronic markets. Next year with the coming of jets on commercial aircraft, the West Coast will only be three to four hours away. This is about the same time required for a train ride run between New York and Washington or Boston, or between Chicago and Milwaukee in the Midwest!

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Automatic Checkout Equipmen

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By LARRY S. KLIVANS
Radioplane Co. Div.
Northrop Aircraft, Inc.
Von Nuys, California

Part One of Two Parts

SINCE the end of World War II, each succeeding year has brought a sizeable increase in complexity of military weapon systems. In addition, technological advances in the military field have given impetus to the new and ever growing field of automatic industrial control. These two major areas of development have already, in many instances reached the point where it is not feasible to use manually operated check-out equipment.

The modern military weapon system or industrial control system is composed of many highly complex interdependent sub-systems, each containing sever major assemblies. In order to successfully accomplis the design mission, each element must function pr cisely.

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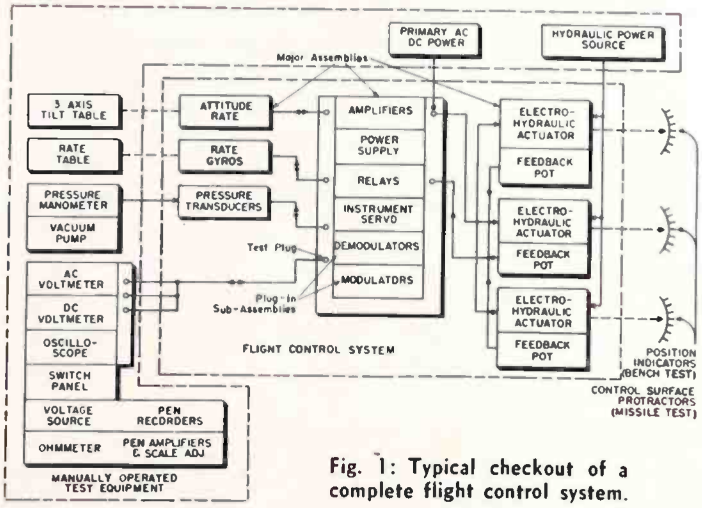

Fig. 1: Typical checkout of a complete flight control system.

Present Test Systems

the present time, the majority of industrial l installations or military weapon systems are d out with large installations of commercially ble, manually-operated, special-purpose test nent. These installations are in all cases tailored cally for the systems they are designed to check- hus they rapidly grow obsolescent, and require redesign each time the systems they are testing odified. Figure I illustrates a typical test oper- of an automatic missile flight control system. y be seen that several personnel are required imulating gyros, transducers, servos, amplifiers, in order to verify static and dynamic perform- to direct test sequence, to operate the commer- test equipment, and finally to log all readings ecord purposes. These tests are almost always cted with a written procedure specifying what d be done, when it should be done, and what the ts should be. However, unless the personnel have orough understanding and familiarity with the m they are testing, and with the test equipment, at deal of difficulty is encountered in interpreting est results and determining whether the system, est procedure, or the test equipment is good or Furthermore, due to human limitations, a great of expensive equipment is often damaged by lessness, lack of experience, or poor judgment.

Design Philosophy

establishing an over-all test philosophy, several rdependent factors must be considered:

1. Purpose
2. Accuracy
3. Time Available
4. Reliability
5. Flexibility
6. Environment
7. Cost

Purpose

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This may be defined as how long the system will operate without failure under actual field or factory environment. As in the case of any electronic equip- ment, reliability is important, but is interdependent with time available and cost. If test time is available, the equipment may be designed to be less reliable, at far less cost; and be very easy to maintain with spare plug-in assemblies, etc.

Flexibility

A broad definition is proposed for flexibility, in which the equipment can not only be readily rede-

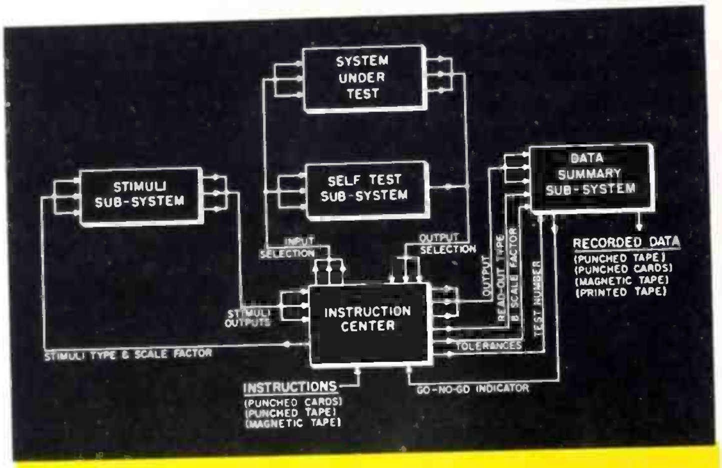
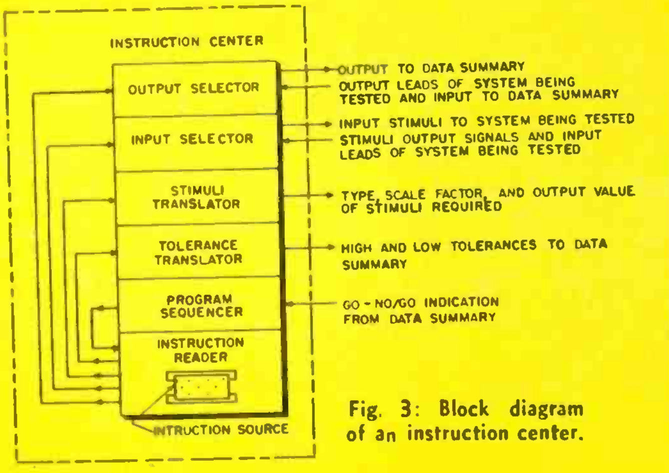


Fig. 2 (above): Block diagram, automatic checkout equipment system.



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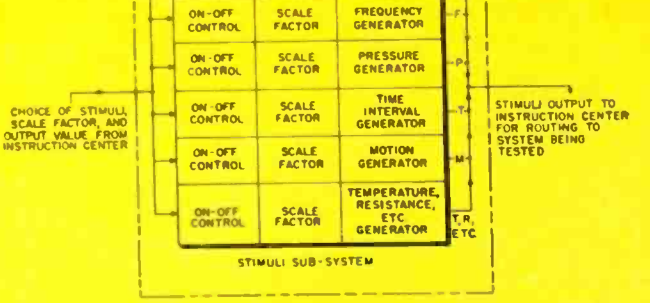

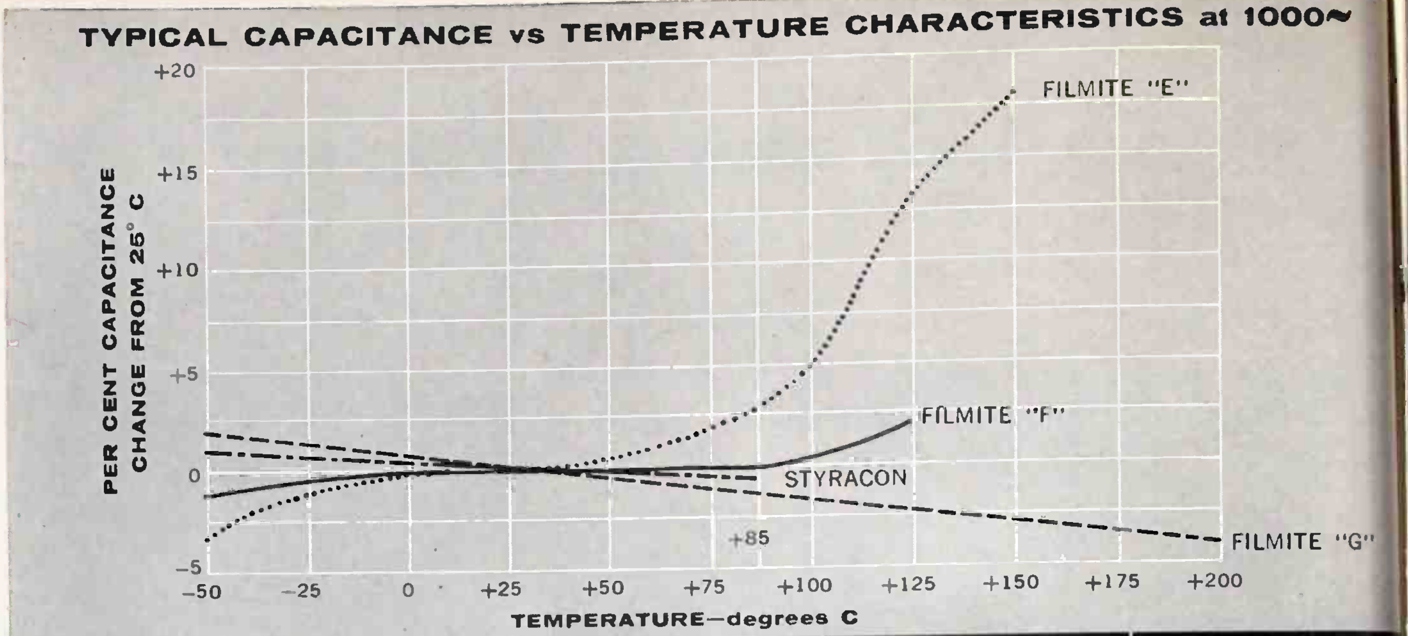

	STYRACON (85°C)	FILMITE "E" (150°C)	FILMITE "F" (125°C)	FILMITE "G" (200°C)
RATINGS	.001 to 1.00 μF 50 to 600 WVDC	.001 to 1.00 μF 200 to 2500 WVDC	.001 to 1.00 μF 200 to 600 WVDC	.001 to 1.00 μF 200 to 600 WVDC
STYLES	tubular metal cases screw-neck cases drawn metal cases	tubular metal cases screw-neck cases	tubular metal cases screw-neck cases "bathtub" cases	tubular metal cases screw-neck cases drawn oval cases
WRITE FOR TECHNICAL DATA	Engineering Bulletin No. 2510	Engineering Bulletin No. 2410	Engineering Bulletin No. 2560	Engineering Bulletin No. 2610

4 kinds of film dielectric capacitors

for specialized applications

Here are four plastic-film dielectric capacitors now in regular production at Sprague:

STYRACON CAPACITORS find wide application in laboratory equipment and in industrial controls where their low dielectric hysteresis (low "soak"), high insulation resistance, high "Q", low and linear temperature coefficient of capacitance are of great value.

FILMITE "E" CAPACITORS are general-purpose capacitors for use up to 150°C where capacitance stability with temperature is of secondary importance. They are also used at lower temperatures where very high insulation resistance is a prime requirement.

FILMITE "F" CAPACITORS are intended for use in circuits where the absolute minimum in capacitance change with temperature is a must and relatively large capacitance values are used. These capacitors typically will be within .05% of their 25°C value from −10°C to +85°C. They may be used up to 125°C where greater capacitance excursion is tolerable.

FILMITE "G" CAPACITORS have the highest temperature rating of any organic dielectric. They may be used up to 200°C! All units are nickel-plated to withstand high temperature corrosion. They also have the highest insulation resistance, the lowest dielectric hysteresis, and the lowest dissipation factor of any capacitor made so that they are often used at lower temperatures which are above the 85°C limit of the lower-cost Styracon Capacitors.

CAPACITANCE VS. TEMPERATU CHARACTERISTICS of all four typ of film capacitors are compared the chart above for the benefit the circuit designer.

ALL SPRAGUE FILM CAPACITO are designed to have positi electrical contact between lea and electrodes, even at low ope ating voltages.

WRITE FOR ENGINEERING BU LETINS on the Sprague plastic-fil capacitors in which you're inte ested. Address your letter Sprague Electric Co., Technic Literature Section, 233 Marsh Street, North Adams, Mass.

SPRAGUE

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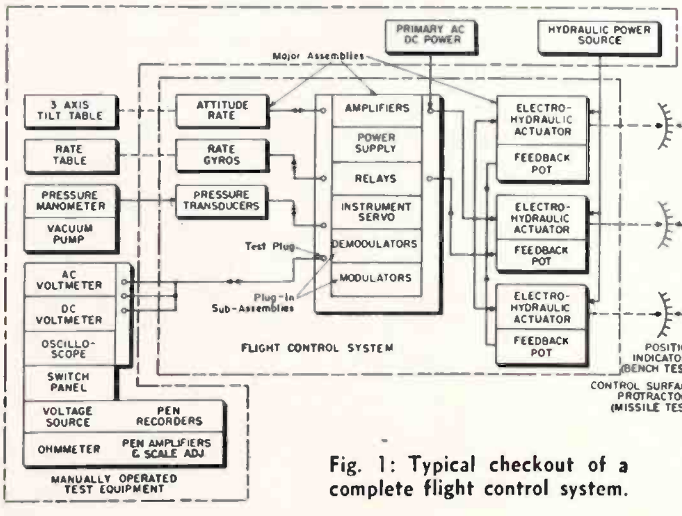

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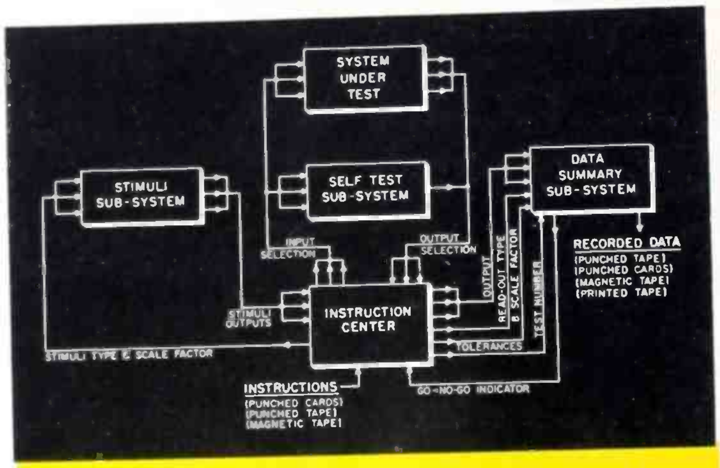

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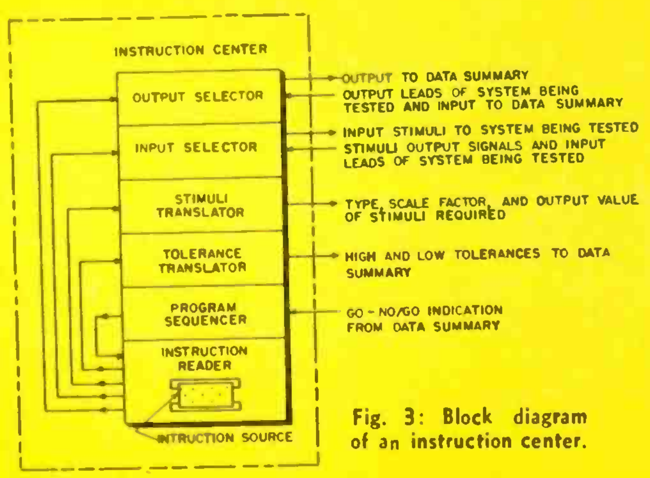

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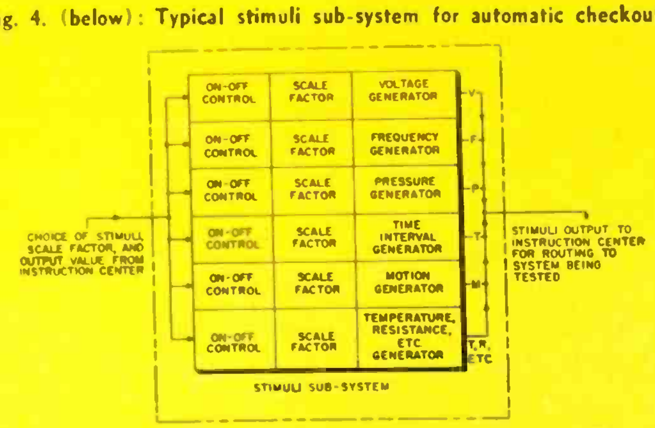


Automatic Checkout

(Continued)

signed within any particular system but can basically handle any industrial control or military weapon system. In all present day check-out equipment, this factor has been minimized because the design of each tester is tailored to the particular model of each system to be tested.

Environment

Where will a test be conducted, and under what conditions? Sub-factors of environment are temperature, vibration, shock, humidity, etc.

Cost

As discussed previously, each of the other factors is influenced heavily by cost. This factor may be considered strictly as development and production costs, but is influenced by other intangible items as reduced inventory of spare parts, production tooling, reduction in trained and skilled personnel, reduction in advertent damaging of equipment, etc.

Major Elements

In order to develop automatic check-out equipment, there should be several basic building blocks, or self-contained sub-systems which contain easily addable or subtractable major assemblies depending on the purpose and complexity of the system to be tested. The most general breakdown of the required sub-systems is as follows:

A. Instruction Center
B. Stimuli
C. Data Summary
D. Self-Test

Figure 2 presents an over-all block diagram for an automatic check-out equipment system, and Figures 3-6 show the functional block diagrams of each of the major sub-systems.

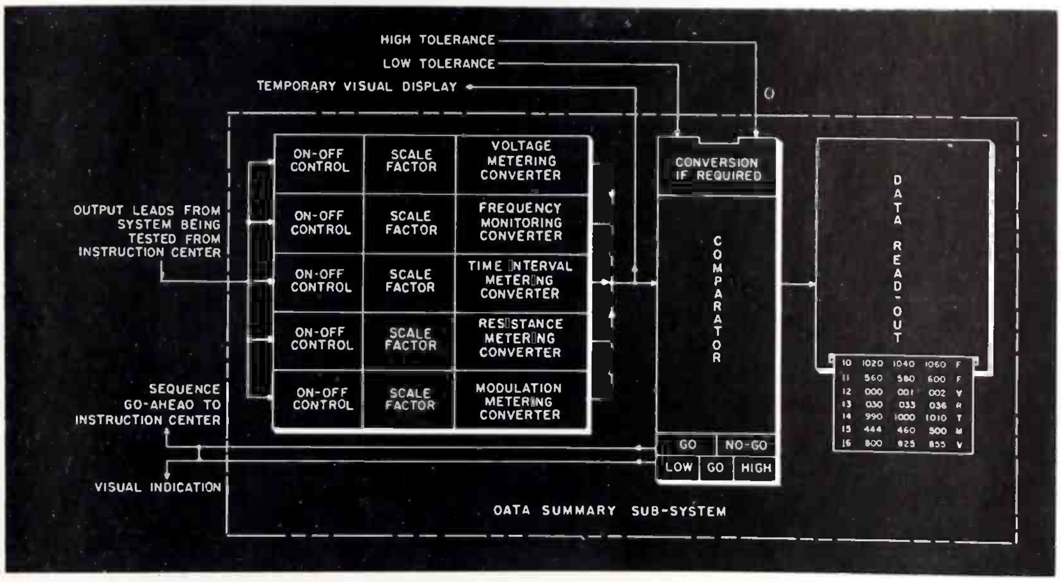


Fig. 5: Comparison and read-out are the functions of the data summary sub-system.

Instruction Cen

The instruction center may be thought of as heart and brain of the check-out system. It establishes, for each test number, the input connection the proper input stimuli function, scale factors output value, the output connections, and the hi and low tolerance levels. In order to accomplish instruction assignments in an automatic fashi several major assemblies are required. These ma assemblies are listed as follows:

A-1 Instruction Source
A-2 Instruction Reader
A-3 Program Sequencer
A-4 Tolerance Translator
A-5 Stimuli Translator
A-6 Input Selector
A-7 Output Selector

Instruction Source and Read

The instruction source and instruction reader a in reality one major assembly, with the source bei either punched cards, punched tape, magnetic tape, special driven potentiometers, stepping switches, et and the reader chosen to go with the particular sour

Stimuli and Tolerance Translat

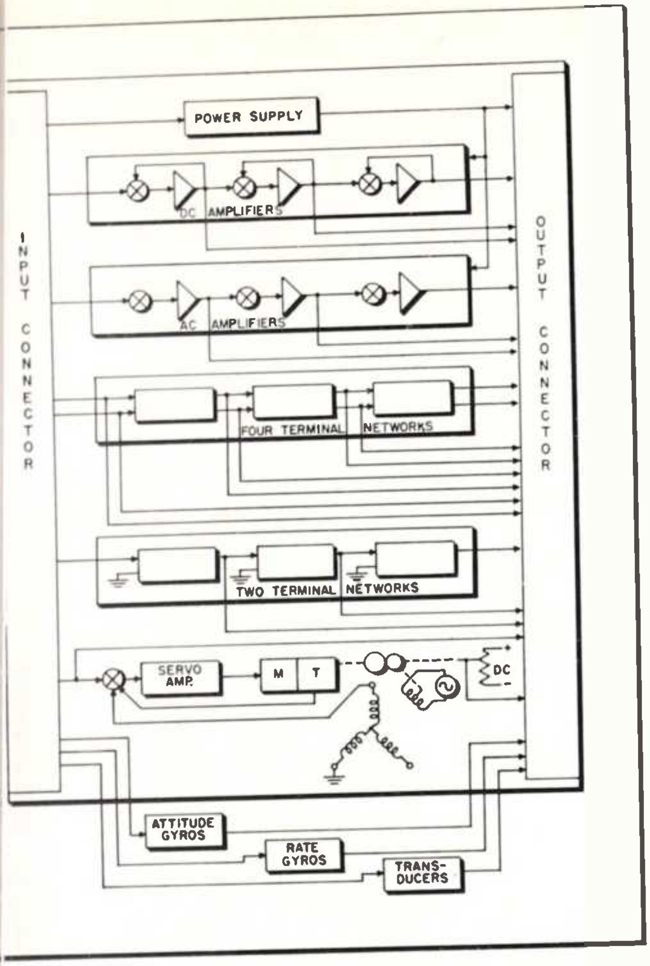
These assemblies receive information from the i struction source via the program sequencer. T translators transmit this inform tion as required to the stimuli a data summary sub-systems in ord to verify the transfer function the system being tested

Input and Output Selecto

The input and output selecto choose the proper leads to the sy tem under test in accordance wi information received from the i struction reader. These leads a then connected to the stimuli a data summary sub-systems.

Stimuli Sub-Syster

The stimuli sub-system serves a muscle function in that it co tains all of the input function gen rators such as voltage, pressur frequency, table displacement, table rate, etc. The function generators are needed to put known inp stimuli into the system undergoing test. This is t only basic part of the automatic tester that wou require special tailoring for each weapon system industrial control system. The state-of-the-art equipment of this nature is not very far along, nece sitating a large amount of original research and d velopment. The basic function of the stimuli su system is to excite or stimulate the system und test, according to commands received from the instru tion center. The stimuli sub-system may be brok down into such typical major assemblies as the fo



6: Complete checkout automation requires a self-test sub-system.

ing:

B-1 Voltage Generator
B-2 Frequency Generator
B-3 Pressure Generator
B-4 Time Interval Generator
B-5 Low Frequency Modulation Generator
B-6 Resistance Generator
B-7 Temperature Generator
B-8 Displacement Generator
B-9 Rate Generator
B-10 Acceleration Generator

Data Summary Sub-System

The data summary sub-system is the eyes and emory of the automatic check-out equipment. It easures and compares the output from the system nder test with the programmed tolerance levels, and esents a temporary visual as well as a permanent cord of the actual reading. It also gives a Go-o/Go and Lo-Go-Hi visual indication and sequence -ahead command to the instruction center.

The major assemblies required to accomplish these jectives are as follows:

C-1 Metering Converter
C-2 Comparator
C-3 Read-Out Recorder

Metering Converter

This assembly measures and displays visually the outputs of the tested system in conjunction with commands received from the instruction center. The visual output can then be utilized for Lo-Go-Hi system adjustments when desirable. In the event analog-to-digital conversion or vice versa is required, such provisions would be included in this assembly.

Comparator

The comparator accepts the tolerance reading from the instruction center, and the measured output from the system being tested. It then compares the two readings and determines whether the measured reading is high or low and whether the difference is within or out of the tolerance values specified by the programming sub-system. If the reading is within tolerance, a "Go" indication is displayed and a command sent to the Instruction Center to go on to the next test. If the reading is out of tolerance, a "No-Go" indication is displayed. Suitable switching is required to either gate the instruction center on to the next test or stop and wait for a manual go-ahead command if it is desirable to make adjustments during the test.

Read-Out Recorder

The read-out recorder serves the dual purpose of providing a permanent record of test results for inspection and for reliability and maintenance purposes. It is necessary that this record contain the measured value, the high and low tolerance, and the test number and, if possible, the type of reading; frequency, voltage, resistance, etc.

Self-Test Sub-System

The self-test sub-system may be thought of as a standard system with known outputs in response to known inputs, and is utilized to verify the entire check-out system prior to, at the end of, or during any test, depending on data received from the instruction center. This capacity may be provided by including a sufficient number of representative transfer functions to receive inputs from the stimuli sub-system and provide outputs to the data summary sub-system with the majority of outputs to be within tolerance and a few purposely out of tolerance so as to check the function of all three other sub-systems. The permanent output of the data summary sub-system can then be compared with a master reference during the self-check phase. Typical major assemblies that would be required for this sub-system are as follows:

D-1 Amplifiers
D-2 Gyros
D-3 Voltage Controlled Oscillators
D-4 Instrument Servo
D-5 Relays
D-6 Two and Four Terminal Impedance Networks
D-7 Power Supplies

Automatic Checkout

(Continued)

Instruction Center

Automatic programming of electronic equipment has been well established in the field of digital computers and commercial telephony. It is, therefore, desirable that the instruction center should utilize digital techniques since what is primarily involved is a series of pre-determined discrete commands or instructions in a pre-determined time sequence. The instruction center must establish for each test number the input connections, the output connections, the proper input stimuli scale and function, and the tolerance levels, for the system being tested. Several methods of providing an automatic instruction source and reader can be utilized, but the three types that appear to possess the flexibility and capacity required are punched cards, punched tape, or magnetic tape, with their associated readers.

Punched Cards

The most well-known punched cards available are either IBM or Remington-Rand. Both cards are the same size, 3.250 inches by 7.375 inches, and the same thickness, 0.0067 inches. Generally, one corner is cut to facilitate card handling, matching, filing, etc. The Remington-Rand or IBM cards do not store the same alphabetical and/or numerical information, and th is a different distribution of fields and zones on ea type of card.

IB

The IBM card has 80 vertical columns with ea containing 12 rectangular holes, or bits of inforn tion. Normally the ten lower positions are assign the digits 0 to 9, and the top two positions des nated X and Y, are more commonly referred to eleven and twelve holes. These last two positio are used for special coding, such as the indication negative numbers, or, in combinations with one the one-to-nine digits, for alphabetical representatic For special purpose usage, a card may be divid into sections, or groups of columns, known as fiel this defines that portion of the card in which speci information of a certain nature will always appea The cost of these cards is about $1 per 1000.

(To be Continued Next Month)

Table 1

Commercially available equipment that can be utilized for automatic check-out equipment.

Category 1.0 Programming Equipment

Classification	Vendor	Part No.	Weight	Size	Est. Cost
Programmer, Card (Includes Reader)	Remington-Rand Univac, New York 10, N. Y.	3906	495 lbs.	34⅜" H, 39" W, 27" D (without curves)	$6450 for I prototype

Utilizes Standard Remington-Rand punched card. Capacity—540 bits per card. Automatic feed using 625 card magazine. Top speed 100 cards/minute. Electric Sensing Switch Box (RR #1800196) and Connection Box (RR #1700171) provide for electrical output from all 540 positions. Driven by ¼ HP motor. Receiving magazine capacity 850 cards. Current carrying capacity of contacts in the Switch Box is 1 AMP maximum at 24 VDC. Voltage rating of contacts are to make and break with no current flowing at time of make and break. Utilizes Standard IBM punched card. Capacity—960 bits per card.

Classification	Vendor	Part No.	Weight	Size	Est. Cost
Programmer, Card (Includes Reader)	Metron Corp., Lambertville, N. J.	K-1	18 lbs.	10½" H, 6¼" W, 9" D	$3500 for early prototype

Utilizes either IBM or Remington-Rand punched card. Reader operation and card insertion are all done manually, one at a time.

Classification	Vendor	Part No.	Weight	Size	Est. Cost
Programmer, Card (Includes Reader)	Cinch Mfg. Corp., Chicago, Ill.				

Capacity—400 bits per card in a 20 by 20 array. Cards are 3" x 5" and inserted and read manually, one at a time. Molded block with 400 floating contacts sandwiched between two printed wire boards. All circuits are disconnected when contacts are open.

Classification	Vendor	Part No.	Weight	Size	Est. Cost
Programmer, Punched Paper Tape (Includes Reader)	California Technical Industries, Belmont, Calif.	171	60 lbs.	19" W, 10" H, 13" D	$1800

Utilizes standard 1-inch teletype tape with holes on 1/10 inch centers. The frame of information read at each step consists of 10 transverse rows of 8 holes each. Maximum rate for continuous operation 6 frames/second. May be operated in excess of 15 frames/second for short periods. Contact rated at 50 ma. Has visual neon bulb in 8 x 10 hole pattern for checking of new tapes. Operates off 115 V, 60 cps and requires 375 watts.

Classification	Vendor	Part No.	Weight	Size	Est. Cost
Programmer, Punched Paper Tape (Includes Reader)	Commercial Controls				
Programmer, Punched Paper Tape (Includes Reader)	Litton Industries, Beverly Hills, Calif.	650	45 lbs.	17"x15"x 8"	$3700

This is a combination tape punch and reader and is utilized normally to program the Litton Digital Differential Analyzer. The punch speed is in excess of 4 characters per second and the reading speed is in excess of 3 characters per second. A standard one-inch Flexowriter tape is used with 5 holes per frame.

Classification	Vendor	Part No.	Weight	Size	Est. Cost
Programmer, Punched Mylar Film (Includes Reader)	Beatie-Coleman, Anaheim, Calif.	Model MPR-13	3¾ lbs.	2"x3"x6"	

Provides 13 channels of independent precisely controlled timing channels. Utilizes 3 mm mylar film driven by either 400 cps or 60 cps syncronous motor. One or two of th thirteen(13) channels can be utilized to control programmer. Contacts rated at 200 m maximum. Designer to meet MIL-E-5272A. Diameter of tape dependant on programme dimensions.

Classification	Vendor	Part No.	Weight	Size	Est. Cost
Programmer, Magnetic Tape	Potter Instrument Co., Great Neck, New York	Model 905	100 lbs.	19" W, 24½" H, 17" D	

This is a digital magnetic tape handle with tape speeds of 7.5 inch/sec. to 75 inch/sec solenoid operated; 3 millisecond; starts and stops. Various tape widths are available fro ¼ inch to 1¼ inches with 2 to 16 channels of information respectively. All machine fun tions may be operated remotely.

Classification	Vendor	Part No.	Weight	Size	Est. Cost
Matrix Switches and/or Scanners	James Cunningham Sons & Co., Inc., Rochester, N. Y.	Model 200 SC1A	Not spec.	12"x12"x 12"	$1350

By means of X, Y and Z selection, one out of 200 input points is brought to the out put terminal. The 200 points are selected in sequence in response to a contact closure Contacts are also provided to operate external devices such as printers. Applications are i general scanning of multiple variable systems. Up to 1200 points per scanner is possible Contact resistance of lower than 0.02 ohms and insulation resistance of better than 10 ohms are specified.

Classification	Vendor	Part No.	Weight	Size	Est. Cost
Matrix Switches and/or Scanners	Electro-Instruments	SK-00 Master	Not spec.	19" W, 12" D, 3½" H	Master = $1300
		SK-03 Slave			Slave = $1950

With single lead switching, 100 channels may be handled by master and multiples o 300 additional for each slave. With 4 wire lead switching, 100 channels may be handle with one slave and master. Scanning time is specified as 0.1 sec. per channel. Signal contact are gold plated, one isolation resistance of 109 ohms is specified.

Classification	Vendor	Part No.	Weight	Size	Est. Cost
Matrix Switches and/or Scanners	North Electric Co., Gallian, Ohio	Relay Matrix Switch	Not spec.	Not spec.	Not spec.

The heart of this matrix switch is a reed armature multiple contact relay. A typical switch might consist of 9 inputs, any one of which can be connected to any of 20 outputs each switching path made up of 36 individual circuits. The operate time is 15 milliseconds and contact rating is 0.25 amps resistive at 50 VDC and 117 VAC. Mechanical life is greate than 500 million operations. Contact resistance of 0.2 ohms is specified.

C sification	Vendor	Part No.	Weight	Size	Est. Cost
Switches r Scanners	Stromberg-Carlson Co., Rochester, N. Y.	X, Y, Universal Switch	Not spec.	Not spec.	Not spec.

his switch is fundamentally a four-wire switch that has four wipers and two addi- control wipers, and is a two-motor flat type, step-by-step switch. The switch operates 00 points, 10 in the X direction, and 10 in the Y direction. The switch can be used to through 100 4-wire circuits to find one in particular or to select a particular circuit 00 4-wire circuits or to routine test a series of circuits or equipment.

C sification	Vendor	Part No.	Weight	Size	Est. Cost
atial Step- Switch	Tensor Electric Development Co., Inc., Brooklyn, N. Y.	Model 6000	Not spec.	Not spec.	$795 in quantity of 10 or more

his multi-element switch assembly is designed for applications in quality control g. telemetering, data sampling and component ageing. There are 624 individual ing sections in the standard configuration with a multiplicity of circuits staying cted for normal operation, while a smaller number are cyclically connected for separate unctions. Circuit transfer is accomplished using multiple-pole double-throw switching ns. The assembly is composed of a modular combination of a 52-step solenoid- tted, sampling drive mechanism and four electrostatically shielding switch plates, having 52 triple-pole double-throw switching sections.

C sification	Vendor	Part No.	Weight	Size	Est. Cost
ry Selector ches	G. H. Leland, Inc., Dayton, Ohio	BD3E Circuit Selector	Not spec.	1⅝"x2" x 3⅜"	Not spec.

The Ledex circuit selector is basically a power-operated rotary switch intended for te control of predetermined circuit patterns. Many versatile designs of stepping, ing, latching and circuit selecting relays are made possible by the combination of the rotary solenoid and wafer-type rotary switches. The Ledex solenoid itself is available starting torque outputs of 0.2 to 54 inch pounds, operating off of direct current. erous configurations are available.

C sification	Vendor	Part No.	Weight	Size	Est. Cost
ry Type ping Switch	Automatic Electric, Chicago, Ill.	Type 45	Not spec.	6⅞"x5¼" x3⅜"	$80 for typical unit with gold contacts

A rotary type solenoid actuated switch available for either DC or AC applications. ve or more bank levels of 25 points plus "home" can be assembled on the single-sided, -type frame. Each bank level has a corresponding wiper level driven by a ratchet l with 52 teeth. Speeds of 75 steps per second, self-interrupted or 35 steps per second lse-controlled are specified. Vibration of up to 10 G and temperature of —55°C to are acceptable environmentally. Life tests of up to 250 million switching operations been passed successfully. Gold contacts are recommended for low level signal switching.

C sification	Vendor	Part No.	Weight	Size	Est. Cost
ys (Line rated)	Union Switch & Signal, Pittsburgh, Pa.	R35FP6A	3.75 oz.	1⅛" diam. 1[61]⁄[64]" overall height 1.562" mounting holes	Not spec.

Hermetically sealed, miniature 26.5 volt relay. Coil resistance 225 ohms. Contacts le double-throw. Either standard or dry circuit contacts available. Standard contacts l at 100,000 operations 2 amps resistive or 1 amp indirect. Dry contacts 100,000 opera- low level dry circuit loads up to a maximum of 1 amp resistance or 0.5 amp indirect .s. pull-in time and 6 m.s. drop-out time.

C sification	Vendor	Part No.	Weight	Size	Est. Cost
ys (Telephone e Sensitive)	Potter & Brom-field, Prince-ton, Ind.	LTL Series	Not spec.	2[21]⁄[32]" x 1[11]⁄[32]" x 2⅞"	Not spec.

Standard telephone type relay designed for sensitive DC current operation. Maximum itivity of 15 MW per moveable coil with 15 grams contact pressure. Fast acting with W coil per pole; operate time of less than 10 MS with greater coil power; up to 24 acts available per relay. Contact rating 4 amp. maximum non-inductive.

C sification	Vendor	Part No.	Weight	Size	Est. Cost
ys, Latching	Filtors, Inc., Long Island, N. Y.	Type L26F18	3.3 oz.	1" diam. 1.375" height 1.406" mounting holes	Not spec.

This is a magnetically held, electrically reset, 6-pole double-throw, hermetically d subminiature latching relay. The coil voltages are normally 26.5 with DC, with 2 ohms specified for the latching coil and 375 ohms for the reset coil. The contacts are d for 1.5 amp inductive or 3 amp resistive. Latch-in time required is 10 milliseconds. contacts can be ordered and test results indicate one million operations without a unction.

C gory 2.0 Stimuli Equipment

C sification	Vendor	Part No.	Weight	Size	Est. Cost
erators, ital to sistance /or Digital Voltage	Julie Research Laboratories, Inc., New York N. Y.	RVD-105	Not spec.	19" W x 5¼" H x 12" D	Not spec.

This unit is a relay operated voltage divider with a 0.001% resistance or voltage accuracy. The instrument utilizes a five-decade binary decimal system with 21 s and a total resistance of 100,000 ohms with a resolution of 1 ohm. Current rating ma and all resistors are hermetically sealed. The unit my be operated from a tape rd programmer.

C sification	Vendor	Part No.	Weight	Size	Est. Cost
erator, ltage to gular placement	Microgee Products, Inc., Culver City, Calif.	Model 10	Amplifier Function Generator 80 lb. Table Assembly 100 lb.	Amplifier Function Generator 20½" x 16½" x 25"	Total: $7800

The Microgee Simulation Table is a single degree of freedom table for angularly lacing gyros and accelerometers either statically or dynamically. The table will follow als from a tape recorder, a digital to analog converter or any low frequency source. natural frequency exceed 15 cps and damping ratio is adjustable between 0.1 and 1.0. threshold is less than 1 second of arc. The maximum load allowable is 5 lbs. if dynamic ormance is to be as specified.

C sification	Vendor	Part No.	Weight	Size	Est. Cost
erator, quency	Krohn-Hite Instrument Co., Cambridge, Mass.	Model 440A	36 lbs.	19" x 8¾" x 12"	$495

This unit is a push button audio oscillator with three rows of 10 digit push buttons a multiplier switch which allows a frequency selection of .001 cps to 100,000 cps in steps for the five frequency bands, .001–10, 10–100, 100–1000, 1000–10,000, 10,000–100,000. Either a sine or a square wave output is available with a 30 volt pk. to pk. sine wave rated at 100 mw for the sine wave, and 10 volts pk. to pk. for the square wave. The amplitude is within 0.1 db. over the 0.1 to 10,000 cps range. Provisions to provide remote control of push buttons and multiplier would be needed in order to provide a digital to frequency generator.

Classification	Vendor	Part No.	Weight	Size	Est. Cost
Generator, Frequency	Teletronics Laboratory, Inc., Long Island, N. Y.	Model TO-100A	25 lbs.	16" W x 8" H x 11" D	$345

Push button audio oscillator with 20 preset frequencies in the range 20 cps to 100 KC. A calibrated output control permits 1 to 25 volts per circuit with level constant within 1 db. over the frequency range. Provisions to provide remote control of frequency selection would still be needed to provide digital to a frequency generator.

Classification	Vendor	Part No.	Weight	Size	Est. Cost
Digital to Voltage Generator	Avion Division, Culver City, Calif.	Model 1002	Not spec.	19" x 5¼" x 9"	Not spec.

The Avion Decoder consists of ten diode gates, a precision resistor network and a voltage summing amplifier. By means of the diode gates, a non-critical input code digit controls the application of a precise voltage step to the precision resistor network. The value of each input resistor is selected so that the current flow through each resistor is proportional to the significance of the corresponding input binary digit. The amplifier, which sums the output of all the resistor currents has an output voltage proportional to the value of the binary number presented to the input gates. The resolution is 1 part in 1024 or ± .05%. The speed is such that the analog voltage is correct to the specified accuracy within 5 microseconds. The long term drift is less than 0.03% of the output range. The input requirements are Binary Zero equals plus 5 volts or below. The analog output voltage is ±1.5 volts across a 75 ohm external load, but may be changed to other values on special orders.

Classification	Vendor	Part No.	Weight	Size	Est. Cost
Generator Digital to AC Voltage	Gertsch Products Inc., Los Angeles, Calif.	Model 222	Not spec.	6" x 6" x 12"	

This unit is a digital to analog precision AC voltage generator. It accepts a binary 18 wire input from punched card, punched tape, etc., and produces a precise division of the input voltage. Greater than 270,000 ratio combinations are available from 0.0000038 to 0.0000062 with one wire energized to eighteen wires energized. The source impedance should be 100–1000 times the source impedance if no loading is desirable. The maximum input voltage is 0.35 times the line frequency with the generator being useable over 50–10,000 cps with a maximum of 350 volts above 1 KC. The phase shift is dependent on frequency and ratio, but in all cases, is negligible for automatic check-out purposes. This model is not militarized, but can be modified readily by the vendor. Temperature range of the unit is —15°C to +80°C with no accuracy degradation.

Category 3.0 Data Summary Equipment

Classification	Vendor	Part No.	Weight	Size	Est. Cost
Frequency Meter with Electric Digital Output	Beckman Berkeley Division, Richmond, Calif.	Model 7360	60 lbs.	10¼" x 20¾" x 16½"	$1245

Berkeley "EPUT" Meters automatically count and display the number of events that occur during a precise time interval. This model, which is one of several available, has a frequency range of 0 cps to 1 mc. and a time interval of 1 μ sec. to 10⁰ sec. with a period of 0 cps to 1 mc. The time base is variable from 1 μ sec. to 10 sec. A binary coded output electrical output is available for driving a digital printer as well as a visual digital indication.

Classification	Vendor	Part No.	Weight	Size	Est. Cost
Time Interval Meter with Electric Digital Output	Beckman Berkeley Division, Richmond, Calif.	Model 7260	50 lbs.	10¼" x 20¾" x 16½"	$830

Any event delineated by varying voltages may be timed. A direct digital reading of elapsed time between any two events, or the duration of a single event is provided with an electrical digital output to drive a digital printer. The timing range is 1 μ sec. to 1 second with an accuracy of 1 μ second. The input requirements are 0.1 vrms ac or dc, and input impedance is 10 megohms.

Classification	Vendor	Part No.	Weight	Size	Est. Cost
Universal Counter-Timer with Electrical Digital Output	Computer-Measurements Corp., North Hollywood, Calif.	Model 226A	50 lbs.	19" x 10½" x 15"	$1100

Model 226A is a multipurpose instrument designed for the precise measurement of frequency, frequency ratio, period, and time interval. The range on time interval measurement is 3 μ sec. to 1.10⁶ sec. The frequency range is 0–1MC and the period range is 10 μs to 1.10⁶ sec. The input sensitivity for all measurements is 0.2 vrms and the input impedance is 1. megohm and 5 0 μμ fd. A six digit visual readout is provided as well as electrical readout utilizing a 1-2-2-4 coded decimal system to operate a digital printer.

Classification	Vendor	Part No.	Weight	Size	Est. Cost
Electronic Counter	Hewlett-Packard Co., Palo Alto, Calif.	Model 523B	50 lbs.	19" x 14" x 19"	$1175

The model 523B is an electronic counter for measuring frequency, period or time interval readings. The frequency range of this instrument is 10 cps to 1.1 mc. Time interval coverage is 3 μ sec. to 100,000 seconds. Period measurement is 0.00001 to 10 KC. There is a six row 10 digit visual readout and a staircase voltage output suitable for driving HP560A digital recorder. Input requirements are 0.2 vrms minimum for frequency and 1 vrms maximum for period and time interval measurements.

Classification	Vendor	Part No.	Weight	Size	Est. Cost
Digital Voltmeter with Electrical Digital Output	Kin-Tel, San Diego, Cal.	Model 401	40 lbs.	Control Unit: 19" x 5¼" x 16" Readout Display: 19" x 3½" x 9"	Not spec.

This unit is a DC digital voltmeter with a single plane, wide angle read-out with a range of 0.0001 to 999.9 volts with automatic polarity and decimal indication. The average reading time is 0.75 seconds. Provisions are built-in to allow the operation of a parallel input digital printer directly. Accessories are available to allow reading of AC voltages, voltage ratios or resistance. The voltmeter has a chopper stabilized voltage reference which is constantly compared against an internal standard call. A difference amplifier and stepping switches are used in a null seeking servo with the stepping switches actuating the read-out when a null is reached.

Simplifying Phase Equalizer Design

The simplest method of synthesizing a desired relative phase-frequency characteristic is to plot graphically the individual characteristics of a number of networks as a function of the "d" parameter.

By WILLIAM J. JUDGE

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Fig. 1: Characteristics of all-pass lattices, function of "d" parameter.

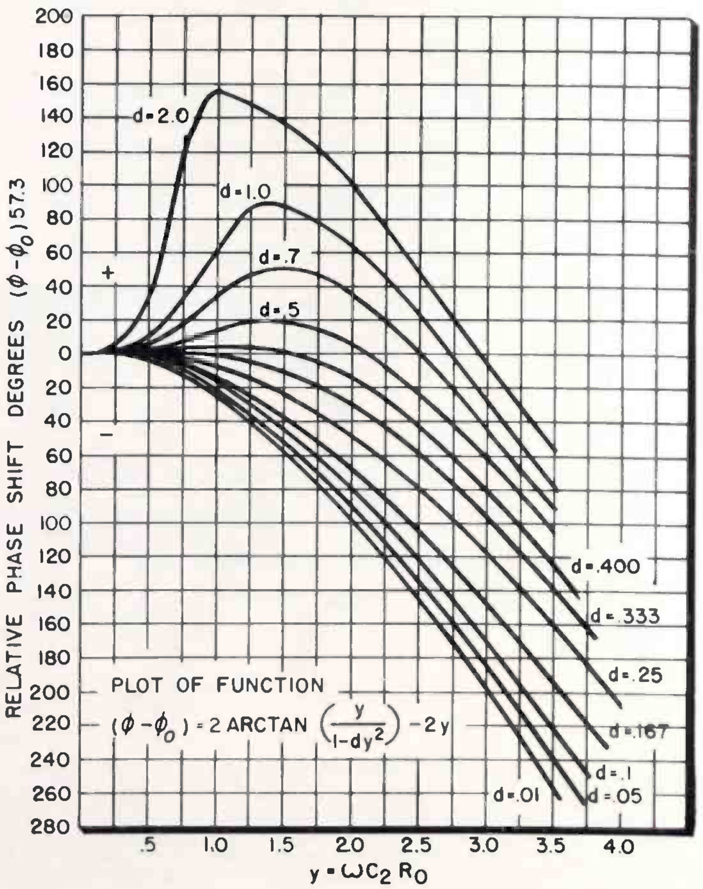
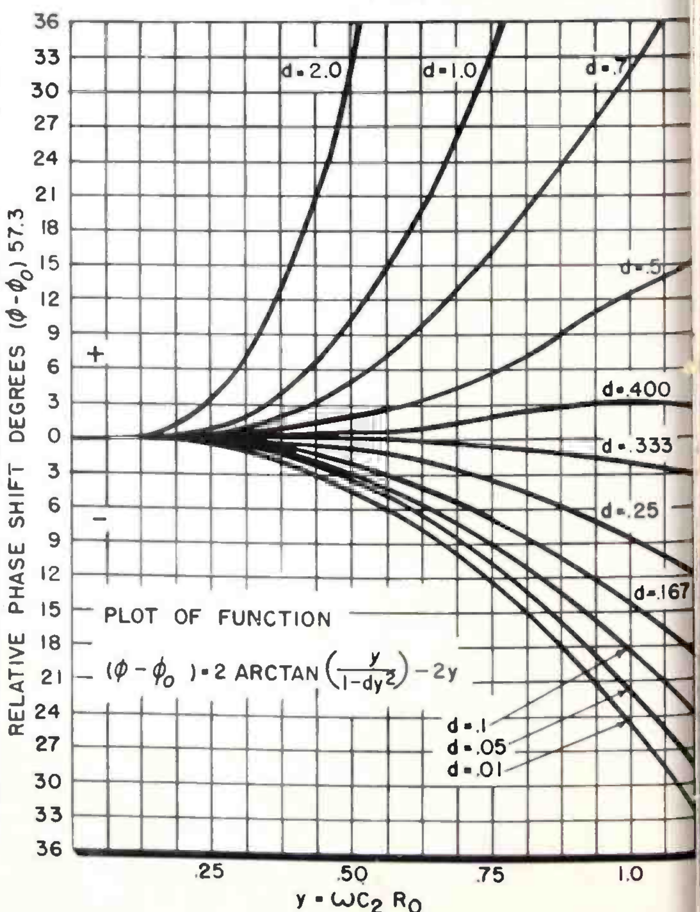


Fig. 2: Expanded plot of lower frequency portion of curves in Fig.



METIMES it is desirable to alter the relative hase-frequency characteristic of a network havin arbitrary amplitude-frequency response withiffecting the latter. The all-pass lattice (and its ged-T equivalent) fulfills the required conditions. tworks of this type exhibit constant input imnce at all frequencies and may supply a variety elative phase-frequency characteristics (positive egative or both) contingent on the choice of a gn parameter "d" and the number of networks aded.

ssibly, the simplest method of synthesizing a red relative phase-frequency characteristic is to graphically the individual characteristics of a iber of all-pass lattice networks as a function of "d" parameter. Such a plot is given by Figs. 1 2, the latter being an expanded plot of the -frequency portion of Fig. 1.

sing the graphs, then, individual curves may be bined to achieve the desired relative phase repse. The lattice and bridged-T arrangements are l for insertion in balanced and unbalanced syss, respectively.

or any given network, once the "d" parameter has n chosen, the design procedure for unbalanced ems is to calculate the lattice parameters and n convert the lattice to its equivalent bridged-T.

Bridged-T Equivalent

ig. 4 is the schematic diagram of a bridged-T ivalent which can be used for "d" values less than equal to one.

he physical inconvenience of a coupling coefficient ying as a function of "d" may be avoided by windthe inductor as a bifilar with a coupling coient near unity and inserting an inductor in series h $2C_2$ to cancel out the additional negative mutual uctance. This most practical form of the bridged-T ivalent is shown schematically in Fig. 5.

further simplification of the network of Fig. 5 possible when "d" is greater than or equal to one shown schematically in Fig 6.

Design Considerations

Vhichever arrangement is used (Fig. 3, 4, 5, or 6), is important for the network to have physical nmetry. Electrical and physical symmetry seem be interdependent and if a number of networks to be cascaded the input impedance of the cascade l suffer if each network is not symmetrical.

When the arrangement of Fig. 5 is used, the disbuted capacity of the bifilar appears lumped across top and must be deducted from the design value $C_1/2$. In all arrangements, if the capacitors are ected to be within ±1% of the design value and coils are made variable, excellent results are ained by inserting the network or networks in a tched line and adjusting for flat input impedance m zero to the highest frequency of interest.

Since unity coupling will never be obtained in the angement of Fig. 5, L_B should have its design ue exist near the maximum inductance setting of coil. Coupling coefficients around 0.95 are readily lized with conventional bifilar designs.

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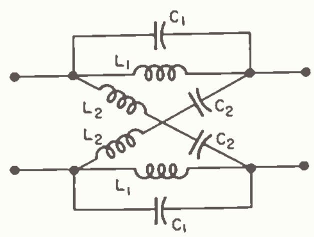
Fig. 3 (below): All-pass lattice network; design equations at right.



$$C_1 = dC_2 \quad (1)$$

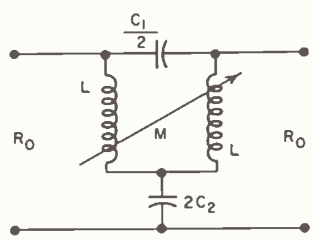
$$\frac{L_1}{C_2} = \frac{L_2}{C_1} = R_0^2 \quad (2)$$

$$L_2 = dL_1 \quad (3)$$

$$\phi = 2 \text{ ARCTAN} \left[\frac{y}{1-dy^2} \right] \quad (4)$$

$$\phi_0 = 2y \quad (5)$$

$$y = \omega C_2 R_0 \quad (6)$$

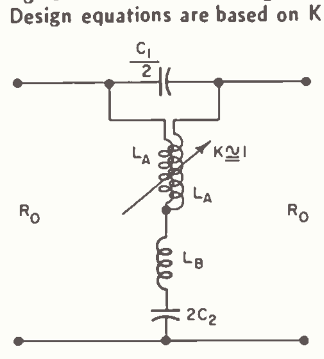


$$M = -\left[\frac{d-1}{2}\right] L_1 \quad (7)$$

$$L = \left[\frac{d+1}{2}\right] L_1 \quad (8)$$

Fig. 4 (above): Bridged-T equivalent has same C_1, C_2 and L_1 as Fig. 3.

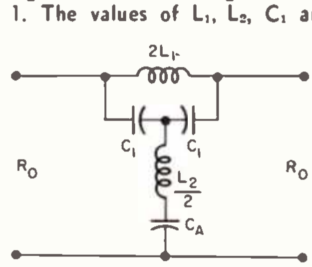
Fig. 5 (below): The bridged-T equivalent using near unity coupling. Design equations are based on $K = 1$; C_1, C_2, L, and M as used before.



$$L_A = \frac{2L + 2M}{4} \quad (9)$$

$$L_B = dL_A \quad (10)$$

Fig. 6 (below): Bridged-T equivalent, d equals or is greater than 1. The values of L_1, L_2, C_1 and C_2 are the same as for the lattice.



$$C_A = \frac{2C_1 C_2}{(C_1 - C_2)} = \frac{2dC_2}{(d-1)} \quad (11)$$

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For Transistor Amplifiers . . .

Designing Multiple Feedback Loops

A criterion of stability is introduced which is useful for calculating the stability margins of multiple loop structures. Part One is directly applicable to circuits which employ junction transistors in the common base configuration.

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Part One of Two Parts

THE most useful multiple loop circuits are conditionally stable.[1] One advantage of designing multiple loop feedback amplifiers with transistors is that the warm-up problem associated with conditionally stable circuits is avoided because transistors turn on almost instantly when power is applied.[a]

Another advantage of using transistors is that they can be located anywhere in a multiple loop structure without introducing excessive capacity to ground.

Stability Criterion

The criterion of stability to be described is directly applicable to multiple loop structures employing vacuum tubes in the common cathode configuration. It is equally applicable to junction transistors in the common base configuration; with some modification, to transistors in the common emitter and common collector connections.

The stability of a multiple loop structure can be determined by examining the denominator of the expression for external voltage or current gain. By straight forward mesh analysis, the voltage gain of any circuit is given by the expression.

$$\frac{E_2}{E_1} = \frac{\Delta_{12} Z_L}{\Delta} \qquad (1)$$

where Δ is the mesh determinant of the circuit, Δ_{12} is a minor of the determinant (first row and second column deleted) and Z_L is the output load impedance.

Similarly, the current gain of any circuit is given by the expression

$$\frac{I_2}{I_1} = \frac{\Delta_{12} Y_L}{\Delta} \qquad (2)$$

where Δ is the nodal determinant of the circuit, Δ_{12} is a minor of the determinant and Y_L is the output load admittance.

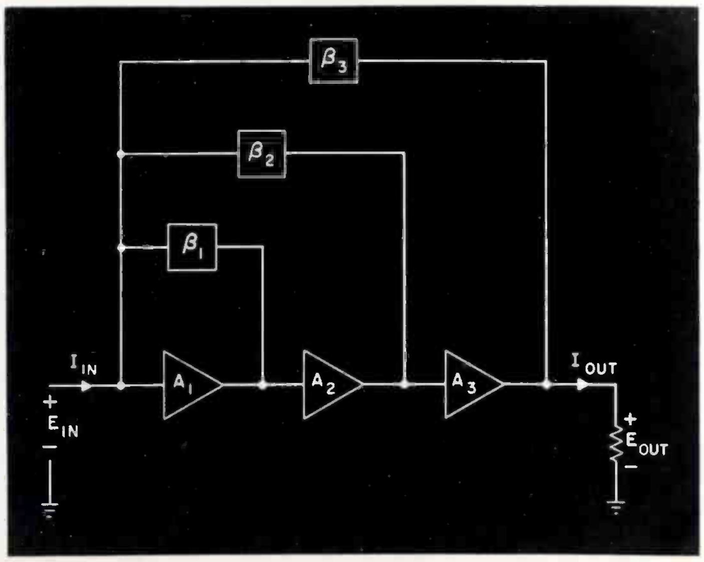
A circuit is stable if the zeros of Δ are restricted to the left half of the complex frequency plane.[b, 2] Consequently, a circuit is stable if the denominator of the gain function does not vanish for any value of the complex frequency variable, p, either on the real frequency axis or in the right half of the complex frequency plane.

Even though this is an important theoretical result, it is not very useful in practice for two reasons. First, because it is relatively difficult to determine the zeros of Δ (without a computer). Secondly, Δ would have to be examined for all possible values of gain that the active elements may assume. For example, in the case of a vacuum tube amplifier, the active elements initially have zero gain (unless the heaters are turned on first) and gradually the gain approaches the design value. Also the gains of the active elements change from their design values due to aging effects.

[a] In practice, the dc biasing circuit must be designed so that the transistors are correctly biased at all times after the circuit is energized.

[b] In this paper it is assumed that a circuit is unstable if the circuit determinant has a zero on the real frequency axis ($p = j\omega$). This zero would correspond to a steady state oscillation.

Fig. 1: Multi-loop feedback amplifier used to illustrate Theorem I.



The next step in deriving a criterion of stability will be to examine in detail the circuit determinant (or the denominator of the gain function). For a circuit employing vacuum tubes in the common cathode connection, the determinant is a multilinear function of the transconductances of the tubes.[3] That is the circuit determinant is a linear function of any one particular transconductance.

Tube or Transistor Operation

Similarly in the case of a circuit employing junction transistors in the common base connection, the circuit determinant is a multilinear function of the current amplification factors of the transistors (alphas). The characteristic function of the system, F is defined as equal to the value of the circuit determinant with the tubes (or transistors) operating at transconductance (or alpha) values of W_1, W_2, W_3, ... W_N respectively, divided by the value of the circuit determinant with all transconductances (or alphas) set equal to zero. The characteristic function is given by the expression

$$F = \frac{\Delta}{\Delta^{000\ldots}} = 1 + W_1F_1(p) + W_2F_2(p) + \ldots + W_NF_N(p) + W_1W_2F_{1.2}(p) + W_1W_3F_{1.3}(p) + \ldots + W_1W_2W_3F_{1.2.3}(p) + \ldots + W_1W_2W_3 \cdots W_NF_{1.2.\cdots N}(p) \quad (3)$$

The functions $F_1(p)$, $F_2(p)$, etc., are complex functions of frequency and are determined by the characteristics of the active devices and the passive components used in the interstage and feedback networks. The characteristic function is equal to the denominator of the gain function after it is normalized so that the constant term (independent of W) is unity.

Gain Theorem

The gain of any multiple loop circuit can be determined by inspection with the use of the following theorem.[4]

Theorem 1: The voltage or current gain between any two nodes of a circuit equals a quotient whose denominator equals one minus the sum of the loop gains taken one at a time; plus the sum of the products of the loop gains taken two at a time for all loops that do not touch (have a common element or node); minus the sum of the products of the loop gains taken three at a time for all loops that do not touch; and, so forth.

The numerator of the quotient equals the sum of the forward path gains, where each path gain is multiplied by a factor which contains the number one and all signed loop gains, and products of loop gains that appear in the denominator and do not touch any node or element found in the forward path circuit.

The above theorem will be illustrated by evaluating the gain of a multiple loop amplifier, Fig. 1. Since the three feedback loops all contain common elements, the denominator of the gain function contains only the individual loop gains and not their products.

The amplifier has only one forward path for which the path gain is $A_1A_2A_3$. By direct application of the theorem the gain (voltage or current) is equal to

$$G = \frac{A_1A_2A_3}{1 - A_1\beta_1 - A_1A_2\beta_2 - A_1A_2A_3\beta_3} \quad (4)^c$$

where A_1, A_2 and A_3 are the gains of the individual stages and β_1, β_2 and β_3 are the feedback fractions.

It should be noticed that when the theorem is used to evaluate the gain, the denominator of the gain function is exactly equal to the characteristic function without further modification.

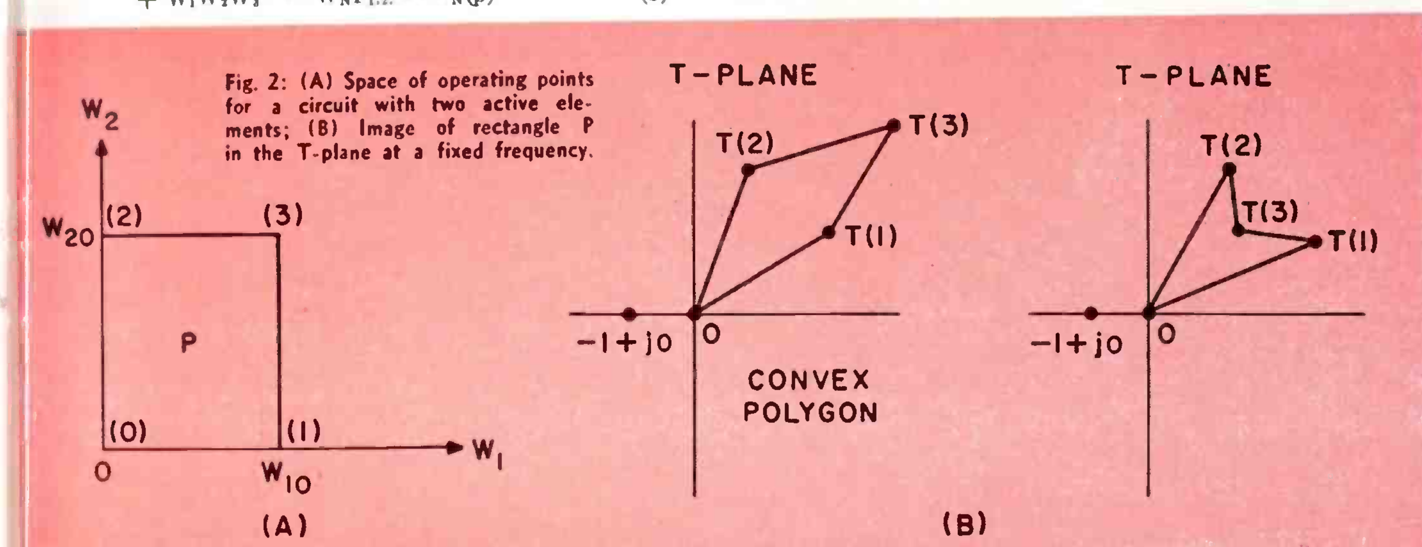


Fig. 2: (A) Space of operating points for a circuit with two active elements; (B) Image of rectangle P in the T-plane at a fixed frequency.

N-Dimensional Space

At this point, it is advantageous to introduce the concept that the parameters W_1, W_2, ... W_N are the rectangular cartesian coordinates of an N-dimensional Euclidean space. This N-dimensional space will be designated as the space of operating points.

Fig. 2A shows the space of operating points for a circuit which has only two active elements with gain parameters W_1 and W_2. The normal value of the parameter W_1 is W_{10} and the normal value of W_2 is W_{20}. It will be assumed that the rectangle defined by W_{10} and W_{20} contains all possible operating points that can exist in the circuit.

---

[c] If the β circuits are reciprocal networks, then strictly speaking, three additional loop gains should appear in the denominator of (4). However, these loop gains involve transmission through two β circuits and are negligibly small in all practical cases.

Feedback Loops *(Continued)*

Vertex (3) corresponds to normal operation of the active elements. If the circuit employs vacuum tubes, then during warmup, the operating point will move from the origin to vertex (3) along a path determined by the relative rates at which the tubes turn on. The operating point will also depart from vertex (3) due to aging of the active elements.

For the general case of a circuit with N active elements, all possible operating points are located on and within an N-dimensional rectangular parallelepiped, P. It is defined by the normal values of the gain parameters, W_{10}, W_{20}, W_{30}, ... W_{N0}.

It is shown in Appendix I that if F does not vanish for any value of p on the real frequency axis, then it will not vanish for any value of p in the right half of the complex frequency plane. This means that it is only necessary to examine real frequencies ($p = j\omega$) in determining the stability of operating points. Even with this simplification the stability criterion appears to be rather difficult to apply to practical problems.

It is only necessary to examine the stability of the operating points corresponding to the vertices of P in order to determine the stability of a multiple loop circuit. This will be proven for the case of two active elements. The proof for N active elements is presented in Appendix II.

To prove this result it is convenient to introduce the function T defined by the equation

$$T = F - 1 \qquad (5)$$

Mapping Function

The function T is useful because it maps the origin of the space of operating points into the origin of the T-plane (refer to (3)). A necessary and sufficient condition for stability is that T does not map any point in P into the critical point ($-1 + j0$) in the T-plane (this point corresponds to the origin of the F-plane.

From (3) and (5) it is evident that for a fixed value of the complex frequency variable p, a straight line in the space of operating points parallel to one of the coordinate axes, is mapped by T into a straight line in the T-plane. This results from the fact that T is a multilinear function of the gain parameters W_1, W_2, W_3, ... W_N. A straight line in the space of operating points not parallel to a coordinate axis is in general mapped by T into a complicated curve in the T-plane.

In the case of a circuit with two active elements, the function T is equal to

$$T = W_1F_1(p) + W_2F_2(p) + W_1W_2F_{1,2}(p) \qquad (6)$$

With reference to Fig. 2A, the function T maps the four sides of the rectangle [0,1], [1,3], [3,2] and [2,0] into the polygon shown in Fig. 2B. Depending on the position of vertex T(3), the polygon is either convex or not. A polygon is convex if a straight line segment joining any two points in the polygon lies completely in the polygon.

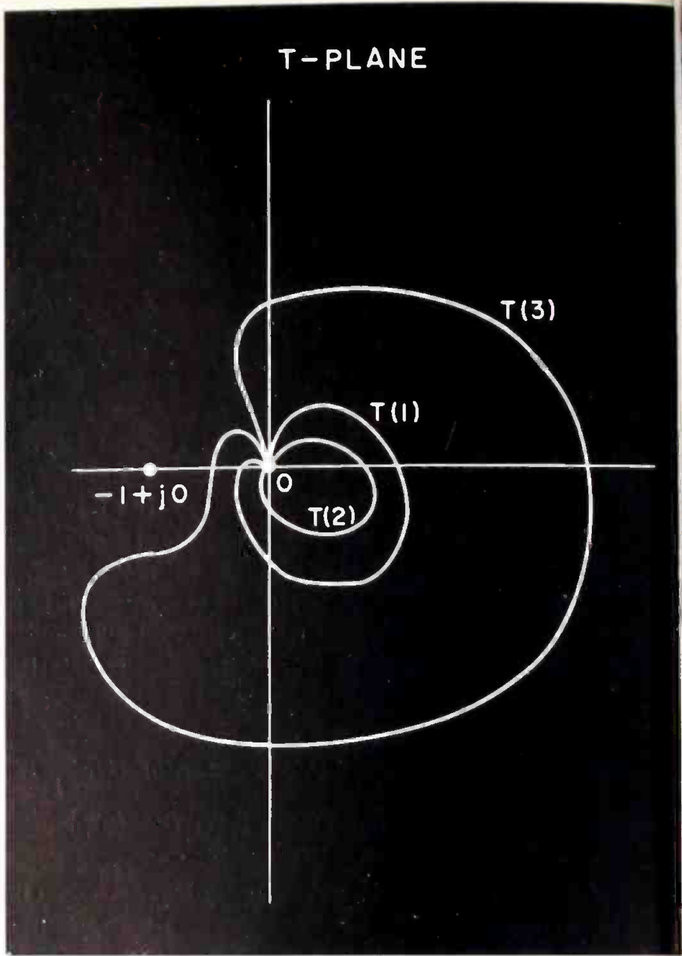


Fig. 3: Contours generated by images of vertices of P in T-plane

We will first consider the case when the polygon in the T-plane is convex. All of the points in the rectangle P can be mapped into the T-plane by mapping all line segments in P which are parallel to the [0,1] side of the rectangle. Start on [0,2] and terminate on [1,3]. Each line segment will map into a straight line in the T-plane, starting on the [0,T(2)] side of the polygon and terminating on the [T(1), T(3)] side. Since the polygon is convex, the image of all operating points in P will lie inside the polygon.

If the polygon is not convex, then some of the points in P will map into points in the T-plane which lie outside the polygon. However, if the vertices T(1) and T(2) are connected by a straight line, then the images of all points in P will lie inside the polygon defined by vertices 0, T(1) and T(2).

Minimal Convex Polygon

These results can be summarized by the statement that all of the operating points in the rectangle P are mapped by the function T into the minimal convex polygon in the T-plane which contains the images of all the vertices of P. The minimal convex polygon which contains the images of all the vertices of P is simply the smallest polygon it is possible to construct which contains all of the vertices and is convex.

As the complex frequency variable, p, moves along the real frequency axis, the polygon in the T-plane also moves. If the polygon defined by 0, T(1), T(2) and T(3) is convex, then a necessary and sufficient condition for stability is that the critical point

-1 + j0) never appear within the polygon. If the polygon defined by 0, T(1), T(2) and T(3) is not convex, then the minimal convex set which contains the vertices has in general a small region into which no points of P are mapped. Even though stability is insured if the critical point (— + j0) is not contained in the minimal convex polygon, this is not a necessary condition.

Fortunately, it is not necessary to plot the minimal convex polygon for each value of p along the real frequency axis in order to determine stability. Fig. 3 shows a plot of the vertices T(1), T(2), and T(3)[d] as p moves from p = 0° to p = j∞ along the real frequency axis. If any vertex of the polygon should lie on the negative real axis so that

$$T < -1 + j0 \qquad (7)$$

then the critical point (—1 + j0) must be included in the polygon. This results from the fact that the origin is a vertex of the polygon for all values of p, and the polygon is convex.

Absolute Stability

A sufficient condition for absolute stability is that the curves generated by the vertices of the polygon as p moves along the real frequency axis, not enclose the critical point (—1 + j0).

In Appendix II the stability criterion is extended to include the case of a circuit with N active elements. This leads to the following theorem:

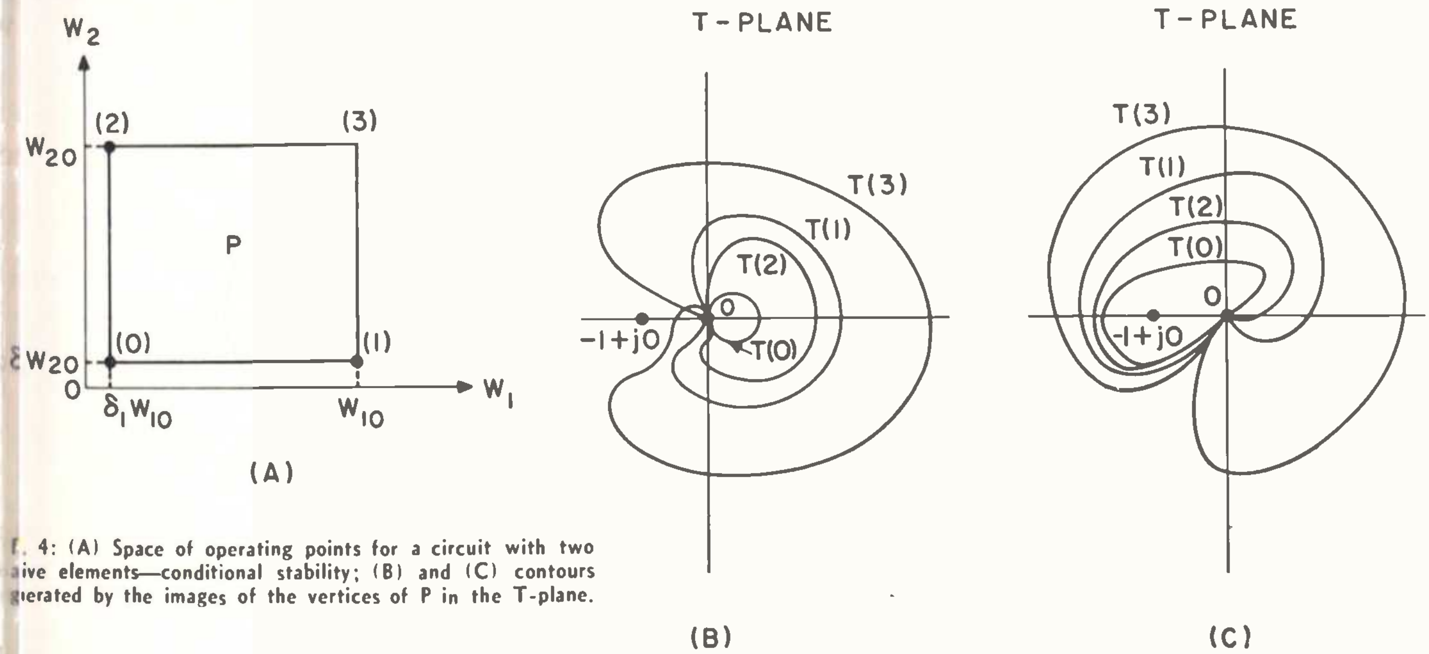


Fig. 4: (A) Space of operating points for a circuit with two active elements—conditional stability; (B) and (C) contours generated by the images of the vertices of P in the T-plane.

Theorem II: A multiple loop circuit is absolutely stable if the image in the T-plane of the vertices of the N-dimensional rectangular parallelepiped, P, does not enclose the critical point, (—1 + j0), as p moves along the real frequency axis from p = 0 to p = j∞. Even though in general this is only a sufficient condition for stability, in many instances it is also a necessary condition.

The above theorem is a very important result. It is analogous to Nyquist criterion of stability for a single loop feedback amplifier. This analogy results from the fact that the criterion of stability developed in this paper is really a straight forward extension of the Nyquist criterion. The characteristic function defined by (3) is equal to the return difference[6] for a single loop feedback circuit.

Similarly, the function T is equal to the return ratio for a single loop feedback circuit. The previous development (for the special case of one active element) can be used as a rigorous proof of Nyquist criterion.

Up to this point, only absolute stability has been considered. That is, it has been assumed that all operating points in the parallelepiped, P, must correspond to stable operation. For vacuum tubes, absolute stability is usually required in order to insure stability during warm-up of the tubes. Transistors though, have essentially no warm-up time. In fact transistors have a small gain even before they are energized because of a "built in field."[7]

Absolute stability is too severe a requirement to place on a multiple loop transistor feedback amplifier. It will be shown in Part Two that some of the most useful multiple loop structures cannot satisfy the condition for absolute stability.

Conditional Stability

The stability criterion will now be extended to include the case of conditional stability. Even though the criterion will be developed for the case of a circuit with two active elements, it will be apparent that the criterion is also applicable to circuits with N active elements. Fig. 4A shows the space of operating points for a two element circuit. The vertex (3) of the rectangle P corresponds to normal operation of the active elements. The three other vertices of the rectangle are determined by the assumption that, during the life of the circuit, the gain parameter W_1 will not be less than $\delta_1 W_{10}$ and W_2 will not be less than $\delta_2 W_{20}$. Figs. 4B and 4C show two possible images in the T-plane of the vertices of P as

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[c] If the polygon defined by 0, T(1), T(2) and T(3) is not convex, then it is only necessary to plot the contours of T(1) and T(2).

[d] From symmetry considerations it is only necessary to check stability as p moves from 0 to p = + j∞ .5.

p moves from p = 0 to p = j∞. It is immediately clear that Fig. 4B corresponds to a stable circuit since the critical point (— 1 + j0) cannot be contained in the polygon determined by the vertices T(0), T(1), T(2), and T(3).

It is possible though, for all of the contours generated by the vertices to encircle the critical point, as shown in Fig. 4C, and for the circuit to be stable. This was not possible when absolute stability was required because the origin of the T-plane was a vertex of the polygon for all values of p.

To determine if the critical point is included in the polygon when all of the contours encircle it, it is necessary to plot the minimal convex polygon corresponding to every value of real frequency. In practice, almost every multiple loop conditionally stable amplifier is designed so that the contours in the T-plane do not enclose the critical point, Fig. 4B. This method of design has the advantage that it is possible to specify precise gain and phase margins against instability as in the case of single loop absolutely stable amplifiers.[8]

The discussion in Part One is directly applicable to circuits which employ vacuum tubes in the common cathode connection and junction transistors in the common base connection. In Part Two it will be shown that the stability criterion can be extended to include junction transistors in the common emitter configuration.

APPENDIX I

Necessary and Sufficient Condition for F to Have a Zero in the Closed Right Half of the Complex Frequency Plane

A necessary and sufficient condition for the characteristic function, F, to have a zero in the closed right half of the complex frequency plane, for an operating point in the rectangular parallelepiped, P, is that F have a zero on the real frequency axis. Let the symbol U denote the set of points, in the space of operating points for which there exists at least one value of p with zero or positive real part such that F = 0. Let the symbol V denote the subset of U such that F = 0 has a purely imaginary root, p = jω.

The necessary and sufficient condition for U to intersect P is that V intersect P. The sufficient condition is obviously true since the set V is a subset of U. It remains to be shown that if U intersects P, then V intersects P.

The first step in the proof, is to show that the set U is closed (contains all of its limit points). If the characteristic function, F (W_1, W_2, . . . W_N, p), is written as a polynomial in p (i.e., write as one rational function and consider only the numerator) and the Hurwitz stability criterion is applied, then we obtain a finite number of polynomials, ϕ_i (W_1, W_2 . . . . W_N).

According to the Hurwitz criterion, a point W is in U, if, and only if, at least one of the polynomials, ϕ_i, is equal to zero or is negative for that value of W. The set of operating point U_i at which $\phi_i \leq 0$ is a closed set since it is the inverse image of a clos set (all the negative real numbers including the lim point zero) under a continuous map, ϕ_i. The set must be closed since it is equal to the union of t closed sets U_i, and the sets U_i are finite in numb

Let the symbol B denote the set of operating poin which form the boundary of the closed set U. S d notes the set of operating points for which the zer of F have only negative real parts (correspondi to stable operating points).

Since U is a closed set, B must be contained in Since the sets U and S are complementary, B mu also be the boundary of the set S. Clearly then, f any operating point, W, in B, at least one zero of must be purely imaginary since all operating poin in B are limit points of the sets U and S. Therefor B is contained in V, and if U intersects the rectang lar parallelepiped, P, V must intersect P.

This completes the proof that the necessary a sufficient condition for U to intersect P is that intersect P. It should be noted that in the abo proof, it was not required that F be a multiline function of the gain parameters. Consequently, t results are also valid for the junction transistor i the common emitter configuration.

APPENDIX II

Proof of the Stability Criterion for a Circuit wit N Active Elements

The stability criterion (Theorem II) is extende to include the case of a circuit with N active ele ments. The proof makes use of mathematical induc tion on the dimensions of the rectangular parallele piped, P. It is assumed that the stability criterio has been proven for all dimensions up to and includ ing N-1.

The mapping function T sends all of the N-1 di mensional faces of P into a minimal convex set whic will be denoted by the symbol C. If T is a multilinea function of the gain parameters, W_1, W_2, ... W_N then a straight line in P parallel to one of the co ordinate axes, is mapped by T into a straight lin in the T-plane.

The image of the N-dimensional rectangular paral lelepiped in the T-plane consists of the image of th N-1 dimensional faces plus the images of all the line in P which are parallel to the W_N axis. Since thes lines are mapped by T into straight line segment joining points already in C (C is convex), the entir image of P lies in C.

A sufficient condition for absolute stability is tha the curves generated by the images of the vertices o P as p moves along the real frequency from p = (to p = j∞, not enclose the critical point (—1 + j0)

(To be Continued Next Month)

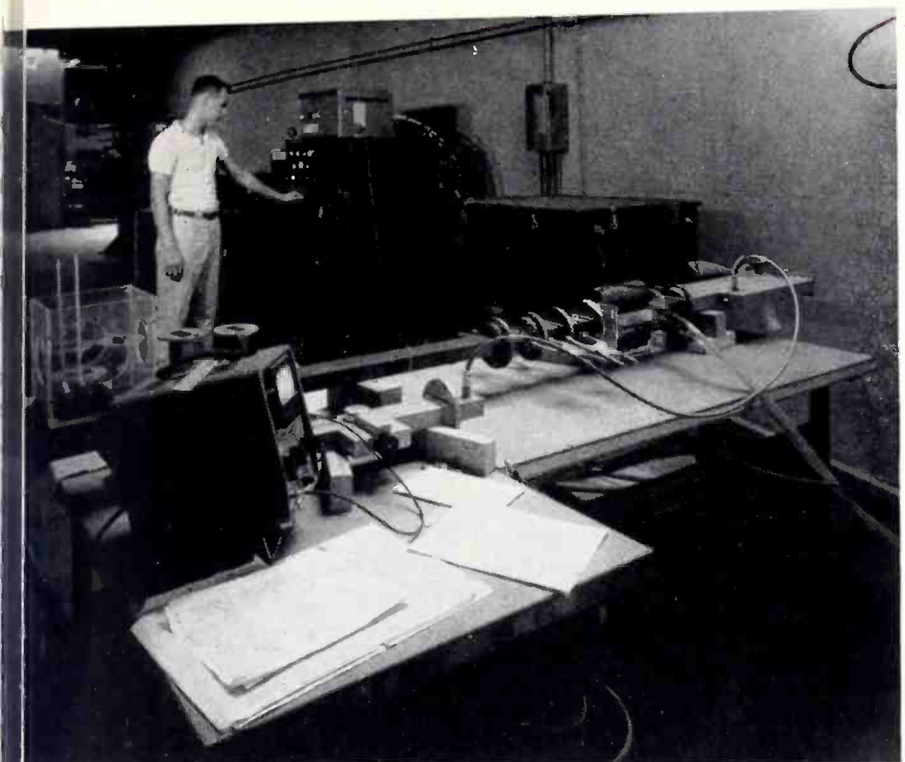


Fig. 1: With this test set-up, microwave ferrite isolators can be given realistic operating tests.

By Dr. E. Wantuch

Vice President
Cambridge Division, Airtron Inc.
Ridgewood, N. J.

A proposed standard method for . . .

High Power Testing of Ferrite Isolators

Low power tests of ferrite isolators are not sufficient to determine the optimum magnetic field for high power operation. A high power test technique has been developed for laboratory use.

NCE the microwave ferrite devices field is relatively new, and ferrite devices are now beginning o find wide application in military equipment to an preciable extent, the technique of high power testin of these components requires standardization. We fr here a suggested procedure which has been nsively used in Airtron's laboratories and has e found to be very satisfactory.

he purpose of a high power test is to optimize e ite isolator performance for the power level exe ed in the operating equipment. With the particua ferrite geometry used, the magnetic field for pmum operation at high power is lower than that eired for optimum low power performance.

he high power tests discussed here are divided n the following subdivisions:

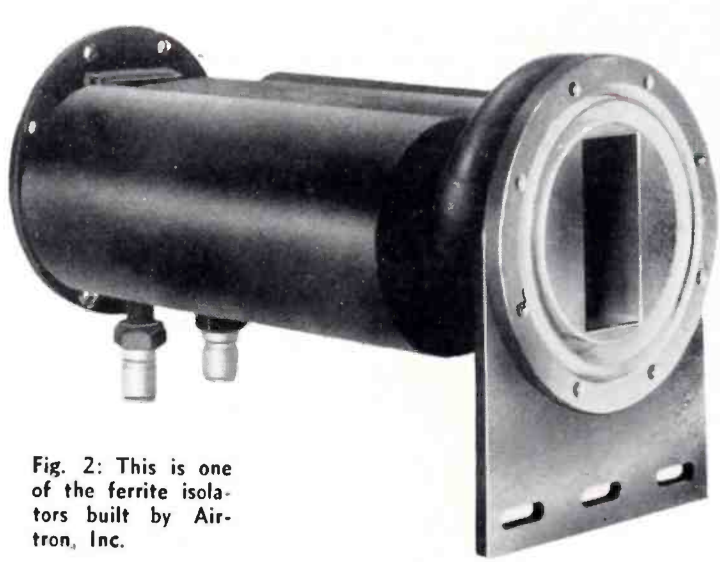


Fig. 2: This is one of the ferrite isolators built by Airtron, Inc.

Ferrite Isolators *(Continued)*

1. Determination of insertion loss.
2. Determination of input standing wave ratio under matched load conditions.
3. Determination of isolation under mismatched load conditions.

Insertion Loss

The block diagram shown in Fig. 3 is used to measure high power insertion loss. In this arrangement, the insertion loss is obtained by connecting the bolometer mount to output No. 1 which is proportional to the generator power, or the power level prevailing in front of the isolator, and is then connected to output No. 2 which is proportional to the power level prevailing after the isolator. The difference between output No. 1 and output No. 2 is the insertion loss.

Since values of insertion loss are small, it is necessary to observe precaution in this measurement. With the isolator out of the circuit, power levels from output No. 1 and output No. 2 have to be compared If they are different, a correction has to be made to future readings to obtain the true insertion loss of the isolator. This initial comparison is extremely important and it should be performed at several frequencies in the range of interest, since the frequency dependence of coupling may be slightly different for the two couplers.

Precaution in this measurement as well as in similar microwave measurements should be exercised to insure good metallic contact between all flanges, since loose contacts or uneven flange faces can lead to severe errors in this measurement.

The advantage of using this two-directional coupler technique is that the comparison between input and transmitted power levels does not require any connections to be made during the test. The time required between the two readings is minimized so that any error due to fluctuations in transmitting power output is minimized.

With this technique, the measured insertion l includes the true resistive losses of the ferrite co ponent, as well as the energy loss due to reflecti at both the input and output of the isolator. should be noted that a VSWR as high as 1.2 o contributes .05 db to the insertion loss measureme In all but very special cases, we consider an in VSWR of 1.15 as acceptable, which contributes l than .05 db to insertion loss of the ferrite device.

Input Standing Wave Ra

The input standing wave ratio may be measu using a standard slotted line if the power level us in the measurement does not require pressurizati Although pressurized slotted lines have been design they are not considered standard test equipment a very few laboratories possess these units. Wh pressurized operation is required, the experimen arrangement shown in Fig. 4 is modified slightly order to be made pressure tight and include a pr sure adapter.

The input standing wave ratio is simply det mined by using a bi-directional coupler or two sep rate identical directional couplers, as shown in Fig. one to sample the forward energy—the other

sample the reflected energy. The coupler used sample the reflected energy must have high dire tivity, since the reflected power level is small com pared to the incident power level. Insufficient dire tivity, in the reverse coupler, will abstract excessi energy from the forward energy and will cause a error which may either seem to improve or degra the true standing wave ratio. The directivity of th largest coupler should exceed 40 db, since a directivit as high as 40 db can contribute an error of 1.0 in this VSWR measurement.

Again, the coupling values of the two couplers use in this measurement should be compared initially, i

Fig. 3: Block diagram of test set for insertion loss and isolation measurements at rated power levels.

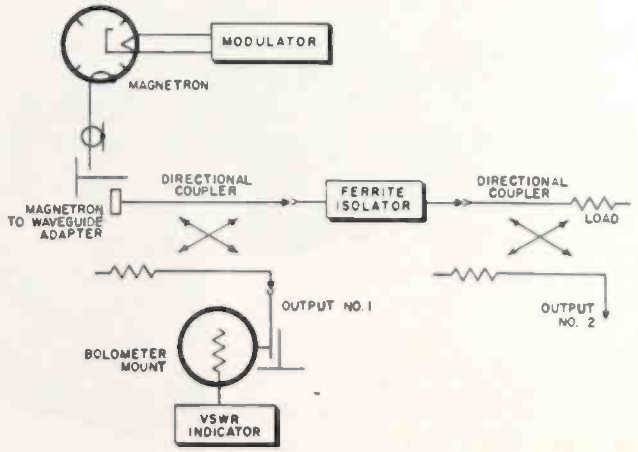
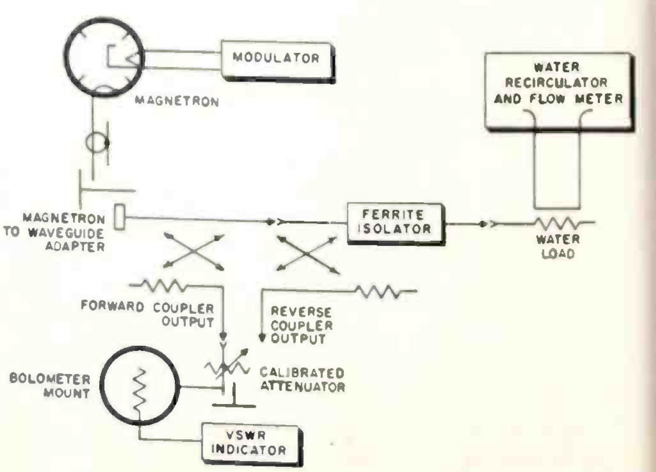


Fig. 4: High power test set-up for VSWR measurements.



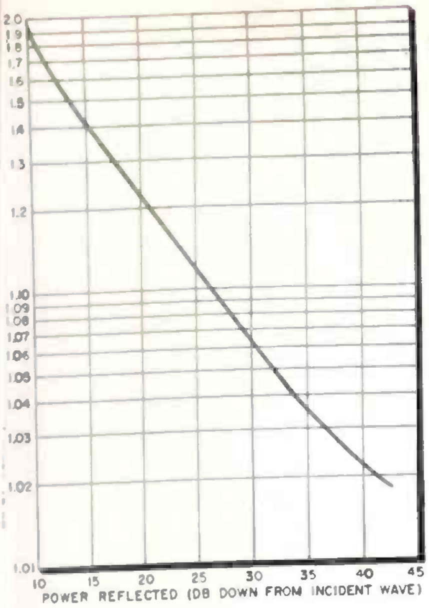
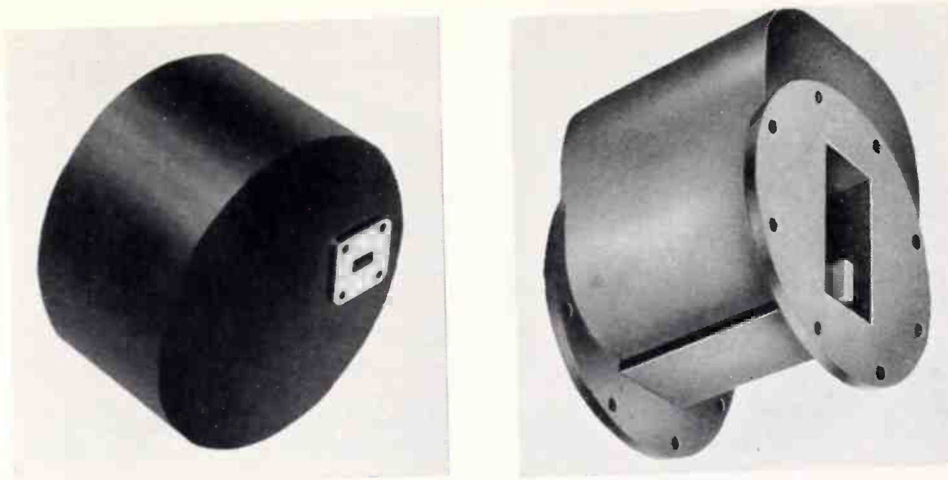


Fig. 5: Plot of attenuator reading vs. standing wave ratio.



Figs. 6 & 7: Typical high power ferrite isolators requiring high power testing.

order to make any correction for an existing difference in coupling values at the frequencies in the range of interest.

This measurement of input standing wave ratio is performed by taking a reference level on the reflected power level. A calibrated attenuator is connected to the input couplers, as shown, and the indicated power level is reduced to the same value as previously recorded on the reflected coupler output. This gives the reflection coefficient or standing wave ratio directly, by using a plot of attenuator reading vs. standing wave ratio as shown in Fig. 5.

Mismatched Loads

The determination of isolation under mismatched load conditions is the most difficult, and the technique outlined here has been adopted as standard in our laboratories. The technique consists of having a known mismatch on the output side of the isolator and observing the behavior of the input standing wave ratio of the isolator in this mismatch which is varied through all phases with constant magnitude.

This measurement is usually performed with load VSWR's of either 1.5 or 2.0. Instead of making the phase of the mismatch continuously variable, we substitute eight different phase lengths of straight waveguides so that the impedance circle on a Smith Chart is approximated by these eight points. Therefore, the phase difference between successive mismatches is 1/16 of a guide wavelength. Any error made by substituting these eight sections of waveguide is negligible when compared with the errors involved in a continuously variable mismatch.

The worst phase mismatch is defined as the one giving the highest value of input standing wave ratio of the isolator. The worst isolator input VSWR occurs when the reflected energy from the load mismatch reaching the input side of the isolator is in phase with the isolator input VSWR under matched load conditions. The ratio of the highest isolator VSWR under the worst phase conditions to the VSWR of the isolator under matched load conditions is defined as the residual load VSWR and this residual VSWR is a measure of isolation of the ferrite isolator.

For Example

If the input standing wave ratio to the isolator under matched load conditions is 1.10, and the highest value of the input VSWR for any load mismatch is 1.18, then the residual load VSWR is

$$\frac{1.18}{1.10} = 1.07$$

A VSWR of 1.07 corresponds to a reflected power level of 30 db as seen in Fig. 5.

Therefore, if the load mismatch had a VSWR magnitude of 1.5 which corresponds to a reflected power level of 14 db below the incident power, under these conditions, the isolation value of the ferrite isolator is 30 minus 14 or 16 db. If the load mismatch had a VSWR magnitude of 2.0 to 1, which corresponds to a reflected power level of 10 db, then the isolation value of the isolator under the same test conditions would be 30 minus 10 or 20 db.

We feel that this technique is superior to the isolation measurement whereby power is inserted from the load side of the ferrite isolator and the power leaking through the isolator is measured. In this latter method, the temperature distribution in the ferrite material under high power conditions is not identical to the temperature distribution found under operating conditions. Actually, our isolation measuring technique is identical to conditions prevailing in the equipment in which this ferrite component is used.

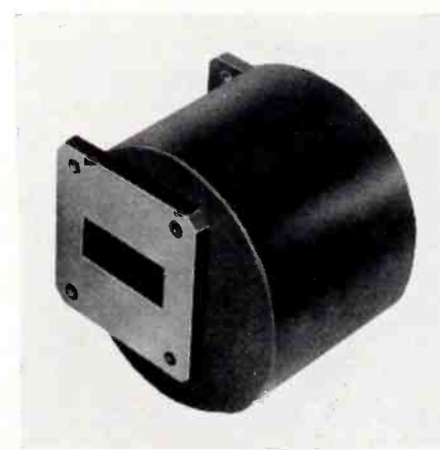


Fig. 8: Effects of temperature vary with power being fed through ferrite isolators such as this.

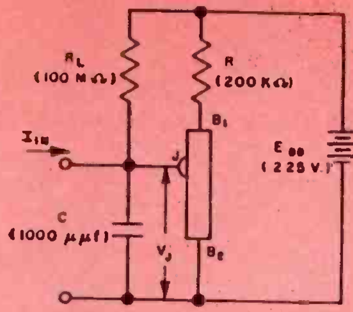


Fig. 1: This silicon double-base diode free-running oscillator was investigated

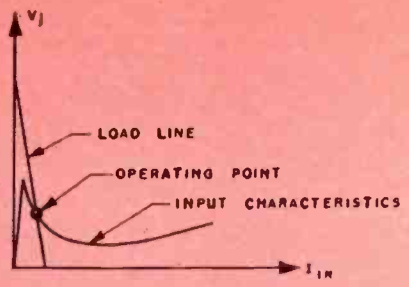


Fig. 2: Operating point must be in negative resistance region for oscillation.

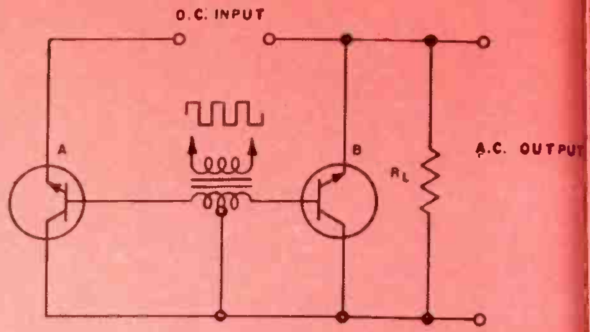


Fig. 3: Alloy junction transistors were most suitable for this switching circuit.

For Instrumentation . . .

Ring-Modulator Reads Low-Level DC

By using high-quality silicon diodes in a ring-modulator circuit, DC signals as low as 10^{-10} amp. can be measured. Combined with a logarithmic attenuator, the output can be made a logarithmic function of the input from 10^{-10} to 10^{-3} amp.

By EDWARD J. KEONJIAN and JOHN D. SCHMIDT

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In instrumentation, the problem of detecting a wide range of low-level dc currents, using semiconductors, is of considerable importance. The lowest limit of this current range could be in the order of 10^{-10} amp, or even lower. This makes it quite difficult to use conventional dc transistor amplifiers, because of the drift encountered. Consequently, it is desirable to find other methods for detecting very low dc signals, free of the shortcomings of conventional transistor dc amplifiers.

Following are some results of a study made to determine the feasibility of various methods of detecting dc signals in the range from 10^{-10} to 10^{-3} amp. It is assumed that signals are available from a source with a large source resistance, in the order of 100 meg.

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Considerations relating to logarithmic attenuation techniques which could be used for convenient reading of currents within the specified region of 10^{-10} amp are also included.

Methods of Approach

Several different methods were investigated to determine the most efficient solution.

A. Use of a silicon double-base diode free-running oscillator.

By feeding dc into the junction of the double-base diode (DBD), the current will change the frequency of oscillation; this frequency change will give a measure of the current fed in. Fig. 1 shows the circuit investigated, along with typical values of circuit components. E_{BB} and R_L give a load line on the input characteristics of the DBD, Fig. 2.

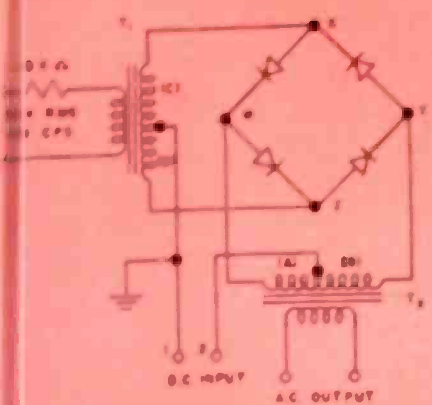


Fig. 4: Transformer T_1 is used to inject reference signal in this ring-modulator.

For the device to oscillate, the load line must inter-
ct the input characteristics in the negative resis-
nce region. This means there is a certain maximum
lue of R_L that will work in the circuit, and thus
ere is a minimum workable value of current flowing
to the DBD junction through R_L. To have a de-
ctable change in frequency for a small dc signal,
must be comparable in magnitude to the current
wing through R_L. This, then, is the sensitivity
nitation of this circuit.

The circuit was investigated for changes in sensi-
vity and stability, varying all parameters. As
pected, from the preceding discussion, experimental
sults showed maximum sensitivity is achieved by
ing a large value of R_L and by using selected
BD's with high input impedance in the cutoff region.
his means the voltage peak of the input characteris-
cs should be closer to the zero current axis, thus
llowing a steeper load line to be used and still inter-
ect the negative resistance region.

By using the circuit shown, and selecting approx.
% of the DBD's from a random lot of 85, it was
ossible to achieve a 5% to 7% change in frequency
or changes in input signal of 10^{-7} amp. The mini-
num reliable reading was for 10^{-8} amp.

. Transistor Switching Circuits.

Various types of transistors have been investigated
n low-level transistor switching circuits to determine
he applicability of this method to the detection of
ow dc signals.

It was found that alloy junction transistors were
nost suitable for this application, Fig. 3. An ex-
lanation of the operation of the circuit is given in
Reference 1.

However, the maximum sensitivity of this arrange-
nent did not exceed 10^{-8} amp. Even this could be
chieved only for a very low source impedance due
o imperfection of transistors as switches. Opera-
ion from a high source impedance introduces an
rror which reduces the sensitivity of the circuit by
t least one order of magnitude.[1]

Since the principle source has a very large output
mpedance, the transistor switching method was
ound unsuitable for this particular application.

. Ring-Modulators.

Preliminary studies of ring-modulators have indicated that this method of dc-ac conversion has a definite advantage over previous methods from the standpoint of sensitivity and circuit simplicity. The use of this method has already produced good results in the current range of 10^{-8} amp.[2] It was decided to concentrate our efforts upon this method, investigating the possibility of extending the sensitivity of the ring-modulator by two more decades (to 10^{-10} amp).

Final circuits

A. Ring-Modulator.

The ring bridge modulator circuit diagram is shown in Fig. 4. Transformer T_1 is used to inject the reference signal. Transformer T_2 is a matching device between the output of the modulator and the input of the ac amplifier.

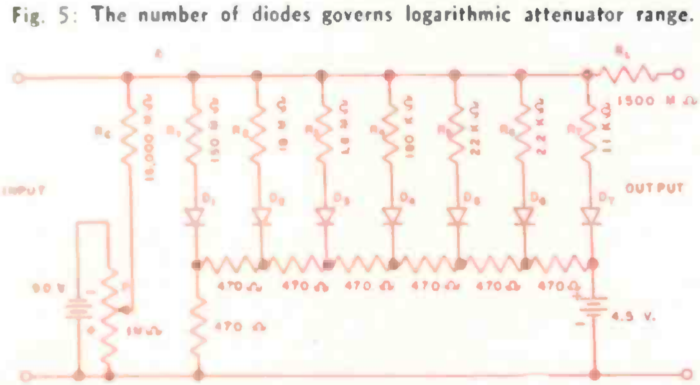
If, to a first order approximation, the diodes may be assumed to be perfect switches, the operation of the circuit is as follows. A symmetrical square wave, with far greater current than that to be modulated, is injected into the bridge by means of T_1. This will cause paths XYZ and XWZ to become alternately conductive. Thus, a current injected into terminal "2" may accept only one of the paths, (a) or (b), in transformer T_2, depending on the reference phase.

The current will pass from terminal W or Y, depending upon which diodes are open at the instant, to terminals X and Z, as two equal components. In returning to terminal "1," they will pass through windings (c) and (d) of transformer T_1 in inductive opposition. Thus, the signal has been commutated with respect to transformer T_2 only, but not with respect to T_1, since no induction occurs in the latter. The result is an ac signal in the secondary of T_2 which is proportional to the dc input.

Since the real diodes are not perfect switches, there will be a certain error introduced into the operation of the ring-modulator. The presence of this error limits the sensitivity of the circuit. Therefore, the diode characteristics play an important role in the operation of the modulator at very low current levels.

The analysis of a bridge modulator operating from a constant current source indicates that the error introduced into this circuit depends primarily on the reverse characteristics of the diodes. For maximum sensitivity, the reverse currents of the diodes should be as small as possible, and their reverse characteristics should be matched.

Fig. 5: The number of diodes governs logarithmic attenuator range.



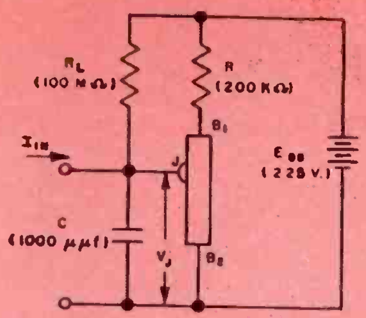


Fig. 1: This silicon double-base diode free-running oscillator was investigated

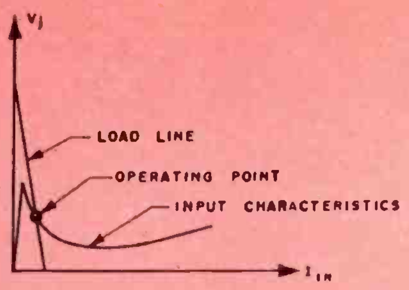


Fig. 2: Operating point must be in negative resistance region for oscillation.

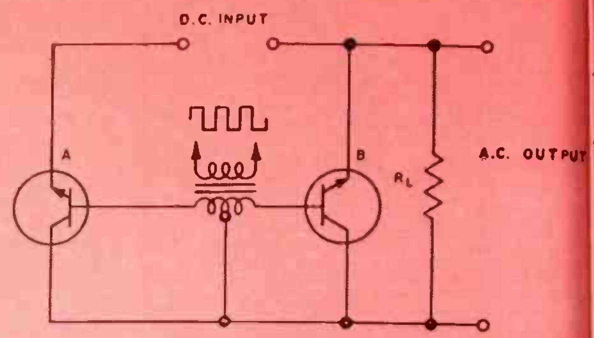


Fig. 3: Alloy junction transistors were most suitable for this switching circuit.

For Instrumentation . . .

Ring-Modulator Reads Low-Level DC

By using high-quality silicon diodes in a ring-modulator circuit, DC signals as low as 10^{-10} amp. can be measured. Combined with a logarithmic attenuator, the output can be made a logarithmic function of the input from 10^{-10} to 10^{-3} amp.

By EDWARD J. KEONJIAN and JOHN D. SCHMIDT

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In instrumentation, the problem of detecting a wide range of low-level dc currents, using semiconductors, is of considerable importance. The lowest limit of this current range could be in the order of 10^{-10} amp, or even lower. This makes it quite difficult to use conventional dc transistor amplifiers, because of the drift encountered. Consequently, it is desirable to find other methods for detecting very low dc signals, free of the shortcomings of conventional transistor dc amplifiers.

Following are some results of a study made to determine the feasibility of various methods of detecting dc signals in the range from 10^{-10} to 10^{-3} amp. It is assumed that signals are available from a source with a large source resistance, in the order of 100 meg.

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Considerations relating to logarithmic attenuation techniques which could be used for convenient reading of currents within the specified region of 10^{-10} amp are also included.

Methods of Approach

Several different methods were investigated to determine the most efficient solution.

A. Use of a silicon double-base diode free-running oscillator.

By feeding dc into the junction of the double-base diode (DBD), the current will change the frequency of oscillation; this frequency change will give a measure of the current fed in. Fig. 1 shows the circuit investigated, along with typical values of circuit components. E_{BB} and R_L give a load line on the input characteristics of the DBD, Fig. 2.

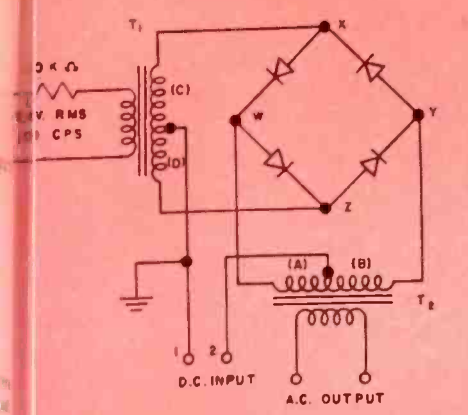


Fig. 4: Transformer T_1 is used to inject reference signal in this ring-modulator.

For the device to oscillate, the load line must inter-ect the input characteristics in the negative resis-ince region. This means there is a certain maximum ·lue of R_L that will work in the circuit, and thus iere is a minimum workable value of current flowing to the DBD junction through R_L. To have a de-ctable change in frequency for a small dc signal, must be comparable in magnitude to the current owing through R_L. This, then, is the sensitivity nitation of this circuit.

The circuit was investigated for changes in sensi-vity and stability, varying all parameters. As xpected, from the preceding discussion, experimental esults showed maximum sensitivity is achieved by sing a large value of R_L and by using selected BD's with high input impedance in the cutoff region. his means the voltage peak of the input characteris-cs should be closer to the zero current axis, thus llowing a steeper load line to be used and still inter-ect the negative resistance region.

By using the circuit shown, and selecting approx. % of the DBD's from a random lot of 85, it was ossible to achieve a 5% to 7% change in frequency or changes in input signal of 10^{-7} amp. The mini-num reliable reading was for 10^{-8} amp.

?. Transistor Switching Circuits.

Various types of transistors have been investigated n low-level transistor switching circuits to determine he applicability of this method to the detection of ow dc signals.

It was found that alloy junction transistors were nost suitable for this application, Fig. 3. An ex-lanation of the operation of the circuit is given in Reference 1.

However, the maximum sensitivity of this arrange-nent did not exceed 10^{-8} amp. Even this could be chieved only for a very low source impedance due o imperfection of transistors as switches. Opera-ion from a high source impedance introduces an rror which reduces the sensitivity of the circuit by it least one order of magnitude.[1]

Since the principle source has a very large output mpedance, the transistor switching method was ound unsuitable for this particular application.

C. Ring-Modulators.

Preliminary studies of ring-modulators have in-dicated that this method of dc-ac conversion has a definite advantage over previous methods from the standpoint of sensitivity and circuit simplicity. The use of this method has already produced good results in the current range of 10^{-8} amp.[2] It was decided to concentrate our efforts upon this method, investigat-ing the possibility of extending the sensitivity of the ring-modulator by two more decades (to 10^{-10} amp).

Final circuits

A. Ring-Modulator.

The ring bridge modulator circuit diagram is shown in Fig. 4. Transformer T_1 is used to inject the refer-ence signal. Transformer T_2 is a matching device between the output of the modulator and the input of the ac amplifier.

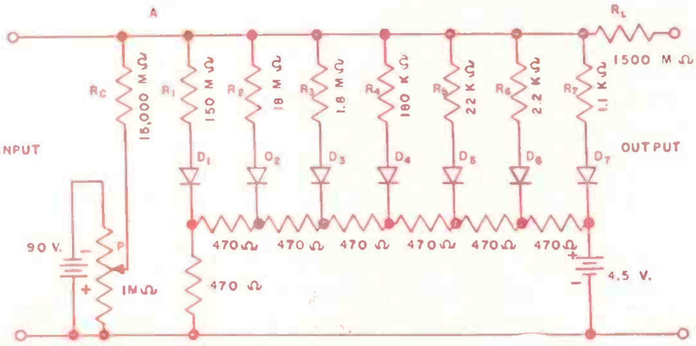
If, to a first order approximation, the diodes may be assumed to be perfect switches, the operation of the circuit is as follows. A symmetrical square wave, with far greater current than that to be modulated, is injected into the bridge by means of T_1. This will cause paths XYZ and XWZ to become alternately conductive. Thus, a current injected into terminal "2" may accept only one of the paths, (a) or (b), in transformer T_2, depending on the reference phase.

The current will pass from terminal W or Y, de-pending upon which diodes are open at the instant, to terminals X and Z, as two equal components. In returning to terminal "1," they will pass through windings (c) and (d) of transformer T_1 in inductive opposition. Thus, the signal has been commutated with respect to transformer T_2 only, but not with respect to T_1, since no induction occurs in the latter. The result is an ac signal in the secondary of T_2 which is proportional to the dc input.

Since the real diodes are not perfect switches, there will be a certain error introduced into the operation of the ring-modulator. The presence of this error limits the sensitivity of the circuit. There-fore, the diode characteristics play an important role in the operation of the modulator at very low current levels.

The analysis of a bridge modulator operating from a constant current source indicates that the error introduced into this circuit depends primarily on the reverse characteristics of the diodes. For maximum sensitivity, the reverse currents of the diodes should be as small as possible, and their reverse characteris-tics should be matched.

Fig. 5: The number of diodes governs logarithmic attenuator range.



Ring-Modulator *(Continued)*

B. Logarithmic Attenuator.

Fig. 5 is a diagram of a logarithmic attenuator. Its operation is as follows: Diodes D_1 to D_7 are all biased in the reverse direction by a 4.5 v. battery and a voltage divider P shunted across a 90 v. battery. Thus, these paths are all practically closed to the input current. If R_C is at least 10 times larger in magnitude than R_L, most of the input current will flow through R_L. This is the condition for very low currents.

As the input current increases, the voltage rises at point A, which will switch D_1 to the ON condition. Thus, some of the input current is diverted through this path, the exact amount being controlled by R_1. This process is repeated and the other diodes are switched on in sequence as the input current increases.

The output can be made the logarithm of the input by the proper choice of the resistances in series with the diodes and by proper biasing of diodes.[3, 4] The logarithmic range of the attenuator is governed by the number of diodes in parallel, larger ranges requiring more diodes.

With a zero input current, the reverse currents of the diodes in parallel will cause a small current to flow in R_L. This current can be compensated for by the use of R_C and a 90 v. battery, as shown. The potentiometer, P, is for a zero adjustment of the output when the input signal is zero.

Experimental Results

It is extremely important that circuits of high sensitivity be completely shielded from any outside interference. Also, it is very important to have shielding between the two transformers of the ring-modulator so that none of the reference signal will be picked up by the output transformer. Furthermore, careful amplifier filtering is necessary to eliminate all harmonics of the reference frequency.

Because of the sensitivity of the circuits, it was necessary to use a narrow band ac amplifier in the output circuit. This, of course, greatly reduces the output noise due to thermal agitation in the source impedance. Our data were taken using an amplifier with 5% bandwidth at 1 KC; however, tests indicate that bandwidths in the order of 10% may be used equally successfully for less stable reference oscillators.

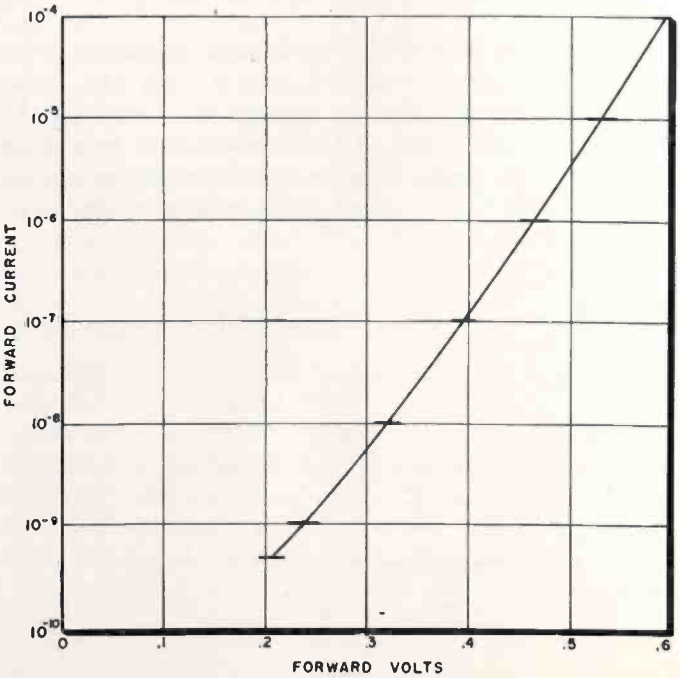
A sine wave was used as the reference signal rather than a square wave. This is possible provided the magnitude of the sine wave is large enough so that the diodes are switched on or off during almost the entire duration of each cycle. At the same time, the use of a sine wave will simplify the filtering and noise problems. The reference frequency was found to be uncritical, and 1 KC was chosen primarily because of the availability of filters and tuned amplifiers for this frequency.

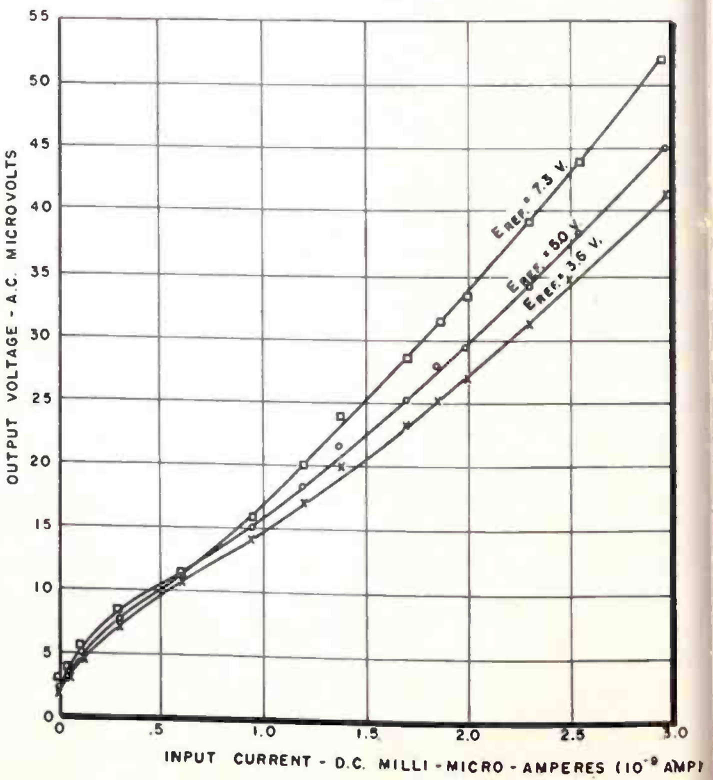
The transformers used were SNC type P318, having a primary impedance of 100 K and a secondary impedance of 1 K. Fig. 6 shows the forward characteristics of the diodes used. It can be seen that the conducting region starts at approximately 0.25 v. This suggests a conservative value of forward current (in the order of 10^{-6} amp) for reliably switching them on, because under this condition the forward impedance of the diodes will be much less than the impedance of the source. This corresponds to approx. 10^{-5} amp current in the primary of transformer T_1.

Since the forward impedance of the diodes is controlled by the forward currents of the diodes, it is desirable to have a constant current reference source

Fig. 7 (right): Characteristics of the ring-modulator.

Fig. 6 (below): Forward characteristics of diodes used.





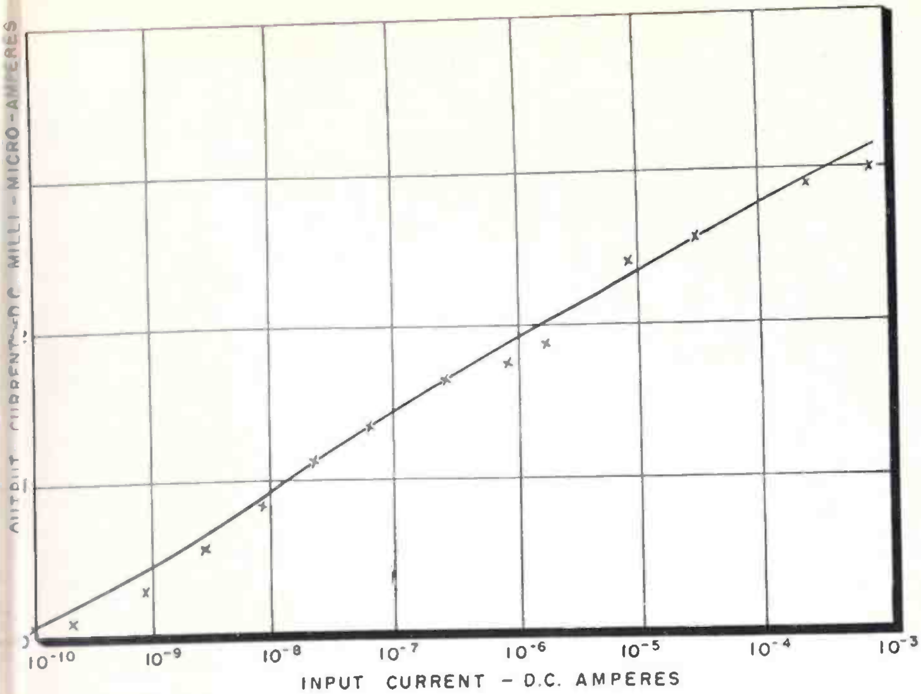


Fig. 8: The output vs the input characteristics of the logarithmic attenuator.

zero balance did not shift noticeably with the passage of time; however, it is temperature sensitive.

For the temperature tests, the zero balance was adjusted for minimum output with no signal input after the temperature has stabilized. The tests included the logarithmic attenuator and the ring bridge modulator.

The no-signal output current of the logarithmic attenuator increased from about 10^{-9} amp at room temperature to 10^{-8} amp at 45°C. This no-signal current is the back current of the 7 diodes in parallel and is compensated for by the zero balance potentiometer.

The tests indicated that the performance of the bridge deteriorated approximately by one order of magnitude as the temperature was changed from 25°C to 45°C.

·hich will keep the impedance of the bridge balanced. ·e constant current source was approximated by us·g a 100 K resistor in series with the reference signal « approx. 4 v. RMS.

Transformers T_1 and T_2 were identical, since the ·imary impedance of the latter should also be very ·gh because of the high source impedance. The ·condary impedance had to be low in order to match ·e low impedance of a transistor amplifier.

The diodes used were Texas Instrument 601C. Out · 10 samples, four were chosen with the lowest values · reverse currents. These reverse currents were ·und to be below 10^{-10} amp with 1 v. reverse bias. ·hese four diodes were interchanged until the best ·mbination was found. However, · selecting them randomly, the de·rioration in performance was less ·an one order of magnitude.

By increasing the value of the ·ad resistance and the resistors · series with diodes D_1 and D_7 ·nd by using diodes with lower ·ack currents, it is possible to build · logarithmic attenuator that will ·e usable from 5 x 10^{-10} amp to ·0^{-3} amp.

Fig. 9 illustrates the performance of the complete circuit consisting of dc signal source, logarithmic attenuator, ring bridge modulator, and narrow band ac amplifier at the output of the bridge modulator. The performance was evaluated at room temperature. The compensating network in the logarithmic attenuator can be used to balance out the error signal in the ring bridge modulator, thus making possible a much smaller zero balance. This

Acknowledgment

The authors wish to express their thanks to Mr. N. F. Moody of Canadian Defense Research Board Telecommunication Establishment in Ottawa, for the numerous helpful suggestions regarding the several aspects of the work.

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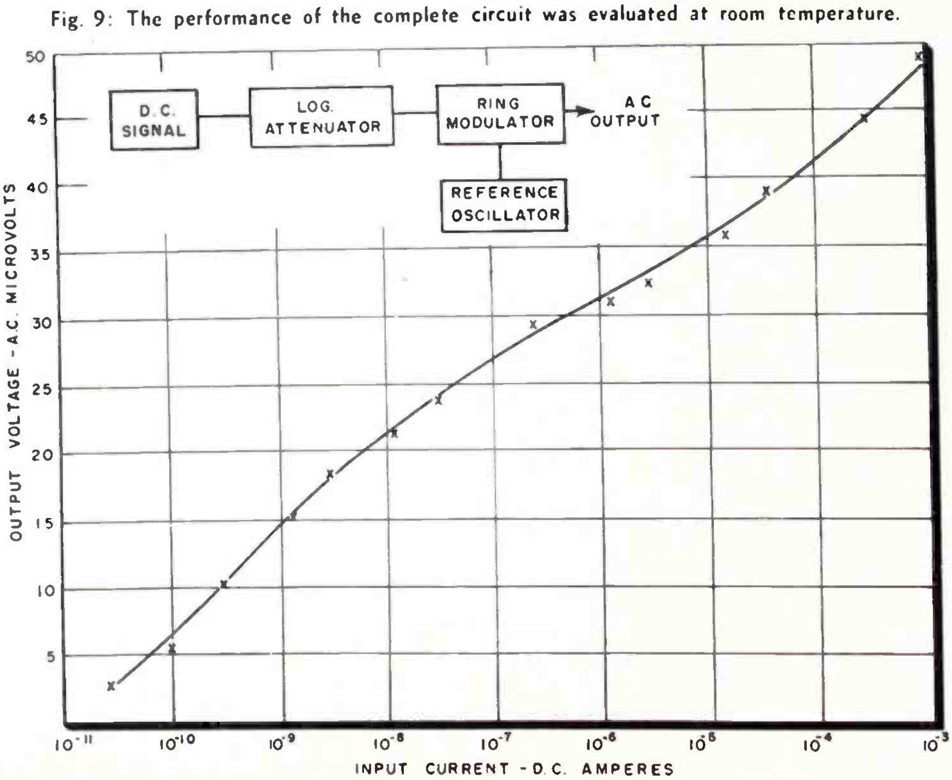
4. H. Goldberg and S. L. Fagin, "Notes on Logarithmic Network Design," *Proceedings of the Aeronautical Electronics,* 1956.

Fig. 9: The performance of the complete circuit was evaluated at room temperature.



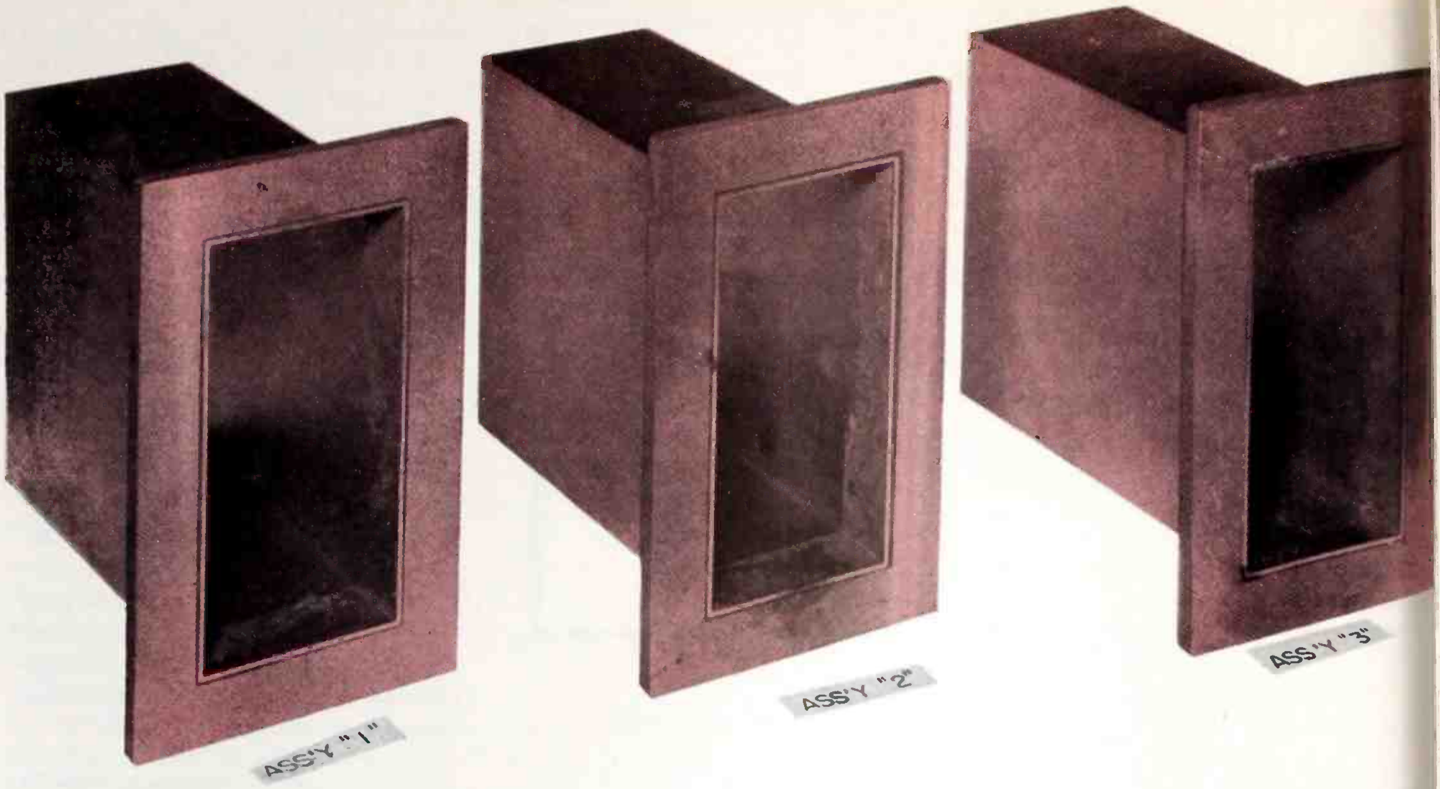


Fig. 1: These assemblies were torch brazed at the flange face.

Aluminum Waveguide, Weld or Braze?

What is the most economical way to form aluminum waveguide? Microwave performance, structural integrity, and fabrication economy must all be achieved for production waveguide.

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Sperry Gyroscope Co.
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L. Virgile

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THE joining of waveguide is generally accomplished by means of a brazing process and, for many applications, this method offers highly satisfactory results. In manufacturing large waveguide components, however, the problems encountered in brazing are of sufficient magnitude to warrant investigation into other techniques in order to arrive at a product that offers the best combination of adequate microwave performance, structural integrity, and fabrication economy. All of the tests described in this article were made with aluminum L-band waveguide. The conclusions derived can also be applied freely to larger sizes and, with discretion, to smaller guide.

The basic criteria that are used to determine the suitability of the brazing and welding procedures may be itemized as follows:

1. General Appearance—The joints obtained must be relatively smooth and void-free to prevent high power breakdown and/or excessive attenuation loss.

2. Strength—It is desirable to maintain the highest possible strength-weight ratio so as to obtain ease of handling in both the shop and field, together with adequate support for structural loads.

3. Manufacturing Economy—In addition to minimizing the brazing or welding time, consideration must be given to associated machining requirements which can vary widely, depending upon the joining procedure utilized.

Brazing Problems

he problems involved in braz-in that led to this investigation a the following:

. The use of dip or furnace bzing is limited because these jhing methods anneal, and conse-q ntly weaken, the waveguide.

. The tight tolerances on small si waveguide result in a satis-f tory fit for brazing with a mini-m m of hand fitting when the g de is placed through the flange o ning. The mill tolerances on l ge aluminum waveguide, how-e r, are so great that considerable f ing is required at assembly to o ain the proper clearance for b zing.

3. The brazing of flanges to waveguide is normally b t accomplished by making the joint at the flange f e. This requires that machining of lands, grooves, a d bolt holes be done after brazing. In the case of l ge size waveguide assemblies, the handling and f uring for machining is sufficiently difficult to make i well worthwhile to utilize a joining method that v uld permit this machining to be done prior to a embly.

4. Brazed aluminum assemblies often contain small v ds which entrap corrosive brazing flux. This, com-b ed with fluids used in the subsequent anodizing p cess, will result in corrosive action that is at best u sightly and frequently detrimental to the perform-a ce of the units.

5. Where castings are involved in the waveguide a embly, the use of brazing restricts the range of a minum alloys that can be used because many cast a oys do not braze satisfactorily.

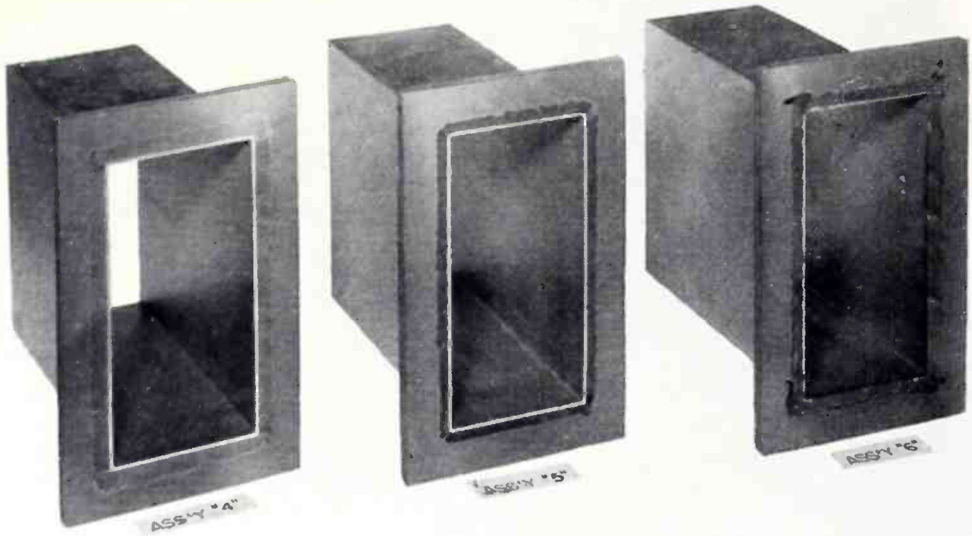


Fig. 3: Heli-arc welded at the flange face, followed by a 1/32-in. face cut.

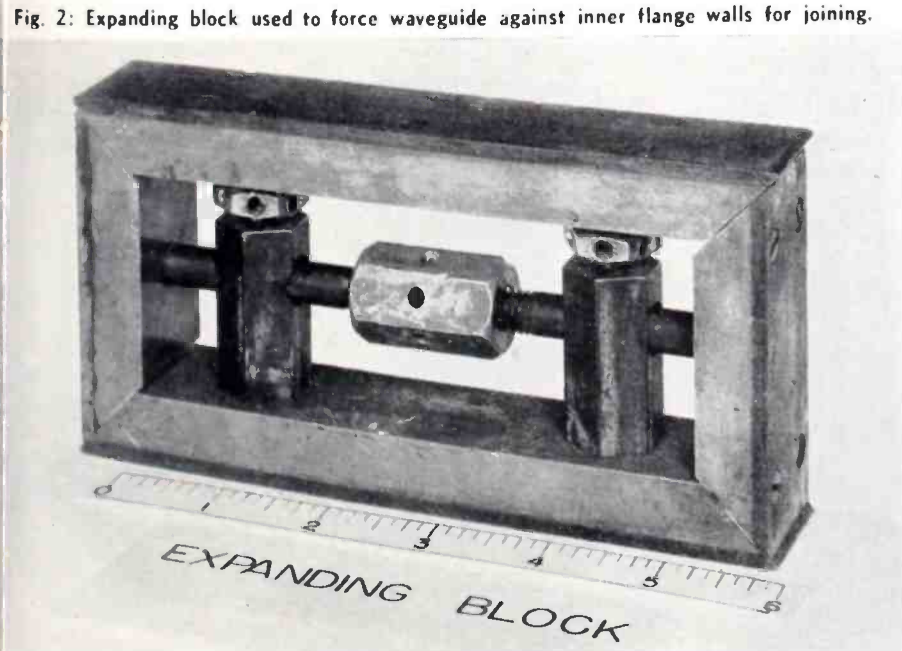
Experiments

The basic problem was established as that of joining an L-band flange to standard 2S aluminum waveguide. All flanges are castings, the alloy being (a) Alcoa 356-T5 for susequent welding and (b) Tenzaloy where brazing is to be used.

Unless otherwise noted, all of the assemblies were fixtured for welding or brazing by means of the tool shown in Fig. 2. This block is capable of expansion in both a sidewise and up-and-down direction. It is placed within the waveguide to force the waveguide against the inner flange walls and remains in place during the joining operation.

Table I describes in detail the procedures followed and results obtained for the various joining methods. Assemblies 1, 2 and 3 (shown in Fig. 1) are torch brazed at the flange face as described in Table I and a 1/32-in. face cut taken after brazing (which would normally be followed by machining of lands, grooves and bolt holes in the flange per the standard configuration). The discoloration in the waveguide opening is flux residue which is easily removed. Of the three, only Assembly 1 gave results which can be considered as satisfactory.

Fig. 2: Expanding block used to force waveguide against inner flange walls for joining.



Assemblies 4, 5 and 6 (see Fig. 3) are Heli-arc welded at the flange face (see Table I for detailed information), followed by a 1/32-in. face cut. None of these three units were of sufficiently good quality (without extensive rework) to warrant further consideration. The basic problem in these three assemblies is that of attempting to weld at a point where there is a great difference in thickness of the materials to be joined. At the flange face, the waveguide is .080 in. thick as compared to a flange width of more than 1 in. Consequently, the heat dissipation of the two parts is so different as to make it almost inevitable that either lack-of-fusion or burn-through will occur regardless of the skill of the welding operator.

To employ full advantage of a

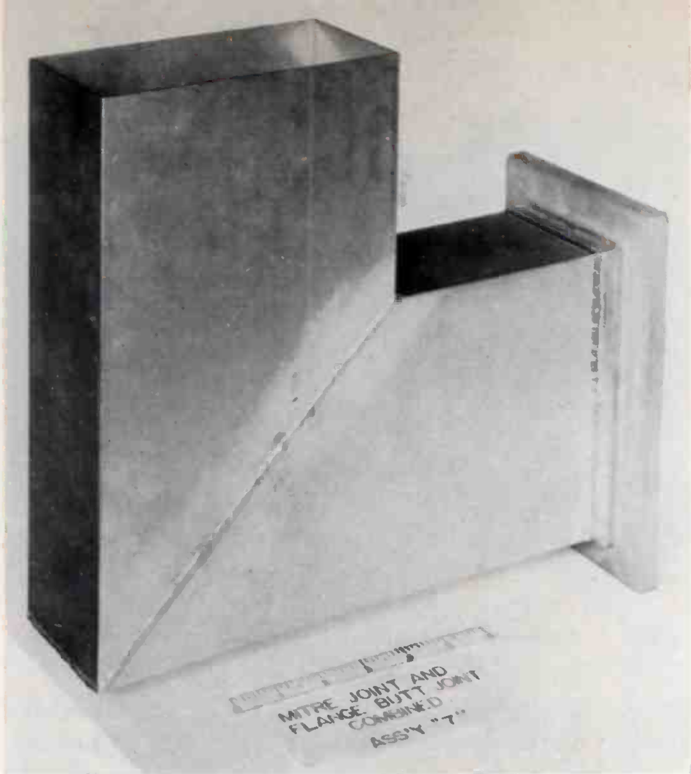


Fig. 4: Flange rear extension about .080 in. thick; butt welded.

Welding vs. Brazing *(Continued)*

welding technique, it is highly desirable that the materials to be joined be of relatively equal thickness, thus obtaining equal heating of both parts. With this thought in mind, a flange was constructed with a rear extension approximately .080 in. thick. This flange was then butt welded to the waveguide as shown in Fig. 4 (at the same time a miter joint was made on this piece using the butt weld technique). Note that this type of construction requires a flange with inside dimensions the same as the waveguide rather than the usual arrangement wherein the flange opening is large enough to permit the waveguide to pass through; the net result after making the joint is, of course, identical with the conventional type of assembly. Both the flange connection and the miter proved to be of good quality. It may be observed that the butt welding method leave a very small gap all around the inside of the waveguide since the weld is not permitted to fully penetrate the guide wall thickness. Extensive low and high power tests have shown that this gap in no way degrades microwave performance. No breakdown has been observed at 7 megawatts actual or 20 megawatts simulated peak power.

Further utilization of this welding technique resulted in the manufacture of the small radius "E" and "H" plane bends shown in Figs. 5 and 6. To make each of these parts, 61 S-T sheet was (a) cut to size to serve as the flat walls and (b) cut to size and rolled to form the curved walls. Two inch thick blocks of 6.500 in. x 3.250 in. outside dimension were used to position the sheets for tack welding, after which the blocks were removed and the assembly finish welded all around. Flanges were attached by putting the welded waveguide through the flange and welding at the flange face. Total welding time was 1 hr. per assembly. The results were generally satisfactory except that (1) the inside dimensions shrank out of tolerance toward the middle of the bend and (2) the flange to waveguide joint was undesirable because of failure of the filler material to fuse with the waveguide. Subsequent excellent bends have been made using similar construction wherein two 90° welded bends are butt welded together instead of a single 180° unit. A typical production assembly is shown in Fig. 7. This unit combines two 90° bends with an intervening straight section (to obtain desired overall length) and is butt welded at all joints.

The Heli-arc welding technique was next attempted on cross guide couplers as typified in Fig. 8. On this assembly, the welding takes place in what amounts to the vertex of a right angle. In supplying sufficient heat to this point, however, considerable heat is also applied to the surrounding waveguide walls, causing the formation of an oversize bead. The resulting excessive distortion, steps, and gaps were considered unsatisfactory and this type of construction is not recommended for this application.

Conclusions

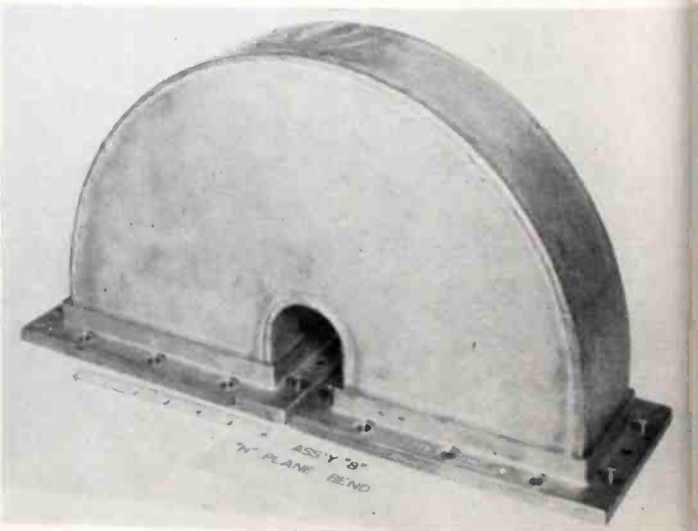
Of the seven brazing and welding techniques attempted, only two (Assemblies 1 and 7) produced results that are considered to be first-rate. Comparison of these two methods, of which No. 1 is torch brazing and 7 is butt welding, reveals the following:

1. As shown in Table I, the time required for welding is only one-half of that needed for brazing, since the two joints making up Assembly 7 were welded in the same amount of time needed to braze the single joint of Assembly 1. Furnace pre-heating of the parts to be brazed could be utilized to reduce the brazing time to approximately that used for welding. The net advantage to welding would then consist of the cost of the pre-heating operation.

2. In addition to this actual joining time, the waveguide used in brazing must be machined prior to assembly to ensure proper brazing clearance whereas the butt welded joint does not require this.

3. Flanges used for butt welding can be completely

Fig. 5: Further extension of technique used in Assembly 7, Fig. 4.

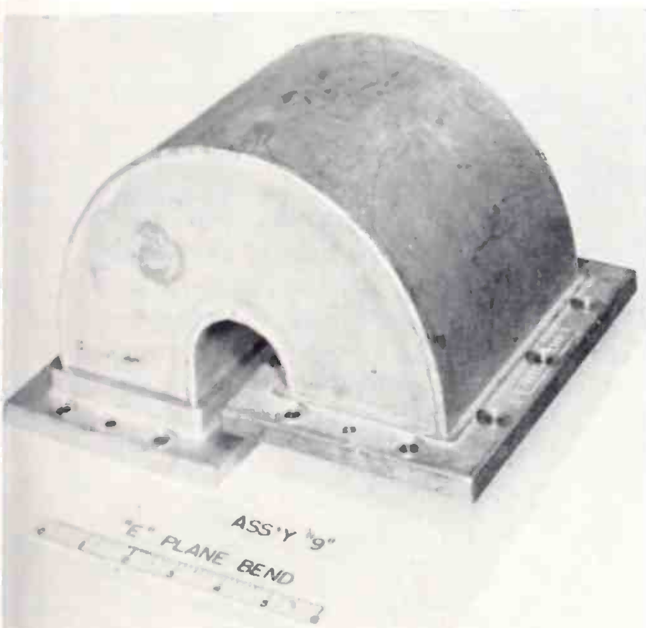


chined (lands, grooves, bolt holes) as a detail part, ereas the flange machining for the brazed assem- must take place after the joint is made. The -machined flanges are considerably less costly since ey can be easily done in a repetitive manner while st assembly flange machining is expensive because the difficulty of handling and fixturing large wave- ide assemblies.

4. Another advantage offered by the welding proc- is minimizing of corrosion. The gas shield used the Heli-arc process eliminates surface oxides, thus aking fluxing unnecessary. On the other hand, the ix required to braze aluminum is difficult to remove mpletely after brazing and is often a factor in omoting subsequent corrosion.

Butt Welding Best

It is thus apparent that the butt welding method fers the best combination of a superior product and aximum manufacturing economy. The question may raised as to whether further improvement can be tained by (1) dip or oven brazing to cut down



ig. 6: Slight gaps in waveguide wall at butt welds cause no trouble.

ining time or (2) eliminating assembly altogether y precision sand casting the entire microwave unit. urnace or dip brazing is generally not suitable for rge size waveguide since it anneals the entire mate- ial whereas the inert-arc welding process anneals nly in a localized area. The full annealing seriously etracts from the waveguide strength; in the case f WR 650 aluminum guide, it reduces the pressure arrying capacity from 5 to 2 psi.[1] Sand casting is sed for some applications but is limited in scope ecause of (1) maximum size that the precision ored process can accommodate, (2) high pattern quipment cost necessitating large-scale production, nd (3) minimum castable wall thickness that adds nnecessary weight to the component.

All of the test results have been reported in rela- ion to a single assembly of each type. Actually, any units were constructed and the reported results represent typical conditions. The most satisfactory technique, butt welding, is now being employed on a major radar system being manufactured at the Sperry Gyroscope Co. Flanges are precision core sand cast with the section farthest from the face at a thickness approximately equal to the .080 in. waveguide wall.

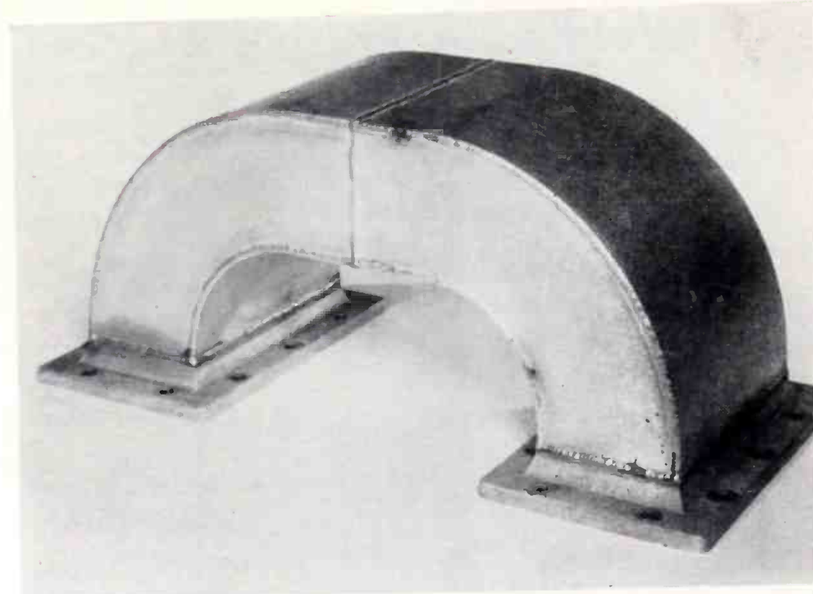
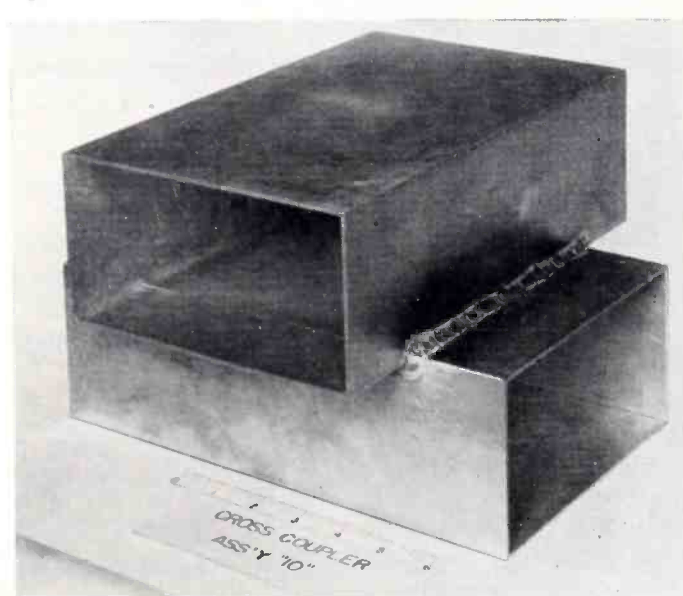


Fig. 7: Typical production assembly using the heli-arc butt weld.

The only flange machining prior to assembly consists of the normal front face cut (lands, grooves, and bolt holes) plus a squaring cut on the back end. The waveguide is cut to pre-determined length, the joint is welded, and no machining is required after welding. Milling the ends of this size waveguide prior to welding did present a problem because of cutter "ring" and chatter. This situation was remedied by inserting near the opening the same expanding block (see Fig. 1) used for welding.

The butt welding has been done to date with manually operated A.C. Heli-arc equipment. Additional improvement in both quality and economy can be achieved by the use of a more advanced technique such as the "filler arc" process. This machine con-

Fig. 8: Heli-arc welding of cross guide coupler was unsatisfactory.



Welding vs. Brazing *(Concluded)*

sists of a welding head mounted on an arm and motorized for adjustment of feed. A rotary table can be fitted to the equipment for welding circular surfaces such as the bend sections. Outstanding features of a machine of this type are:

1. Penetration is automatically controlled and largely independent of operator skill.
2. High welding speed (approximately 30 ipm) is obtainable.
3. General ease of operation is achieved since equipment is mechanized, the electrode also being filler material.

The combination of all factors (the butt weld technique, tooling based on the expanding block, proved joint design, and advanced welding equ ment) described in this article results in a super product at a substantially reduced manufacturi cost.

[1] L. Virgile, "Deflection of Waveguide Subjected to Inter Pressure," *I.R.E. Transactions On Microwave Theory and Te niques*, Volume MTT-5, #4, pp. 247-250, October, 1957.

Table I

Summary of results of typical specimens of various types of brazing and welding assemblies.

Ass'y #	*Basic Joining Method*	*Flange Fit to Waveguide*	*Joining Time*	*Resulting Dimensional Stability (Rectangularity, Size, Bow & Distortion*	*Voids)*	*Structural Adequacy*	*Accep abilit*
1	Torch Braze	Waveguide extended ⅛″ thru flange—flange chamfered 1/16″ x 45° - .001″ to .005″ gap between waveguide and flange	40 min	Satisfactory	Unimportant shallow pin holes	Satisfactory	Excell
2	Torch Braze	Same as Ass'y #1 except waveguide flush with flange face	45 min	Satisfactory except for slight bow on one surface	Cons. voids requiring rework	Satisfactory	Fair
3	Torch Braze	Waveguide force fitted to flange and staked together in eight places (expanding block not used)	25 min*	Assembly seriously distorted—flange twisted and bent	Open joints in 20% of area	Satisfactory	Scrap
4	A.C. Heliarc weld	Waveguide extended ¼″ thru flange—flange face stepped down ⅛″ deep x 3/16″ all around opening—waveguide force fitted to flange	20 min	Satisfactory	One void area in filler material	Doubtful since filler material did not fuse with waveguide	Fair
5	A.C. Heliarc weld	Flange chamfered ⅛″ x 45° around, opening at both ends force fitted waveguide extended ¼″ thru flange	20 min	Satisfactory	Many voids at joint requiring rework	Same as above	Fair
6	D.C. Heliarc weld	Same as Ass'y #5 except chamfer on front flange face only	15 min	Satisfactory	Filler material chipped in removing excess, causing voids that required rework	Satisfactory although penetration was excessive requiring rework noted in previous column	Fair
7	A.C. Heliarc weld	Combination flange butt joint and mitered corner	40 min**	Satisfactory	None	Satisfactory	Exceller

* Required less time than other brazing assemblies because expanding block was not used, thus resulting in reduced heat dissipatio
** Required more time than other welding assemblies because this was actually a dual combination unit. (See Figure 4.)

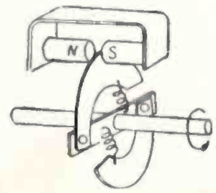
Japanese Speed Control

When dialing a telephone number, the coded information sent on the line to the number selectors consists of regularly spaced pulses.

These pulses are produced, while the dial returns to its rest position. by an electromechanical device, customarily including a centrifugal speed regulator using mechanical friction braking.

Now, the Japanese Post Office has developed a new kind of speed regulator in which there is no contact or mechanical friction. Two C-shaped parts in brass or aluminum tend to move outwards, because of the centrifugal force, against th two springs. However, by movin outwards they penetrate mor deeply inside the magnetic fiel produced by a permanent magnet

The induced eddy currents in th C-shaped parts create a magneti flux opposing the flux of the permanent magnet, and produce an electromagnetic braking action. This braking action increases with the penetration of the C-shaped sectors into the magnetic field; thus th device acts as an efficient non-friction and no-wear speed regulator.



The Japanese Post Office has come up with a no-friction, no-wear speed regulator for telephone number - selecting dials.

Page from an Engineer's Notebook

#43—"Reliability" in Terms of Time

Relating hours, days, months and years to provide a quick measurement of equipment "life"

R. F. Graf

Reliability data of components completed equipment is generally given in terms of guaranteed or expected hours of life. As a result the high degree of complexity of present day equipment and the absolute reliability requirements of military electronics, such data usually run into many thousands hours. In order to make such information more easily perceived, hours are related to days, months and years in this nomograph.

The graph is based on a 24 hr. day, a 30½ day month and a 365 day year. (The very slight inaccuracy resulting from the assumption of a 30½ day month and the disregard of the leap years is negligible.) The coordinants for the various columns are derived in the following manner: Hours are divided by 24 to get days; days are divided by 30½ to get months and months are divided by 12 to get years.

Several uses suggest themselves for this graph. When something is to function for 20,000 hrs. this sort of information is certainly more easily visualized if given as being nearly 28 months, or about 2 1/3 years. Nowadays a few component manufacturers test representative parts for 1000 hrs. before shipping the lot. Reference to the graph shows that such testing alone takes about 42 days. Other applications of this chart will easily suggest themselves.

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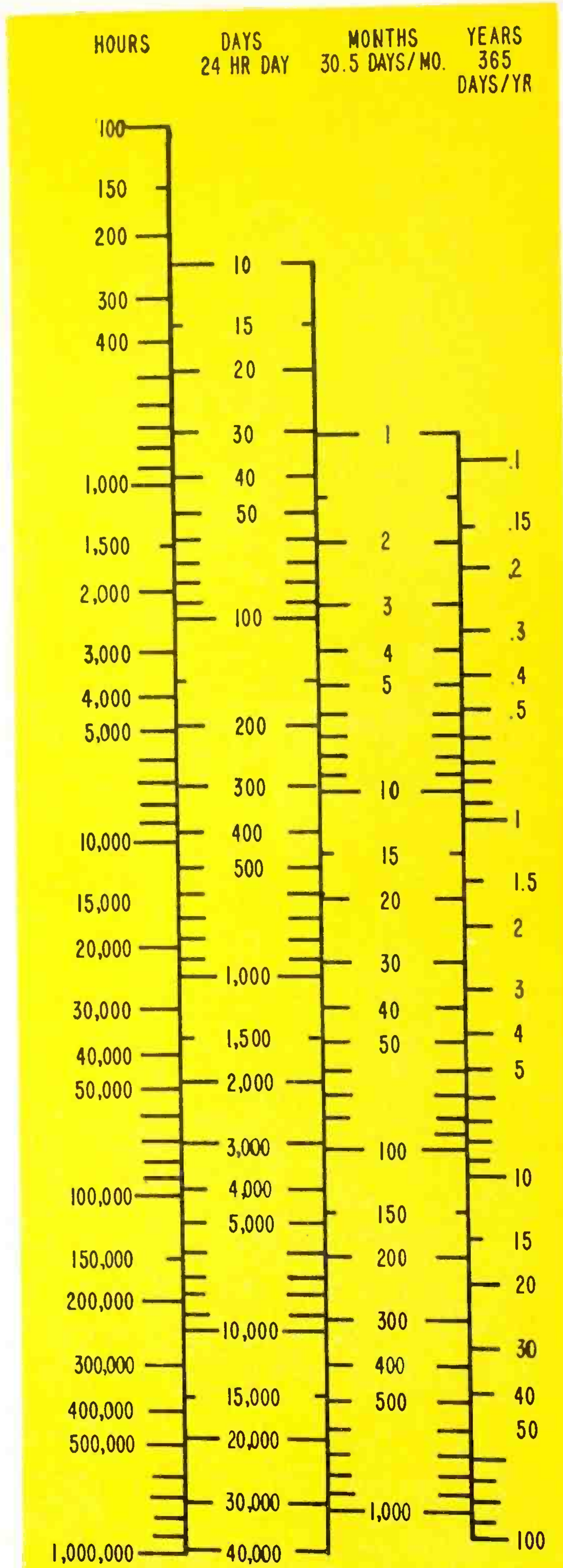

VSWR Reduction By Padding

Equations and design curves are given for reducing VSWR due to mismatch.

By Henry W. Kasper
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A HIGH VSWR due to a given mismatch can be translated to any lower value by inserting an appropriate amount of padding. Here are equations and useful design curves for both reflecting and non-reflecting pads, and for a ferrite isolator.

Consider the system shown in Fig. 1,

where P_i is the incident power
D is the amount of padding expressed as a power ratio
Γ is the voltage reflection coefficient of the mismatch

Percent reflected power is defined as:

$$P_r = \left(\frac{VSRW - 1}{VSWR + 1}\right)^2 = (\Gamma)^2 \quad (1)$$

At A,

$$P_r = \frac{P_i \times D^2 \times \Gamma^2}{P_i} = \left[\frac{(VSWR)\ A - 1}{(VSWR)\ A + 1}\right]^2 \quad (2)$$

$$D\Gamma = \frac{(VSWR)\ A - 1}{(VSWR)\ A + 1} \quad (3)$$

and

$$(VSWR)\ A = \frac{1 + D\Gamma}{1 = D\Gamma} \quad (4)$$

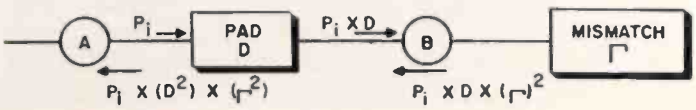
However

$$\Gamma = \frac{(VSWR)\ B - 1}{(VSWR)\ B + 1} \quad (5)$$

then,

$$(VSWR)\ A = \frac{1 + D\left[\frac{(VSWR)\ B - 1}{(VSWR)\ B + 1}\right]}{1 - D\left[\frac{(VSWR)\ B - 1}{(VSWR)\ B + 1}\right]} \quad (6)$$

Fig. 1: In the typical system, VSWR can be reduced by padding.



To facilitate computation, Eq. 6 can be rationalized

$$(VSWR)\ A = \frac{(VSWR)\ B + D\ (VSWR)\ B - D + 1}{(VSWR)\ B - D\ (VSWR)\ B + D + 1}$$

Note that Eq. 7 holds only for a bilateral elemen such as a resistor, or a lossy transmission line. Als note that we have considered the pad to be reflection less.

Whether the pad is unilateral or bilateral in it function is important. A good example of a unilatera device of this type is a ferrite isolator. For a ferri isolator, D in eq. 7 is replaced by $\sqrt{L_i L_r}$ where:
L_i is the insertion loss expressed as a power rati
L_r is the reverse loss expressed as a power ratio.
Equation 7 then becomes:

$$(VSWR)A = \frac{(VSWR)B + \sqrt{L_i L_r}\ (VSWR)B - \sqrt{L_i L_r} + 1}{(VSWR)B - \sqrt{L_i L_r}\ (VSWR)B + \sqrt{L_i L_r} + 1}$$

*The effect of pad reflections can be taken in account by replacing Γ in eqns. 3, 4, and 5 by:

$$\Gamma_t = \Gamma_1 + \Gamma_2\,(1 - \Gamma_1^2)\,\frac{ej\varphi}{1 + \Gamma_1\Gamma_2 ej\varphi}$$

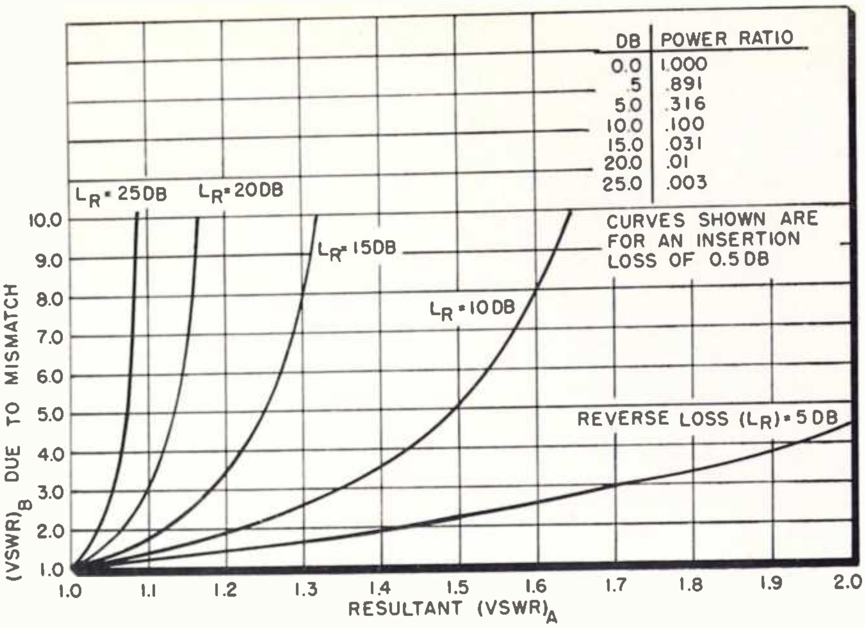
where Γ_t is the total reflection coefficient resultin from the pad reflection Γ_1 and mismatch reflectio Γ_2 adding in arbitrary phase φ. Since the phase angl φ is seldom known, two cases are of special interest case 1 when $\phi = 0, 2\pi, 4\pi, \ldots$ and

$$\Gamma_t = \Gamma_{max} = \frac{\Gamma_1 + \Gamma_2}{1 + \Gamma_1\Gamma_2} \text{ or } (VSWR)\ B\ max = (VSWR)_1 \times (VSWR)_2 \quad (10$$

and case 2 when $\varphi = \pi, 3\pi, 5\pi, \cdots$ and

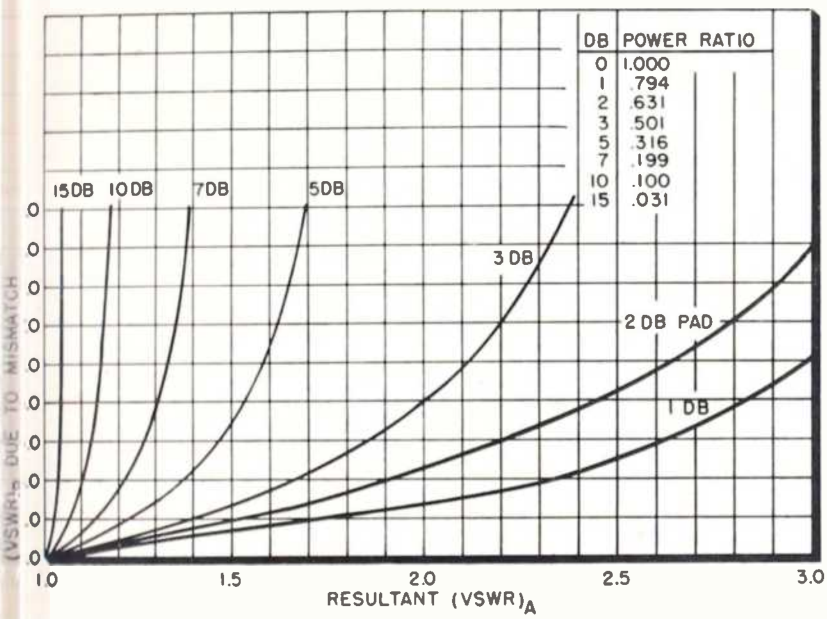
$$\Gamma_t = \Gamma_{min} = \frac{\Gamma_2 - \Gamma_1}{1 - \Gamma_1\Gamma_2} \text{ or } (VSWR)\ B\ min = \frac{(VSWR)_2}{(VSWR)_1} \quad (11$$

*It is assumed that the pad attenuation precedes the pa reflection.



Fi 2 (right): VSWR reduction with a ferrite isolator—unilateral element.

Fi 3 (below): Plot of VSWR reduction y padding—using a bilateral element.



The expression (VSWR)B in eqns. 7 and 8 would then be either the maximum or minimum value possible, depending on whether the reflections add in or out of phase. Although this analysis is more exact, eqns. 7 and 8 are sufficient for accuracies in the order of 1% when the pad VSWR is less than 1.2.

The accompanying graphs are plots of eqns. 7 and 8 and will serve as useful guides in choosing the proper pad or ferrite isolator.

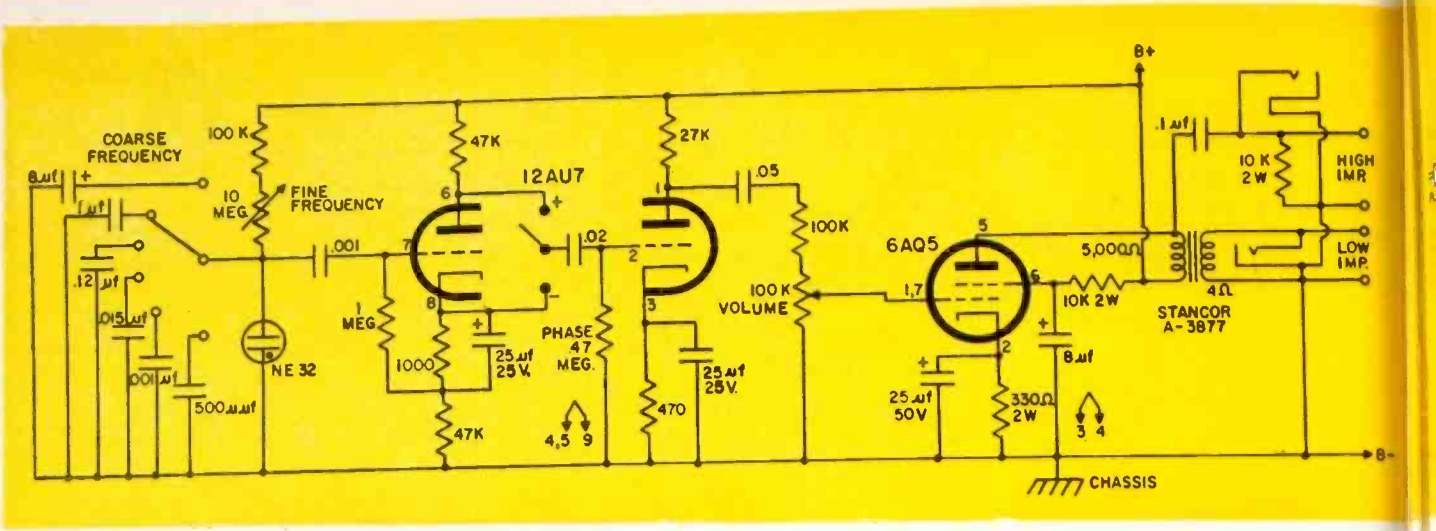
The Standard Ampere

A recent experiment at the National Bureau of Standards has shown that the standard ampere maintained by the Bureau has drifted no more than a few parts per million in the last 15 years. Such a small apparent change may well be due to slight errors in measurement so that the standard ampere may actully have remained perfectly stable since its original evaluation in 1942.

Because of the importance of precise electrical measurements to modern science and industry, the Bureau maintains permanent primary standards of two basic electrical quantities, voltage and resistance. From these basic electrical standards, the Bureau has derived other standards for all electrical quantities in use today. One of these, of course, is electric current.

Each time the standard ampere is required, it must be obtained anew from the standard volt and the standard ohm by use of Ohm's law. However, a gradual change might sometimes occur in the standard cells or the standard resistors. One method of checking the stability of these standards is to compare the standard ampere derived from them with the "absolute" ampere, that is, the ampere obtained experimentally in terms of mechanical units of length, mass, and time.

In the latest determination, R. L. Driscoll and R. D. Cutkosky of the Bureau staff measured the standard ampere in absolute amperes using two different sets of apparatus. One was the current balance used in the 1942 evaluation[3]; the other was a Pellet type electrodynamometer, which was introduced to reduce the possibility of systematic errors. The standard ampere was found to equal 1.000008 absolute amperes by the current balance method and 1.000013 absolute amperes by the Pellat instrument. The weighted mean of these two values is 1.000010 absolute amperes, but in this mean there is an uncertainty of 5 parts per million. If no accidental errors were made in either the original or the present evaluation and if all systematic errors remained fixed, then the value of the current yielded by the electrical standards of resistance and voltage has decreased by 6 parts per million. On the other hand, known sources of accidental error in the current balance determinations could easily account for the apparent drift.



A Neon Pulser for the Computer Laboratory

Many components require high voltage pulses for test routines. Here is a pulse generator circuit which will give pulses of more than 70 volts, either positive or negative, from around one cps to above 2500 cps. The set is designed for reliability, long life, and ease of construction.

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FOR a wide variety of experimental tests, involving rate meters, counters, high speed relays, mechanical counters and submultipliers, some sort of a repeating pulser with a fairly high voltage output, is needed. At frequencies above about five per second, a motor-driven interrupter becomes either costly or undependable. In the lower frequency ranges, below about 200 cps, the self-pulsed strobotron circuit, described some years ago, is still very useful and inexpensive.[1] At frequencies considerably above 1000 cycles per second, an asymmetrical multivibrator or sine wave oscillator, driving a pulse-shaping circuit, such as a Schmitt Trigger, performs well. In some instances, these higher frequency pulses can be tapped off from the sweep circuit of an oscilloscope.

In the medium frequency range, roughly from 1 cps to somewhat above 2500 cps, the range in which much experimental equipment is operated, pulsing equipment is usually "goldberged," with results that leave much to be desired. A simple combination of a neon oscillator, a fairly conventional amplifier, and small power supply produces a very satisfactor pulser, covering this frequency span in six range with a pulse height of more than 70 volts, either pos tive-going or negative-going, as desired, and a pow output of somewhat more than two watts (at 1,00 cycles PRF).

The driver oscillator for this pulser consists of neon bulb, a resistor, a condenser, and a voltag source, as shown in Fig. 2. To transform the sav tooth output of the neon oscillator into nearl straight-sided pulses, a differentiator circuit is use The oscillator circuit is shown in Fig. 2, along wit salient formulae.

Complete circuit by which the output of the neo oscillator is converted into high voltage pulses either polarity, and the power supply necessary f its operation, is shown in Fig. 1. Here, the neo oscillator output is differentiated across a .001 condenser, which also functions as the coupling co

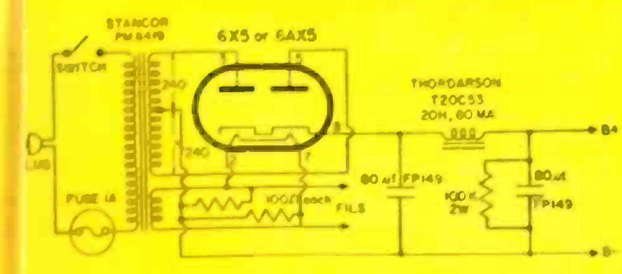


Fig. 1 (left and above): Complete schematic for the amplified neon pulser. See prototype parts list at end of article.

denser to the first triode. Size of this condenser is not critical, it can be made much smaller without reducing power output appreciably.

The first triode functions as a phase splitter, giving "+" pulse output from the plate circuit, and "–" pulse output from the cathode. Either output can be selected by means of a switch, and the amplitudes of pulses in both directions will be equal. These pulses are amplified in the second triode and thence coupled to the grid of the output tube, by a .05 uf coupling condenser, a fixed resistor, and a variable volume control potentiometer. The fixed resistor on the high side of the volume control is to prevent overdriving of the 6AQ5, with resultant distortion and asymmetry of output. If the 6AQ5 is driven to plate current cutoff, flybacks in the output transformer may rise to several thousand volts, causing output jack sparkovers.

Both high and low impedance outputs are available in the output of the 6AQ5, by use of a conventional output transformer. A 10,000 ohm load resistor is connected across the high impedance output, to increase system stability. Operation of the pulser with no load connected is not recommended.

Pulser Adjustments

When all wiring is completed, and tubes and fuse are in place, the pulser is ready for checking. Turn on the power, being sure that the cord is plugged in, and let it warm up for a few minutes. Set the "coarse frequency" at 4, the "fine frequency" at center scale, and the "volume" at about 3. The neon lamp should now glow. It will work best if the glow is concentrated about the central element (solid cylinder). If the glow is mainly about the wire, reverse the bulb by removing it from the socket, rotating it 180°, and replacing it.

Now connect a headset across the "high imp." output, and note the behavior of the pulser as the "fine frequency" control is rotated. It should produce low frequencies when at the counterclockwise limit, and higher frequencies as it is rotated clockwise. If the reverse is the case, reverse the 10 meg. variable resistor connections. On some of the ranges, oscillation may stop at some position short of full clockwise. This indicates nothing wrong—the charge rate has simply become greater than the discharge rate, so that the neon lamp circuit no longer oscillates.

Oscillation on the lowest frequency range (setting 1, coarse frequency) may be somewhat erratic at first, as the electrolytic condenser may not be fully formed. If this makes trouble, connect the condenser across about 150 volts dc for a few hours, until its leakage current stabilizes.

PRF Ranges

Frequencies available on the various ranges are shown in the following table:

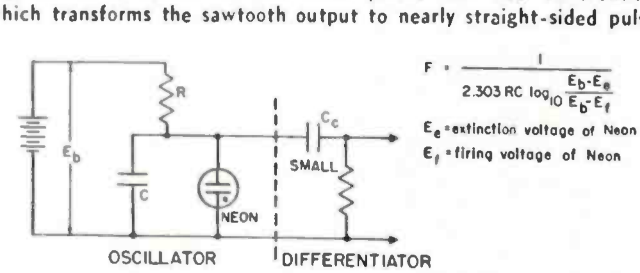
Range	Frequencies
1	4 per min. to 1.4 per sec.
2	1.2 to 25 per sec.
3	22-150 per sec.
4	110-700 per sec.
5	600-1600 per sec.
6	1400-2500 per sec.

The lowest frequency, approximately 4 per minute, may vary by a factor of 2 or more, due to vagaries of the electrolytic timing condenser, but will eventually stabilize. The upper frequency limit is determined not only by the R-C characteristics of the circuit, but also by the deionization time of the neon lamp. If the upper limit is much below 2500 cps, try another NE-30 bulb. A few lamps will oscillate at frequencies as high as 3500 cps, but this cannot be counted on, and the practical upper limit of oscillation is about 2500 cycles.

Output is more than 70 volts in both polarities, at all frequency settings. This must be measured on an oscilloscope, or with a peak-reading ac VTVM, as an ordinary ac instrument, which measures RMS values will give entirely spurious readings, almost invariably too low, and varying with frequency. A quick check on voltage output can be made by connecting a small neon lamp, such as an NE-2, across the "high imp." output terminals. When the lamp lights, the voltage output is approximately 65.

Although a standard ac voltmeter will not indicate the voltage output correctly, a conventional frequency meter, such as a Heathkit Audio Frequency Meter (AF-1) will give satisfactory indications at all frequencies above about 10 cps. At lower frequencies, a mechanical counter and stopwatch will be found useful. If these are not available, a neon lamp across the

Fig. 2: Basic circuit of the neon pulser and the differentiator which transforms the sawtooth output to nearly straight-sided pulses.



Neon Pulser *(Concluded)*

output, and a watch movement can be used as a simple stroboscopic indicator, it being remembered that a standard American-made watch beats five times per second.

Typical Use

In most uses, the output of the pulser is connected directly to the device, such as a flipflop counter, to be tested, and run at the frequency or frequencies to be desired. Polarity, if critical, can be selected by the polarity switch, and amplitude can be varied from zero to maximum by use of the volume control.

For testing noise limiters, and other discriminator devices, in which a combination of pulses and sine waves are needed, the sine wave generator (low impedance output) can be connected to the "low imp." terminals of the pulser, and the device to be tested to the "high impedance" terminals. Mixed output can be monitored by use of an oscilloscope connected across the load, and adjusted to suit the needs of the specific test. This procedure is ideal for setting noise limiters to the point of maximum effectiveness. A similar procedure was found most effective while developing a speech-music discriminator.

Performance of this pulser, and of several of its predecessors, built according to the same principles for specialized uses, has been very satisfactory, and its construction and use is recommended for a wide variety of test functions.

Parts List of Prototype

1—Aluminum chassis, Seezak 7" by 12" by 2" with bottom plate.
4—large rubber feet.
1—power transformer, 240-0-240 vac at 70 ma; 6.3 vac at 3 a. Stancor PM 8419 or equivalent.
1—filter choke, 12h, at 80 ma dc, Thordarson T 20C53 or equivalent.
1—output transformer, 5,000 ohms to 4 ohms, 5 watts, Stancor A-3877.
2—filter condensers, 80 µf, 450 volt, Mallory FP149.
2—Cinch-Jones 2 C 7 condenser sockets.
2—dual insulated binding posts, Eby 21-R.
2—single circuit midget jacks.
1—octal socket.
1—noval socket with shell.
1—noval tube shield 1 15/16" high.
1—7 pin miniature socket with shell.
1—tube shield to fit, 2¼" high.
1—double contact bayonet socket, Millen 33991.
1—NE-32 neon lamp.
1—6X5 or 6AX5 tube.
1—12AU7 tube.
1—6AQ5 tube.
1—sunk male ac plug, Amphenol 61-61.
1—fuse holder.
1—chassis mount female receptacle (optional).
1—dial plate 0-6, 30° spacing.
2—dial plate 0-10, over 300°.
1—spst toggle switch and plate.
1—spdt toggle switch.
3—knobs with pointer.
1—1 pole, 6 position, 30° rotary tap switch.
1—10 meg linear pot.
1—100k linear pot.
2—1 meg. 1 w 10% resistors.
1—.47 meg. 1 w 10% resistors.
1—100 k 2 w 10% resistors.
1—100k 1 w 10% resistors.
2—47k 1 w 10% resistors.
1—27k 1 w 10% resistors.
2—10k 2 w 10% resistors.
1—1000 ohm 1 w 10% resistors.
1—470 ohm 1 w 10% resistors.
1—330 ohm 2 w 10% resistors.
2—100 ohm 1 w 10% resistors.
1—25 µf. 50 volt electrolytic.
2—25 µf. 25 volt electrolytic.
2—8 µf. 450 volt electrolytic
1—1 µf. 400 volt paper bathtub.
2—.1 µf. 600 volt tubular paper.
1—.05 µf. 400 volt tubular paper.
2—.02 µf. 400 volt tubular paper.
1—.015 µf. 400 volt tubular paper.
2—.001µf. 400 volt tubular paper.
1—500 µµf. 600 volt ceramic.
1—1 amp fuse.

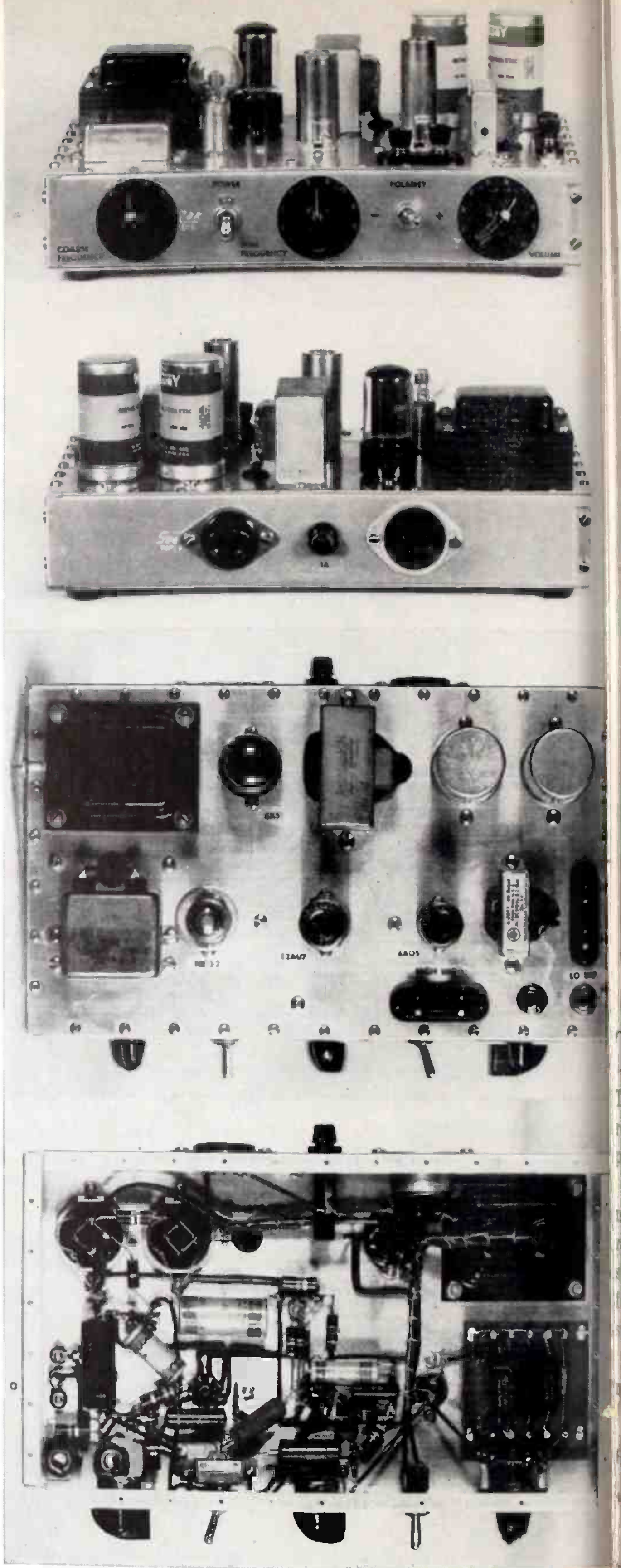


Fig. 3: The above photographs clearly indicate the location of components and controls of the prototype neon pulser. The author comments, "Major components in this pulser are substantially immortal, and should outlast the builder. The elecrolytic condensers, being rated at 450 volts, and used at less than 350 volts maximum, have a life measured in years of use, and approximately two years idle."

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1. Ives, R. L. "Low Frequency Strobotron Pulser," *Radio Electronics*, Vol. 22, No. 7, July 1951, 45-47.
2. Rider, J. F., and Uslan, S. D. "Encyclopedia on Cathode Ray Oscilloscopes and Their Uses," New York, 1950, 218-222.

Reliability of Multi-Moded Systems

Here is a method for computing the reliability of a multi-moded system. The theory is applied to a hypothetical multi-moded fire control system, and detailed calculations are shown.

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THE advent of modern technology has resulted in the development of equipment of great complexity. This increased complexity has created the need for reliability studies of the system design and components to insure proper operation.

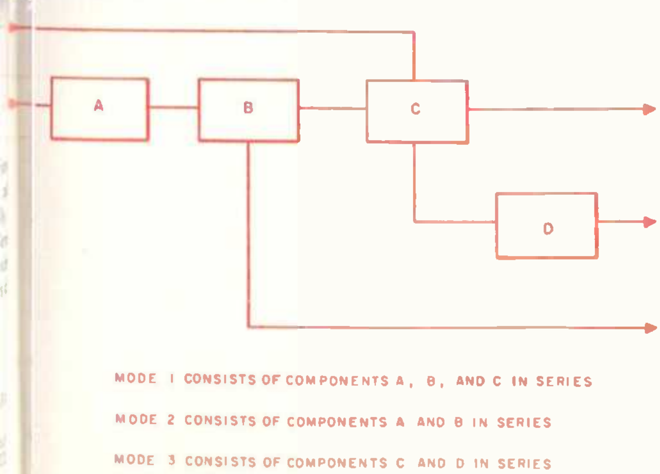
Various authors[1, 2, 3] have attempted, among other methods, to improve reliability through the use of redundant components. Here critical sections of the system are duplicated in their entirety and upon failure of the primary section, the alternate is switched into operation.

A variation of system redundancy is the multi-moded concept. Here all, or selected numbers of, the comprising system components can be switched into modes which give varying degrees of task performance. In case of a failure in a mode, it is possible to switch to a lesser mode and still get some measure of system performance, even though degraded from the previous mode. Thus a failure in a moded system may not necessarily be catastrophic as one can shift operations to a lower mode. Hence mean-time-between failure does not apply, per se, in the case of moded systems, since a moded system can tolerate a minimum number of failures and still remain operable.

It should be noted that secondary modes in the design of a moded system provide additional operational capability, not only additional reliability. Hence a good moded system design will comprise a sub-optimum balance between the expected increase in reliability and the increased complexity caused by additional components and switches attendant upon moded operation.

This paper presents a method of determining the reliability of a multi-moded system and applies the theory to a hypothetical fire control system.

Fig. 1: Model of multi-moded system consisting of four components.



Model for Moded System

A set consisting of n members can have $2^n - 1$ subsets. Hence, a system consisting of n – components can have at most $2^n - 1$ subsystems or modes. However, in any physical system, there are fewer than $2^n - 1$ modes as not all possible modes are realizable, or desirable.

Multi-Mode Reliability

(Continued)

A model of a multi-moded system consisting of four components. *A, B, C, D,* is shown in Fig. 1.

Mode 1, the primary mode, is the best mode for task performance. Mode 2 operates when component *C* fails, and Mode 3 operates when component *A* or *B* fails.

In general, the secondary modes may employ some of the components of the primary mode together with additional components.

A. Reliability, R

Reliability is the probability of a device performing its task adequately for the period of time intended under the operating conditions encountered. Thus, its two aspects are task capability and task performance.

The reliability of a moded system may be determined by computing the probability of operation of each mode. However, since each mode does not perform the system task with equal effectiveness, its probability of operation must be weighted by an effectiveness factor. For example, one system operating in the primary mode can be more effective than two similar systems operating in a secondary mode.

Then the reliability of the *i* th mode is

$$R_i = E_i P_i \qquad (1)$$

where P_i = probability of system operation in the *i* th mode at at any specified time, and

E_i = effectiveness of the *i* th mode.

E_i will have a value between the limits zero and unity,

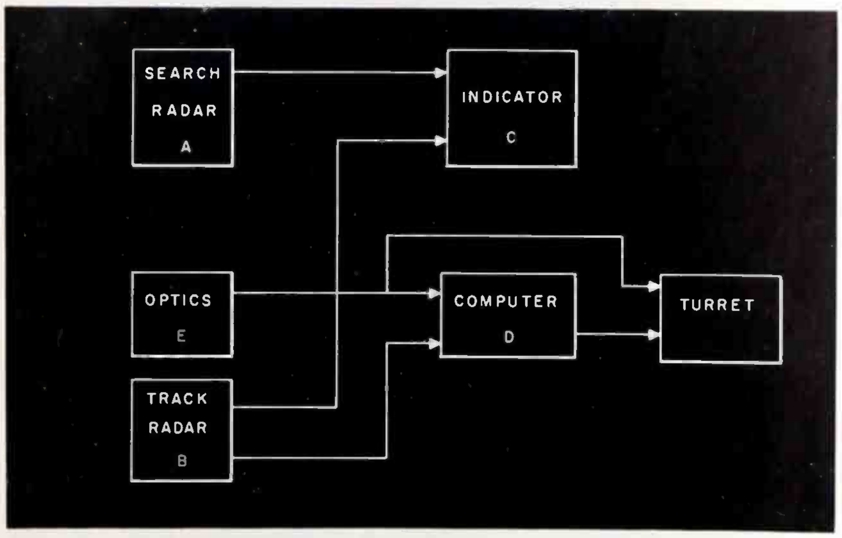


Fig. 2: Block diagram of hypothetical multi-mode fire control system.

Table 1

All Six Possible Modes of Operation of Fire Control System

Mode	Search	Track
1	Radar	Radar & Computer
2	Radar	Optical & Computer
3	Radar	Opitcal Alone
4	Optical	Radar & Computer
5	Optical	Optical & Computer
6	Optical	Optical Alone

with the primary mode assigned the value of u
It should be noted that

$$P = \sum_{i=1}^{m} P_i$$

represents the probability of the system operat in any one of m – modes. Hence, the total reliabi of a multi-moded system consisting of *m* – mode given by

$$R = \sum_{i=1}^{m} R_i = \sum_{i=1}^{m} E_i P_i$$

Eq. (2), the reliability of a multi-moded system the subject of this paper.

R is the probability of the system performing task as measured in primary mode effectiveness un E_1, since E_i has been normalized to unity for primary mode. For a given number of ident multi-moded systems, *P* percent of them will be operation. However, the equivalent total effecti ness will be the same as *R* percent operating in primary mode, or with unity effectiveness.

Probability of Moded Operation,

We note that P_i is the joint probability that *i* th mode will operate when that mode is ente To enter the *i* th mode, it is not necessary for all previous *(i – 1)* modes to have failed in seque since the failure of different combinations of c ponents can cause these previous *(i – 1)* modes be inoperable.

For any given combination of failures, the m that will operate is the first mode in the seque that does not contain any of the failed componer Since the *i* th mode can be entered through differ combinations of component failures, several decis paths are possible for reaching this mode.

Thus P_i is given by

$$P_i = P(i_M) \cdot P(i_{op})$$

where $P(i_M)$ = the probability of entering the *i* th mode w due regard to possible decision paths thru v ous combinations of component failures, and

$P(i_{op})$ = probability that mode *i* will operate wher is entered.

It is readily seen that the individual compon failures, within the combination of failures, are co mutative with respect to time, resulting in the ope tion of only one possible mode at any given time.

For *n* components, there are

$$\sum_{i=1}^{n} \binom{n}{i} = 2^n - 1$$

Table 2

Preferred Mode Sequence

Mode Sequence			Effectiveness,
1	Radar	Radar & Computer	1.00
2	Radar	Optics & Computer	0.60
3	Radar	Optics alone	0.50
4	Optics	Radar & Computer	0.30
5	Optics	Optics & Computer	0.18
6	Optics	Optics alone	0.15

Table 3

Independent Decision Paths for Each Mode

[Mode]ions	Independent Decision Paths	
1		
2	B	= B
3	D V BD	= D
4	A	= A
5	C V AB V AC V BC V ABC	= CVAB
6	AD V CD V ABD V BCD V ACD V ABCD	= D · AVC
0	Aborts, i.e., E · AVBVCVD.	

Table 4

Reliability of the Multi-Moded Fire Control System

Mode Sequence	P_i	E_i	R_i
1	.27	1.00	0.27
2	.09	0.60	0.05
3	.33	0.50	0.16
4	.08	0.30	0.02
5	.06	0.18	0.01
6	.13	0.15	0.02
0 (Aborts)	.04		

$$P = \sum_{i=1}^{6} P_i = .96 \qquad R = \sum_{i=1}^{6} R_i = 0.53$$

[pos]sible combinations of failures. [In c]ase of a multi-moded system of [gre]at complexity the number of [po]ssible decision paths may be very [la]rge, necessitating use of com[put]ers.

Determination of E

[T]he definition of system success [giv]en by eqn. (2) includes both [sys]tem reliability, P, and system [eff]ectiveness, E. To determine E [val]ues, systems analysis considera[tio]ns concerning a specific system [mu]st be incorporated into the re[liab]ility calculations:

[F]or example, consider the hypo[the]tical multi-mode fire control [sy]stem shown in Fig. 2, which pro[vi]des two ways of searching, and three ways of tracking, for a target. The six different modes of operation are listed in Table 1. Weighting factors are estimated from theoretical analysis of the system design, actual field operational data, and discussions with experienced field personnel.

Table 2 shows the mode sequences arranged in decreasing order of effectiveness, giving the preferred order of operation.

Example

Estimate the reliability of the multi-moded fire control system shown in Fig. 2 consisting of a search and track mode. The search mode comprises radar and/or optics, and the track mode comprises track, optics, and computer subsystems.

Modal Representation

The modal representation of this FCS is shown in Fig. 3. The reliabilities for each of the functional black boxes indicated by circles in Fig. 3 can be estimated from (1) factory and/or field failure data, (2) failure data from approximately similar equipments, (3) state of the art reliability indices published by EIA, government, and industrial laboratories.[4]

The component reliability values shown in Fig. 3 are estimated from data in Ref. 3 and represent probability of failure within 15 hours operation time.

The individual mode sequence reliabilities are given by the product[5] of the reliabilities of each of the components in the mode sequence.

Calculation of P

If Fig. 3 is examined, all independent decision paths for each of the six modes can be tabulated as shown in Table 3.

There are two straightforward ways to construct Table 3. In one, we start from the primary mode and notice the absence of a component in the lower modes and the presence of that same component in the primary mode. For mode 2, it is component B.

For mode 3, we can see that components B and D satisfy this condition. Hence, independent decision paths comprise all combinations of B and D, less B, which was previously accounted for in mode 2. Thus, for mode 3, independent decision paths are B, D, and BD, less B; or D and BD, and the probability of entering mode 3 is there-

Fig. 3: Model representation of hypothetical fire control system shown in Figure 2.

[CO]MPONENT [BR]EAKDOWN	SEARCH RADAR, A	TRACK RADAR, B	INDICATOR C	COMPUTER D	OPTICS E	$P(i_{op})$
[CO]MPONENT [REL]IABILITY	0.75	0.73	0.95	0.52	0.95	
[MO]DE SEQUENCE						
1	.75	.73	.95	.52		0.27
2	.75		.95	.52	.95	0.35
3	.75		.95		.95	0.68
4		.73	.95	.52	.95	0.34
5				.52	.95	0.49
6					.95	0.95

fore D or B and D failing. Thereupon, methods of Boolean algebra can be employed to reduce *P(D or BD)* to *P(D)*.

The second method, which overcomes the necessity to use the Boolean algebra approach, consists in noting in a systematic manner those components which must fail in the previous modes in order to achieve operation in a required mode. This involves constructing a tree in which we use as starting points each of the components in the previous mode. For example, in order for mode 6 to operate, component D in mode 5 must fail. However, if component D fails initially, operation continues in mode 3. For mode 6 to operate, it is clear that components A or B in mode 3 must fail. Thus, mode 6 operates when components D and *(A or B)* fail.

To compute P_5, we note from Table 3 that mode 5 can operate only if component group C or AB have previously failed. Hence, we first compute the probability of C or AB having failed and then multiply this probability value by the probability of mode sequence five operating, in accordance with eqn. (3). Since order of failures is of no consequence, either AB failing, or A failing and then B failing, or B failing and then A failing, all result in mode 5 operating.

Symbolically this can be written as:

$$P_5 = P(C + AB) \cdot P(5_{op}). \qquad (4)$$

To evaluate eqn. (4), we note that:

$P(C+AB) = P(C) + P(AB) - P(ABC$

From Fig. 3,

$P(C) = 1-0.95 = 0.05$

$P(AB) = (1-0.75)(1-0.73) = 0$

$P(ABC) = (1-0.75)(1-0.73)(1-0.95) = 0.003$

$P(5_{op}) = 0.49$

Hence $P_5 = (0.12)(0.49) = 0.06.$

This is done for each of modes in turn, with the resu tabulated in the P_i column of Ta 4. The sum $\sum_{i=1}^{6} P_i$, the probabi of the system operating in any of the six modes, equals 0.965.

To show the computation is co plete, i.e., all possible decision pa have been taken into account, $\sum_{=0}^{6} P_i$ equals unity, as can readily seen in Table 4.

Calculation of

In Table 4, R_i is computed fro eqn. (3), and tabulated. For si plicity, assume 100 identical sy tems in operation. Then the numb of systems expected to operate each mode is given by 100 P_i. Fro Table 4, it can be seen that 96 o of the 100 systems will be opera ing at $t = 15$ hours in one or t other of the modes, or only four the systems are complete aborts.

The physical meaning of 100 is that 53 systems operating in t primary mode is effectively equiv lent to the 96 systems operating all the various modes.

It should be noted that use the E_i factor will not change t results previously calculated fo the number of systems expected operate in all of the modes, namel that 96 systems out of 100 ar operable.

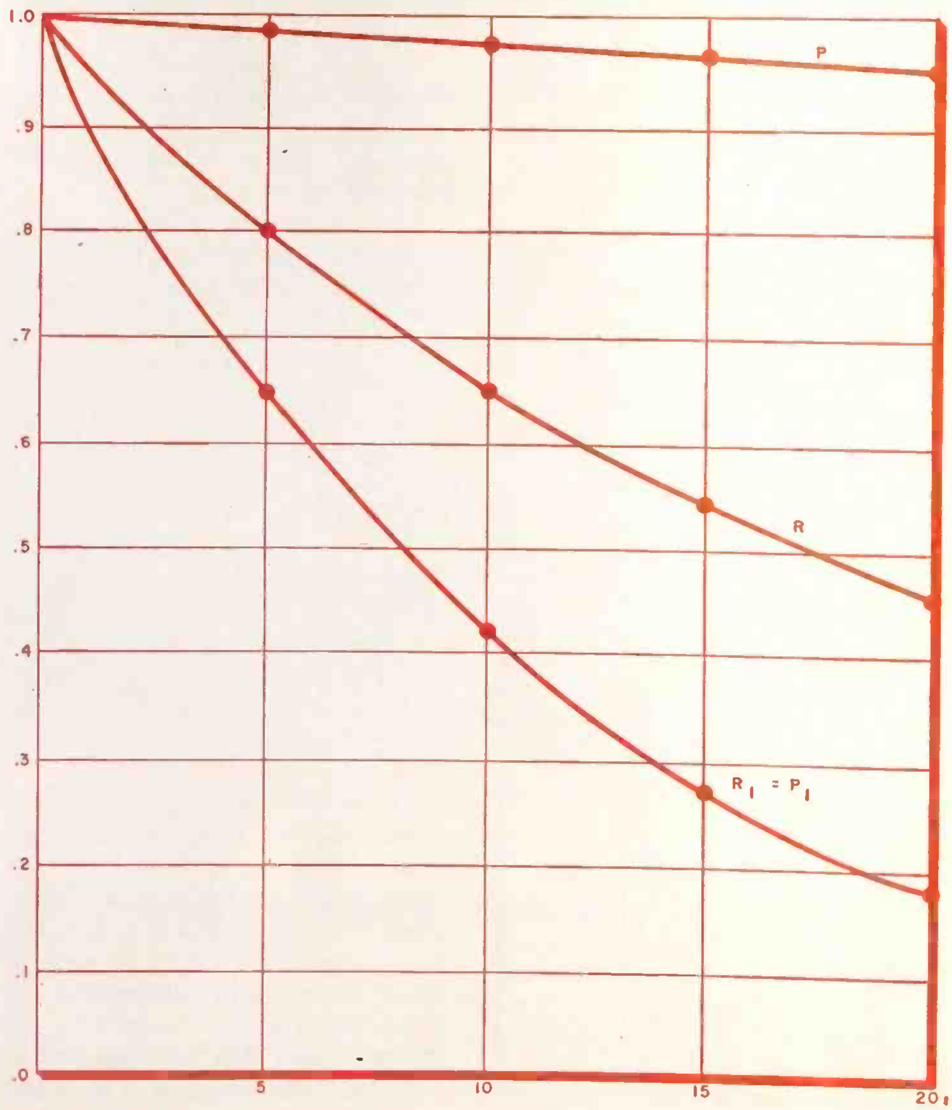
Means of Analys

The analysis as outlined here ca serve as a monitor for the desig of multi-moded systems. It is ev dent in designing a multi-mode system that the mode sequence re liability R_i should be greatest fo the most desirable mode, and low est for the least desirable mode However, examination of Table reveals that mode 3 has a highe reliability figure than mode 2, eve though it was originally consid ered to be a less desirable mode.

If mode 3 is made the secon mode, the original second mod will never be used and may be dis

(*Continued on page* 164)

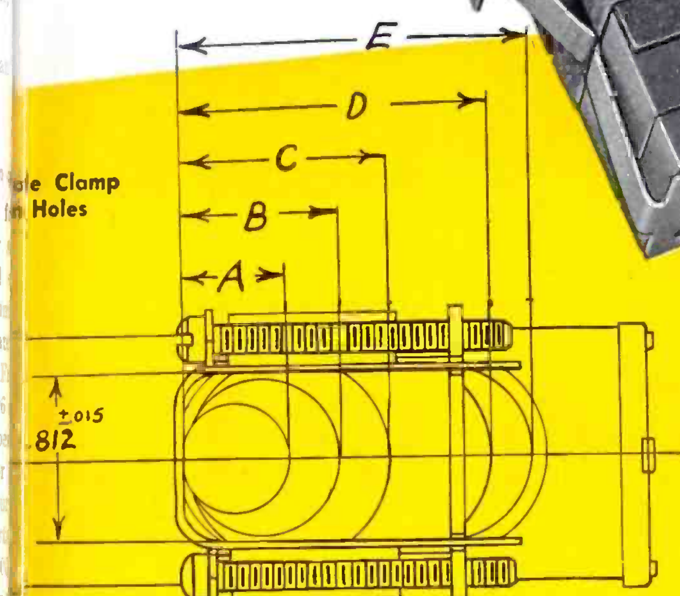
Fig. 4: Analytical graph of reliability of fire control system.



NEW

☆
PATENT PENDING

Plug with
Cable Clamp
Assembly and Socket
50 Contacts

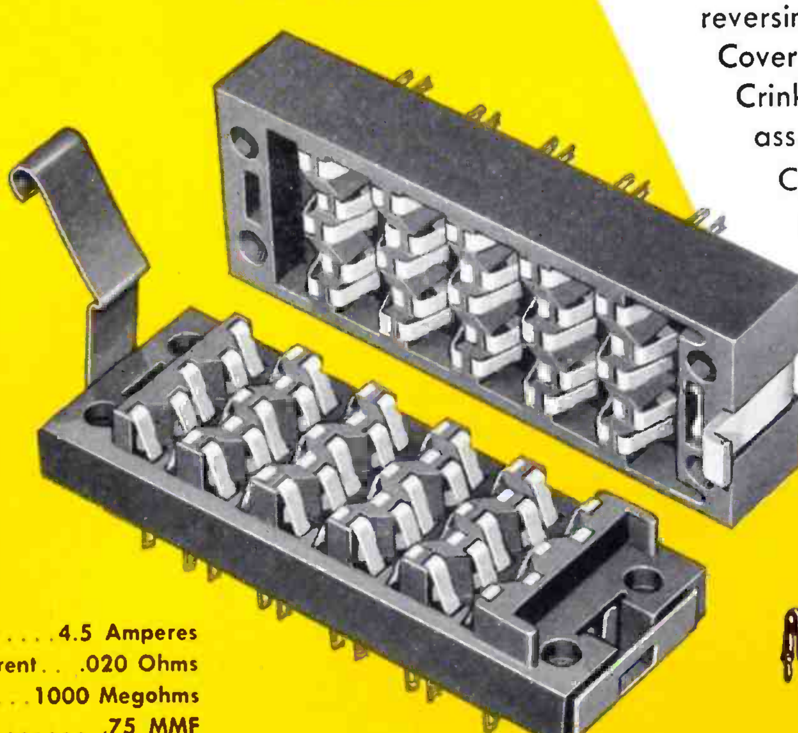


...le Clamp
...n Holes

CINCH HINGE CONNECTOR

— insures positive contact; has simple locking device, easy release. Maximum number of contacts in minimum space. Equipped with cable hole, cable clamp, top or end or both. Plug or socket can be mounted in cover, reversing hardware for catch. Cover assembly finished in black Crinkle (E 73); cable clamp assemble is Cadmium plated. Contact tails will take either conventional solder wiring or AMP "78" series Taper Tab receptacles.

Plug and Socket



...LE SIZE		CABLE CLAMP
...R	DIM.	SIZE
	½ Dia.	SMALL
	¾ Dia.	
	13/16x1	MEDIUM
	13/16x1½	
	13/16x1 11/16	LARGE

...LTAGE RATING:

	VOLTS	
	ACRMS	DC
...cent ...inals	930	1300
...round	1400	2000

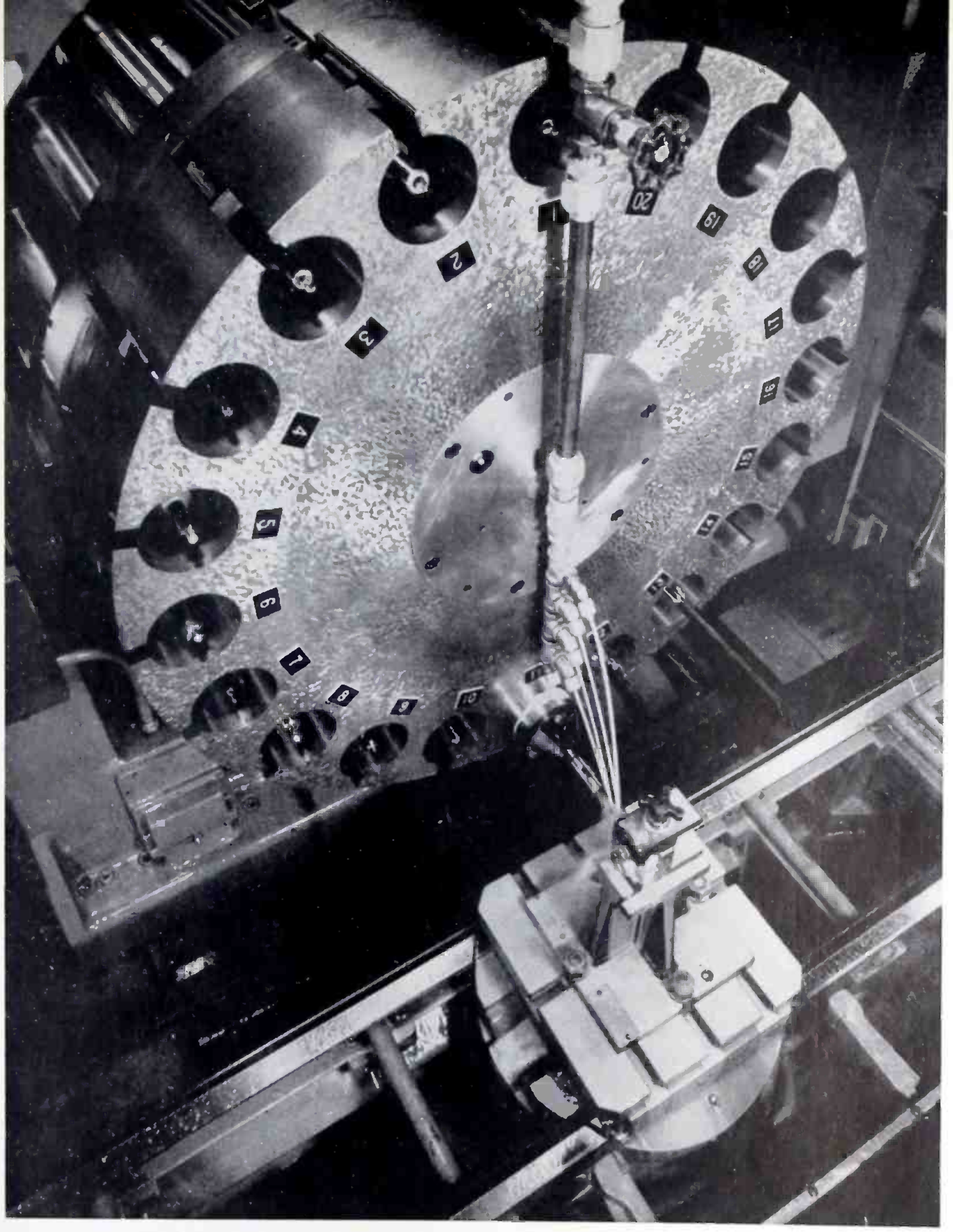
...rent Rating: ....4.5 Amperes
...tact resistance @ rated current . . .020 Ohms
...ulation Resistance ....1000 Megohms
...acitance adjacent contacts .... .75 MMF

Contacts in multiples of 10 from 20 to 100

Centrally located plants at
Chicago, Illinois;
Shelbyville, Indiana;
La Puente, California;
St. Louis, Missouri

Cinch ELECTRONIC COMPONENTS

CINCH MANUFACTURING CORPORATION
1026 South Homan Ave., Chicago 24, Illinois
Subsidiary of United-Carr Fastener Corporation, Cambridge, Mass.



Computer Produces Aircraft Parts

Fig. 1: Twenty different drills, taps, reamers, etc., can be set up at once on this machine. The appropriate one is chosen, positioned, and operated from punched tapes.

Fig. 2: This tape-punch keyboard is used to translate data from the engineers' plan sheet to punched tape which will operate the Digitape machine tool controls.

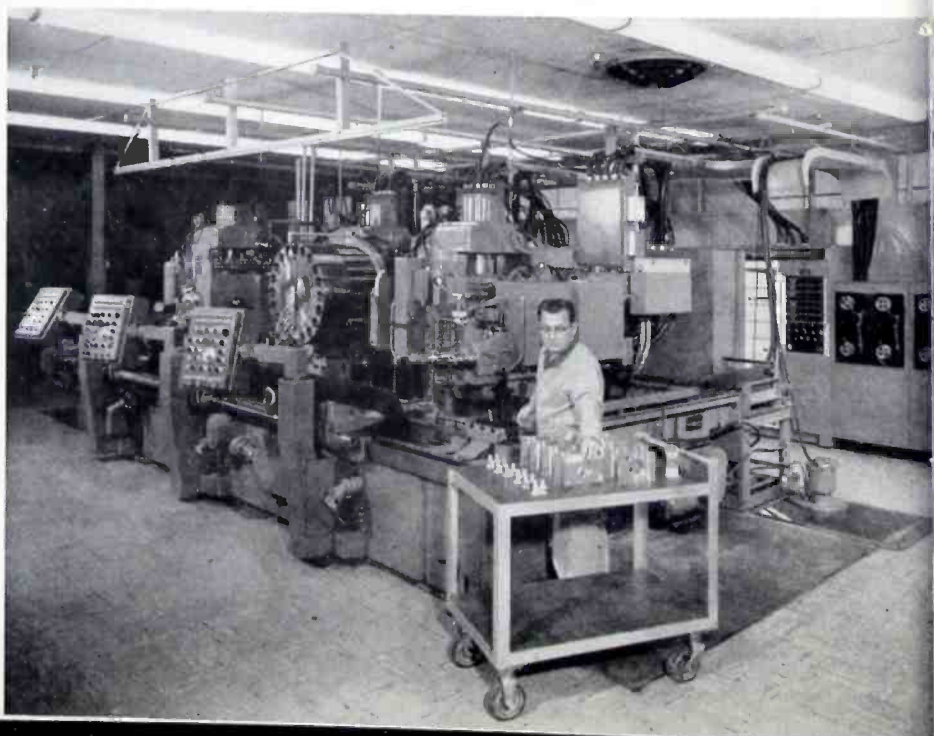
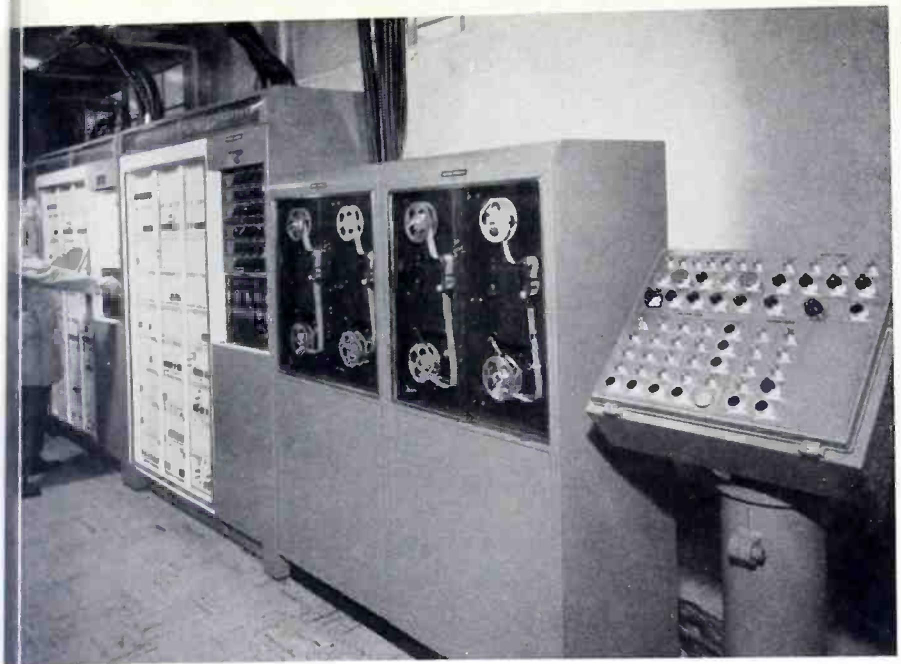
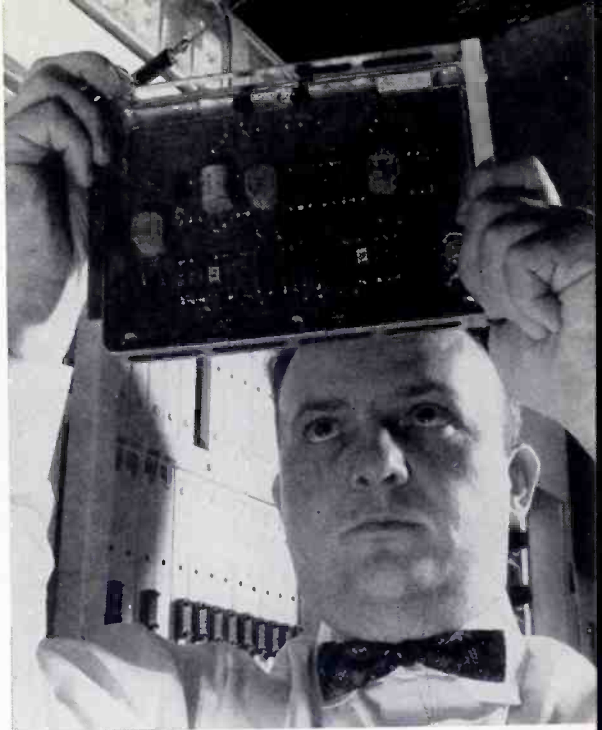


Fig. 3: Hughes Aircraft has revealed a secretly-developed line of electronically-controlle machine tools. Seen here are drilling, milling, and boring machines.





ig 4: This is the electronic "Digitape" nerve center of the electronically controlled machine
sp. Norman Wells, Hughes research assistant, checks drilling control cabinet.

Fig. 5: Hughes research assistant Charles Trott shows typical computer flip-flop card.

"Crash" development programs of the type now in effect for guided missiles will be sharply accelerated by the important new technological progress in factory automation just revealed by officials of Hughes Aircraft Company's Products Group.

"The nation's first all-electronically controlled line of machine tools" has been developed and is being used in production of vital aircraft parts at the Hughes plant. Transistorized digital computer-controllers, directed by durable punched tapes, control an entire series of precision machining operations—"untouched by human hands."

i 6: Rollin M. Russell, Hughes VP, ex-
ils production of machined casting.

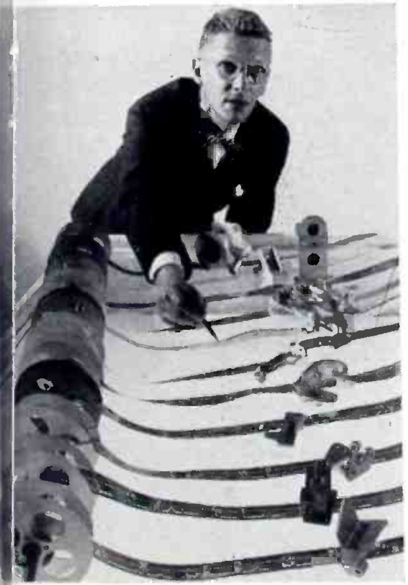


Fig. 7: Hughes engineer William Wagenseil shows how simple the production of job lots can become with "Digitape."

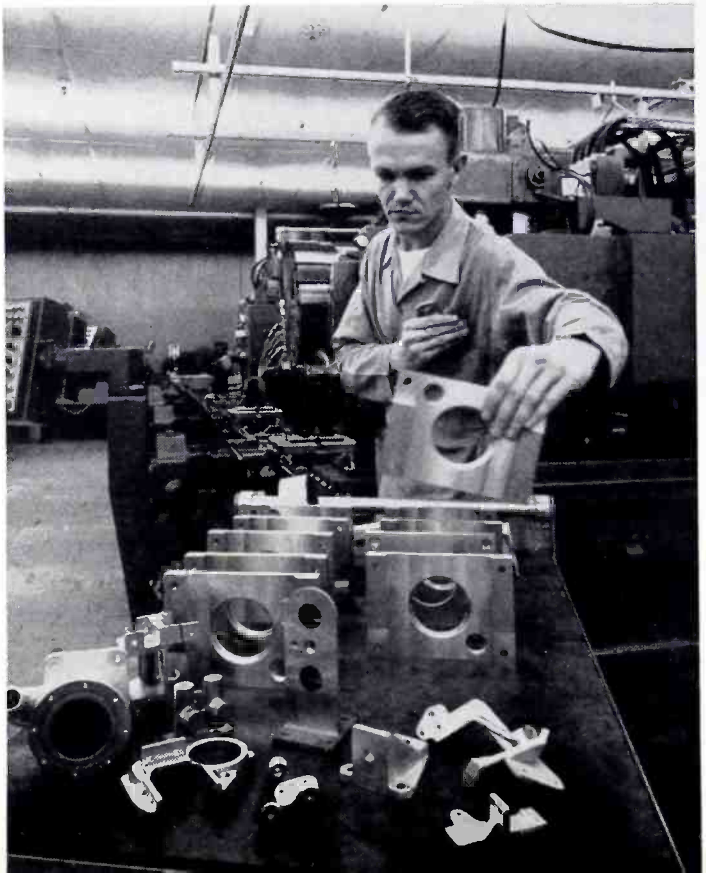


Fig. 8: All the machined parts shown here can be made simultaneously on the electronically controlled line of tools developed by Hughes and the Kearney and Trecker Corp.

Computer Produces Aircraft Parts

(Continued)

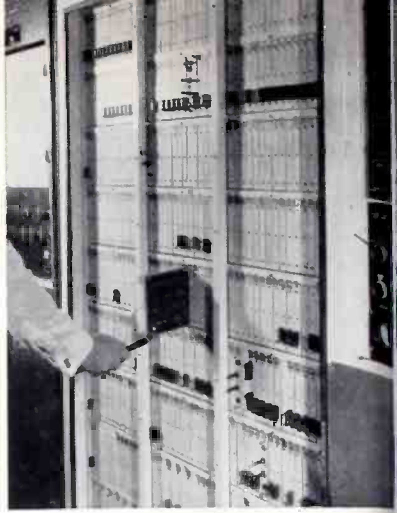


Fig. 10: Printed circuits, transistors, pl in boards are combined to form the Digit automatic machine controls.

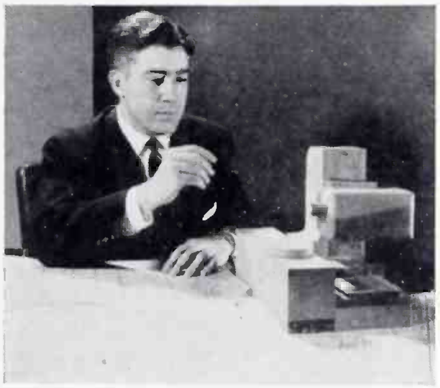


Fig. 9: Dr. William Leone, Hughes head of engineering for industrial systems and controls, works out planning sheet from which tape will be punched to control the Hughes automated machine shop.

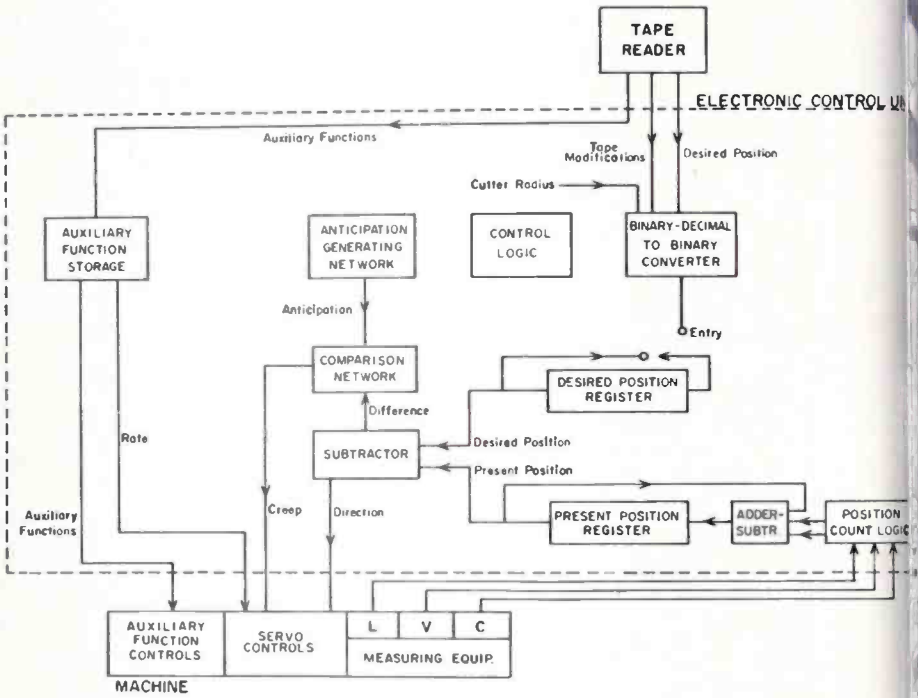
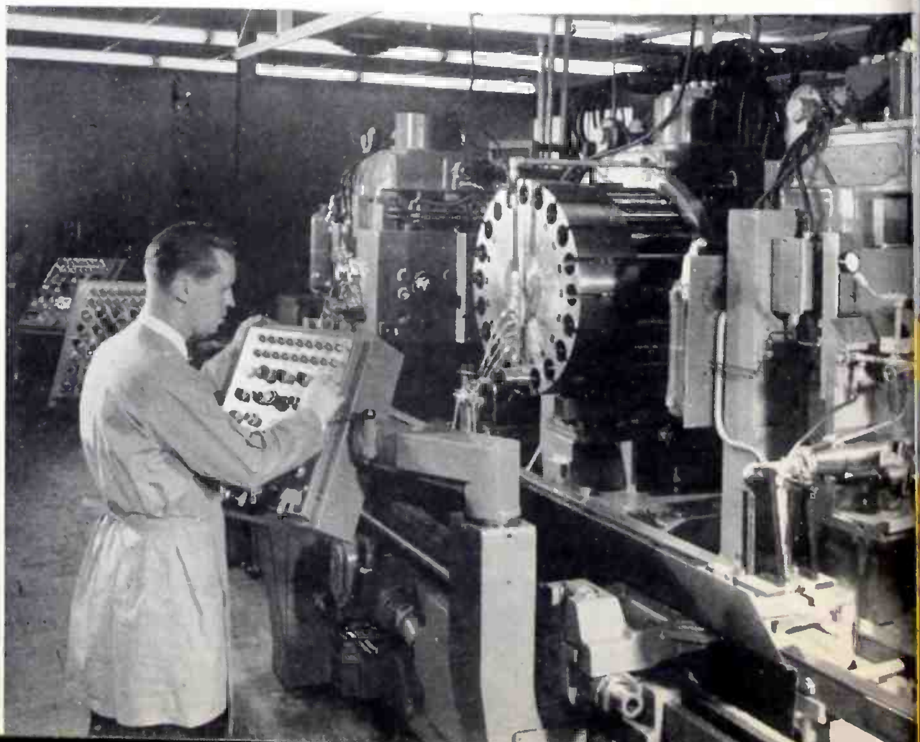
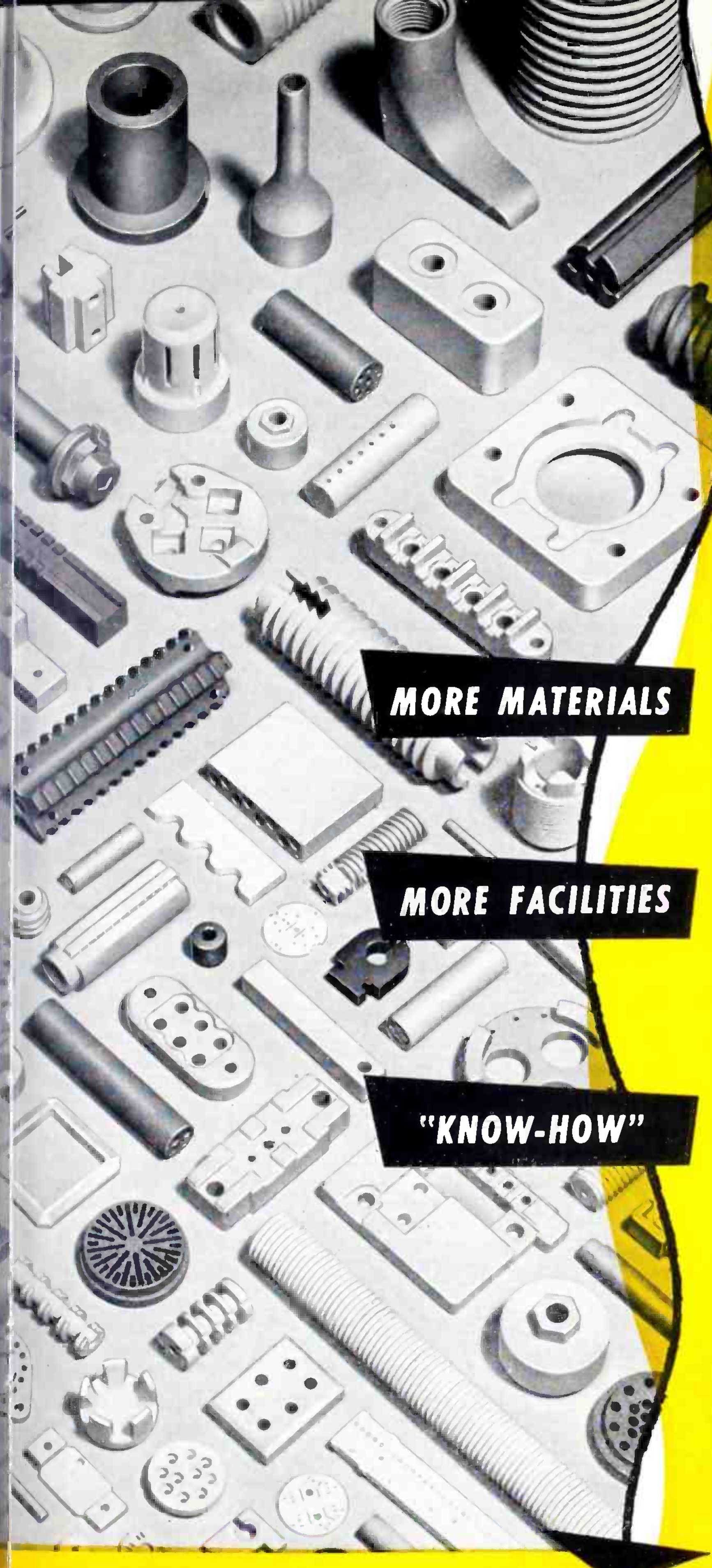


Fig. 11: Simplified block diagram shown here indicates the engineering philosophy underlyi the new tape-controlled machine shop used in production at Hughes Aircraft.

Fig. 12: The tapes and controls shown here can slash lead times and costs in "Crash" development programs such as missiles.

Fig. 13: Push the button, and the machine does its job exactly according to instructions fr the tape-controlled Digitronic control panels. Succeeding parts can be made from the sa tape-recorded know-how.





Circle 57 on Inquiry Card, page 117

ELECTRONIC INDUSTRIES'

1958 Roster of Associations Serving the Electronic Industries

A listing of the technical, religious and fraternal organizations functioning for the professionally employed in the electronic arts and sciences. Shown are the name of the organization; the number of members; mailing address; principal officers; date and locati of the prime annual meeting; and summary of the aims a objectives of the group.

ACOUSTICAL SOCIETY OF AMERICA—2400 Members—335 E. 45th St., New York, N. Y. MU 5-1940 . . . Richard K. Cook, Pres.; Wallace Waterfall, Sec. . . . Spring Meeting May 6-9 . . . at Washington, D. C. . . . To disseminate information on the subject of acoustics and to promote practical applications.

AIRCRAFT INDUSTRIES ASSOCIATION OF AMERICA, INC.—145 Members—610 Shoreham Bldg., Washington, D. C. . . . Orvall R. Cook, Pres.; Harrison Brand, Jr., Sec.-Treas. . . . Annual conv. none . . . Concerned with the industry-wide aspects of aeronautical research, development and production.

AMERICAN SOCIETY OF ENGINEERS—8 S. Michigan Ave., Chicago 3, Ill. RA 6-9085 . . . P. J. Lucey, Pres.; M. E. McIver, Nat'l Sec. . . . Annual conv. undetermined . . . To promote the social and economic welfare of the engineering profession and the professional engineer.

AMERICAN ELECTROPLATERS SOCIETY — 7,600 Members — 445 Broad St., Newark 2, N. J. HU 2-3400 . . . Francis T. Eddy, Pres., John P. Nichols, Exec. Sec. . . . 45th Annual conv. May 19-22 . . . Sheraton-Gibson Hotel, Cincinnati, Ohio.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS — 51,000 Members—33 W. 39th St., New York, N. Y. PE 6-9220 . . . W. J. Barrett, Pres.; N. S. Hibshman, Sec. . . . Summer General Meeting June 22-27 . . . at Buffalo, N. Y. . . . Advancement of theory and practice of electrical engineering and of allied arts and sciences.

AMERICAN INSTITUTE OF PHYSICS—18,500 Members—335 E. 45th St., New York 17, N. Y. MU 5-1940 . . . Frederick Seitz, Chrm.; Wallace Waterfall, Sec. . . . Annual conv. none . . . Advancement and diffusion of knowledge of the sciences of physics and its application to human welfare.

AMERICAN PHYSICAL SOCIETY—14,000 Members—Columbia University, New York 27, N. Y. UN 5-4000-Ext. 416 . . . Dr. Karl K. Darrow, Sec.; Prof. S. L. Quimby, Treas. . . . Annual meeting Jan. 29 thru Feb. 1 . . . Hotel New Yorker, New York City . . . Fosters the science and the profession of physics in America.

AMERICAN RADIO RELAY LEAGUE—75,000 Members—38 LaSalle Rd., W. Hartford, Conn. AD 6-2535 . . . G. L. Dosland, Pres.; P. C. Noble, Sec.-Gen. Mgr. . . . ARRL 10th Nat'l conv. . . . at Washington, D. C., Aug. 15-17 . . . Association of amateur radio operators.

AMERICAN SOCIETY FOR MECHANICAL ENGINEERS — 45,000 Members—29 W. 39th St., New York 18, N. Y. PE 6-9220 . . . James N. Landis, Pres.; O. B. Schier, Sec. . . . Annual Meeting Nov. 30 thru Dec. 5 . . . Hotels Statler & Sheraton-McAlpin, New York City . . . Educational, professional body concerned with the mechanical engineering; allied arts.

AMERICAN SOCIETY FOR QUALITY CONTROL—10,500 Members—6197 Plankinton Bldg., Milwaukee 3, Wisc. BR 2-3347 . . . Leon Bass, Pres.; L. S. Eichelberger, Exec. Sec. . . . 12th Annual conv. May 26-28 . . . Hotel Statler, Boston, Mass. . . . Advancement and diffusion of knowledge of the science of quality cont and its application to industrial processes.

AMERICAN SOCIETY FOR TESTING MATERIALS—9,000 Memb—1916 Race St., Phila. 3, Penna. RI 6-5315 . . . Richard T. Kro Pres.; R. J. Painter, Exec. Sec. . . . 61st Annual Meeting & 1 ASTM Exhibit June 22-27 . . . Hotel Statler, Boston, Mass. . To promote the knowledge of the materials of engineering, and t standardization of specifications and methods of testing.

AMERICAN SOCIETY OF TOOL ENGINEERS—39,000 Members-10700 Puritan Ave., Detroit 38, Mich. UN 4-7300 . . . H. E. Colli Pres.; David A. Schrom, Sec. . . . ASTE Industrial Exposition Annual Meeting May 1-8 . . . at Phila., Penna. . . . Disseminati of knowledge of tool engineering.

AMERICAN STANDARDS ASSOCIATION — 2,300 Companies — 1 Trade & Technical Societies—70 E. 45th St., New York 17, N. MU 3-3058 . . . H. Thomas Hallowell, Jr., Pres., Geo. F. Hussey, J Vice Admiral, USN (Ret.), Managing Dir. & Sec. . . . 9th Na Conference on American Standards Nov. 18-20 . . . at New Yo City . . . Provide an orderly set of voluntary coordinated standar and to promote their knowledge and use.

AMERICAN WOMEN IN RADIO & TV—1,550 Members—501 Ma ison Ave., New York 22, N. Y. EL 5-7281 . . . Margo Anderso Exec. Sec. . . . Conv. of American Women in Radio & TV April 2 27 . . . at San Francisco, Calif. . . . An organization for intercha of information and mutual benefit of women in broadcasting.

ARMED FORCES COMMUNICATIONS & ELECTRONICS ASSOC ATION—10,492 Members & Subscribers—1624 Eye St., N. W Washington, D. C. EX 3-3033 . . . Rear Adm. Frederick R. Fur USN (Ret.), Pres.; Capt. Wilfred B. Goulett, USN (Ret.), Exe V. P. . . . Annual Conv. & Exhibit June 4-6 . . . Sheraton-Pa Hotel, Washington, D. C. . . . A patriotic educational and non-pro communication and electronic society for military, scientific a industrial preparedness.

ASSOCIATION FOR APPLIED SOLAR ENERGY—900 Members 3424 N. Central Ave., Phoenix, Ariz. CR 7-5401 . . . Jan Ooste meyer, Pres.; John I. Yellott, Exec. Dir. . . . Solar House Symposiu . . . Date Undetermined . . . at Phoenix, Ariz. . . . To gather, comp and disseminate information relating to solar energy.

ASSOCIATION FOR COMPUTING MACHINERY—3,000 Members-2 E. 63rd St., New York 21, N. Y. . . . John W. Carr, Pres.; Ja Moshman, Sec. . . . 13th Annual Meeting June 11-13 . . . Uni of Illinois, Urbana, Ill. . . . Advancement, design and developme of modern mathematical machinery for logic, statistics, and kindre fields.

ASSOCIATION OF FEDERAL COMMUNICATIONS CONSULTIN ENGINEERS—46 Members—710 14th St., N. W., Washington, D. HU 3-9000 . . . Robert E. L. Kennedy, Pres.; George P. Ada Sec. . . . Annual conv. not determined . . . To provide for mut improvement of consulting engineers before the FCC and to pr mote the proper applications of the radio communication regulatio from the proper Federal authorities.

SSOCIATION OF ELECTRONIC PARTS & EQUIPMENT MANU-
F:TURERS—132 Members—11 LaSalle St., Chicago 3, Ill. SE 2-
4?7 . . . A. N. Haas, Pres.; Kenneth C. Prince, Exec. Sec. . . .
A ual Meeting March . . . at Chicago, Ill. . . . To treat all
p lems relating to the sales and distributors of electronic items
t ugh distributors.

U D ENG'G SOCIETY—2,000 Members—Box 12, Old Chelsea
S, New York 11, N. Y.—OR 5-7820 . . . Sherman Fairchild, Pres.;
C J. LeBel, Sec. . . . Annual Conv. October . . . at New York City
. To further the engineering program in audio recording and
r oducing equipment.

R DCAST PIONEERS—1,000 Members—589 5th Ave., New York
1 N. Y. PL 9-1500 . . . John F. Patt, Pres.; Raymond F. Guy,
S . . . Annual Dinner-Meeting April 29 . . . at Los Angeles,
C if. . . . Persons with long years of service in radio.

L E TROCHEMICAL SOCIETY — 2,711 Members — 1860 Broadway,
N w York 23, N. Y. CI 5-6282 . . . Norman Hackerman, Pres.;
H iry B. Linford, Sec. . . . Annual Spring Meeting April 27 thru
M y 1 . . . Statler Hotel, New York City . . . The advancement
o the science and technology of electrochemistry, electronics,
e :trothermics, electrometallurgy, and allied subjects.

LETRONIC INDUSTRIES ASSOCIATION—375 Members—1721
D iales St., N. W., Washington, D. C. NA 8-3902 . . . Dr. W. R. G.
B :er, Pres.; James D. Secrest, Exec. V. P. & Sec. . . . Annual conv.
M y 21-23 . . . Sheraton Hotel, Chicago, Ill. . . . A non-profit
a ociation of the radio-electronics-TV industry.

LETRONIC MANUFACTURERS ASSOCIATION, INC.—30 Mem-
b s—55 W. 42nd St., New York 36, N. Y. PE 6-4864 . . . I. A.
M chell, Pres.; J. W. Martindale, Exec. Sec. . . . Annual conv.
J ne . . . Assist members in handling of the labor relation problems.

N NEERS JOINT COUNCIL—17 Societies—29 W. 39th St., New
Y k 18, N. Y. PE 6-9220 . . . E. R. Needles, Pres.; E. Paul Lange,
S . . . Nuclear Engineering & Science Congress March 17-21
. at Chicago, Ill. . . . To provide information and assist in
a ivities on professional engineering matters and to advance the
s ence and profession of engineering.

M DEVELOPMENT ASSOCIATION—15401 W. Ten Mile Rd.,
D roit 37, Mich. Harold I. Tanner, Sec. . . . Meeting in April
. . at Los Angeles . . . To develop greater markets for FM
s tions through FM car radios, etc.

N STRIAL COMMUNICATIONS ASS'N—30 E. 42nd St., New
Y rk, N. Y.—MU 7-8000 . . . R. E. Frew, Pres.; W. L. Hendershot,
S . . . Annual Conv. May 21-23 Francis Drake Hotel, San Fran-
c co, Calif.

N TITUTE OF AERONAUTICAL SCIENCES—17,000 Members—
. 64th St., New York 21, N. Y. TE 8-3800 . . . Edward C. Wells,
P s.; Robert R. Dexter, Sec. . . . Annual Meeting Jan. 27-31 . . .
H tel Sheraton-Astor, New York City . . . To facilitate by all
a ilable means, the interchange of technical ideas among aero-
n itical engineers throughout the world.

N ITUTE OF HIGH FIDELITY MANUFACTURERS—100 Members
—125 E. 23rd St., New York 10, N. Y. AL 4-3532 . . . Officers
t be elected . . . Annual Meeting Jan. 16.

N ITUTE OF PRINTED CIRCUITS—6 Members—27 E. Monroe
. Chicago 3, Ill.—RA 6-3727—W. J. McGinley, Pres.; A. R.
H ghes, V. P.

N ITUTE OF RADIO ENGINEERS—62,000 Members—1 E. 79th St.,
N w York 21, N. Y. LE 5-5100 . . . Donald G. Fink, Pres. . . . IRE
I t'l Conv. & Radio Engineering Show March 24-27 . . . Waldorf-
A toria Hotel & Coliseum, New York City . . . Advancement of the
t ory and practice of radio and allied branches of engineering and
o the related arts and sciences.

N RUMENT SOCIETY OF AMERICA—11,000 Members—313 6th
A e., Pittsburgh 22, Penna. AT 1-3171 . . . Dr. R. J. Jeffries, Pres.;
H C. Frost, Pres.-Elect-Sec. . . . 13th Annual Instrument-Auto-
m tion Conference & Exhibit Sept. 15-19 . . . at Phila. Convention
H ll . . . Advance the art & science of instrumentation and
a omatic control.

I RNATIONAL MUNICIPAL SIGNAL ASSOCIATION — 1,700
M mbers—130 W. 42nd St., New York 36, N. Y. CH 4-4663 . . .
C ester B. Kern, Pres.; Irvin Shulsinger, Sec. . . . Annual Con-
f ence Oct. 20-23 . . . Sheraton Hotel, Phila., Penna. . . .
A vancement and improvement of municipal signal and communi-
c ions systems.

(Continued on page 113)

Circle 59 on Inquiry Card, page 117

sociations Roster

(Continued from page 111)

ELECTRON TUBE ENG'G COUNCIL OF RETMA & NEMA ommittees—11 W. 42nd St., New York 36, N. Y.—LO 5-3450 r. W. R. G. Baker, Pres. . . . Deals with standards for receiv- ansmitting tubes and semiconductors.

TECHNICAL ADVISORY COMMITTEE—1 E. 79th St., New 21, N. Y. . . . Wm. H. Radford, Chairman; L. C. Cumming, . . . Annual Conv. none . . . To assist the Federal Government Industry on electronic engineering matters on an engineering

ETIC RECORDING INDUSTRY ASSOCIATION—37 Members 7 S. Tripp St., Chicago, Ill. SA 2-3201 . . . Irving Rossman, ; Herman Kornbrodt, Sec. . . . Further the uses of magnetic ding and to bring about a better understanding among the rs, distributors and manufacturers in the industry.

. POWDER ASSOCIATION—81 Members—130 W. 42nd St., York 36, N. Y. WI 7-0645 . . . George A. Roberts, Pres.; ton H. Roll, Exec. Sec.-Treas. . . . 14th Annual Meeting and Powder Metallurgy Show April 21-23 . . . Sheraton Hotel, ., Penna . . . A trade association for the powder metallurgy try.

NAL ALLIANCE OF TV & ELECTRONIC SERVICE ASSO- IONS—7,500 Members—5906 S. Troy St., Chicago 29, Ill. -6363 . . . Russel Harmon, Pres.; Frank J. Moch, Exec. Dir. Directors Meeting April 20 . . . Springfield, Mass. . . . To ethical local and regional associations into a national group ing cooperatively.

NAL APPLIANCE AND RADIO TV DEALERS ASSOCIATION 00 Members—1141 Merchandise Mart, Chicago 54, Ill. MI 2- . . . Officers to be elected . . . Annual Conv. Jan. 12-14 . . . ad Hilton Hotel, Chicago, Ill. . . . Build better dealers by r relationship, further their knowledge and provide various ces.

NAL ASSOCIATION OF ELECTRICAL DISTRIBUTORS— Members—290 Madison Ave., New York 17, N. Y. MU 6-4633 George Albiez, Pres.; Arthur W. Hooper, Exec. Dir. . . . Annual Conv. June 8-12 . . . at San Francisco, Calif. . . . sseminate information on industry matters and to promote ficial relationship among distributors.

NAL ASSOCIATION OF MUSIC MERCHANTS—1,500 Mem- —222 W. Adams St., Chicago 6, Ill. AN 3-0679 . . . Paul E. hy, Pres.; Willard R. Gard, Exec. Sec. . . . Music Industry & e Show July 21-24 . . . Palmer House Hotel, Chicago, Ill. . . . nutual advancement of individuals and organizations selling at

NAL ASSOCIATION OF BROADCASTERS—2,168 Members— N St., N. W., Washington, D. C. DE 2-9300 . . . Harold llows, Pres.; Everett E. Revercomb, Sec.-Treas. . . . Annual April 27-May 1 . . . Biltmore & Statler Hotels, Los Angeles, . . . Advancement of aural and visual broadcasting arts.

NAL AUDIO-VISUAL ASSOCIATION—601 Members—Fairfax, CR 3-4467 . . . Wm. W. Birchfield, Pres.; Ray S. Swank, Sec. Nat'l Audio-Visual Conv. & Exhibit July 26-29 . . . Morrison l, Chicago, Ill. . . . Trade association of audio-visual dealers manufacturers.

NAL COMMUNITY TV ASSOCIATION—300 Members— E. St., N. W., Washington, D. C. ME 8-1415 . . . Geo. J. Barco, ; A. J. Malin, Sec. . . . 7th Annual Conv. June 10-12 . . . flower Hotel, Washington, D. C. . . . To promote community ision antenna industry.

NAL CONFERENCE ON AERONAUTICAL ELECTRONICS O. Box 621, Far Hills Sta., Dayton, Ohio . . . 1958 Nat'l Con- ce on Aeronautical Electronics May 12-14 . . . Dayton Biltmore l, Dayton, Ohio . . . To disseminate the latest developments in autical electronics.

NAL ELECTRICAL MANUFACTURERS ASSOCIATION—570 bers—155 E. 44th St., New York 17, N. Y. MU 2-1500 . . . O'Brien, Pres.; Joseph F. Miller, Mgr. Dir. . . . Annual Conv. 10-14 . . . Hotel Traymore, Atlantic City, N. J. . . . To dis- nate information and to develop industry standards.

NAL ELECTRONICS CONFERENCE—84 E. Randolph Ave., ago 1, Ill., FR 2-1211 . . . J. H. Enebach, Pres.; R. E. Bard, Sec. . . . Nat'l Electronics Conference Oct. 13-15 . . . man Hotel, Chicago, Ill. . . . A national forum on electronic rch, development and application.

NAL ELECTRONICS DISTRIBUTORS ASSOCIATION—510 bers—343 S. Dearborn St., Chicago 4, Ill. HA 7-5526 . . . h A. DeMambro, Pres.; V. N. Zachariah, Sec. . . . May Parts May 19-21 . . . Conrad Hilton Hotel . . . The dissemination formation concerning the electronics industry.

NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS—42,000 Members—2029 K. St. N. W., Washington 6, D. C. FE 7-2211 . . . Garvin H. Dyer, Pres.; Paul H. Robbins, Exec. Dir. . . . Annual Meeting June 11-14 . . . Chase Hotel, St. Louis, Mo. . . . Devoted to social, professional, economic and ethical aspects of engineering.

OPERATIONAL FIXED MICROWAVE COUNCIL—35 Members—No fixed address—Robert W. Olin, Chairman, Wm. E. Elder, Acting Sec. . . . Annual meeting undetermined . . . To foster mutual interest of organizations concerned with operational fixed radio systems.

PHONOGRAPH MANUFACTURERS ASSOCIATION—10 Members—37 W. 53rd St., New York 19, N. Y. CI 6-2940 . . . Joseph Dworken, Pres.; A. D. Adams, Exec. Sec. . . . Annual Conv. none. . . . A non-profit organization to foster the mutual interest of its members in the electronic industries.

RADIO CLUB OF AMERICA—375 Members—11 W. 42nd St., New York 36, N. Y.—LO 5-6622—Walter A. Knoop, Pres.; James Morelock, Cor. Sec. . . . Annual Meeting December . . . Technical Organization of engineers and suppliers to the electronic industry. Established 1907.

RADIO TECHNICAL COMMISSION FOR AERONAUTICS—130 Members—Room 1072, Bldg. T-5, 16th & Constitution Ave. N. W., Washington, D. C. ST 3-8984 . . . J. S. Anderson, Chairman, L. M. Sherer, Sec.-Treas. . . . Fall 1958 RTCA Assembly Meeting—date & location not determined . . . To advance the art and science of aeronautics through the applications of the telecommunication art.

RADIO-TV EXECUTIVES SOCIETY, INC.—1,200 Members—The Biltmore, New York 17, N. Y. MU 9-3480 . . . John C. Daly, Pres.; Claude Barrere, Exec. Dir. . . . Annual Conv. none . . . An organization of persons professionally interested in radio & TV broadcasting and allied fields.

RECORD INDUSTRY ASSOCIATION OF AMERICA—50 Members—1 E. 57th St., New York 22, N. Y. MU 8-3778 . . . Frank B. Walker, Pres.; John W. Griffin, Exec. Sec. . . . Annual Conv. March . . . at New York Athletic Club . . . To disseminate information to its members, and promote beneficial relations.

REPRESENTATIVES OF ELECTRONIC PRODUCTS MANUFACTURERS—600 Members—600 S. Michigan Ave., Chicago 5, Ill. HA 7-2402 . . . Jules J. Bressler, Pres.; R. Edw. Stemm, Sec. . . . May Parts Show, in May . . . Conrad Hilton Hotel, Chicago, Ill. . . . To serve the Electronics Industry, our principals, our customers and our fellow members in a constructive and profitable manner.

SCIENTIFIC APPARATUS MAKERS ASSOCIATION—222 Members—20 N. Wacker Dr., Chicago 6, Ill. ST 2-0277. R. E. Welch, Pres.; T. M. Mints, Treas. . . . Annual Meeting April 20-24 . . . El Mirador Hotel, Palm Springs, Calif. . . . To strengthen and back-up the scientific and technological progress of the country.

SOCIETY OF MOTION PICTURE & TV ENGINEERS—6,139 Members—55 E. 42nd St., New York 36, N. Y. LO 5-0172 . . . Barton Kreuzer, Pres.; G. Carleton Hunt, Conv. V. P. . . . 83rd & 84th Conv. (83rd) April 21-26 (84th) Oct. 19-24 . . . (83rd) Ambassador Hotel, Los Angeles, Calif. (84th) Sheraton-Cadillac Hotel, Detroit, Mich. . . . Advancement of theory and practice of engineering in motion pictures and allied arts and sciences.

SOCIETY OF PLASTIC ENGINEERS—5,900 Members—34 E. Putnam Ave., Greenwich, Conn. TO 9-5617 . . . Officers to be elected . . . 14th Annual Nat'l Technical Conference Jan. 28-31 . . . Sheraton Cadillac Hotel, Detroit, Mich. . . . To promote in all lawful ways, the arts, sciences, standards and engineering practices connected with the use of plastics.

STANDARD ENGINEERS SOCIETY—700 Members—P. O. Box 281, Camden 1, N. J. . . . Herbert G. Arlt, Pres.; Jean A. Caffiaux, Sec. 7th Annual Meeting—date not determined . . . Ben Franklin Hotel, Phila., Penna. . . . To further standardization as a means of enhancing general welfare.

ULTRASONIC MANUFACTURERS ASSOCIATION—21 Members—P. O. Box 555, W. Chester, Penna. . . . J. T. Welch, Pres.; R. M. Moschella, Sec. . . . Nat'l Metal Show—In Nov. . . . at Phila., Penna. . . . To promote dissemination of sound and accurate information about ultrasonic equipment and its applications and to assist the ultrasonic industry in adopting ethical practices in sales, publicity and advertising.

VETERAN WIRELESS OPERATORS ASSOCIATION—400 Members—c/o Brooklyn Press, 59 Lawrence St., Brooklyn 1, N. Y. . . . Wm. J. McConigle, Pres.; Wm. C. Simon, Sec. . . . Dinner-Cruise Feb. 27 . . . Hotel Sheraton-Astor, New York City . . . To foster and extend espirit de corps among wireless operators.

WEST COAST ELECTRONIC MANUFACTURERS ASSOCIATION—256 Member Companies—1435 S. LaCienega Blvd., Los Angeles 35, Calif. OL 5-8462 . . . Officers to be elected . . . WESCON Aug. 19-22 . . . Pan-Pacific Auditorium, Los Angeles, Calif. . . . To advance electronic industries in the West.

(Continued on page 114)

Associations Roster

(Continued from page 113)

PROFESSIONAL ENGINEERING GROUPS OF I.R.E.

AERONAUTICAL & NAVIGATIONAL ELECTRONICS—2,950 M bers—Joseph General, Chairman, Wm. P. McNally, Sec.-Treas. Conference on Aeronautical Electronics May 12-14 . . . at Da Ohio . . . The application of electronics to the operation traffic control of airborne aircraft and to the navigation o craft whether military or civilian.

ANTENNAS AND PROPAGATION — 2,700 Members — Dr. Joh Bohnert, Chairman . . . IRE Nat'l conv. March 24-27 . . . York Coliseum . . . To encourage technical advances in the of antennas, wave propagation, and radio astronomy and to pro the utilization of techniques and products in these fields.

AUDIO—4,000 Members—Dr. H. F. Olson, Chairman . . . IRE conv. March 24-27 . . . New York Coliseum . . . The dissemin of information on technology of communications in the audio quency field.

AUTOMATIC CONTROL—2,600 Members—E. M. Grabbe, Chair John M. Selzer, Sec.-Treas. . . . IRE Nat'l Conv. March 24-27 New York Coliseum . . . Technology of communications at frequencies and of the audio portion of radio frequency syst including acoustic terminations, recording, and reproduction.

BROADCAST & TELEVISION RECEIVERS — 1,950 Members — Lyman R. Fink, Chairman, Gilbert C. Larson, Sec.-Treas. . . . Nat'l Conv. March 24-27 . . . New York Coliseum . . . The d and manufacture of broadcast and television receivers and ponents; and activities related thereof.

BROADCAST TRANSMISSION SYSTEMS—1,313 Members—Clu Owen, Chairman, Geo. E. Hagerty, Sec.-Treas. . . . Broadcast IRE Nat'l Conv. March 25 . . . New York Coliseum . . . To ulate interest in engineering as applied to broadcasting art.

CIRCUIT THEORY—5,890 Members—Dr. W. H. Huggins, Chai . . . IRE Nat'l Conv. March 24-27 . . . New York Coliseum Design and theory of operation of circuits for use in elec equipment.

COMMUNICATION SYSTEMS—2,600 Members—Mr. J. W. W ington, Jr., Chairman . . . Annual Symposium on Aeronautical munication Oct. 20-21 . . . Hotel Utica, Utica, N. Y. . . . Radi telephone, telegraph and facsimile in marine, aeronautical, relay, coaxial cable and fixed station services.

COMPONENT PARTS—1,500 Members—R. M. Soris, Chairman Electronics Components Conference April 22-24 . . . Ambas Hotel, Los Angeles, Calif. . . . The characteristics, limitat applications, development performances and reliability of ponent parts.

EDUCATION—600 Members—Dr. John D. Ryer, Chairman . . . Nat'l Conv. March 25-27 . . . New York Coliseum . . . To fu the field of education in electronics.

ELECTRON DEVICES—3,600 Members—T. M. Liimatainen, C man . . . 1958 Electron Devices Meeting Oct. 30-31 . . . Shor Hotel, Washington, D. C. . . . Electron devices including partic electron tubes and solid state devices.

ELECTRONIC COMPUTERS—6,900 Members—Dr. Werner Buch Chairman, H. W. Nordyke, Sec-Treas. . . . IRE Nat'l Conv. 24-27 . . . New York Coliseum . . . Design and operatio electronic computers.

ENGINEERING MANAGEMENT—4,310 Members—Dr. C. R. Bur Chairman, Dr. Henry M. O'Bryan, Sec.-Treas. . . . IRE Nat'l March 25-27 . . . Waldorf-Astoria Hotel, New York City Engineering management and administration as applies to tech industrial and educational activities in the field of electr

ENGINEERING WRITING & SPEECH—600 Members—D. J. Namara, Chairman . . . IRE Nat'l Conv. March 24-27 . . . New Coliseum . . . The study, development, improvement and prom of techniques for collecting and disseminating information ir electronic field.

HUMAN FACTORS IN ELECTRONICS—300 Members—H. T mingham, Acting Chairman . . . Establishment and utilizati human engineering techniques for the design of electronics electromechanical man-machine systems.

INDUSTRIAL ELECTRONICS — 1,800 Members — W. R. Thu Chairman, C. A. Priest, Sec.-Treas. . . . 7th Annual Indu Electronic Symposium . . . Late Sept. . . . at Detroit, Mich. Electronics pertaining to control, treatment and measurement, cifically in industrial processes.

Circle 60 on Inquiry Card, page 117

I·F··MATION THEORY—2,600 Members—W. B. Davenport, Jr., C·irman, S. Deutsch, Sec.-Treas. . . . IRE Nat'l Conv. March 24-27 . New York Coliseum . . . Advancement of the theory and p··tice of the art and science of the generation, transmission, r··ption, and processing of information.

IS··UMENTATION—3,500 Members—Frank C. Smith, Jr., Chair-m· . . . IRE Instrumentation Conference Dec. 7-9 . . . at Atlanta, C . . . Measurement and instrumentation utilizing electronic t··niques.

E··CAL ELECTRONICS—1,700 Members—Dr. Lee B. Lusted, C·irman, Walter E. Tolles, Sec.-Treas. . . . IRE Nat'l Conv.-M·dical Electronics Session March 24 & 25 . . . Waldorf-Astoria H·el, New York City . . . The application of electronic engineering t·the problems of the medical profession.

I··OWAVE THEORY AND TECHNIQUES—2,000 Members—Dr. V L. Pritchard, Chairman, P. D. Strum, Sec. . . . Annual Meeting o·PGMTT May 5-6 . . . Stanford University, Palo Alto, Calif. . . . M·crowave theory, circuitry and techniques, measurements and t· generation and amplification of microwaves.

I··ITARY ELECTRONICS—3,262 Members—Adm. W. E. Cleaves, C·airman . . . Nat'l Conv. June 16-18 . . . Sheraton Park Hotel, W·shington, D. C. . . . This group is concerned with the elec-t·nics, sciences, systems, activities, and services germane to the r·uirements of the military.

U··LEAR SCIENCE—1,624 Members—Dr. John N. Grace, Chair-m·n, J. P. Franz, Sec-Treas. . . . 5th Annual Meeting . . . in C·tober . . . Location undetermined . . . To promote interest and a·ancement of the practice of engineering in the field of nuclear s·ence.

R··ESSIONAL GROUP ON PRODUCTION TECHNIQUES—859 M·mbers—1 E. 79th St., New York 21, N. Y. LE 5-5100 . . . E·R. Gamson, Chairman; R. R. Gerhold, Sec.-Treas. . . . Second A·nual Symposium on Production Techniques June 5-6 . . . Hotel N·w Yorker, New York City . . . To promote technical progress i·the design and manufacture of electronic equipment by manual o·automatic means.

A··O INTERFERENCE REDUCTION—250 Members—H. R. Schwenk, C·airman . . . IRE Nat'l Conv. March 24-27 . . . New York Coliseum . Advance study of origin, effect, control and measurement of r·io frequency interference.

E··IABILITY AND QUALITY CONTROL—1,372 Members—Dr. V·tor W. Wouk, Chairman . . . 4th Nat'l Symposium on Reliability & Quality Control in Electronics Jan. 6-8 . . . Hotel Statler, W·shington, D. C. . . . Techniques of determining and controlling r·reliability and quality of electronic parts and equipment manu-f·ture.

E··METRY AND REMOTE CONTROL—2,400 Members—Charles H. Doersam, Jr., Chairman, J. E. Hinds, Sec.-Treas. . . . Symposium & Exhibit Sept. 22-24 . . . American Hotel, Bal Harbor, Miami B·ch, Fla. . . . The control of devices and the measurement and r·ording of data from remote points by radio.

··ASONIC ENGINEERING—787 Members—Dr. Cyril M. Harris, C·irman . . . IRE Nat'l Conv. March 24-27 . . . New York C·iseum . . . Ultrasonic measurements and communications, in-c·ding underwater sound, ultrasonic delay lines, and various chem-i· and industrial ultrasonic devices.

··CULAR COMMUNICATIONS—1,149 Members—Mr. Charles M. H·ided, Chairman . . . Annual Conv. Nov 6-7 . . . at Chicago, Ill. . To promote close cooperation among those interested in the f·d of vehicular communications.

Circle 61 on Inquiry Card, page 117

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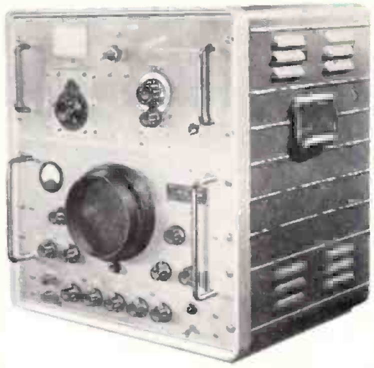

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58 Acme Electric Corp.—Transformers

39 Aetna Life Insurance Co.—Business life insurance

90 Aircraft Radio Corporation—Snapslide fastener

87 Alford Mfg. Co., Inc.—TV antennas

16 Allen-Bradley Co.—Resistors

57 American Lava Corporation—Technical ceramics

66 Amperex Electronic Corp.—Twin tetrode tubes

3 Amphenol Electronics Corp.—Connectors

30 Arnold Engineering Co., The — Tape wound bobbin cores

72 Assembly Products, Inc.—Meter-relays

11 Astron Corporation—Sub-miniature capacitors

98 Audio Devices, Inc.—Magnetic recording tape

69 Automatic Metal Products Corp.—Connectors

15 Barker & Williamson, Inc. — Bandpass filters

504 Bell Aircraft Corp.—Engineering personnel

104 Birtscher Corp., Industrial Div.—Transistor clips

106 Biwax Corporation—Potting compounds

19 Blaw-Knox Co., Equipment Div.—Microwave towers

102 Bliley Electric Co.—Low frequency-high temperature crystals

96 Boehme, Inc., H. O.—Precision gears

54 Bomac Laboratories, Inc. — Microwave equipment

107 Borg Equipment Div., The George W. Borg Corp. — Potentiometers, microdials, motors, instruments

109 Borg Equipment Div., The George W. Borg Corp.—Micropots

20 Bourns Laboratories—Potentiometers

37 Brush Instruments Division of Clevite Corporation—Recorder

6 Burnell & Co., Inc.—Crystal filters

25 Bussmann Mfg. Div. McGraw-Edison Co.—Fuses and fuseholders

14 Cannon Electric Co. — Miniature and sub-miniature plugs

35 Chatham Electronics Div. of Tung-Sol Electric, Inc.—Special purpose tubes

40 Chicago Standard Transformer Corp.—Transistor transformers

68 Chicago Telephone Supply Corp.—Military variable resistors

56 Cinch Mfg. Co.—Hinge connector

17 Cleveland Container Co.—Phenolic tubing

33 Clevite Electronic Components Div. of Clevite Corp.—Piezoelectric material

73 Connecticut Hard Rubber—Pressure sensitive TEFLON tape

84 Conrac, Inc.—Monochrome, color m tors, audio, video receivers

8 Consolidated Electrodynamics, Analyt & Control Instrument Div.—Leak tectors

38 Corning Glass Works — Sub-miniat fixed glass capacitors

101 Cutler-Hammer, Inc.—Transistorized lay

9 Dale Products, Inc.—Resistors

53 Delco Radio Div. of General Motor High power transistors

61 Dialight Corp.—Pilot lights

100 Dimco-Gray Company—Snapslide fa eners

23 Dow Corning Corp.—Silicone dielectr

27 Du Mont Laboratories, Inc., Allen Instrument Div. — Rack-mounted cilloscope

105 Elbe File & Binder Co., Inc.—Literat binders

42 Electro-Motive Mfg. Co., Inc.—Dur-m capacitors

65 Elgin National Watch Co., Electron Div.—Sub-miniature relays

7 Engineered Electronics Co.—Transit plug-in circuits

2 Ferroxcube Corp. of America—Ferr recording head cores

41 Formica Corp., Subsidiary of Americ Cyanamid—Laminated plastics

111 Freed Transformer Co.—Incremental ductance bridge, variable test volta megohmmeter

505 Garrett Corp., The—Engineering perso nel

80 Gates Radio Corp.—Intercom and inp console

76 General Chemical Div., Allied Chemic & Dye Corp.—"Electronic-grade" so vents

91 General Electric Co.—Brush-free volta regulators

93 General Electric Co.—Heavy-duty vol age regulators

95 General Electric Co.—Tubeless voltag regulators

97 General Electric Co.—Induction voltag regulators

503 General Electric Co., Missile Guidan Prod. Sect.—Engineering personnel

63 General Transistor Corp.—Phototransis tor

112 Graphic Systems—Visual control board

36 Hammarlund Mfg. Co., Inc.—Commu cations receiver.

46 Heath Company A Subsidiary of Da strom, Inc.—Electronic analog com puter kit

79 Houston Fearless Corp. — Portable TV pedestal

4 Hughes Products, Hughes Aircraft Co.—Storage type oscilloscope

502 Hughes Aircraft Co.—Engineering per sonnel

64 Industro Transistor Corp.—Germanium transistors

67 Illinois Condenser Co. — Sub-miniatu electrolytic capacitors

26 Johnson Co., E. F.—Variable capacito

74 Jones Div., H. B., Cinch Mfg. Co.—Plugs & sockets

32 Kearfott Co., Inc.—Microwave Div. Microwave components

13 Kester Solder Co.—Solder

34 Klein & Sons, Mathias—Shear cutting plier

21 Kleiner Metal Specialties Inc.—Tubu and tubular components

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- agnetic Metals Co.—Stamped and tape wound cores and shields
- elpar, Incorporated—Engineering personnel
- innesota Mining & Manufacturing Co. —Video recording tape
- arda Ultrasonics Corp., The—Ultrasonic cleaning and chemical processing unit
- ational Lead Company—Solder
- ew Hermes Engraving Machine Corp. —Engraving machines
- nan & Sons, D. W.—Standby electric plants
- lytechnic Research & Development Co., Inc. — Spectrum analyzers and microwave components
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- arkes Tarzian, Inc.—Video level control unit
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- ylvania Electric Products Inc.—Electron tube news
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58 Acme Electric Corp.—Transformers

39 Aetna Life Insurance Co.—Business life insurance

90 Aircraft Radio Corporation—Snapslide fastener

87 Alford Mfg. Co., Inc.—TV antennas

16 Allen-Bradley Co.—Resistors

57 American Lava Corporation—Technical ceramics

66 Amperex Electronic Corp.—Twin tetrode tubes

3 Amphenol Electronics Corp.—Connectors

30 Arnold Engineering Co., The — Tape wound bobbin cores

72 Assembly Products, Inc.—Meter-relays

11 Astron Corporation—Sub-miniature capacitors

98 Audio Devices, Inc.—Magnetic recording tape

69 Automatic Metal Products Corp.—Connectors

15 Barker & Williamson, Inc. — Bandpass filters

504 Bell Aircraft Corp.—Engineering personnel

104 Birtscher Corp., Industrial Div.—Transistor clips

106 Biwax Corporation—Potting compounds

19 Blaw-Knox Co., Equipment Div.—Microwave towers

102 Bliley Electric Co.—Low frequency-high temperature crystals

96 Boehme, Inc., H. O.—Precision gears

54 Bomac Laboratories, Inc. — Microwave equipment

107 Borg Equipment Div., The George W. Borg Corp. — Potentiometers, microdials, motors, instruments

109 Borg Equipment Div., The George W. Borg Corp.—Micropots

20 Bourns Laboratories—Potentiometers

37 Brush Instruments Division of Clevite Corporation—Recorder

6 Burnell & Co., Inc.—Crystal filters

25 Bussmann Mfg. Div. McGraw-Edison Co.—Fuses and fuseholders

14 Cannon Electric Co. — Miniature and sub-miniature plugs

35 Chatham Electronics Div. of Tung-Sol Electric, Inc.—Special purpose tubes

40 Chicago Standard Transformer Corp.—Transistor transformers

68 Chicago Telephone Supply Corp.—Military variable resistors

56 Cinch Mfg. Co.—Hinge connector

17 Cleveland Container Co.—Phenolic tubing

33 Clevite Electronic Components Div. of Clevite Corp.—Piezoelectric material

73 Connecticut Hard Rubber—Pressure sensitive TEFLON tape

84 Conrac, Inc.—Monochrome, color m tors, audio, video receivers

8 Consolidated Electrodynamics, Analyt & Control Instrument Div.—Leak tectors

38 Corning Glass Works — Sub-miniat fixed glass capacitors

101 Cutler-Hammer, Inc.—Transistorized lay

9 Dale Products, Inc.—Resistors

53 Delco Radio Div. of General Motor High power transistors

61 Dialight Corp.—Pilot lights

100 Dimco-Gray Company—Snapslide fa eners

23 Dow Corning Corp.—Silicone dielect

27 Du Mont Laboratories, Inc., Allen Instrument Div. — Rack-mounted cilloscope

105 Elbe File & Binder Co., Inc.—Literat binders

42 Electro-Motive Mfg. Co., Inc.—Dur-m capacitors

65 Elgin National Watch Co., Electron Div.—Sub-miniature relays

7 Engineered Electronics Co.—Transit plug-in circuits

2 Ferroxcube Corp. of America—Ferr recording head cores

41 Formica Corp., Subsidiary of Americ Cyanamid—Laminated plastics

111 Freed Transformer Co.—Incremental ductance bridge, variable test volta megohmmeter

505 Garrett Corp., The—Engineering perso nel

80 Gates Radio Corp.—Intercom and inp console

76 General Chemical Div., Allied Chemic & Dye Corp.—"Electronic-grade" so vents

91 General Electric Co.—Brush-free voltag regulators

93 General Electric Co.—Heavy-duty vo age regulators

95 General Electric Co.—Tubeless voltag regulators

97 General Electric Co.—Induction volta regulators

503 General Electric Co., Missile Guidan Prod. Sect.—Engineering personnel

63 General Transistor Corp.—Phototransi tor

112 Graphic Systems—Visual control board

36 Hammarlund Mfg. Co., Inc.—Commu cations receiver.

46 Heath Company A Subsidiary of Da strom, Inc.—Electronic analog com puter kit

79 Houston Fearless Corp. — Portable T pedestal

4 Hughes Products, Hughes Aircraft Co.— Storage type oscilloscope

502 Hughes Aircraft Co.—Engineering pe sonnel

64 Industro Transistor Corp.—Germaniu transistors

67 Illinois Condenser Co. — Sub-miniatu electrolytic capacitors

26 Johnson Co., E. F.—Variable capacito

74 Jones Div., H. B., Cinch Mfg. Co— Plugs & sockets

32 Kearfott Co., Inc.—Microwave Div— Microwave components

13 Kester Solder Co.—Solder

34 Klein & Sons, Mathias—Shear cutti plier

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New Products and Technical Data—April '58

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230 Antenna, mobile—D. S. Kennedy & Co.
221 Camera, color TV—General Electric Co.
225 Camera, TV—General Precision Labs.
203 Capacitors, feed-thru — Cornell-Dubilier
219 Capacitor kits, piston—JFD Manufacturing Co.
232 Capacitors, tantalum — Texas Instruments, Incorporated
208 Ceramics—Coors Porcelain Co.
233 Ceramics, alumina — American Lava
195 Chokes, charging — Osborne Electronic
201 Connectors, coax — Automatic Metal Products Corp.
240 Connectors, special—AMP, Inc.
194 Dash pots—Electric Regulator Corp.
207 Differential—Waldorf Instrument Co.
198 Diode, cold cathode—The Victoreen Instrument Co.
214 Discriminator—Magnetic Research
202 Duplexer, ferrite—Kearfott Co.
215 Frequency changer—Carter Motor
204 Gas noise source—Bendix Aviation
199 Gauge, go-no-go — Computer-Measurements Corp.
234 Heterodyne equipment — Beckman Instruments, Inc.
220 Heterodyne repeater—Adler Electronics
231 Megaphone, power—Motorola, Inc.
236 Meters, panel—Weston Instruments
229 Microphone kit—Shure Brothers, Inc.
237 Pans, industrial — National Vulcanized Fibre Co.
241 Power supply—Foto-Video Labs.
217 Power supply, ac—Behlman Engineering
235 Radiation alarm—The Victoreen Instrument Co.
224 Recorder, strip chart—The Rust Industrial Co.
196 Rectifiers, expandable — Audio Devices
210 Regulators, microwave—Brocker Labs
197 Relay, mercury—The Adams & Westlake Co.
213 Relays, miniature—Iron Fireman
239 Resistor, miniature—Electra Mfg. Co.
209 Resistor, variable — Chicago Telephone Supply Corp.
205 Servo motor—Induction Motors Corp.
254 Sliding shorts—Polytechnic Research & Development Co.
227 Spotlights, studio — Century Lighting
216 Switch, subminiature — Electro-Snap Switch & Mfg. Co.
206 Tester, automatic—Lavoie Labs., Inc.
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242 Transformer, shielded — Osborne Electronic Corp.
218 Transistors, miniature—Raytheon Mfg.
211 Transistor, photo — General Transistor
223 Transmitter, FM—Gates Radio Co.
200 Tube, beam power—CBS-Hytron
228 Turntables—Collins Radio Co.
226 Video level control—Sarkes Tarzian Inc.
222 Video monitor—Conrac, Inc.
243 Voltmeter, digital—Electro Instruments
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171 Power supplies—The NJE Corp.
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161 Tester, linearity—Carrier Corp.
247 Testing equipment, electronic — Webschel Engineering
188 Thermometers — Minneapolis-Honeywell
162 Towers, telescoping—Alpar Mfg. Corp.
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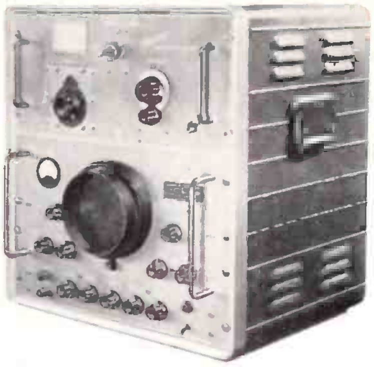

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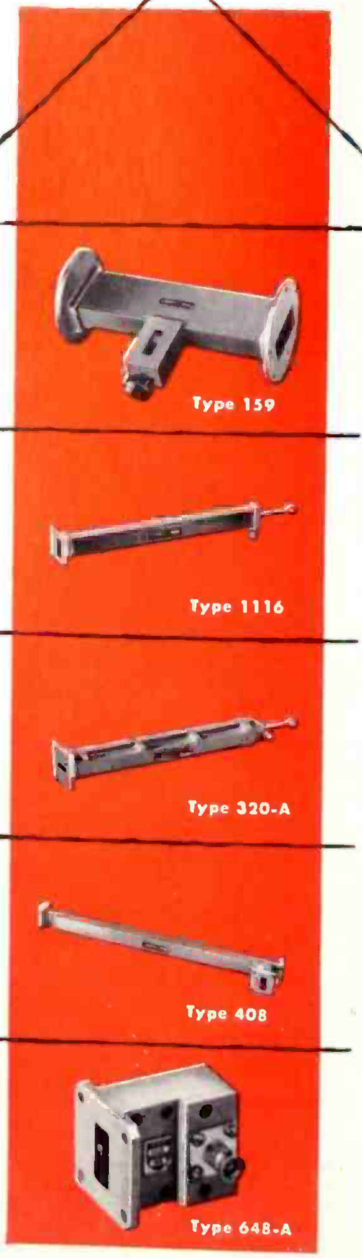

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YOUR NAME .... TITLE ....

FIRM ....

FIRM ADDRESS ....

CITY or TOWN . ... ZONE .... STATE ....

New Products and Technical Data—April '58

238 Amplifier, vswr—Narda Microwave Corp.
230 Antenna, mobile—D. S. Kennedy & Co.
221 Camera, color TV—General Electric Co.
225 Camera, TV—General Precision Labs.
203 Capacitors, feed-thru — Cornell-Dubilier
219 Capacitor kits, piston—JFD Manufacturing Co.
232 Capacitors, tantalum — Texas Instruments, Incorporated
208 Ceramics—Coors Porcelain Co.
233 Ceramics, alumina — American Lava
195 Chokes, charging — Osborne Electronic
201 Connectors, coax — Automatic Metal Products Corp.
240 Connectors, special—AMP, Inc.
194 Dash pots—Electric Regulator Corp.
207 Differential—Waldorf Instrument Co.
198 Diode, cold cathode—The Victoreen Instrument Co.
214 Discriminator—Magnetic Research Co
202 Duplexer, ferrite—Kearfott Co.
215 Frequency changer—Carter Motor Co
204 Gas noise source—Bendix Aviation Co
199 Gauge, go-no-go — Computer-Measurements Corp.
234 Heterodyne equipment — Beckman Instruments, Inc.
220 Heterodyne repeater—Adler Electronics
231 Megaphone, power—Motorola, Inc.
236 Meters, panel—Weston Instruments, In
229 Microphone kit—Shure Brothers, Inc.
237 Pans, industrial — National Vulcanized Fibre Co.
241 Power supply—Foto-Video Labs, Inc.
217 Power supply, ac—Behlman Engineering
235 Radiation alarm—The Victoreen Instrument Co.
224 Recorder, strip chart—The Rust Industrial Co.
196 Rectifiers, expandable — Audio Devices
210 Regulators, microwave—Brocker Labs
197 Relay, mercury—The Adams & Westlake Co.
213 Relays, miniature—Iron Fireman
239 Resistor, miniature—Electra Mfg. Co.
209 Resistor, variable — Chicago Telephone Supply Corp.
205 Servo motor—Induction Motors Corp
254 Sliding shorts—Polytechnic Research & Development Co.
227 Spotlights, studio — Century Lighting
216 Switch, subminiature — Electro-Snap Switch & Mfg. Co.
206 Tester, automatic—Lavoie Labs., Inc.
255 Transformers — Electro Engineering Works, Inc.
242 Transformer, shielded — Osborne Electronic Corp.
218 Transistors, miniature—Raytheon Mfg
211 Transistor, photo — General Transistor
223 Transmitter, FM—Gates Radio Co.
200 Tube, beam power—CBS-Hytron
228 Turntables—Collins Radio Co.
226 Video level control—Sarkes Tarzian Inc
222 Video monitor—Conrac, Inc.
243 Voltmeter, digital—Electro Instruments
212 Waveguides, flexible—Airtron, Inc.

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NEW TECH DATA

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185 Amplifier, X-band power—Resdel Engineering
189 Anodizing and plating — Anachrome
160 Cable support systems — Rome Cable
187 Capacitors, polystyrene — Aerovox
182 Computer, antenna system — The Andrew Corp.
192 Computer data, analog—Donner-Scientific Co.
251 Clutches and brakes—Autotronics, Inc
169 Connectors, sheath—Burndy Corp.
180 Cooling liquid—Bureau of Ships, USN
174 Cores, bobbin—G-L Electronics
250 Diode, silicon switching—Beckman Instruments, Inc.
191 Filters, quartz crystal—Burnell & Co.
170 Gamma radiation—The Applied Radiation Corp.
167 Grounding braid samples—Lenz Electric
178 Indicators, data display—Union Switch & Signal
193 Meters, 400 cycle—Varo Mfg. Co.
179 Meter, microwave frequency—Polytechnic Research & Development Co.
246 Monitoring systems—The Victoreen Instrument Co.
175 National Defense Brochure — Sylvania Electric Products, Inc.
253 Panel lamps — United Catalog Publishers
248 Panels & name plates—U. S. Radium Corp.
168 Phase meters & delay lines—Advance Electronics Lab.
244 Phenolic products—General Electric Co
252 Plastic sheets, laminated—New England Laminates Co.
172 Potentiometer, miniature — Technology Instrument Corp.
171 Power supplies—The NJE Corp.
163 Racks & desk assemblies — Par-Metal Products Corp.
177 Recorder, videotape—Ampex Corp.
190 Rectifiers, metallic power—Sel-Rex Corp
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186 Television, closed circuit—General Electric Co.
184 Television, industrial — Blonder-Tongue Labs.
161 Tester, linearity—Carrier Corp.
247 Testing equipment, electronic — Welschel Engineering
188 Thermometers — Minneapolis-Honeywell
162 Towers, telescoping—Alpar Mfg. Corp.
165 Transistor, silicon — Transitron Electronic Corp.

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This miniature, optically sensitive unit is extremely reliable and resistant to shock and vibration . . . hermetically sealed in a metal case with glass headers—light is applied through te glass top of the case. Tinned flexible leads may be soldered directly into circuit or used with standard sockets.

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"THE FASTEST GROWING NAME IN TRANSISTORS"

Circle 63 on Inquiry Card, page 117

"Inchworm" Motor

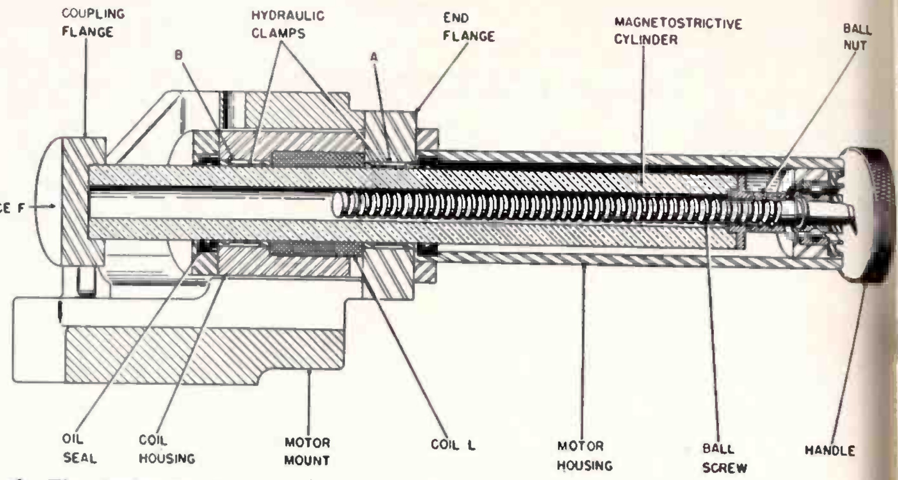

Fig. 1: The Inchworm linear actuator provides micro-inch dimensional control of delicate machine operations. One noteworthy application is in centerless grinders.

THE very nature of anti-friction bearing applications is defined in terms of tolerances in the tenths of thousandths of an inch range, micro-finished surfaces, and extreme uniformity of every component. Maintaining close tolerance specifications on a high-speed assembly-line operation has always presented many problems, but now the Torrington Company, major U. S. manufacturer of precision anti-friction bearings, has revealed new automatic control techniques that result in substantial improvements in bearing quality.

The new control techniques, developed by Airborne Instruments Laboratory of Mineola, New York, use a revolutionary Inchworm Motor. The Inchworm, together with other equipment built by Airborne, is being used to inspect precision bearing rollers as they are made, determining whether each roller is of the necessary precision, supplying the necessary corrective information, and actually adjusting the machine so as to correct any lack of precision in the parts it produces.

Disadvantages of the conventional lead-screw method of controlling centerless grinders were overcome at Torrington by removing the leadscrew and replacing it with an Inchworm Motor. The Inchworm uses magnetostriction to achieve precise movements of heavy loads over minute distances.

Magnetostriction is the effect that occurs when certain iron alloys, among them nickel, are subjected to a magnetic field such as produced by electric current flowing through a coil of wire surrounding the magnetostrictive material. Under the influence of the magnetic field the magnetostrictive material lengthens or shortens, returning to the original length when the magnetic field is removed by turning off the current in the coil of wire.

Magnetostriction is combined in the Inchworm, with a pair of hydromechanical clamps. Motion is produced by shrinking the magnetostrictive armature while the clamp at one end is locked and the one at the other end unlocked. This allows one end of the armature to move. The opposite clamp is then locked while the first one is unlocked and the armature is expanded by removing the magnetic field. The result is a net motion of the armature in the direction along its length. The motion may be either forward or backward, depending upon the order in which the clamps are locked and unlocked, together with the timing of the

(*Continued on page* 150)

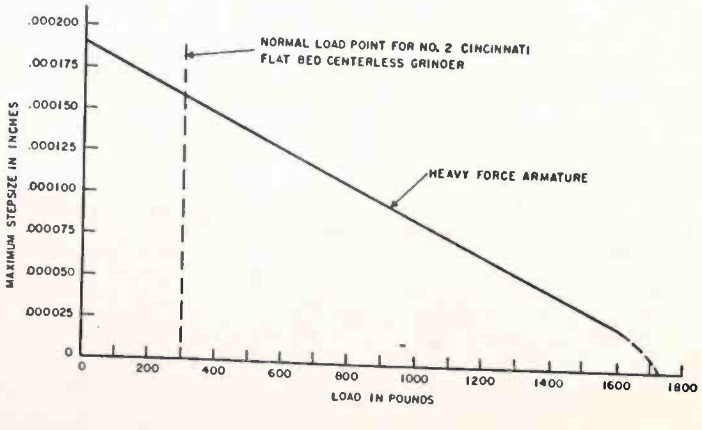

Fig. 2 (left): This is a plot of step size versus load for the new magnetostrictive motor.

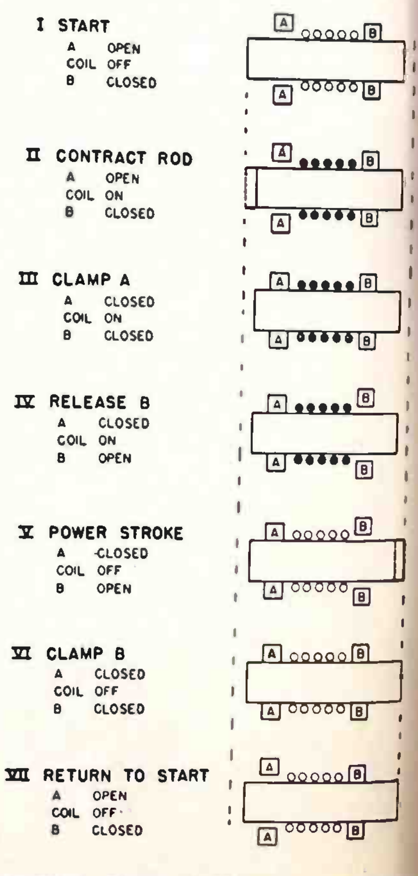

Fig. 3 (right): These steps are followed to generate the Inchworm motion.

INDUSTRO TRANSISTOR

TRANSISTORS FOR INDUSTRY

PNP Germanium Alloy-Junction Transistor Specifications

TRANSISTOR TYPE	MAX. RATINGS ▸▸ @ 25° C: V_{CE} Max. (Volts)	Dissipation Coefficient: In Air °C/mw	Dissipation Coefficient: With Ht. Sink °C/mw	TYPICAL CHARACTERISTICS @ 25° C (V_{CB} = −6 volt, I_E = 1ma except where otherwise noted): ** Beta @ 270 Cycles	** P'wr. Gain (db)	** Noise Figure (db)	$F_{\alpha cb}$ (mc)	C_c (μμf)	I_{CBO} (μa)	Application
GENERAL PURPOSE TYPES										
N422	—20	0.36	—	90	40	6 max.			6	Gen'l Purpose Audio
N464	—40	0.36	0.15	22	40	12			6	Gen'l Purpose Audio
N465	—30	0.36	0.15	45	42	12			6	Gen'l Purpose Audio
N466	—20	0.36	0.15	90	44	12			6	Gen'l Purpose Audio
N467	—15	0.36	0.15	180	45	12			6	Gen'l Purpose Audio
R-81	—25	0.36	0.15	90	44	12			6	Gen'l Purpose Audio
R-722	—20	0.36	0.15	22	40	16			6	Gen'l Purpose Audio
N413	—18	0.4	0.18	25			2.5	12	2	Gen'l. Purpose H.F
N414	—15	0.4	0.18	40	26†		8	12	2	Gen'l. Purpose H.F.
N416	—12	0.4	0.18	60	18☐		10	12	2	Gen'l. Purpose H.F.
N417	—10	0.4	0.18	80	25☐		20	12	2	Gen'l. Purpose H.F.
AUDIO RADIO TYPES					CLASS A / B					
N359	—20	0.36	0.15	150	A: ¶ 40 / B: ‡ 37				6	Radio Audio Output
N360	—20	0.35	0.15	100	A: ¶ 37 / B: ‡ 34				6	Radio Audio Output
N361	—30	0.36	0.15	70	A: ¶ 34 / B: ‡ 31				6	Radio Audio Output
N362	—20	0.36	—	120	A: § 41 / B: —	12			6	Radio Audio Driver
N363	—40	0.36	—	50	A: § 37 / B: —	12			6	Radio Audio Driver
R. F. RADIO TYPES										
N481	—12	0.4	0.18				2.5	12	2	Radio OSC
N482	—12	0.4	0.18		31*			12	2	Radio I.F.
N483	—12	0.4	0.18		35*			12	2	Radio I.F.
N485	—12	0.4	0.18		26†			12	2	Radio Converter
N486	—10	0.4	0.18		30†			12	2	Radio Converter

* Maximum Available Gain @ 455KC
† Conversion Gain @ 1640KC
‡ Maximum Available Gain @ 250 mw, 9 volts, 1KC
¶ Maximum Available Gain @50mw, 9 volts, 1KC
§ Maximum Available Gain @ 1mw, 9 volts, 1KC
** Grounded Emitter
☐ Maximum Available Gain @ 2 mc

▸▸ Maximum Junction Temperature is 85°C. All types are hermetically sealed in JETEC #30 welded case. The maximum allowable collector current is only limited by the maximum allowable transistor dissipation.

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Circle 64 on Inquiry Card, page 117

What's New . . .

New Digital Readout

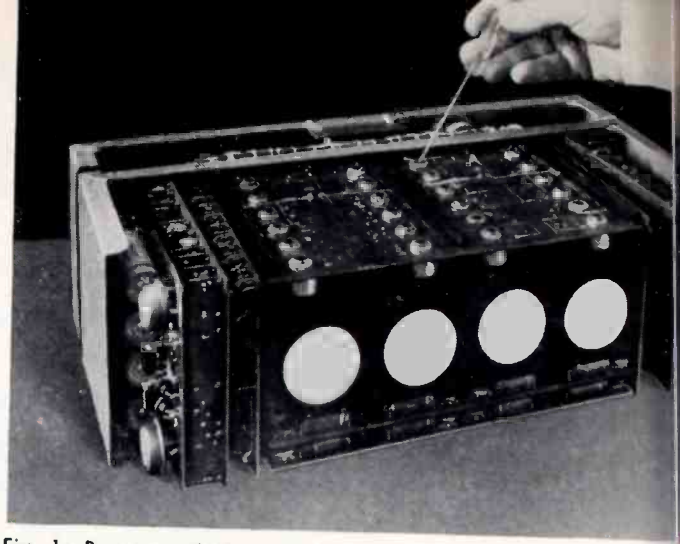


Fig. 1: Power supply is at left, then the number generating panel for tubes one and two. The third panel is for high voltage. The unretouched photograph shows high readability of electronic numbers.

A NEW digital display, developed by the Semiconductor Division of Hoffman Electronics Corporation, Evanston, Illinois, is a unique device with all-electronic construction. It uses new printed circuit plug-in panels which can easily be removed or inserted.

Display Medium

The display medium is a two-inch cathode ray tube. The viewing angle is quite large and does not have the limitations of edge lighted panels or horizontally aligned grids. The viewing brightness is constant since there is nothing in front of any of the numbers.

In the block diagram of the electronic digital display (Fig. 2), the dotted lines indicate the external contact closures that must be made to display the number "0682." The first digit explains the operation. The external contact closure connects the low voltage 100 KC signal from the oscillator to the number two high voltage r-f transformer on the units digit high voltage generator board. The high voltage r-f from this board is applied to the units gate board. The vertical and horizontal number waveshapes are continuously applied to the gate boards. The high voltage r-f is rectified on the gate board and used to open two gates. These two gates allow the vertical and horizontal waveshapes to be applied to the corresponding deflection plates on the units CRT.

Separate r-f transformers are used for each number in each digit to allow external control from pulse magnetic amplifier decade counters and other logical circuitry.

100 KC Oscillator

In the 100 KC oscillator circuit, the output voltages are taken across the r-f chokes in the collector circuits. Two digits are energized from each phase. This oscillator is the same type used to power the pulse magnetic amplifiers that will be used in conjunction with this digital display unit. This circuit is contained on a printed circuit board along with its associated low voltage dc supply, and the high voltage supplies for the CRTs.

High Voltage Generator

The high voltage generator printed circuit board consists of 20 r-f transformers. These transformers are tuned to 100 KC. The primaries are excited through a silicon diode by the 100 KC oscillator when the proper external connection is made. There are 10 transformers per digit and two digits per board. The input voltage is a rectangular pulse 5 μsec wide and 12 volts in amplitude at 20 ma. The output is a sine wave of 250 volts RMS.

Gate Board

The high voltage r-f from the high voltage generator board is applied to the appropriate number gates on the gate board. There are two gates per number: a gate for the vertical waveshape and a gate for the horizontal waveshape. All

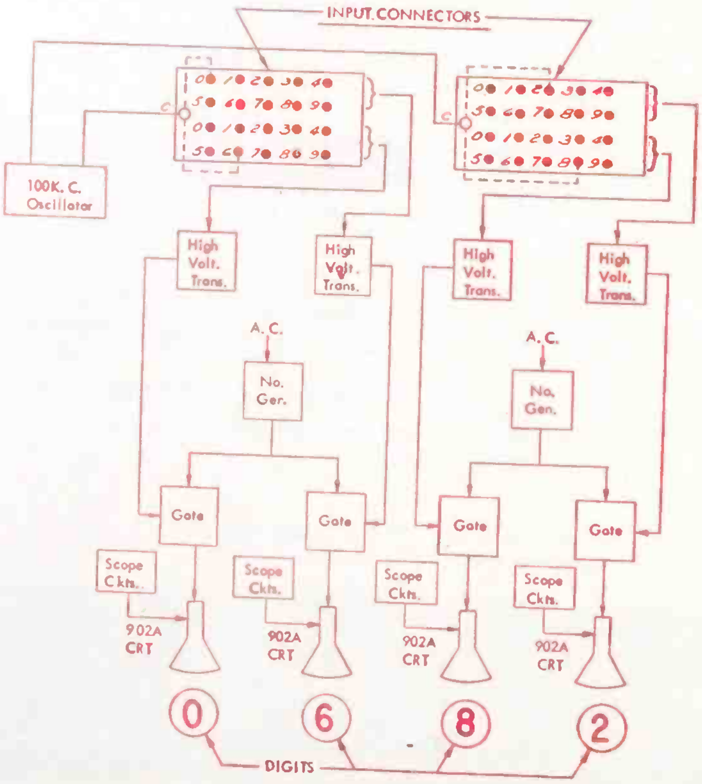


Fig. 2: Block Diagram, Hoffman digital readout Model DR-4C.

he gates for one digit are con-
tructed on a printed circuit board. 'he number waveshapes are always resent at the input to the gates. 'he waveshapes cannot pass hrough due to the back-to-back liodes of the gate. When the 100 kc high voltage is applied to a pair of gates, these two diodes are brought into a conducting state by rectification of this voltage. This allows the number waveshapes to pass through to the common out-put terminals which go to the de-flection plates.

Number Generator

The number waveshapes are generated by circuits that are constructed on a printed circuit board. The numbers are formed by Lissajous patterns. A horizontal waveshape and a vertical waveshape are generated for application through the gates to the proper CRT deflection plate. All waveshapes are derived from a 60 cycle, center-tapped, sine wave source.

Reliability is achieved in the design by the exclusive use of passive elements to generate the necessary waveshapes. The only components used in the number generator circuits are resistors, capacitors and silicon diodes. Simplicity of design is another factor that contributes to the reliability of the device. All circuits utilize standard techniques of diode clipping, diode limiting and/or phase-shifting.

Zero

The zero is derived in the usual way, from two sinusoidal waveshapes with a 90° phase difference.

One

Number one, of course, requires only a vertical waveshape. A sine wave is used since it can be taken directly from the zero vertical waveshape.

Two

The vertical waveshape for number two is an unshifted sine wave with a diode limiter on the negative excursion. The horizontal waveshape has three components. Two of these are derived from phase-shift networks and the third directly from the supply. The positive portions of these waves are summed into a common point to yield the number two horizontal waveshape.

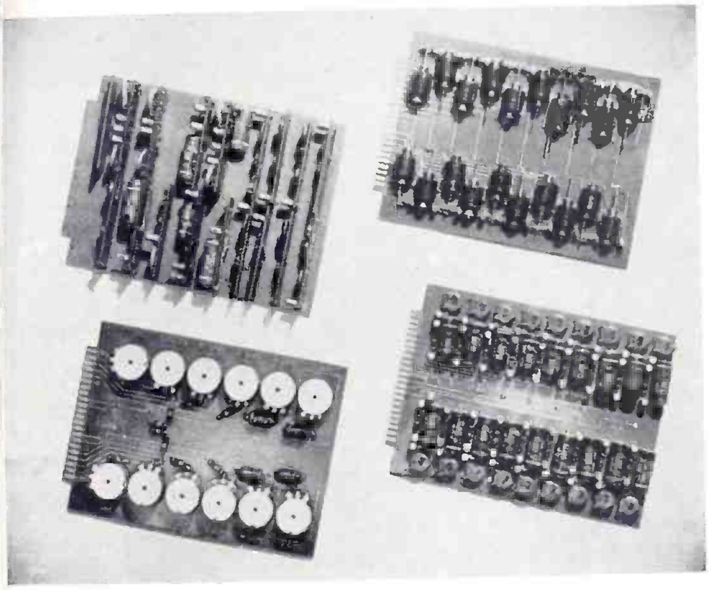


Fig. 3: These are the four basic plug-in panels used in the all-electronic digital display unit.

Three

The vertical waveshape of number three is a shifted sine wave with the positive excursion of smaller amplitude than the negative excursion. This is accomplished by shunting a diode with a resistor. The horizontal waveshape has four components. Two of them are derived from phase-shift networks and the other two directly from opposite phases of the supply. The positive portions are summed together to yield the number three horizontal waveshape.

Four

Number four is generated in the following manner: The vertical waveshape is a series of negative half sinusoids with every other one clipped slightly below maximum amplitude. This is accomplished by clipping the positive excursion from one phase of the supply and summing in the positive excursion of the other phase unclipped. The horizontal waveshape is a negative half sinusoid clipped at half amplitude and summed with a positive half sinusoid of slightly greater amplitude.

Fig. 4: Richard White, chief application engineer, and Eugene Gould, chief engineer, manufacturing, show how punched card input is used with the digital display unit.

Five

The vertical waveshape of number five is an unshifted sine wave with a diode limiter on the positive excursion. The horizontal

(*Continued on page 147*)

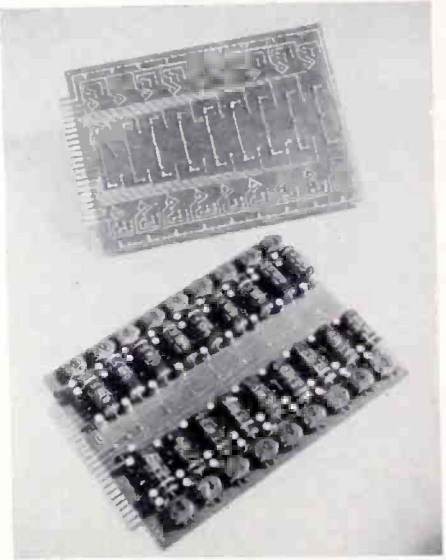
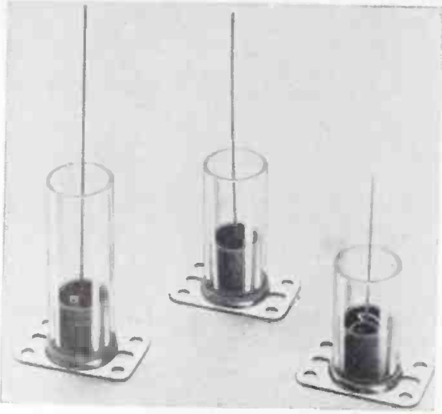


Fig. 5: Passive diodes, capacitors and resistors form the gate control circuits.

New Products . . . for the Electronic Industries

DASH POTS

Airpot, a new line of precision air damping dashpots for system stabilization, vibration damping and time delay, has been developed. Units are available with two-way or one-way

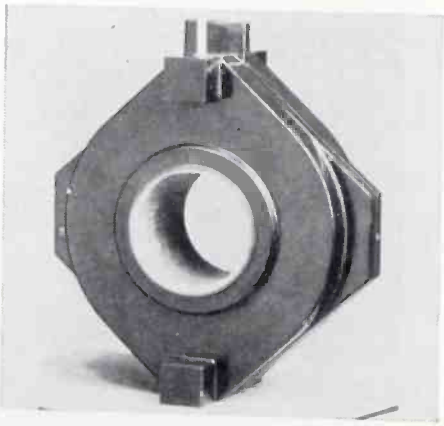


damping action in either direction. Two-way damping pots provide adjustable damping, equal in both directions. One-way damping models offer non-linear adjustable damping in the push or pull direction and fast reset. Weighing less than an ounce, they are available in various cylinder lengths and connecting rod spring gradients. Electric Regulator Corp., Pearl St., Norwalk, Conn.

Circle 194 on Inquiry Card, page 117

CHARGING CHOKES

New in the field of charging chokes is this production model, by manufacturers of a complete line of transformers, precision potentiometers, and other electronic components for use in aircraft and similar systems. Engineers developed a new encapsulating technique to provide a casting that would withstand temperatures from −40° C to +105° C. The layer-

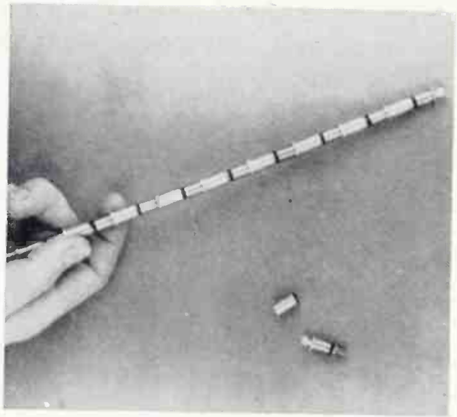


wound coil is encapsulated in a special material to resist corona effects as well as voltage and temperature shock. Osborne Electronic Corp., 712 S. E. Hawthorne Blvd., Portland, Ore.

Circle 195 on Inquiry Card, page 117

EXPANDABLE RECTIFIER

A versatile new silicon rectifier that can be used singly, or assembled instantly into series chains for higher voltage applications, is available. The A750 can be combined with inex-

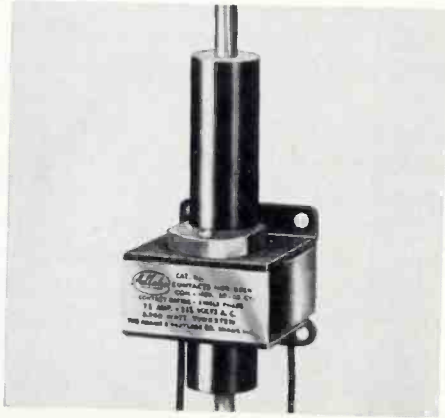


pensive threaded bushings to form simple assemblies for kilowatts of rectified power. The individual unit is sealed and threaded at each end, so it can be screwed into the bushings, or into a chassis "heat sink," or plugged into a clip holder. Unit is 1 in. long with an inverse rating of 400 v. and maximum forward current of 750 ma. Audio Devices, Inc., 620 E. Dyer Rd., Santa Ana, Calif.

Circle 196 on Inquiry Card, page 117

MERCURY RELAY

With 75 a. capacity in overall dimensions of 4 23/32 x 2 3/16 x 2 1/16 in. the "Little Giant" mercury-to-mercury relay achieves new reduced size-to-capacity ratio. Based on a power factor of 75-80%, the relay contacts are rated at 75 a. The Type 1141 relay also is rated at 8000 w. Tungsten. Both ratings are based on 115 v. 50-60 CPS. It has a molded coil



and flexible leads. It features the advantages of perfect snap action without pitting, sticking or burning and has hermetically sealed case. The Adams & Westlake Co., Elkhart, Ind.

Circle 197 on Inquiry Card, page 117

COLD CATHODE DIODE

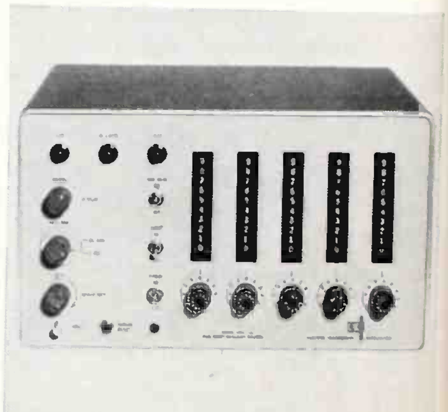
A new micro-miniature cold cathode gas trigger diode tube is available for electronic, avionic and missile applications where weight, physical size and high G considerations are

involved. It can be used for isolation purposes, electronic switching, RC timing circuits, relaxation oscillators, etc. It has high input resistance before a critical voltage is reached, at which time the new diode "breaks down" and becomes a very low resistance. Available in a wide variety of characteristics. The Victoreen Instrument Co., 5806 Hough Ave., Cleveland 3, O.

Circle 198 on Inquiry Card, page 117

GO-NO-GO GAUGE

An electronic go-no-go gauge, Model 620A, for speed and rate control has been developed. It monitors any control or limiting situation that can be stated in terms of frequency. In operation, an unknown frequency is applied to the input of the instrument. Upper and lower frequency limits are selected by setting control knobs. Any 2 frequencies falling between 1 and



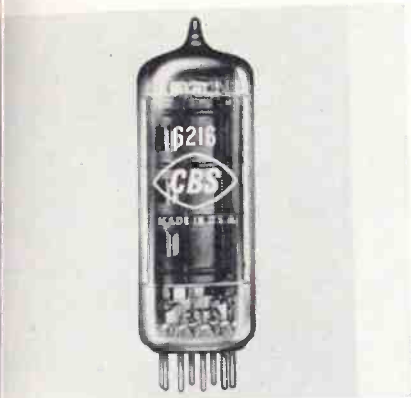
40,000 CPS can be selected in 1 CPS increments. If frequency is below or above limits, a light lights. Computer-Measurements Corp., 5528 Vineland Ave., N. Hollywood, Calif.

Circle 199 on Inquiry Card, page 117

New Products . . . for the Electronic Industries

BAM POWER TUBE

The CBS 6216 is especially suitable f use as a series pass tube in reg- ι ted power supplies. This 9-pin rniature beam power tube was orig- i lly designed as a filter reactor to



place the bulky iron-core choke in ilitary airborne and vehicular equip- ent. Now it is also finding wide age in pass, switching, control, thode follower and power amplifier rcuits. It carries maximum ratings 10 w. plate dissipation and 110 ma. ιthode current, and is ruggedized to ithstand impacts up to 650 g. CBS- ytron, Parker St., Newburyport, ass.

Circle 200 on Inquiry Card, page 117

FERRITE DUPLEXER

A new rotation type ferrite duplexer, designed especially for the most popular frequency in the X-Band spectrum is available. Model W163-1C-1 Faraday Rotation Duplexer

weighs 7 oz. and offers a frequency range of 9.2 to 9.4 KMC with isolation at 20 db min. and insertion loss of 0.5 db max. It incorporates a unique coaxial termination to permit both transmission and reception. Other features include: vswr of 1.25 max.; max. power absorbed in load is 12 w. and peak power at 10 kw. Kearfott Co., Western Div., 14844 Oxnard St., Van Nuys, Calif.

Circle 202 on Inquiry Card, page 117

GAS NOISE SOURCE

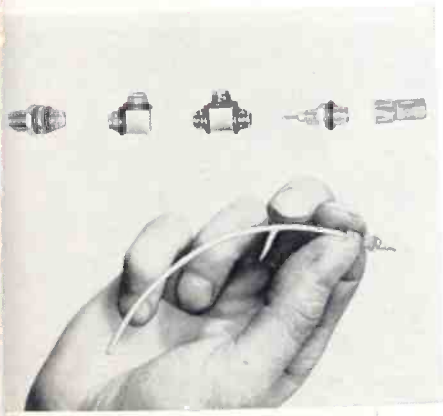
Tube is designed for use as a noise source in super high frequency (SHF) measurements. It is constructed for use with a 90° H-plane mount in RG/48U waveguide to pro-

vide noise in the 7.6-11.5 cm waveband. When used in the suggested mount assembly it functions essentially as an untuned noise generator over the recommended transmission bandwidth of the mount. Typical applications are: radio receiver calibration, radiometer, micro-wave radio relay, radio telescope reference and noise measurement standard. Bendix Aviation Corp., Eatontown, N. J.

Circle 204 on Inquiry Card, page 117

OAX CONNECTORS

The micro-miniature connectors ave been designed for use with the resent minute coaxial cables. The lug is designed for cables with a acket diameter from 0.069 to 0.080 nch. With a special reducing adapter, able sizes of 0.058 to 0.068 inch acket diameter may be used. This nit has a slotted collet type clamp-

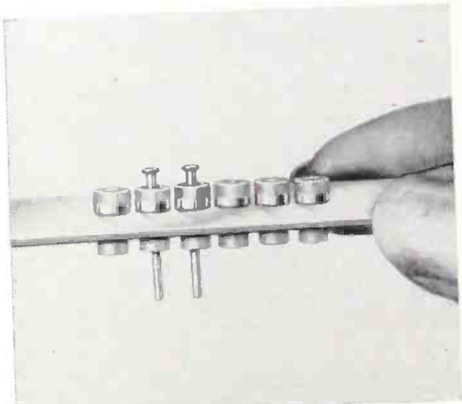


ing device as an integral part of the body, providing a wide clamping area. Automatic Metal Products Corp., 315 Berry St., Brooklyn 11, N. Y.

Circle 201 on Inquiry Card, page 117

FEED-THRU CAPACITORS

Designed to save space and reduce assembly costs, Type CFT ceramic feed thru capacitors are particularly useful where compactness is an essential part of equipment design. They are self-positioning. The electrode is hot-solder coated. The capacitor feed-thru hole (0.62 in. min.) accommodates wires up to No. 15 AWG. They



have a dc working voltage of 600 v. and are available 4.7 $\mu\mu$f to 1000 $\mu\mu$f. Operating temperature range is $-55°$ C to $+85°$ C. Cornell-Dubilier Electric Corp., S. Plainfield, N. J.

Circle 203 on Inquiry Card, page 117

SERVO MOTOR

A line of size 8 servo motors featuring extra-short length with high-torque-to-inertia ratio has been introduced as the 700 series. Achieving a high-torque-to-inertia ratio within an extra-short length of 1.062 in. and a diameter of 0.750 in., the series serves a wide variety of aircraft and missile applications. The units are

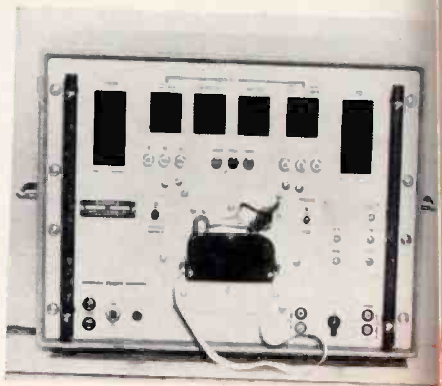
available with inputs from 6 to 57 v. and operate within an ambient temperature range of $-55°$C. to $+125°$C. Induction Motors Corp., 570 Main St., Westbury, L. I., N. Y.

Circle 205 on Inquiry Card, page 117

New Products

AUTOMATIC TESTER

An automatic tape-programmed r[e]sistance measuring instrument whi[ch] can cut final test time by 80% [is] available. It can select any two of 24 points and measure the resistance be-

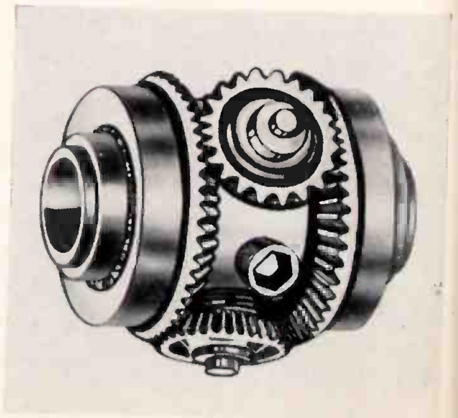


tween them, in a range from 1 ohm to 9.99 megohms. In addition to selecting either a 1%, 5%, 10%, or 20% nominal tolerance, it may be programmed to pass any value below or above a selected median resistance. The Robotester will perform a series of circuit checks automatically at 60 to 100 tests per minute. Punched tape provides a permanent test program. Lavoie Laboratories, Inc., Morganville, N. J.

Circle 206 on Inquiry Card, page 117

DIFFERENTIAL

A new differential designed specially for miniature servo and computer applications is now available. Weighing only 0.2 oz., this differential is the smallest unit available for a 1/8 inch shaft. A maximum load rating of 5-6 oz. -in. and a 500 RPM



maximum operating speed are recommended. Waldorf Instrument Co., Electronics Division, Huntington Station, Long Island, N. Y.

Circle 207 on Inquiry Card, page 117

→

1 Amperex 6939
5 watts
total anode
dissipation

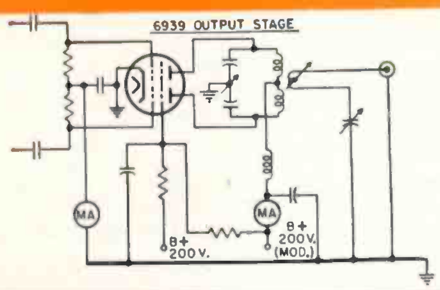
2 Amperex 6360
14 watts
total anode
dissipation

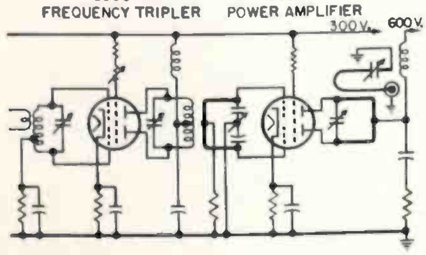
3 Amperex 6907
20 watts
total anode
dissipation

4 Amperex 5894
40 watts
total anode
dissipation

Compatibility

an Amperex® concept in tube design





	Type	Max. Power Input (watts)	Max. Power Output (watts)
1	6939	14 ICAS 12 CCS	7.5 ICAS 5.8 CCS
2	6360	30 ICAS 22.5 CCS	18.5 ICAS 14.5 CCS
3	6907	112 ICAS 90 CCS	67 CCS
4	5894	150 ICAS 120 CCS	96 ICAS 90 CCS

Presenting a Compatible Family of 4 Twin Tetrodes, Specifically Designed to Simplify Circuitry in Mobile VHF/UHF Transmitter Design

These four AMPEREX twin tetrodes, designed from the ground up as a compatible group, complement one another in electrical and mechanical characteristics. The designer of light VHF and UHF transmitting equipment in the 5 to 85-watt category can draw on this group for all of his power amplifier, oscillator, frequency multiplier and modulator requirements, with considerable benefit in design efficiency. He can (1) save entire stages in his transmitter, (2) reduce power consumption requirements and (3) generally optimize transmitter design. The superior performance and reliability of the AMPEREX twin tetrodes, particularly in the 460 Mc band, have made them the most widely accepted small transmitting tubes in the world for amateur, professional, military and airborne applications.

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about tubes and useful circuitry for VHF/UHF transmitters

AMPEREX ELECTRONIC CORP., 230 DUFFY AVENUE, HICKSVILLE, L.I., N.Y.

In Canada: Rogers Electronic Tubes & Components, 11-19 Brentcliffe Road, Toronto

New Products . . .

CERAMICS

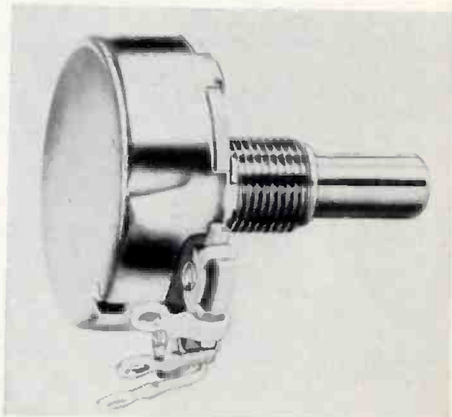
The new ceramic, type AD-99, has a tensile strength of 34,000 psi—as strong as cast iron. This is 30% greater strength than the commercial

high aluminas of 96% to 98% aluminum oxide. It is superior to any ordinary metals in strength at high temperatures. At modern microwave frequencies, loss tangents are lower than those of plastics and all but one or two special ceramic materials. These properties, combined with the hardness and wear resistance of the alumina family are available for commercial use. Coors Porcelain Co., 714 9th St., Golden, Colo.

Circle 208 on Inquiry Card, page 117

VARIABLE RESISTOR

A high temperature 2 w. military variable resistor with greater stability and certified to meet MIL-R-94B Style RV4 is available. Ambient operating temperature of −63° C to +150° C. Type 96 is available with spst switch, printed circuit terminals and a variety of shafts and bushings. Also available in 2 or 3 section concentric shaft and straight shaft tan-



dem construction. All insulated parts are non-fungus nutrient hi temp silicon fibre glass construction. New design has closed openings under terminals. Chicago Telephone Supply Corp., Elkhart, Ind.

Circle 209 on Inquiry Card, page 117

MICROWAVE REGULATOR

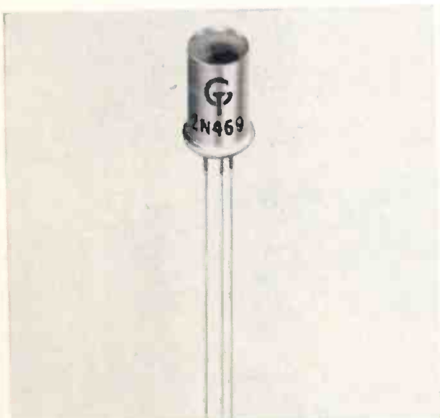
Model #301, Microwave Regulator is designed primarily for use with a traveling wave tube and for the traveling wave tube manufacturer. It is the connecting link for a 1KC

square wave modulated constant power source. The device itself operates at an audio frequency, hence, is completely independent of microwave power and frequency. By utilizing constant power, systems are more versatile and some measurements heretofore long and laborious, if not impossible, are done swiftly and with high accuracy. Brocker Labs., Dept. TT, P. O. Box 967, Sunnyvale, Calif.

Circle 210 on Inquiry Card, page 117

PHOTOTRANSISTOR

PNP phototransistor, type 2N469, is a highly improved version of the GT type 2N318 phototransistor, being smaller, and having greater optical sensitivity. This new device has a wide variety of industrial and military applications where light is utilized to activate electronic equipment. It is especially important in punched card and tape readouts in computer

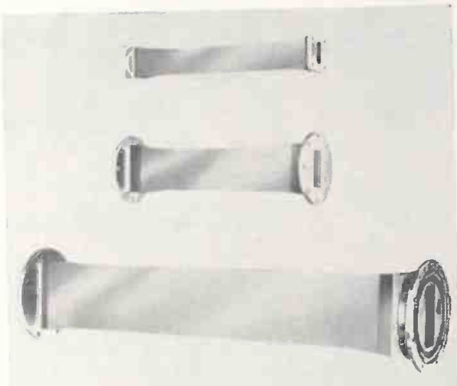


systems. The primary advantages are small size, low power consumption, head-on construction, good light sensitivity, high gain and low leakage current. General Transistor Corp., Jamaica, N. Y.

Circle 211 on Inquiry Card, page 117

FLEXIBLE WAVEGUIDES

Low and high temperature resistant silicone rubber molded Flexaguide has been made available. They operate over a range of −100° F to +300° F, higher for short periods. They retain

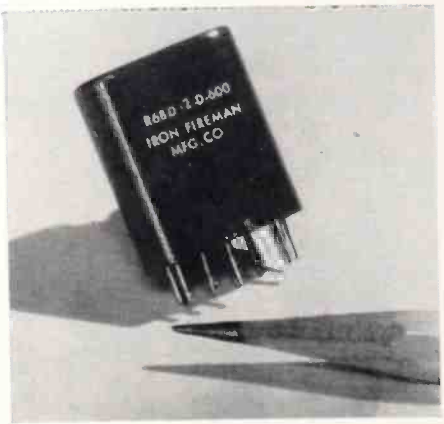


complete flexibility, with a minimum bending radius identical to that of neoprene molded flexible waveguides. Available in all waveguide sizes from WR-284 to WR-28. Obtainable with standard military or EIA type, brass or aluminum flanges in all combinations for both pressurized and non-pressurized applications. Airtron, Inc., 1096 W. Elizabeth Ave., Linden, N. J.

Circle 212 on Inquiry Card, page 117

MINIATURE RELAYS

A series of micro-miniature relays that have long life at high temperatures is available. Both current-sensitive and voltage-sensitive models are offered. Designated as Series R600 (dpdt) and RS600 (spdt), these relays will withstand shocks of 50 G and vibration up to 2000 CPS at 20 G. Contacts are rated at 2 a. resistive, 28 vdc or 115 vac. Continuous op-

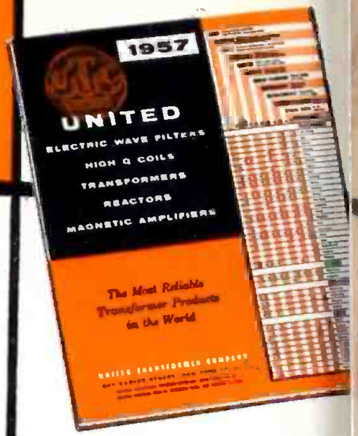


eration is possible throughout a temperature range from −65° C to +125° C. Conform to or exceed Mil. Specs MIL-R-5757C. Iron Fireman Electronics Div. 2838 S.E. 9th Ave., Portland 2, Ore.

Circle 213 on Inquiry Card, page 117

The Transformer for Your Application ..FROM STO[CK]

Three hundred hermetic items proved to MIL-T-27A...Filters, high Q coils, power, plate, filament, pulse, audio transformers. Eliminates costs and delays of initial MIL-T-27A testing. Seven hundred stock items for virtually every application in the electronic field . . . each with UTC Reliability, highest in the field.



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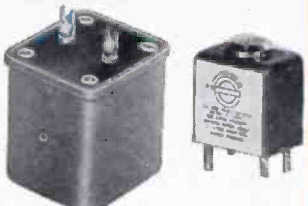
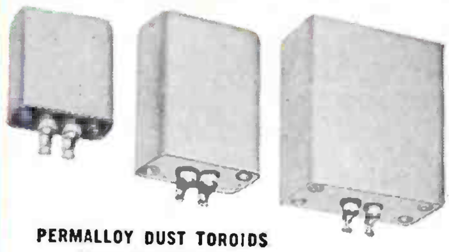


VARIABLE INDUCTORS
Standard,
Hermetic MIL-T-27A

LOW FREQUENCY INDUCTORS
INDUCTANCE DECADES



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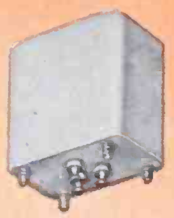
Highest Q, accuracy and stability



LOW PASS, HIGH PASS, BAND PASS FILTERS
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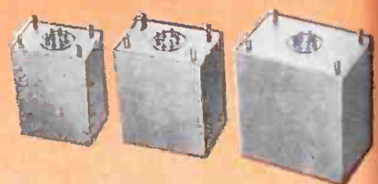
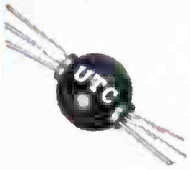
AUDIO COMPONENTS
Hermetic, MIL-T-27A
for every application

POWER COMPONENTS
Hermetic, MIL-T-27A
Power, Plate, Filament Transformers,
Filter chokes

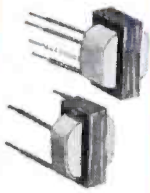


MAGNETIC AMPLIFIERS
Hermetic, MIL-T-27A

DECI-OUNCER
Transistor transformers .1 oz.
Hermetic, MIL-T-27A



PULSE TRANSFORMERS
Wound Cord, MIL-T-27A



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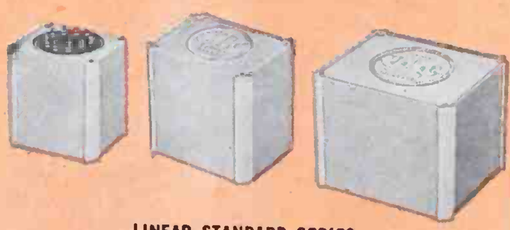
Audio and
Transistor

OUNCER AND PLUG-IN
Wide Range Audios

EQUALIZERS
Broadcast and Hi-Fi



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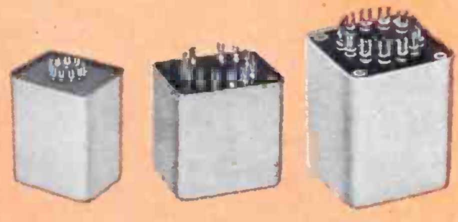

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Power and audio units for industrial service

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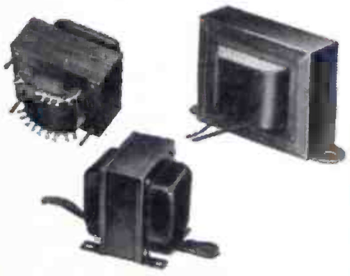

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Units for every amateur application.

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PACIFIC MFG. DIVISION, 4008 W. Jefferson Blvd., Los Angeles, Cal.

Circle 70 on Inquiry Card, page 117

WASHINGTON

News Letter

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GOING ON FOR YEARS—This process of pressures over station approvals has been going on for years principally in the broadcasting-television field during the existence of the FCC since 1934 and its predecessor agency, the Federal Radio Commission. The results of the House investigation, it is felt, will bring about a constructive "house cleaning" of the situation and will place the Commissioners who have abstained from such pressures in a greatly strengthened position.

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SPECIAL INDUSTRIAL RADIO — Some encouragement—but "no promise"—that at least part of the FCC's special industrial radio service may remain under that name when current rulemaking affecting the service is concluded was offered recently to members of the Special Industrial Radio Service Association by FCC Safety & Special Radio Services Bureau Industrial Division Chief Daniel H. Arnold. Mr. Arnold was referring to outstanding rule proposals which would abolish the present special industrial and low power radio services and create in their place a "business" radio service. He declared that in FCC staff rulemaking discussions the idea of retaining the special industrial radio service in a modified form even though a business service is established is under consideration. Mr. Arnold also disclosed that the FCC planned to issue early this month (April) an announcement on the finalization of the industrial split-channel rules.

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ROLAND C. DAVIES
Washington Editor

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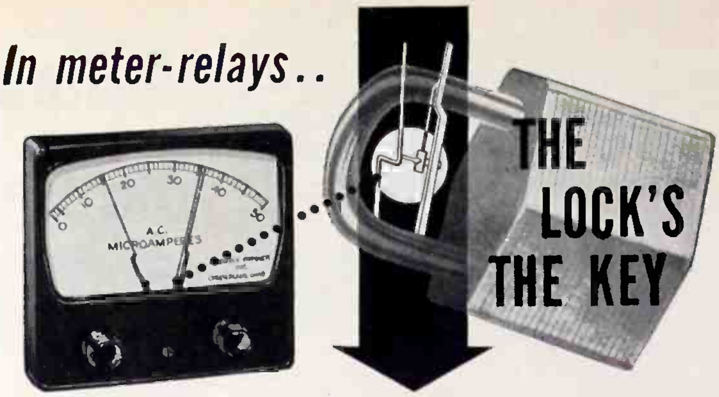
Circle 71 on Inquiry Card, page 117

In meter-relays . .



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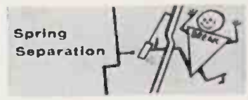

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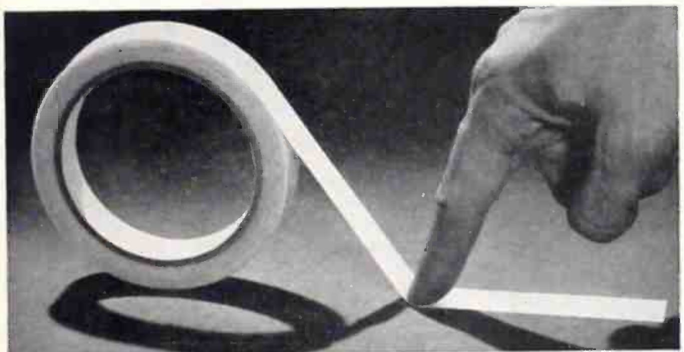
Circle 72 on Inquiry Card, page 117



New TEMP-R-TAPE® C

.002" thick, 2750 v/m pressure sensitive TEFLON* tape For -100°F to 500°F applications

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*du Pont TM.

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Circle 74 on Inquiry Card, page 117

WASHINGTON

News Letter

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MOBILE RADIO CASE—The FCC hearings on lease-maintenance arrangements by the telephone companies for mobile radio systems which spanned a period of five weeks have finally ended in March, with a voluminous record of testimony and legal viewpoints through participation by nearly a score of attorneys. The major issue of whether the 1956 Bell System-Justice Department consent decree bars the telephone companies from such arrangements is the significant policy. If the FCC rules that the consent decree prohibits lease-maintenance arrangements, it is felt that the door will be open for private electronics engineering firms to install and maintain mobile radio systems.

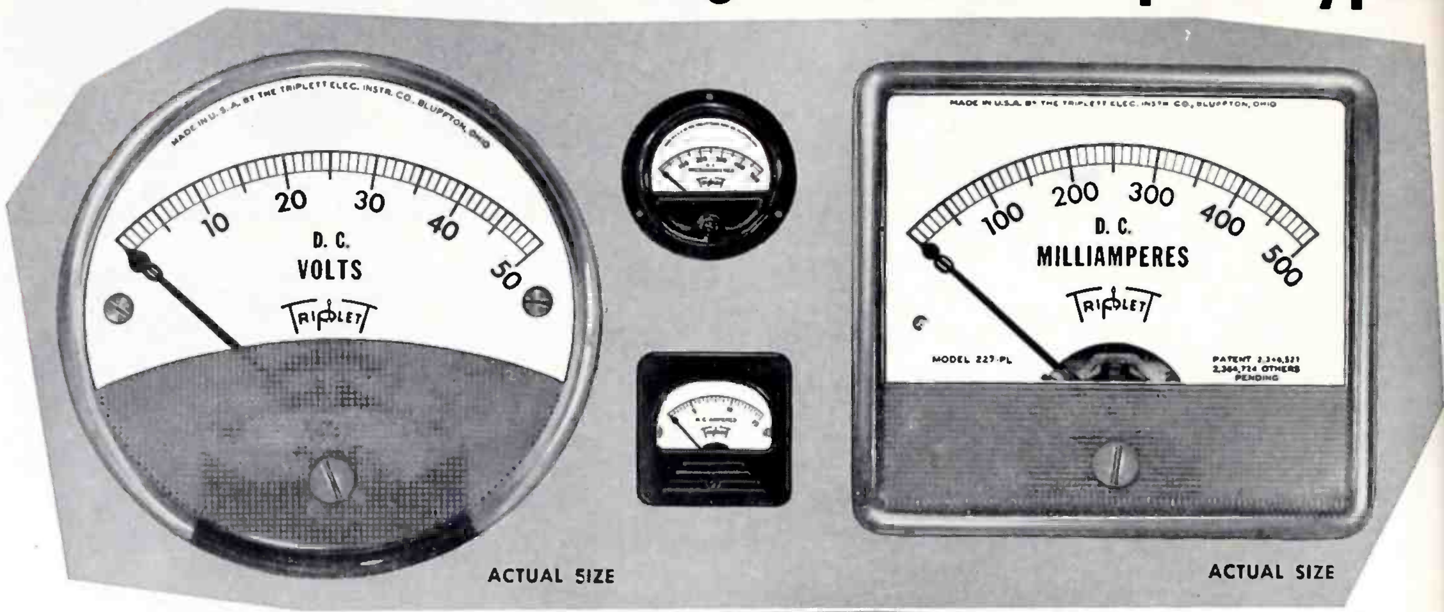
MICROWAVE COUNCIL—A "combined special and annual" meeting of the operational Fixed Microwave Council was held in Washington last month bringing together the representatives of private microwave and mobile communications systems from virtually every segment of the nation's industrial economy. The Council discussed the status of the FCC's investigation to determine future usage policies for the frequencies above 890 MC; the current FCC hearings on the proposed tariff of the AT&T Long Lines Dept. for the leasing and maintenance of private mobile communication systems; and OFMC policies concerning the dissemination of microwave usage information to equipment suppliers.

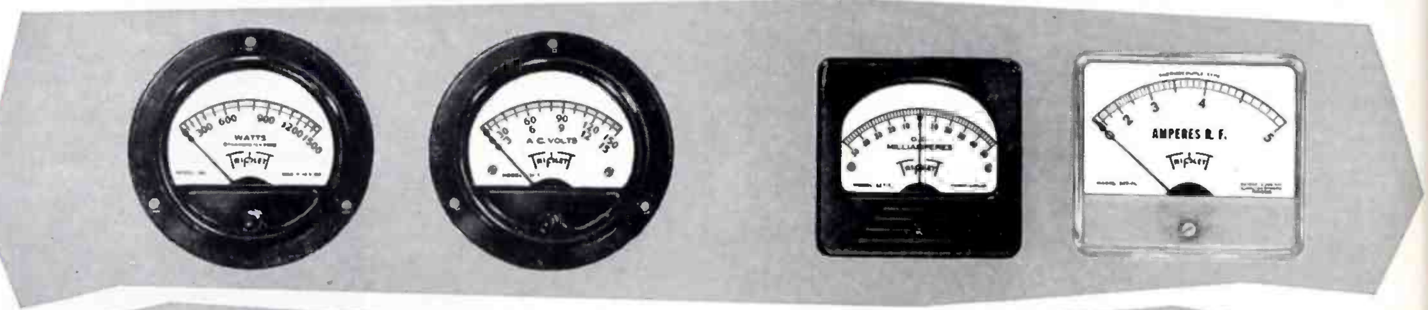
SPECIAL INDUSTRIAL RADIO — Some encouragement—but "no promise"—that at least part of the FCC's special industrial radio service may remain under that name when current rulemaking affecting the service is concluded was offered recently to members of the Special Industrial Radio Service Association by FCC Safety & Special Radio Services Bureau Industrial Division Chief Daniel H. Arnold. Mr. Arnold was referring to outstanding rule proposals which would abolish the present special industrial and low power radio services and create in their place a "business" radio service. He declared that in FCC staff rulemaking discussions the idea of retaining the special industrial radio service in a modified form even though a business service is established is under consideration. Mr. Arnold also disclosed that the FCC planned to issue early this month (April) an announcement on the finalization of the industrial split-channel rules.

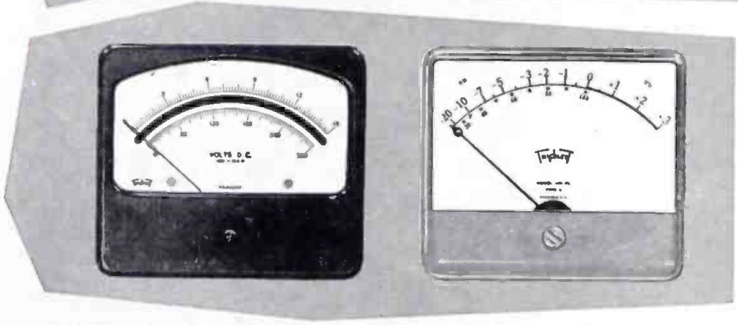
National Press Building
Washington 4

ROLAND C. DAVIES
Washington Editor

TRIPLETT Reliability... through 15,631 accepted types







Clear plastic (PL) meters feature;

- Longer scale length
- Visibility unlimited
- Light unobstructed—no shadows
- Interchangeability—universal
- Appearance revolutionized

UNIQUE FEATURES AND CHARACTERISTICS

These guarantee superior quality in *all* TRIPLETT meters:

- High torque to weight ratio for extra rugged movement. Specially developed bearings withstand severe vibration and reduce friction to a minimum.
- Bearings are microscopically graded not only for depth and radius, but also for *polish*. Only best quality jewels are used.
- Unique hardening method assures uniformly hard pivots.
- High flux scientifically aged alnico magnets for greatest permeability. Micrometrically balanced all metal frame construction protects bearings against vibration from any direction.
- Simplicity of frame construction assures easy, accurate alignment in servicing.
- Dials are all metal—no paper dials are ever used—will not become abrasive, warp, crack or discolor under normal conditions. (Printing presses in Triplett's own plant allow fast, inexpensive service on special dial requirements.)
- Extra strong ribbed pointers precisely balanced with triple "slide and lock" adjusting weights.
- Insulations provide extra allowance for breakdown voltages.
- All metal parts processed, all molded parts pre-cured to eliminate distortions from stresses and strains.

BURTON BROWNE ADVERTISING

TRIPLETT ELECTRICAL INSTRUMENT COMPANY • 52 years of experience • BLUFFTON, OHIO

Triplett design and development facilities are available for your special requirements for meters and test equipment.

New Products ... for the Electronic Industries

DISCRIMINATOR

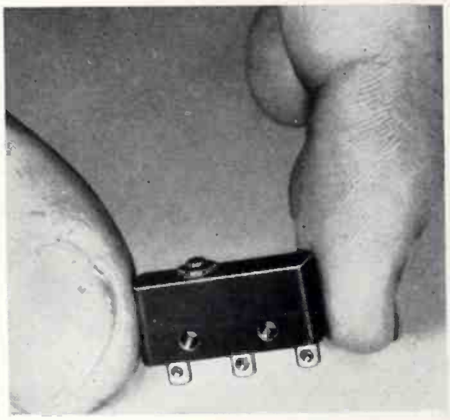
A new line of magnetic frequency discriminators has been developed for the purpose of converting frequency deviation into analog voltage variation. These converters are primarily

intended for telemetering instrumentation. The units produce a well filtered 0-5 vdc output voltage in response to a frequency deviation. Two representative models of the new line are the FD-400 for 400 CPS power sources and the FD-2000 for inverters operating at 2000 CPS. Frequency discriminators are available for frequencies up to 10 KC. Magnetic Research Corp., Hawthorne, Calif.

Circle 214 on Inquiry Card, page 117

SUBMINIATURE SWITCH

The spdt, E4-134 snap-action switch features small size, dimensional stability, precision and long mechanical life. Available with turret or standard solder terminals and with a wide

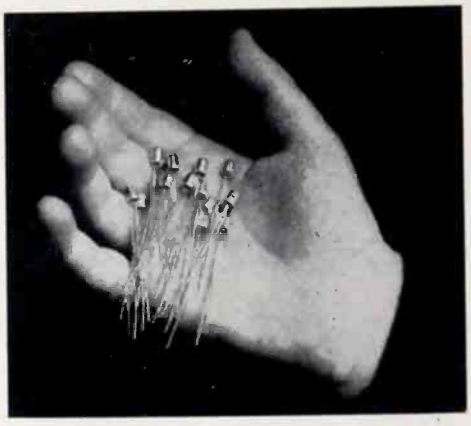


range of actuators for manual, in-line, cam or slide applications. The small size and sensitive operation make it applicable to business machine, vending, electronics and other uses requiring precise electrical control in limited space. Can be used individually or in multiple unit bank assemblies. Electro-Snap Switch & Mfg. Co., 4218 W. Lake St., Chicago 24, Ill.

Circle 216 on Inquiry Card, page 117

MINIATURE TRANSISTORS

A line of reliable subminiature transistors is available. These are pnp germanium units made by the fusion-alloy process. The new subminiature types have a volume only



1/14 that of the JETEC-30 package. Four types, CK25, CK26, CK27 and CK28 duplicate the electrical characteristics of the Raytheon computer types. Four more types, CK13, CK14, CK16 and CK17 are for general purpose r-f use, four types, CK64, CK65, CK66 and CK67 are for general purpose audio use. CK22 is a low noise audio amplifier. Raytheon Mfg. Co., 55 Chapel St., Newton 58, Mass.

Circle 218 on Inquiry Card, page 117

FREQUENCY CHANGER

The Change-A-Cycle operates on a principle different from conventional motor-generator devices. The ac input is rectified to dc, then fed to a special dc to ac converter, having a 50 or 60 CPS output, as specified. A rheostat provides a ±10% adjustment for cycle variation. The design

requires no transformer. Works on any input frequency. Output capacities range from 40 to 2000 watts ac. Carter Motor Co., 2760A W. George St., Chicago 18, Ill.

Circle 215 on Inquiry Card, page 117

A. C. POWER SUPPLY

The latest addition to the line of Invertrons is the 2KVA single phase model. Designed to meet the need for ever increasing power requirements, models are available in a wide range of output frequencies, both variable and fixed. The model shown has an output frequency range of 50 to 1350

CPS, output voltage 0-130 volts, single phase, 2KVA. Input is 230 volts 60 CPS, single phase. Behlman Engineering Co., 2911 Winona Ave., Burbank, Calif.

Circle 217 on Inquiry Card, page 117

PISTON CAPACITOR KITS

To assist electronic engineers in expediting research and development of new projects, 7 new piston capacitor kits are available. Each kit includes a number of capacitors (from 4 to 9) designed for a particular mounting application. The trimmers are housed in a compact

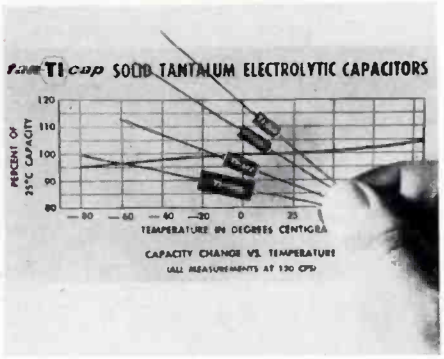
dust-proof styrene case complete with electrical characteristic charts for instant reference. JFD Manufacturing Co., Inc., 6101 Sixteenth Ave., Brooklyn 4, N. Y.

Circle 219 on Inquiry Card, page 117

New Products . . . for the Electronic Industries

TANTALUM CAPACITORS

Designed for use in miniaturized circuitry where both reliability and temperature stability are vital factors, these new devices, tan-TI-cap capacitors, are available. Five are 6 v. units



ranging from 22 to 200 μf, five are 15 v. devices from 10 to 100 μf, five are 25 v. capacitors from 10 to 100 μf, five are 25 v. capacitors from 5 to 55 μf, and four are 35 v. units from 4 to 25 μf. Mechanically they provide a solution to many of major space and mounting problems. Texas Instruments Incorporated, P. O. Box 312, Dallas, Tex.

Circle 232 on Inquiry Card, page 117

HETERODYNE EQUIPMENT

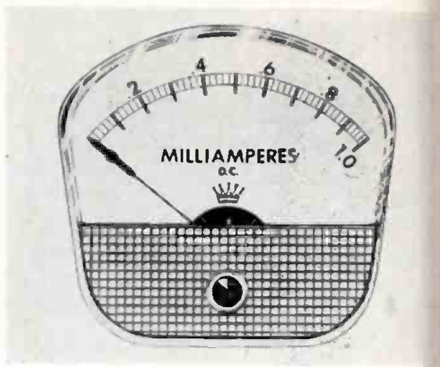
Heterodyne equipment to extend the frequency measuring range of its 10 MC EPUT meters to over 220 MC is available. Consisting of a basic amplifier and heterodyne units in 2 ranges,

the new series features high sensitivity, reduced size and elimination of plug-ins. Model 7570 serves as a preamplifier of 1 mv. sensitivity in the 10KC to 10 MC range. Models 7571 and 7572 are heterodyne units with 10 to 110 MC and 110 to 220 MC ranges, respectively. Berkeley Div. Beckman Instruments, Inc., 220 Wright Ave., Richmond 3, Calif.

Circle 234 on Inquiry Card, page 117

PANEL METERS

The Crown Series is designed to satisfy the need for functional beauty without sacrificing accuracy, readability or ease of mounting. Clear plastic covers and long scales afford

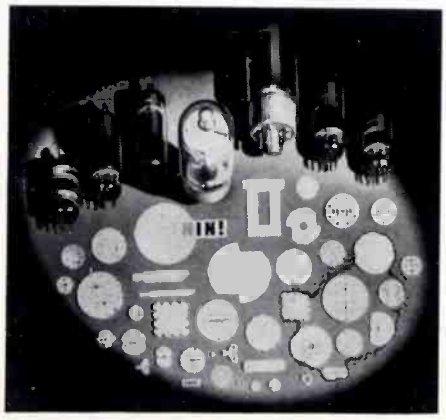


greater readability with good illumination from the top, front and sides of the case. Available custom colored to specifications. The new scales are 2½ in. long in a 100° arc. Lance type pointers are standard. Instruments are interchangeable in mounting with any 2½ in. JAN or MIL Spec instrument. Weston Instruments, Inc., Newark 12, N. J.

Circle 236 on Inquiry Card, page 117

ALUMINA CERAMICS

Ceramic parts so thin they are actually translucent are being produced in volume. Material is vitrified, vacuum-tight AlSiMag Alumina. Thicknesses as low as 0.005 in. are now practical. Dimensional accuracy is good. In Electron tube applications, for example, they: 1. Withstand higher degassing temperatures. 2. Extend operating temperature range of the completed tube. 3. Reduce damage from fatigue failure and heat de-



terioration. 4. Eliminate emission losses caused by high temperatures, shock and vibration. American Lava Corp., Cherokee Blvd. & Mgrs. Rd., Chattanooga 5, Tenn.

Circle 233 on Inquiry Card, page 117

RADIATION ALARM

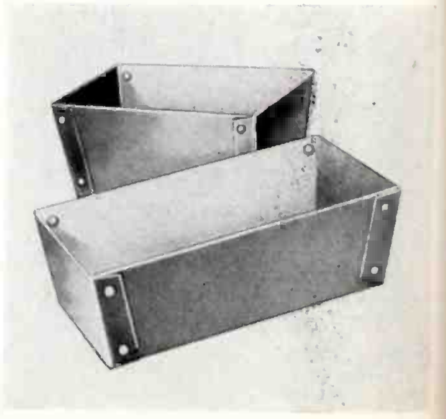
A new combination radiation alarm monitor and rate meter for providing continuous visual and audible indication of radioactivity levels is available. The Model 743 Combination Radiation Alarm Monitor and Rate Meter was designed to AEC specifications. The alarm circuit automatically triggers a bell when radiation reaches a present level, and switches the alarm off immediately when radiation level falls below the alarm set point.

It has a meter and neon light for visual warning. Sensing unit can be either an alpha scintillation probe or a GM tube. The Victoreen Instrument Co., 5806 Hough Ave., Cleveland 3, O.

Circle 235 on Inquiry Card, page 117

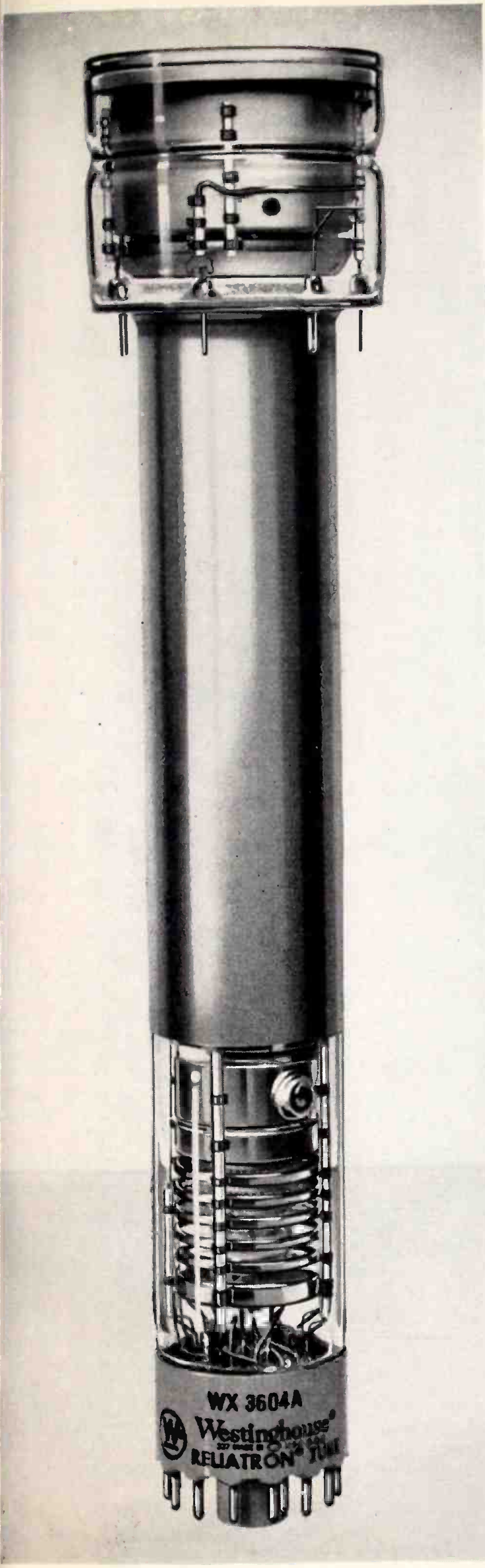
INDUSTRIAL PANS

A line of Kennett Industrial pans for small parts handling features light weight, durability and low cost. These pans make ideal separation, storage and transporting containers for such items as electrical and electronic components, machined or stamped metal pieces, plastics and other small parts. Constructed from 0.050 in. thick vulcanized fibre with riveted construction, these trays utilize several of the advantages of fibre



that make possible good materials handling equipment. Trays are available in 5 sizes. National Vulcanized Fibre Co., 1059 Beech St., Wilmington 99, Del.

Circle 237 on Inquiry Card, page 117



New Ruggedized Westinghouse Image Orthicon!

DURABLE NEW WL-7198 WITHSTANDS SEVERE ENVIRONMENTAL CONDITIONS, SHOWS NO DEGRADATION AFTER 30 G'S!

Now Westinghouse has developed an image orthicon tube that's rugged enough to withstand 30 g's . . . yet sensitive enough to perform efficiently at low light levels. The new WL-7198 is ideal for military, industrial and scientific applications subject to extreme environmental conditions.

TYPICAL CHARACTERISTICS OF THE WL-7198 ARE:

Vibration: (1) Operable throughout MIL-E-5272A Procedure I (10 g's from 50 to 500 cps)
(2) 350 lines horizontal resolution at 5 g's from 50 to 500 cps with 3 x 10^{-2} foot-candles on photocathode.

Shock: No degradation after 30 g's.

Low light level performance: 250 lines minimum resolution 3 x 10^{-4} foot-candles on photocathode.

Sample quantities of the WL-7198 are available for immediate delivery.

WESTINGHOUSE ENGINEERS WILL HELP YOU SOLVE YOUR IMAGE ORTHICON PROBLEMS UPON YOUR REQUEST.

YOU CAN BE SURE...IF IT'S

Westinghouse

Please send me complete information on the new Westinghouse WL-7198.

NAME ______________________________

ADDRESS ______________________________

____

____

Send to: Westinghouse Electric Corporation, Electronic Tube Division, Elmira, New York.

Circle 110 on Inquiry Card, page 117

New Tech Data for Engineers

Cable Support Systems

A new 60-page catalog contains the latest information on J. T. Cope Div., Rome Cable Corp., Collegeville, Pa., complete line of cable supporting systems including cable trough, cable ladder, cable channel, and Rak-it supports and accessories. Complete information is included in this plastic cover loose-leaf binder.

Circle 160 on Inquiry Card, page 117

Linearity Tester

Spectrol Electronics Div. of Carrier Corp., 1704 S. Del Mar Ave., San Gabriel, Calif. has issued a brochure describing their new linearity tester, Model 10. This 2-color brochure is complete with specifications, photographs and suggested usages.

Circle 161 on Inquiry Card, page 117

Telescoping Towers

A bulletin issued by Alpar Mfg. Corp., 2910 Spring St., Redwood City, Calif. describes completely their telescoping aluminum towers and work structures.

Circle 162 on Inquiry Card, page 117

Racks and Desk Assemblies

A 28-page catalog issued by Par-Metal Products Corp., 32-62 49th St., Long Island City 3, N. Y. describes their new line of Universal cabinet racks and utility desk assemblies. Also shown are the accessories and fittings used in conjunction with these basic housings. Catalog is complete with illustrations, descriptions, technical specifications and prices.

Circle 163 on Inquiry Card, page 117

Small Lamp Sockets

Leecraft Mfg. Co., Inc., 58-60 Greene St., New York 12, N. Y. has just published a comprehensive catalog of their complete line of sockets for small lamps used in every electrical or electronic product. The 28-page, 2-color catalog contains full technical descriptions of each group of sockets along with illustrations.

Circle 164 on Inquiry Card, page 117

Silicon Transistor

NPN silicon transistor, 2N474A, is described in a 4-page bulletin issued by Transitron Electronic Corp., Wakefield, Mass. Complete technical data is included.

Circle 165 on Inquiry Card, page 117

Alloys for Electronics

The Carpenter Steel Co., Reading, Pa. has issued a comprehensive 64-page, 2-color booklet which describes in great detail their alloys for electronic, magnetic and electrical applications. The booklet describes their alloys completely with graphs, tables, photographs and other engineering data. Also included are typical graphical symbols for electrical diagrams and a glossary of terms.

Circle 166 on Inquiry Card, page 117

Grounding Braid Samples

Lenz Electric Mfg. Co., 1751 N. Western Ave., Chicago 47, Ill. has just issued a new sample board of their shielding and grounding braid. It was planned to provide actual samples of the various standard sizes of braid for engineers and purchasing agents in the electronic industry. Samples are mounted on heavy cardboard.

Circle 167 on Inquiry Card, page 117

Phase Meters & Delay Lines

A 6-page, 2-color brochure issued by Advance Electronics Lab., Inc., 249 Terhune Ave., Passaic, N. J. describes in complete detail their phase meters, delay lines, and counters. Brochure is complete with photographs, specifications, tables, and prices.

Circle 168 on Inquiry Card, page 117

Sheath Connectors

A complete line of one-piece and two-piece compression sheath connectors for shielded or coaxial cables is described in a 16-page catalog available from the Omaton Div., Burndy Corp., Norwalk, Conn. Catalog includes complete listings, dimensional drawings, assembly procedures, tooling information and other related products.

Circle 169 on Inquiry Card, page 117

Gamma Radiation

The Applied Radiation Corp., Walnut Creek, Calif. has issued Report AM-100 entitled "Production of Gamma Radiation with a Linear Electron Accelerator." Contents include radiation lengths, forward intensity, angular distribution, total conversion efficiency, spectral shape, and shielding calculations. Ten graphs are included along with formulas, tables, and descriptions.

Circle 170 on Inquiry Card, page 117

Power Supplies

The NJE Corp., 345 Carnegie Ave., Kenilworth, N. J. has issued a 16-page data source which covers more than 900 new power supply models. Complete information is given on these various types of power supplies. Also included are price information, formulas, tables, diagrams and application data.

Circle 171 on Inquiry Card, page 117

Miniature Potentiometer

A 4-page, 2-color brochure issued by Technology Instrument Corp., 523 Main St., Acton, Mass. describes in complete detail, their line of miniature multiturn potentiometers. Brochure is complete with photographs, tables and specifications.

Circle 172 on Inquiry Card, page 117

Low-Frequency Scope

A 4-page, 2-color brochure issued by A. B. Du Mont Labs., Inc., 760 Bloomfield Ave., Clifton, N. J. describes their new low-frequency scope. Brochure contains photographs of the various units in the scope along with complete mechanical and electrical specifications and prices.

Circle 173 on Inquiry Card, page 117

Bobbin Cores

A new 4-page folder illustrating and describing their line of uniform high quality bobbin cores for use in digital data processing systems is now available from G-L Electronics, 2921 Admiral Wilson Blvd., Camden 5, N. J. Complete electrical and mechanical specifications are given with photographs.

Circle 174 on Inquiry Card, page 117

National Defense Brochure

A new 32-page, 3-color brochure entitled "Sylvania Electronic Systems of National Defense" has been made available by Sylvania Electric Products Inc., 100 First St., Waltham, Mass. The brochure outlines the company's capabilities in the fields of electronic warfare and missile systems, intelligence and reconnaissance systems, data processing systems, related subsystems and equipment in communications, navigational aids, radar, countermeasure, counter-countermeasures, and computers.

Circle 175 on Inquiry Card, page 117

(*Continued on page* 142)

New Tech Data for Engineers

(*Continued from page* 140)

Silicon Power Rectifiers

Sarkes Tarzian Inc., 415 N. College Ave., Bloomington, Ind. has just issued a 2-color bulletin describing their new mass produced lead-type silicon power rectifiers. Complete specifications are included with photographs.

Circle 176 on Inquiry Card, page 117

Videotape Recorder

A 12-page, 2-color brochure has been issued by Ampex, 934 Charter St., Redwood City, Calif. which describes their VR-1000 videotape recorder. Brochure is complete with photographs and descriptions.

Circle 177 on Inquiry Card, page 117

Data Display Indicators

A 12-page technical catalog is available which describes construction, operation, specifications and typical applications of these versatile plug-in indicators for data display, storage and transfer. Union Switch & Signal, Div. of Westinghouse Air Brake Co., Pittsburgh 18, Pa.

Circle 178 on Inquiry Card, page 117

Microwave Frequency Meter

The Polytechnic Research & Development Co., Inc., 202 Tillary St., Brooklyn 1, N. Y. has just issued a 2-color brochure describing their microwave frequency meter Type 587-A. Complete mechanical and electrical specifications are included along with prices.

Circle 179 on Inquiry Card, page 117

Liquid Cooling

A transcript of the symposium on liquid cooling of electrical and electronic equipment sponsored by the Bureau of Ships is now available for distribution. Code 816C3, Bureau of Ships, Washington 25, D. C.

Circle 180 on Inquiry Card, page 117

Research and Development

Dresser Dynamics Inc., 18157 Napa St., P. O. Box 162, Northridge, Calif. has issued a 20-page brochure describing their research and development laboratory. The laboratory is primarily for a missile and reactor control, testing and instrumentation. Complete information on the personnel and facilities is included along with pictures.

Circle 181 on Inquiry Card, page 117

Antenna System Computer

The Andrew Corp., 363 E. 75th St., Chicago 19, Ill. has made available a slide rule type computer to enable communication engineers to rapidly and accurately calculate parabolic antenna radiation characteristics, passive repeater performance, free space and scatter propagation attentuation, and thermal and equivalent noise input of receiver. The reverse side is a transmission line and waveguide selector.

Circle 182 on Inquiry Card, page 117

Semiconductor Machinery

Kahle Engineering Co., 1307 7th St., North Bergen, N. J. has just issued 10 more sheets for their catalog. These 10, 2-color sheets describe various types of machinery for manufacturing semiconductors and transistors.

Circle 183 on Inquiry Card, page 117

Industrial TV

Blonder-Tongue Laboratories, Inc., 9 Alling St., Newark 2, N. J. has just published a 16-page booklet describing their low-cost closed circuit television systems. The booklet is a comprehensive presentation of typical closed circuit TV camera systems, applications, and equipment.

Circle 184 on Inquiry Card, page 117

X-Band Power Amplifier

Resdel Engineering Corp., 330 So. Fair Oaks Ave., Pasadena, Calif. has issued a 4-page bulletin describing their X-band, pulse-CW power amplifier. Complete mechanical and electrical specifications are included along with descriptions.

Circle 185 on Inquiry Card, page 117

Closed Circuit TV

The Industrial Electronics Div., General Electric Co., Electronics Park, Syracuse, N. Y. has just issued a 12-page, 2-color brochure which describes in detail their complete closed circuit television equipment and systems.

Circle 186 on Inquiry Card, page 117

Polystyrene Capacitors

The Aerovox Corp., New Bedford, Mass. has just issued a new 4-page engineering bulletin describing their complete line of polystyrene dielectric capacitors. Complete information is included.

Circle 187 on Inquiry Card, page 117

Thermometers

Catalog C-60-2 issued by Minneapolis Honeywell Regulator Co., Wayne & Windrim Aves., Philadelphia 44, Pa. contains 60 pages of graphs, charts, photographs, electrical and mechanical specifications describing indicating, recording and controlling thermometers.

Circle 188 on Inquiry Card, page 117

Anodizing and Plating

A new 20-page brochure entitled "Precision Finishes on Metals" is offered by Anachrome Corp., 10647 Garfield St., South Gate, Calif. Particular emphasis is placed on the "Hardas Process" in the brochure which has been proven to be the best methods of hard anodizing.

Circle 189 on Inquiry Card, page 117

Metallic Power Rectifiers

A fully illustrated, 32-page "Guide" to metallic power rectifiers utilizing germanium, silicon and selenium semiconductors has been published by Sel-Rex Corp., Nutley, N. J. The booklet covers a wide variety of applications for rectifier equipment.

Circle 190 on Inquiry Card, page 117

Quartz Crystal Filters

Burnell & Co., Inc., 10 Pelham Pkwy., Pelham Manor, N. Y. has just issued a new 2-color, 4-page brochure outlining their comprehensive product line of stock and special miniaturized quartz crystal filters.

Circle 191 on Inquiry Card, page 117

Analog Computer Data

An 8-page data File 310 describes the new Donner 3100 high accuracy, medium size analog computer available from Donner Scientific Co., Concord, Calif. The 8-page, 2-color file describes the various components of the system along with electrical specifications.

Circle 192 on Inquiry Card, page 117

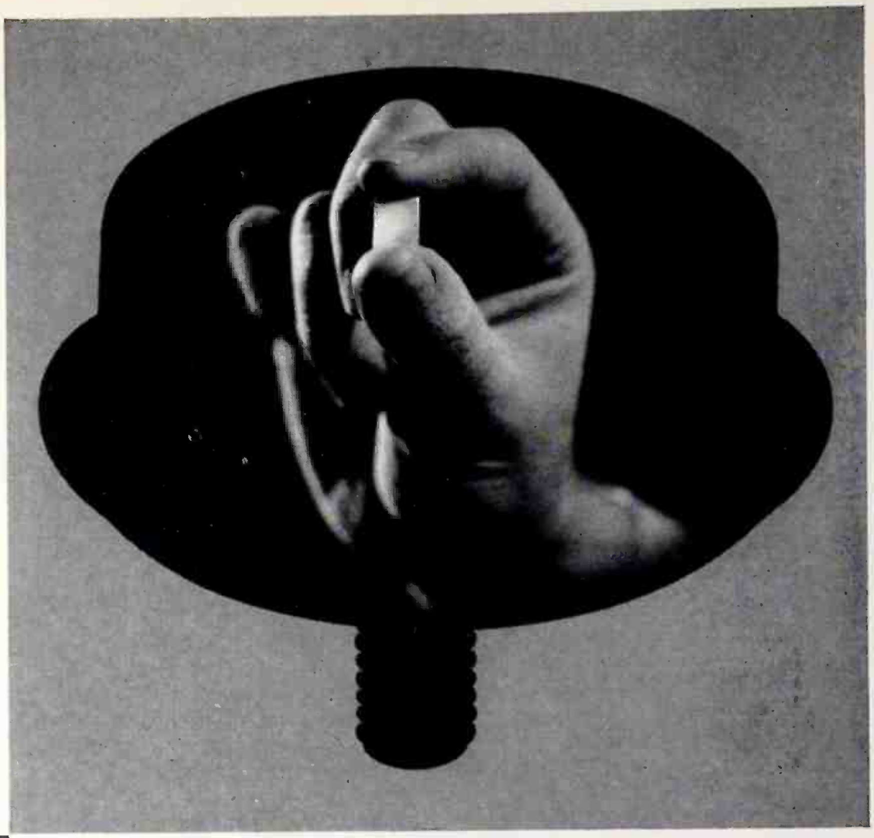
400 Cycle Meters

An 8-page, 2-color bulletin describing their line of 400 cps frequency meters has been issued by the Varo Mfg. Co., Inc., 2201 Walnut St., Garland, Tex. Catalog is complete with electrical and mechanical specifications and photographs.

Circle 193 on Inquiry Card, page 117

(*Continued on page* 148)

DELCO HIGH POWER TRANSISTORS are made from



GERMANIUM

In the center of the quartz housing, a germanium crystal is being grown. A "perfect crystal lattice," it will be cut into wafers 3/10ths of an inch square and less than 1/100th of an inch thick to become the heart of Delco High Power transistors.

because it alone combines these 5 advantages:

Lower saturation resistance—Germanium gives Delco High Power transistors a typical saturation resistance of only *3/100ths* of an ohm. No other present material offers this characteristic, which permits efficient high-power switching and amplification from a 12- or 24-volt power supply.

Higher current gain—Gain with germanium is not only higher but is more linear with current.

Lower distortion—In many applications, distortion requirements can be satisfied only with germanium transistors.

Lower thermal gradient—As far as deliverable power of present devices is concerned, germanium meets the need and, in addition, provides a thermal gradient of only 1.2° C/watt.

Greater economy—More power per dollar.

DELCO RADIO

Division of General Motors, Kokomo, Indiana

BRANCH OFFICES

Newark, New Jersey
1180 Raymond Boulevard
Tel.: Mitchell 2-6165

Santa Monica, California
726 Santa Monica Boulevard
Tel.: Exbrook 3-1465

Examine Delco High Power germanium transistors and see how practical it is to go ahead with your plans now. For high current applications there is no better material than germanium, or Delco Radio would be using it. All Delco High Power transistors are produced in volume; all are normalized to retain their fine performance and uniformity regardless of age. Write for engineering data and/or application assistance.

Circle 53 on Inquiry Card, page 117

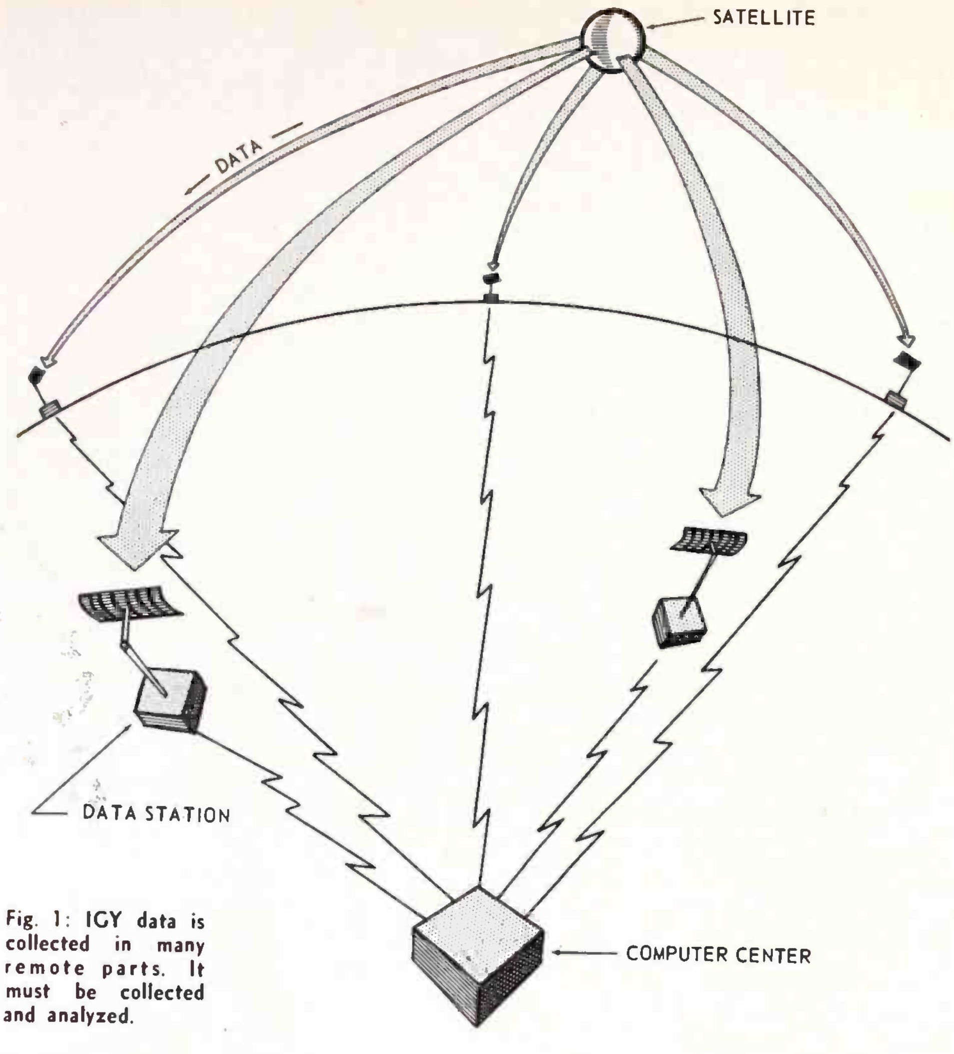


Fig. 1: IGY data is collected in many remote parts. It must be collected and analyzed.

By H. D. DICKSTEIN
Senior Electronics Engineer
Convair Division
General Dynamics Corp.
San Diego, Calif.

World-Wide IGY Data Collection

We could speed up collection and analysis of IGY data by using existing, compatible Teletype equipment. Here is how such a system could work.*

OVER forty nations are participating in a vast geophysics project, the International Geophysical Year, to gather much-needed new facts about our universe. Artificial earth satellites are already circling the earth and recording stellar data which has been previously unknown to earth-bound observers. The satellites are the first giant step in interplanetary travel. They will bring closer the day when stratospheric rockets will carry passengers from one side of the globe to the other in a few hours. Tracking of the artificial earth satellites emphasizes the need for synchronized data collection systems.

After each satellite is launched, enters its orbit, and starts its travel around the earth, hundreds of observation stations begin tracking its motion and receiving the data it transmits to earth. The collection and analysis of this data is a full-time job for each observation station, but synchronizing data from the various stations is a much more difficult task.

The satellite problem is but one of many engineering problems which will require the accurate, simultaneous collection of data. Central collection of data and automatic analyses will give the systems man a rapid, powerful tool. Can we design a new method to provide world-wide system studies without large outlays for equipment or new communication systems?

Compatibility

The great use of teletype tape and equipment in computers today suggests their possible application in large-scale data collection systems. Teletype communication

* "Teletype" is a trade mark of Teletype Corp.

:quipment is everywhere. Frequen-:y allocations already exist and al-nost all large computer facilities 1ow in existence use teletype tape.

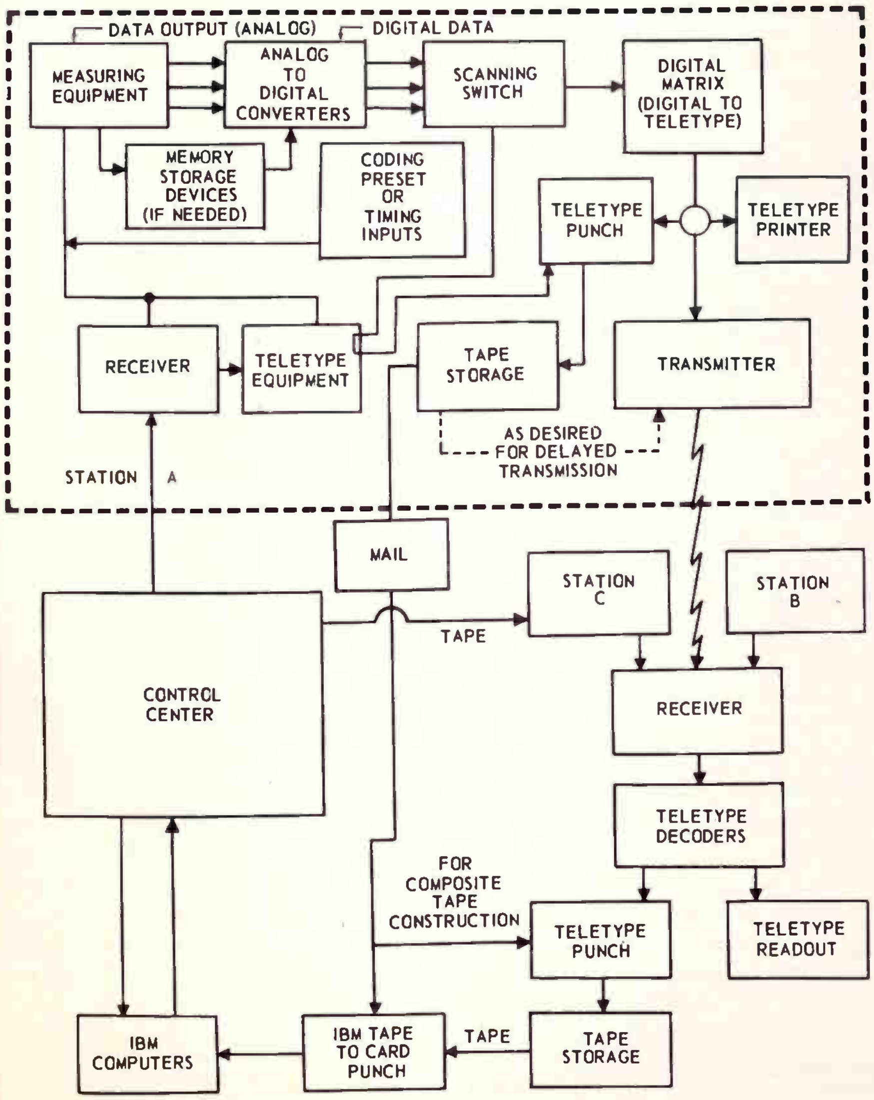
Since teletype systems have been :ransmitting news over the world 'or many years, their application o world-wide data collection should oe a natural development. The many 1ecessary components of the system 1ave already been developed. Data n almost any form can be con-verted to teletype code. Shaft posi-:ions, voltage and current strengths, 1nd other analog quantities can be :hanged into teletype form easily. A diode matrix and stepping switches can program and convert ligital information to teletype code with perfect accuracy. Once data is n teletype code, it can be used in several desirable ways. It can be read out (printed) on a standard :eletype printer, it can be punched onto tape for easy storage, and it :an be transmitted to any distant point. Easy, quick transmission of data over long distances will appeal to any systems man.

Remote Control

But transmission alone is not enough. The data must be ordered and it must be taken with exact timing. Here again, teletype equipment offers the answer. Teletype equipment can be remotely controlled; can be keyed to extract data, punch, or transmit in any order. It is also possible to control and synchronize many different teletype systems. The letter symbols not now being used in number data systems provide many relays which can be converted to control jobs. If direct teletype recording is too slow, these relays can control faster means of readout which can be stored, and then converted to the slower teletype system.

(*Continued on page* 146)

Fig. 2: Block diagram of proposed system of integrating teletype and computers.



(*Continued from page* 145)

The many data stations in the system can be controlled so that their data can be combined in any desired order. When teletype data is received at the central collection point, it can be easily changed back to its useful forms. The receiver output can be punched on tape for storage or processing, or it can be printed for examination.

Practical System

Let us examine in detail how a teletype data collection system might work: At remote sites where the data is originally found, all measuring devices will have teletype facilities. If the quantities are in analog form, devices exist for conversion to digital forms. Thus, shaft positions, voltages, and currents can be changed easily to digital form. A diode matrix will convert this data from digital form to teletype code. Next, stepping switches triggered by the teletype equipment, will scan the different quantities and program them into the teletype equipment in the desired, ordered form. Finally, the data in teletype code form, will be fed into various pieces of teletype equipment for data transmission, storage, or readout. The data collection time or method will be controlled by using some symbol that is not normally used in the teletype code. When the teletype receiving equipment receives the pulses corresponding to the desired symbol, the modified equipment can start the reading, select some part of it, or present changes in the readings. It can also store the readings so that the actual readout can be triggered by some other symbol at another time.

Data Analysis

The large scale of world-wide data collection also calls for an automatic type of analysis. Here again, teletype systems provide an answer. An IBM tape-to-card punch exists which can convert teletype tape to IBM punched cards. Punched cards provide a popular means for programming or introducing data to a computer system. Since the data has already been collected and synchronized so that all stations are in the proper order, each card contains information grouped in its correct classification, with the deck arranged for immediate calculation. The IBM equipment can be programmed to reject cards containing errors other than number substitution. The conversion of tape to cards does not affect the tape. The tape remains unchanged for convenient storage of the entire system operation.

While this tape-to-card conversion takes place within hours after the original reading has been made, the data collection station itself can add to the overall accuracy of the data.

Teletype systems also have the following additional advantages:

1. Teletype equipment has been used long enough to produce good design and reliable equipment.
2. System failures occur less often than in many other methods of data transmission.
3. Communication channels are already available and authorization for operation can probably be obtained from the F.C.C.
4. New equipment can probably be leased from the teletype manufacturers.
5. Defense projects can take advantage of miliary equipment.
6. Surplus equipment is available and should be cheap.

Therefore, if economical and effective world-wide or large-scale data collection is his aim, the systems engineer may accomplish it by looking more closely into teletype methods.

Digital Readout

(Continued from page 125)

waveshape has three components. Two of these are derived from phase-shift networks and the third is taken from one phase of the supply. Series resistors are used with two components to reduce their amplitudes. All three components are summed to yield the number five horizontal waveshape.

Six

Number six is derived from two phase-shift networks with diodes by-passing the capacitors. The vertical circuit is from one phase of the supply to the center-tap. The horizontal circuit is across the total supply.

Seven

The vertical waveshape for number seven is the conventional half-wave rectifier waveshape without filtering. The horizontal waveshape is the conventional full-wave rectifier waveshape without filtering with alternate half sinusoids of smaller amplitude.

Eight

Number eight has a phase-shifted sine wave for the vertical waveshape. The horizontal waveshape resembles the horizontal waveshape of seven except that a capacitor is used to round out every other valley.

Nine

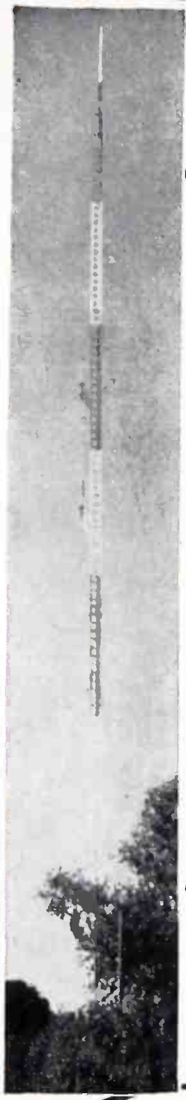
A phase-shifter from one phase of the supply to the center-tap, by-passed by a diode to the other side of the supply furnishes the vertical waveshape for number nine. The horizontal waveshape comes from a negative half wave rectifier without filtering.

The numbers are generated at the voltage levels required by the deflection plates of a two-inch cathode-ray tube. This puts a high back voltage requirement on the diodes in these circuits. For this reason, type 1N222 silicon diodes are used. The silicon diodes also contribute to increased reliability due to their better temperature characteristics and inherent low back current.

Four scope circuits are used. One printed circuit board contains the scope circuits for two cathode ray tubes.

Construction

The entire display unit is composed of printed circuit cards that slide into a U-shaped chassis. All interconnecting wiring is done on the back of the chassis. A smaller U-shaped chassis containing the power transformers and input connectors fits on the back of the main chassis.



New Tech Data

for Engineers

Phenolic Products

A 12-page catalog issued by General Electric's Chemical Materials Dept., 1 Plastics Ave., Pittsfield, Mass. includes detailed technical data, special properties and product features of phenolic molding powders, rubber phenolic molding powders, phenolic laminating varnishes, phenolic foundry resins, coating resins, and industrial resins and varnished.

Circle 244 on Inquiry Card, page 117

Subminiature Relays

A broad range of over 325 subminiature relays meeting and excluding Military Specifications are described in a new 12-page bulletin just issued by the Industrial Electronic Products Section of Radio Corporation of America, Bldg. 15-1, Camden 2, N. J. Brochure contains photographs, diagrams and complete descriptions of the various relays.

Circle 245 on Inquiry Card, page 117

Monitoring Systems

The Victoreen Instrument Co., 5806 Hough Ave., Cleveland 3, Ohio has issued a 4-page bulletin describing the basic units in the systems and give specification data such as ranges, response, accuracy, stability, etc., for remote area monitoring systems. Model numbers, suggested uses, dimensions and weights are also included.

Circle 246 on Inquiry Card, page 117

Electronic Testing Equipment

The Weinschel Engineering, 10503 Metropolitan Ave., Kensington, Md. has made available a 32-page, 2-color brochure describing their electronic testing equipment. Brochure contains photographs, tables, graphs, block diagrams, mechanical and electrical specifications on this equipment.

Circle 247 on Inquiry Card, page 117

Panels & Name Plates

A new 6-page, 2-color idea file on the company's line of dials, panels and nameplates has just been published by United States Radium Corp., Morristown, N. J. The folder, prepared for design, engineering, purchasing and standards personnel, is a grouping of data for guidance in specification of dials, panels and nameplates.

Circle 248 on Inquiry Card, page 117

Meter-Relays

Bulletin 103-B contains complete information on a line of meter-relays. Assembly Products, Inc., P. O. Box XX, Palm Springs 9, Calif., has issued this bulletin which contains photographs, electrical and mechanical specifications along with descriptions. Price list is included.

Circle 249 on Inquiry Card, page 117

Silicon Switching Diode

Recommended for application in sawtooth oscillators, pulse generators, bistable circuits, ring counters, and various switching functions, the 4-layer npnp silicon diode is discussed in a new bulletin available from the Shockley Semiconductor Laboratory of Beckman Instruments, Inc., Newport Beach, Calif.

Circle 250 on Inquiry Card, page 117

Clutches and Brakes

Autotronics, Inc., Route 1, Box 812, Florissant, Mo. has published a new 28-page illustrated catalog covering its complete line of miniature and subminiature electromagnetic clutches and brakes. Included in the catalog is complete information on each type of clutch and brake produced, including cutaway drawings, engineering data, schematic diagrams, dimensional data, minimum performance curves, oscilloscope readings and other technical information.

Circle 251 on Inquiry Card, page 117

Laminated-Plastic Sheets

New England Laminates Co., Inc., 481 Canal St., Stamford, Conn. now has available for distribution a loose-leaf catalog describing its Nelco thermosetting laminated-plastic sheets for printed-circuit and similar uses. Included in the catalog is a complete materials list for quick identification of each product by NEMA grade, resin and base, and significant characteristics.

Circle 252 on Inquiry Card, page 117

Panel Lamps

A special industry-wide chart on panel and flashlight lamps has been compiled by United Catalog Publishers, Inc., 60 Madison Ave., Hempstead, N. Y. The new chart is a composite listing, arranged numerically, of all panel and flashlight lamps manufactured by leading companies. All bulb types are illustrated with physical dimensions.

Circle 253 on Inquiry Card, page 117

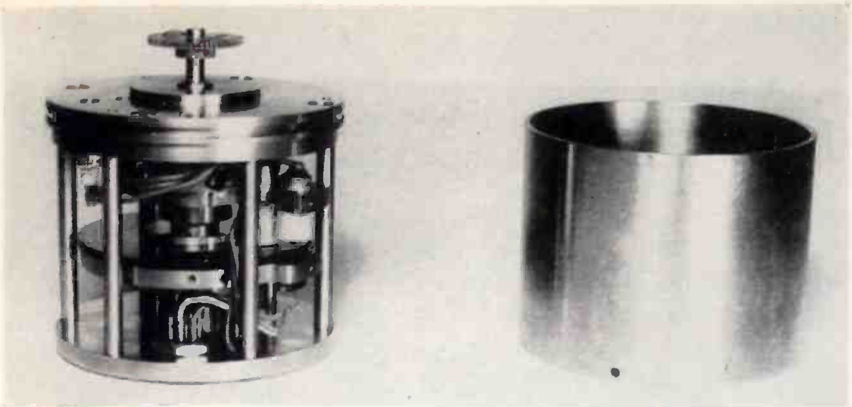


Fig. 1: The encoder with cover removed. It measures 3 inches in diameter by 2½ inches in length and weighs approximately one pound.

Photo-Electro-Mechanical Digitalizer

An analog - digital conversion system which combines mechanical advantages with electronic speeds is found in the Oread analog-digital converter of Cubic Corporation in San Diego, California. It uses a photo-electro-mechanical method to digitalize input data, and electronic logic circuits to provide digital readout.

The conversion scheme includes three basic stages: (1) the mechanical to electronic converter, or encoder, (2) the logic and gating circuits, and (3) a bidirectional binary counter, with or without converted decimal readout.

The mechanical portion of the encoder consists of a shaft, a plastic disk and two incandescent lamps. Actual digitalization of input data takes place photoelectrically with the two incandescent lamps acting as exciters for two phototransistors, which are energized by the light pulsations resulting from the chopping effect of the plastic disk.

The disk itself is divided into 100 opaque segments alternating with 100 clear segments. The two lamp - phototransistor pairs are mounted at a displacement of 90 electrical degrees, or half a segment, from each other. As the disk rotates, the phototransistors generate two nominally square waves 90° apart.

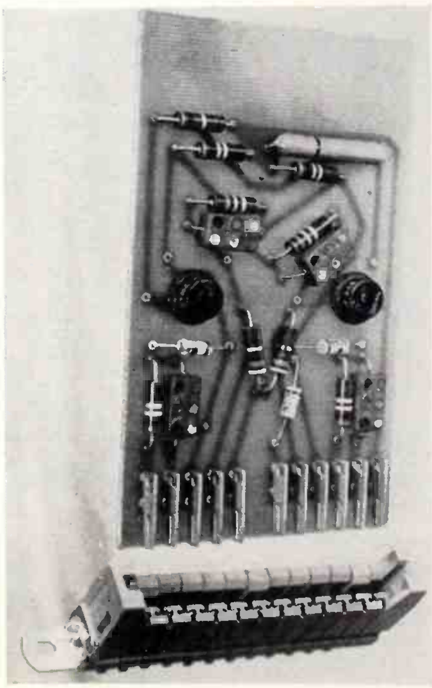
Considering both outputs with their staggered waves, there are a total of 400 polarity reversals, or increments, for every complete rotation of the disk. Phototransistor sensitivity and lamp intensity set an upper limit to the speed of operation, which is normally held to a maximum rate corresponding to 6000 rpm in the disk.

The nominally square wave from each phototransistor is fed into a Schmitt trigger which converts it into a truly square wave. The wave then passes directly into a differentiating element and simultaneously into a 180° phase inverter, which in turn feeds another differentiating element.

The net result is four waves from the original two waves of the phototransistors, each with a phase displacement of 90° from

(*Continued on page* 150)

Fig. 2: Standard packages and plug-in sockets permit flexibility of design.



Digitalizer

(*Continued from page* 149)

one another, corresponding to 0° and 180° for one input wave and 90° and 270° for the other. Each of the four differentiating elements separates the leading edges of its wave and feeds them as definite pulses into a polarized summing circuit, known as an "OR" circuit.

The logic portion of the second stage incorporates the proper coding elements to the incremental count, in accordance with the particular logic diagram followed in any specific application. To do this, it takes a reference wave from each circuit before the differentiating elements, and, by means of quadruple "AND" gates, provides a control signal for the above mentioned "OR" circuits.

This signal determines whether the count increases or decreases, corresponding to clockwise or counterclockwise rotation of the disk, as well as the type of binary code used for the count.

"Inchworm" Motor

(*Continued from page* 122)

current through the magnetic coil.

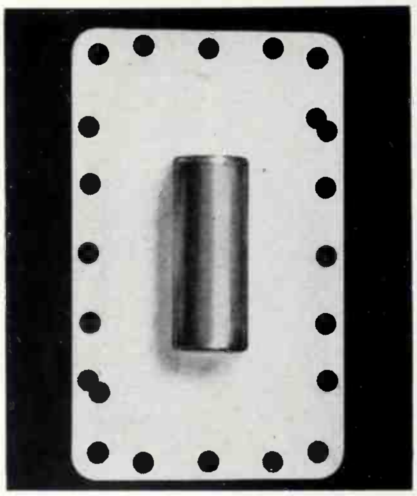
The overall effect is very similar to that by which the Inchworm's familiar green namesake progresses along a tree branch, gripping the branch with its forefeet, hunching its body forward, then gripping with the hind-feet, hunching forward again, and so on. Unlike the green inchworm, the Inchworm can "crawl" backward as well as forward.

The base of the Inchworm Motor is bolted to the bed of the grinder, and the magnetostrictive armature is attached to the wheel slide. Thus, movement of the armature through the clamps moves the wheel slide backward or forward as desired. The minute movements can be as small as five millionths of an inch, or as "large" as one hundred millionth.

New Products

DUPLEXING ELEMENT

The Attenutron, a new kind of duplexing element, has been successfully tested at 40 megawatts peak—80 KW average power—and has a very low arc loss (non-measurable on present

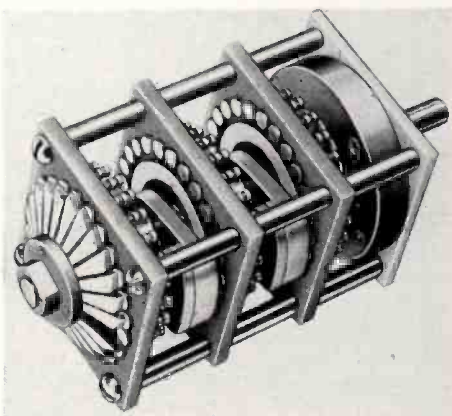


instruments). Design and performance characteristics are: recovery time—3 to 40 microseconds; broad band; high level attenuation—30-35 db; low Q. The Attenuation is available in single or dual gas switching tubes, in all wave guide sizes greater than RG 52. Bomac Laboratories, Inc., Beverly, Mass.

Circle 256 on Inquiry Card, page 117

SHORTING SWITCH

A Progressive Shorting Type Switch shorts out every other position on the switch but the one actually in use. Switch assures that only one, the desired position, is in operation at any one time. Also the switch's separate ring connection makes possible switching one meter between every position consecutively, continu-



ous programming, and other special applications. Available as 20, 24, and 32 pole units, they can be ganged for multiple deck applications. The Daven Co., Livingston, N. J.

Circle 257 on Inquiry Card, page 117

World's Biggest Eater Dines Without Interruption

Typical insulator and insulating bolts used on power shovels.

You are looking at 3 million dollars' worth of power shovel, a 14-story monster capable of biting off 70 cubic yards of dirt at a clip.

Continuous operation is essential because downtime on a shovel of this size could top 500 dollars an hour. Reliability is shared by many interrelated parts. Some are made of Synthane laminated plastics.

Why Synthane? Because Synthane laminated plastics have the right combination of properties—dielectric strength, mechanical strength, and ease of machining. And Synthane uses only first-quality raw materials, watches every step in the production and fabrication of the laminate, is deeply concerned about delivery requirements.

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ANTENNAS, PROPAGATION

***Aerodynamically Balancing a Radar Antenna,** Paul Slysh. "El. Ind. Ops. Sec." April 1958. 4 pp. The goal of minimum drive power requirements is realized when the radar antenna is aerodynamically balanced about all its stabilizing axes independent of wind direction. Wind tunnel data and vector diagrams illustrate balancing procedure. (U.S.A.)

The Probability of the Eccentric Rayleigh Distribution and Its Application for Propagation Measurements, H. Zuhrt. "Arc. El. Uber," Vol. 11, Issue 12, December 1957, 7 pp. In the communication field, the received voltage consists of individual voltage waves plus a number of interfering voltage waves fluctuating at random; thus establishes an eccentric Rayleigh distribution. Published papers are summarized, and equations and curves of these distributions are clearly represented. Finally, some statistically-evaluated propagation measurements are compared with the theoretical family of curves; a good agreement is found over a wide range of curves. (Germany.)

Computing the Gain of a Periscope Antenna System, A. M. Pokras. "Radiotek." Nov. 1957. 8 pp. Formulas and universal graphs are obtained for computing the gain of a periscope antenna system when this system has a radiator in the form of an ellipsoidal reflector with a circular or square mouth. Systems with plane and parabolic re-radiators are analyzed. (U.S.S.R.)

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The Mechanism of Propagation of Very High Frequencies over Great Distances, Schoenemann. "Hochfreq.," Vol. 66, No. 2, September 1957. 9 pp. The author analyzes the propagation of very high frequencies caused by tropospheric and atmospheric conditions. He supports his analysis by actual field strength measurements. Examples are given of frequency spectrum from 40 to 3,000 mc. (Germany.)

AUDIO

Braking Action in Tape Recorders, G. Hartmann. "El. Rund." February 1958. 5 pp. The general theory of the mechanics of braking action is specifically applied to modern studio conditions. It is shown that the application of constant braking moment gives better results than the proportional moment of winding speed. (Germany.)

Transistorized P-A System Adjusts to Aircraft Noise, J. M. Tewksbury. "El." February 14, 1958. 2 pp. Aircraft passenger-address system uses single preamplifier and up to five power amplifiers and speakers for uniform audio distribution throughout seating area. (U.S.A.)

Acoustical Criteria of Old and Modern Well Designed Concert Halls, F. Winckel. "Freq.," Vol. 12, No. 2, February 1958. 10 pp. This article provides a great deal of information of various European concert halls. It correlates the structural design of various concert halls with their reverberation characteristics. Highlighted are the influence of coupled rooms and the change in the acoustical characteristics when musicians and audience are present. A table is included which provides the characteristics as well as the name of the architects of more than 50 famous concert halls. (Germany.)

Study of Transients in Loudspeakers, G. Kaszynski. "Hochfreq.," Vol. 66, No. 2, September 1957. 15 pp. A sound consists of two parts: the stationary portion representing the characteristic tone, and the brief periods of build-up and decay. These transient areas distort the true representation of a composite sound picture. The time required for the system to reach a steady state depends on the damping constants. The article provides a thorough analysis of the build-up and decay phenomena of electro-dynamic loudspeakers. (Germany.)

REGULARLY REVIEWED

AUSTRALIA

AWA Tech. Rev. AWA Technical Review
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
Bul. 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 Ubertragung
El Rund. Electronische Rundschau
Freq. Frequenz
Hochfreq. Hochfrequenz-technik und Electro akustik
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 Elektrotechniczne

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. Electronic 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)

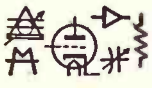
International ELECTRONIC SOURCES

Directivity of an Acoustic Emitter Located on an Arc, K. Feik. "Hochfreq.," Vol. 66, No. 2, September 1957. 7 pp. The article is a thorough treaty of loud speaker systems arranged in form of arcs or spheres. To reduce the linear distortions the coupling factor of the loudspeaker in the direction of the free sound path must be frequency independent. It is demonstrated that the theoretical evaluations correspond with the experiments. (Germany.)

Principles of Loudspeaker Design and Operation, Joseph Chernof. "IRE Trans. PGAU." September-October 1957. The electrical and physical parameters which are of interest in loudspeaker design are discussed. The analysis of loudspeaker action on the basis of its analogy to a vibrating rigid disk is presented. (U.S.A.)

A Loudspeaker Installation for High-Fidelity Reproduction in the Home, C. J. Bleeksma and J. J. Schurink. "IRE Trans. PGAU." September-October 1957. 11 pp. (U.S.A.)

A Transistorized Decade Amplifier for Low-Level Audio-Frequency Applications, Alexander B. Bereskin. "IRE Trans. PGAU." September-October 1957. 5 pp. The amplifier described in this paper has an input resistance of approximately 400,000 ohms in the audio-frequency range. The output noise level is equivalent to 5γV at the input terminals with a response that is down 3 db at 5 cycles and at 100 kc. (U.S.A.)



CIRCUITS

***Simplifying Phase Equalizer Design,** William J. Judge. "El. Ind." April 1958. 2 pp. The simplest method of synthesizing a desired relative phase-frequency characteristic is to plot graphically the individual characteristics of a number of networks as a function of the "d" parameter. (U.S.A.)

Certain Optimum Relationships in an Ideal Magnetic Amplifier When it is Controlled by Means of an AC Signal, by K. S. Volchkov. "Avto. i Tel." Jan. 1958. 10 pp. The paper analyzes the operation of an ideal saturable-reactor magnetic amplifier with a resistive load and an AC control signal. Optimum relationships are derived for amplifiers that are designed for amplifying a signal at one fixed frequency and for amplifying AC signals over a specified band width while assuring maximum gain. The relationship between the coefficient of frequency distortion and the time constant is derived. (U.S.S.R.)

Filter With Electronic Bandwidth Control, C. Kurth. "El. Rund." February 1958. 6 pp. After the consideration of some circuit examples, the mathematical relations are derived for a two circuit filter with bandwidth control by a tube inserted in the negative feedback line. A connection between bandwidth and control factor is given. Bandwidth control is effected mainly by displacement of the real part of the standardized parabola of a filter. (Germany.)

Subharmonic Oscillation in Some Non-Linear Circuits, Mintcho and P. Zlatev. "Onde." December 1957. 7 pp. The authors suggest an analytical method of synthesis for determination of the linear parameters and the external effects. (France.)

A Transformless Class B Power Amplifier with Identical Transistors, M. Fedorowski. "Prace ITR." No. 3, 1957. 21 pp. The article contains an analysis of a single-ended push-pull AF power amplifier (output stage) with transistors of the same conductivity type. (Poland.)

Foster-Seeley Discriminator, C. G. Mayo and J. W. Head. "E. & R. Eng." February 1958. 8 pp. The Foster-Seeley discriminator is essentially a parallel-tuned circuit and an impedance inverter by means of which the frequency variation is converted into amplitude variation in a linear manner. A series-tuned circuit could also in theory achieve this conversion, but impossibly-high values of inductance would be required. (England.)

Optimum Filters with Monotonic Response, A. Papoulis. "Proc. IRE." March 1958. 4 pp. A class of filters is developed whose amplitude characteristic has no ripple in the pass band and a high rate of attenuation in the stop band; thus it combines the desirable features of the Butterworth and Tchebycheff response. (U.S.A.)

Relay Phenomena in Toroid Circuits Containing Magnetic Elements With a Rectangular Hysteresis Loop, by V. A. Zhozhikashvili, K. G. Mitiushkin. "Avto. i Tel." Jan. 1958. 11 pp. The paper describes relay phenomena which appear in circuits that contain magnetic cores with a rectangular hysteresis loop and are encompassed by positive feedback. An analysis is made of the static characteristics and the transient response resulting from single or multiple perturbation. Response to pulse interference is also analyzed. (U.S.S.R.)

The Frequency Response of Cut-off Attenuators with Coaxial Launching and Pick-up Probes, A. Sander. "Nach. Z." January 1958. 5 pp. The frequency response of capacitively coupled cut-off attenuators, type I and type II, is calculated. The attenuation ratio is independent of wavelength in the first case and proportional to wavelength in the second case. (Germany.)

New Types of D. C. Amplifier—Part 2. The Reflex-Monitor System, D. J. R. Martin. "E. & R. Eng." February 1958. 7 pp. The cascade-balance principle, described in Part 1, is now revised and embodied in a direct-coupled amplifier of the type using overall drift-correction. Contrary to normal practice, the correcting amplifier, or monitor, is not inherently drift-free but is itself direct-coupled and is a replica of the first stage of the main amplifier; it corrects alternately its own drift and the drift of the main amplifier. The residual effects of supply-voltage and temperature fluctuations are balanced between the two amplifiers, which are effectively in cascade during the overall-correction phase. (England.)

Integrator-Amplifier for Core Measurements, Charles E. Goodell. "El." February 14, 1958. 4 pp. Electronic integrator-amplifier simplifies and speeds grading and matching of magnetic cores. Miller-type integrator measures instantaneous and peak flux in cores at excitation frequencies of 60, 400 and 1,600 cps. (U.S.A.)

On Improving the Properties of Iterative RC Networks, by I. A. Zakharia. "Radiotek," Nov. 1957. 6 pp. The paper examines the possibility of improving the properties of iterative RC networks when the networks overlap. Comparative graphs are given for three-section and four-section networks with shunt resistors. Formulas are given for computing the characteristics of a three-section iterative RC network when individual resistances are varied and when elements of the network are varied progressively. (U.S.S.R.)

Magnetic Amplifiers With Half-Cycle Response, Part 2, B. W. Glover. "El. Energy." February 1958. 7 pp. (England.)

Interchange of Infinite Attenuation Elements in Ladder Filter Structures, J. E. Colin. "Cab. & Trans." January 1958. 13 pp. Relationships between various types of equivalent ladder filters show that a series antiresonant circuit may be replaced by a shunt resonant circuit, provided a capacitor is added to the structure. (France.)

Low Noise Tunable Preamplifiers for Microwave Receivers, M. R. Currie and D. C. Forster. "Proc. IRE." March 1958. 10 pp. (U.S.A.)

The Design of Grounded-Grid Oscillators, by E. E. Korchagina, G. M. Utkin. "Radiotek." Nov. 1957. 10 pp. The paper analyses the problem of selecting the optimum mode of operation for amplifiers and frequency multipliers in grounded-grid circuits. It is shown that when the magnitude of the resonant impedance of the tank circuit is limited the energy relationships in the plate circuit must consider the power dissipated by the preceding stage of the transmitter. Recommendations are given for selecting the cutoff angle and the height of the plate current pulse in amplifiers and frequency multipliers when the power gain of the stage is considered. (U.S.S.R.)

Overcoupled Staggered Tuned Amplifier Circuits, M. Legendre. "Elec. Prof.," Vol. 3, No. 3. 4 pp. The design of overstaggered doubles is outlined, and numerical examples are provided. (France.)

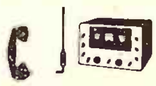
Impulse Distortion in Band-Pass Filters, K. Emden. "Arc. El. Uber," Vol. 11, Issue 12. December 1957. 3 pp. The roots are given of the homogeneous differential equations for image parameters of band pass filters with on to four stages. They are needed for calculating the transients in these filters. The integration constants are determined for square-wave modulated carriers, and the transient functions are represented. (Germany.)

Branching Filters, J. Oswald. "Cab. & Trans." January 1958. 43 pp. The paper first mentions the main features of Cauer's and Piloty's theories of constant impedance branching filters and then supplements certain parts of this theory, particularly those relating to the scattering matrices of perfect branching filters and of Cauer's branching filters. (France.)

Crystal Oscillator Has Variable Frequency, G. A. Gedney and G. M. Davidson. "El." February 14, 1958. 2 pp. Two-stage crystal feedback amplifier operates at 9.1 kc with long-term frequency stability of a few parts per million. (U.S.A.)

Total Differential Feedback, J. C. H. Davis. "E. & R. Eng." February 1958. 5 pp. (England.)

Magnetic Amplifier Drives Gyro Indicator, Clifford C. Voice. "El." February 14, 1958. 4 pp. Three-stage fast-response magnetic servo amplifier occupies only 22 cubic inches in military airborne gyroscope indicator. (U.S.A.)



COMMUNICATIONS

***Synchronous SSB for Communications,** W. L. Firestone, et. al. "El. Ind. Ops. Sec." April 1958. 6 pp. The Synchronous SSB system allows the receiver to phase lock to the pilot carrier more easily, and also cuts frequency stability requirements. The pilot carrier permits easy compatibility with AM systems. (U.S.A.)

Diversity Systems and Reliability in Tropospheric Scatter Links, P. Chavance. "Onde." November 1957. 4 pp. The C.C.I.F. classifies link between two points by the «coefficient of overall reliability», that is to say, the percentage of time during which the link is usable. The author feels that this is insufficient for classifying tropospheric scatter links which are subject to two types of fading, one short term, the other long term. (France.)

A Pulse-Code Modulation Telemetering System, by G. V. Burdenkov. "Avto. i Tele." Jan. 1958. 9 pp. High speed pulse-code telemetering devices are considered. It is demonstated that telemetering circuits can be designed on the basis of combining magnetic elements with a rectangular hysteresis loop with transistors and crystal diodes. The basic parameters of the unit are derived and its telemetering accuracy is evaluated. (U.S.S.R.)

The Generation and Amplification of Millimetric Waves, W. Kleen and K. Poschl. "Nach. Z." January 1958. 12 pp. Following some statements on the significance of millimetric waves for physics and engineering the paper continues with a summary of the various methods for generating and amplifying such waves. (Germany.)

Satellite Local Telephone Exchanges, W. Mirkowski. "Prace ITR." No. 3, 1957. 24 pp. The author deals with the choice of the most advantageous system of satellite local exchanges, taking into account the existing technical principles of exploitation. (Poland.)

Electronic Regenerative Repeater for Start-Stop Telegraph Signals, N. G. Green. "ATE J." January 1958. 8 pp. The advantages to be gained by using an electronic regenerative repeater at the various stages in a telegraph link are discussed, together with features desirable in such an instrument. (England.)

Atmospheric Noise Interference to Short-Wave Broadcasting, S. V. Chandrashekhar Aiya. "Proc. IRE." March 1958. 10 pp. In order to determine the different parameters necessary for assessing the interfering effect of atmospheric noise to shortwave broadcasting, a systematic physical analysis is made of how the atmospheric noise impulse, as heard by the ear, arises and how it causes annoyance to the listener of broadcast programs. (U.S.A.)

Large Capacity Radio Links in the 7,000 Mc/s Band, J. Polonsky and E. Safa. "Onde." November 1957. 19 pp. The radio link comprises a base equipment, common to all channels, and an accessory equipment for mixing or coding the signal channels and to maintain them also. (France.)

On the Correlation of Fading Effects in Adjacent Sectors of Radio-Relay Communication Lines, Iu. B. Sindler, A. S. Nemirovskii. "Radiotek." Nov. 1957. 8 pp. Analysis of the factors which affect the probability of radio-relay line failure due to fading effects. Certain problems of the statistical analysis of fading effects in radio-relay lines with a large number of sectors are discussed. Results are given of the analysis of data obtained from observing the operation of the Moscow-Gorkii radio-relay line during 1954-1956. (U.S.S.R.)

The Statistical Accuracy of Traffic Unit Measurements, A. Lotze. "Nach. Z." January 1958. 3 pp. By applying the theory of random tests to measurements of telephone traffic, the reliability of traffic unit measurements, i.e., the interval for confidence in a certain accuracy of statements, can be determined with the aid of simple diagrams. (Germany.)

Carrier Communications on High-Voltage Power Lines, J. J. H. Keillar. "ATE J." January 1958. 9 pp. (England.)

A Communication Technique for Multigraph Channels, R. Price and P. E. Green, Jr. "Proc. IRE." March 1958. 16 pp. Application of principles of statistical communication theory has led to a new communication system, called Rake, designed expressly to work against the combination of random multipath and additive noise disturbances. (U.S.A.)

The FHT 4,003 Radio Link Equipment, A. Laurens and J. D. Koenig. "Onde." November 1957. 14 pp. This article describes a long distance radio link equipment for the transmission of a television channel or a large number of telephone channels. (France.)

COMPONENTS

Voltage Conversion with Transistor Switches, P. L. Schmidt. "Bell Rec." February 1958. 5 pp. Modern magnetic-core components are powerful new running mates for semiconductor devices. In many areas of electronics, this combination has greatly improved the reliability, efficiency and ruggedness of existing apparatus. In some cases, such as the conversion of a dc voltage to ac, the combination of transistors and magnetic-core components has provided an entirely new approach to the problem. (U.S.A.)

Dynamic Characteristics of Cores with a Rectangular Static Hysteresis Loop (The Effect of Eddy Currents), M. A. Rozenblat. "Avto i Tel." Jan. 1958. 10 pp. The author analyzes the effect of eddy currents on the shape of the dynamic hysteresis loop, the magnitude of the differential magnetic permeability and the magnitude of the dynamic coercive force of cores with a rectangular static hysteresis loop. Analytical expressions are derived for the dynamic hysteresis loop when the induction varies sinusoidally, when the field intensity varies sinusoidally, and when the core is remagnetized by means of a dc voltage. The computed results are experimentally verified. (U.S.S.R.)

Performance of Metal-Film Resistors, C. Wellard and S. J. Stein. "El. Eq." February 1958. 2 pp. In this article, the manufacturing methods are described, characteristics and performance data noted, for general purpose, molded metallic-film resistors. (U.S.A.)

COMPUTERS

***A Neon Pulser for the Computer Laboratory,** R. L. Ives. "El. Ind." April 1958. 3 pp. Many components require high voltage pulses for test routines. Here is a pulse generator circuit which will give pulses of more than 70 volts, either positive or negative, from around one cps to above 2500 cps. The set is designed for reliability, long life, and ease of construction. (U.S.A.)

The Synthesis and Analysis of Digital Systems by Boolean Matrices, Joseph O. Campeau. "IRE Trans. PGEC." December 1957. 11 pp. In this paper methods are described by which Boolean matrices can be used to synthesize digital systems. The matrices offer a means by which the design of such systems can be systematized much in the same way as do matrix methods when applied to electrical circuit design. (U.S.A.)

An Optimum Character Recognition System Using Decision Functions, C. K. Chow. "IRE Trans. PGEC." December 1957. 8 pp. The character recognition problem, usually resulting from characters being corrupted by printing deterioration and/or inherent noise of the devices, is considered from the viewpoint of statistical decision theory. (U.S.A.)

An Analysis of Certain Errors in Electronic Differential Analyzers, I—Bandwidth Limitations, Paul C. Dow, Jr. "IRE Trans. PGEC." December 1957. 6 pp. (U.S.A.)

Analysis of Sequential Machines, D. D. Aufenkamp and F. E. Hohn. "IRE Trans. PGEC." December 1957. 10 pp. This paper begins with Mealy's model of a sequential machine and introduces a "connection matrix" which describes the machine completely. The "equivalence" of states of such a machine may be analyzed systematically by an iterative technique, the validity of which is rigorously established. Once equivalence is completely analyzed, it is a simple matter to write the connection matrix for the simplest equivalent machine. The process is not difficult to execute, even in complex cases, and could be programmed for a computer. (U.S.A.)

CONTROLS

The Relaxation of Sufficient Conditions for Absolute Stability, Vasile-Mikhai Popov. "Avto. i. Tel." Jan. 1958. 7 pp. Investigation of sufficient conditions for absolute stability of an automatic control system with one nonlinearity in the speed characteristic of the servomotor. It is shown that in certain cases these conditions may be relaxed. The three-dimensional case (with the exception of special cases) is treated and the necessary and sufficient conditions are derived. (U.S.S.R.)

Automation—Information and Terminology, K. Raylec. "Radio Rev." Vols. 9 and 10. Nos. 9 and 10. December 1957 and January 1958. 3 pp. each. This is a part of a series of articles explaining the various methods and devices used in modern automation processes. (Belgium.)

Magnetic Systems Recording Media, Techniques and Devices, Part III, Will Gersch. "Auto. Con." February 1958. 5 pp. This is the last of a three-part series broadly surveying recording devices. Previously reviewed: direct visual indicating systems in December, perforation systems in January, and now with magnetic systems. (U.S.A.)

Optimum Transient Response in an Automatic Control System with a Position-Bounded Control Element, E. K. Krug, O. M. Minina. "Avto. i. Tel." Jan. 1958. 16 pp. Optimum transient response curves are derived for automatic control systems with position-bounded control elements when the control objects have various dynamic properties (objects with lag are included). It is shown that it is difficult to achieve optimum transient response with continuous controllers since the characteristics of the nonlinear transducers contained in such controllers depend on the magnitude and point of application of the perturbations and on the initial values of the bounding coordinates. The use of a discrete controller is recommended. (U.S.S.R.)

GENERAL

Space Exploration—The New Challenge to the Electronics Industry, Henry E. Prew. "IRE Trans. PGMIL." December 1957. 6 pp. (U.S.A.)

New Look At Submarines, C. B. Momsen. "IRE Trans. PGMIL." December 1957. 4 pp. (U.S.A.)

Suggestions for Proper Use of an Electronic Flash Gun, J. Debrie. "Radio Rev." Vol. 10, No. 10. January 1958. 5 pp. Calculated is the light output from an electronic flash gun. This is followed by a theoretical analysis relating flash illumination to shutter motion. (Belgium.)

Various Devices Used for Prospecting and Detection of Radio-Active Material, J. Bauche and R. Fordyce. "Elec. Prof." Vol. 3, No. 3.

8 pp. This is a survey of devices manufactured for the detection and measurement of radio-active material. (France.)

Print Timer Controls Density and Contrast, James E. Weir. "El." February 14, 1958. 2 pp. Electronic timer, used to develop photographic prints of consistant quality makes use of phantastron circuit to arrive at the right combination of exposure time and color filter necessary to obtain and repeat the desired exposure values. (U.S.A.)

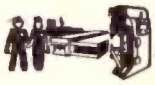
Type 54 Vehicle-Actuated Traffic Controller, A. L. Range. "ATE J." January 1958. 12 pp. The author describes how vehicles themselves control the bulk of timing operations carried out by the controller. (England.)

A Graphic Method for Determining the Critical Elements of a Wobbulator, A. Verbist. "Radio Rev." Vol. 9, No. 9. December 1957. 4 pp. The design parameters for a wobbulator operating in the frequency range from 44 to 56 mc are discussed. A graphical method is outlined which permits a rapid determination of the various electrical values. (Belgium.)

An Electronic Balance, J. Cathy. "Elec. Prof." Vol. 3, No. 3. 5 pp. The basic principle and operation of an electronic balance is described. This is followed by practical industrial applications for such devices. (France.)

Reliable and Economical System Design, M. M. Tall and S. M. Sherman. "El. Eq." February 1958. 4 pp. This article gives a detailed step-by-step analytical procedure which can be applied to both military and commercial complex electronic systems. (U.S.A.)

Intruder Alarm Uses Phase-Sensitive Detector, S. Bagno and J. Fasal. "El." February 14, 1958. 4 pp. Transistorized burglar alarm has electronically modulated infrared light source and synchronous phase-sensitive demodulator pickup unit. (U.S.A.)



INDUSTRIAL ELECTRONICS

Rapid Glueing of Wood with the Aid of High Frequencies, R. Osmond. "Elec. Prof." Vol. 3, No. 3. 3 pp. The article describes the practical applications of the use of high frequencies in the field of carpentry. The high frequency is used for accelerating the curing cycle of glued sections. The location of the electrodes for mitered and dove-tailed sections is illustrated. (France.)

Air Cleaning with Electrostatic Precipitators, B. K. R. Prasad. "El. Energy." February 1958. 3 pp. The principle of dust precipitation is briefly discussed and details are given of an equipment which uses voltages only of the order of 6 to 13 kv and which thus generates little "ozone." (England.)

INFORMATION

Detection of Fluctuating Pulsed Signals in the Presence of Noise, Peter Swerling. "IRE Trans. PGIT." September 1957. 4 pp. This paper treats the detection of pulsed signals in the presence of receiver noise for the case of randomly fluctuating signal strength. The system considered consists of a predetection stage, a square law envelope detector, and a linear postdetection integrator. (U.S.A.)

Fixed Memory Least Squares Filters Using Recursion Methods, Marvin Blum. "IRE Trans. PGIT." September 1957. 5 pp. (U.S.A.)

Locally Stationary Random Processes, Richard A. Silverman. "IRE Trans. PGIT." September 1957. 6 pp. (U.S.A.)

The Solution of a Homogeneous Wiener-Hopf Integral Equation Occurring in the Expansion of Second-Order Stationary Random Functions, D. C. Youla. "IRE Trans. PGIT." September 1957. 7 pp. (U.S.A.)

The Correlation Function of Smothly Limited Gaussian Noise, R. F. Baum. "IRE Trans. PGIT." September 1957. 5 pp. The correlation function of "smoothly" limited Gaussian noise is calculated and compared with the correlation function of "extremely" clipped Gaussian noise. The limiting function is assumed to have the shape of the error integral curve. The output spectrum is calculated for the case of noise passed through an RC filter. (U.S.A.)

On the Role of Dynamic Programming in Statistical Communication Theory, R. Bellman and R. Kalaba. "IRE Trans. PGIT." September 1957. 7 pp. The fundamental problem of determining the utility of a communication channel in conveying information can be interpreted as a problem within the framework of multi-stage decision processes of stochastic type, and as such may be treated by means of the theory of dynamic programming. (U.S.A.)

Complex Processes for Envelopes of Normal Noise, Richard Arens. "IRE Trans. PGIT." September 1957. 4 pp. The paper presents a brief exposition of the technique of complex normal random variables as utilized in the study of the envelopes of Gaussian noise processes. (U.S.A.)

A Theory of Multilevel Information Channel with Gaussian Noise, Satosi Watanabe. "IRE Trans. PGIT." December 1957. 6 pp (U.S.A.)

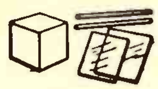
A Generalization of a Method for the Solution of the Integral Equation Arising in Optimization of Time-Varying Linear Systems with Nonstationary Inputs, Marvin Shinbrot. "IRE Trans. PGIT." December 1957. 5 pp. A new method is presented for the solution of the integral equation which arises in the optimization of a system in the presence of noise when the inputs are not stationary. The method depends on the correlation functions satisfying a certain condition which, fortunately, is frequently satisfied in practical situations. A simple example is presented to illustrate the method. (U.S.A.)

On the Mean Square Noise Power of an Optimum Linear Discrete Filter Operating on Polynomial Plus White Noise Input, Marvin Blum. "IRE Trans. PGIT." December 1957. 7 pp. (U.S.A.)

The Distribution of the Number of Crossings of a Gaussian Stochastic Process, Carl W. Helstrom. "IRE Trans. PGIT." December 1957. 6 pp. It is shown how filtered Gaussian noise having a power spectrum which is a rational function of the square of the frequency can be represented as one component of a multi-dimensional Markov process. Methods are studied for obtaining the distribution of the number of times such a noise process crosses a given amplitude level in a fixed time interval. (U.S.A.)

An Analysis of Coherent Integration and Its Application to Signal Detection, K. S. Miller and R. I. Bernstein. "IRE Trans. PGIT." December 1957. 12 pp. (U.S.A.)

The Sequential Detection of a Sine-Wave Carrier of Arbitrary Duty Ratio in Gaussian Noise, H. Blasbalg. "IRE Trans. PGIT." December 1957. 9 pp. In this paper the Wald theory of sequential analysis is applied to the detection of a sine-wave carrier of arbitrary duty ratio in Gaussian noise. This is a generalization of a familiar problem. The detector law for the problem is obtained. (U.S.A.)



MATERIALS

Fundamental Properties of Permalloy 45 N of Soviet Make, R. Pac. "Prace ITR." No. 3, 1957. 15 pp. The paper contains a specification of fundamental properties of Permalloy 45 N of Soviet make, falling into the class of alloys having a nickel content of about 50%. (Poland.)

Nature and Properties of Electron Gas, M. Bayet. "Onde." December 1957. 5 pp. A definition is given of what is meant by electron gas, and it is recalled that the major part of electronics is limited to the study of beams of electrons, and can be developed without regard to the interaction of these particles. (France.)

An Introduction to Soft Magnetic Ferrites, W. A. Turner. "ATE J." January 1958. 13 pp. This article is a review of the progress made in the development and application of soft ferrite materials. (England.)

Magnetic After Effect in Hot-Rolled Silicon Steel Sheets, A. Smolinski and M. Zbikowski. "Prace ITR." No. 3, 1957. 15 pp. Among many phenomena of magnetic after effect, magnetic desaccommodation has been given particular consideration because of its important effect on the accuracy of magnetic measurements at low field intensity. (Poland.)

High-Voltage Applications of Casting Resins, K. A. Fletcher. "Brit. C. & E." January 1958. 6 pp. A field of application where casting resins provide unique advantages of reliability and miniaturization is that of high-voltage components, where a considerable reduction of size and weight can be made due to the excellent electrical properties of the resins. (England.)

MEASURING & TESTING

***Automatic Checkout Equipment, Part 1,** Larry S. Klivans. "El. Ind." April 1958. 6 pp. You can't use hand checkout methods with modern weapons systems. But automatic checkout systems are expensive. One answer to this dilemma is to design the checkout system so it is easily adaptable to different systems. As the author points out, this requires a rational approach to both system design, and selection of sub-systems and components. (U.S.A.)

***For Instrumentation . . . Ring-Modulator Reads Low-Level DC,** E. J. Leonjian and J. D. Schmidt. "El. Ind." April 1958. 4 pp. By using high-quality silicon diodes in a ring-modulator circuit, DC signals as low as 100 micromicroamps can be measured. Combined with a logarithmic attenuator, the output can be made a logarithmic function of the input from 100 micromicroamps to 1 milliamp. (U.S.A.)

Sample Tests and Estimation of Errors, W. Chladek. "Nach. Z." January 1958. 10 pp. A brief introduction into the methods used for the supervision of characteristics and into the evaluation of measurements result is given. The "risc," which has to be taken in order to save in measurement work, is a common fact in all these methods. (Germany.)

Evaluating the Accuracy to Which Inputs Are Reproduced by Linear Tracking and Recording Systems, V. G. Vasil'ev. "Avto. i Tel." Jan. 1958. 23 pp. The necessary and sufficient conditions are given for the accurate reproduction of a specified class of inputs by a linear reproducing system. Maximum values of the perturbation modulus and its local growth index are used to define the class of perturbations. (U.S.S.R.)

Measurement of Piezoelectric and Elastic Constants of Titanate Ceramics, W. Pajewski. "Prace ITR." No. 3, 1957. 22 pp. Parameters defining piezoelectric and elastic properties of piezoelectric ceramics are specified. Because of the rather lacunar treatment of this subject in technical literature, not suitable for practical application, a method measuring these parameters is presented. (Poland.)

Approximate Relations Between Transient and Frequency Response, H. H. Rosenbrock. "J. BIRE." January 1958. 8 pp. The paper is based upon an existing graphical method for obtaining the transient response of a stable, linear device from its frequency response, and vice versa. (England.)

Extending Transducer Transient Response by Electronic Compensation for High-Speed Physical Measurements, F. F. Liu and T. W. Berwin. "Rev. Sci." January 1958. 9 pp. Systems are described which automatically and continuously correct for dynamic errors of transducers during transient and steady-state measurements. (U.S.A.)

Investigations of the Magnetic Circuit in Relays for Telephone Exchanges, W. Kruger. "Nach. Z." January 1958. 12 pp. The relationship between the characteristics of relays, the magnetic stray flux and the hysteresis loop of ring samples from ferrous core material is determined by magnetic flux measurements. (Germany.)

Automatic Trace of Electron Trajectories, O. Cahen. "Onde." December 1957. 6 pp. (France.)

Transients in a System Consisting of an RF Amplifier and a Detector, L. S. Gutkin, O. S. Chentsova. "Radiotek." Nov. 1957. 12 pp. The paper examines transients in an RF amplifier-diode detector system for several different types of amplifier tank circuits (a tuned tank circuit, a detuned tank circuit, two coupled tank circuits). The analysis is performed by the method of low-frequency equivalents. This method makes it possible to consider the effect of transients in the system of tank circuits supplying the detector when various laws govern the envelope variation of the input signal. (U.S.S.R.)

Sinusoidal Response Measurements with Bridge-Connected Transducers, John J. Earshen. "Auto. Con." February 1958. 6 pp. (U.S.A.)

Measurements of Low-Reflection Coefficients at High Frequencies in Terms of Magnitude and Phase, A. Linnebach. "Arc. El. Uber." Vol. 11, Issue 12. December 1957. 7 pp. The paper describes a method which allows the measurements of low-reflection coefficients at high frequencies in terms of magnitude and phase. Theory and practical use of this method are described. No special instruments are employed, apart from a directional coupler, and a four-terminal network of simple design with variable stubs. Design parameters are given. (Germany.)

Recording Microwave Hygrometer, J. B. Magee and C. M. Crain. "Rev. Sci." January 1958. 4 pp. This paper describes a rapid response microwave hygrometer for continuously recording the water vapor pressure of atmospheric air over a wide ambient range. (U.S.A.)

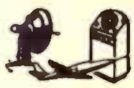
Operation of Direct Indicating Frequency Meter for 50 c/s to 300 kc/s, R. Kosfeld and B. Ricke. "El. Rund." February 1958. 4 pp. A frequency meter is described which permits the direct reading, with an accuracy better than 2%, of frequencies between 50 c/s and 300 kc/s. The accuracy is independent of the input voltage which may fluctuate between the permitted limits of 5 mV and 10 V. (Germany.)

Thorough Vibration Tests Aid Successful Design, M. G. Comuntzis. "El. Eq." February 1958. 4 pp. Test procedures and design examples are given. (U.S.A.)

Properties and Design of Electronic Components with Regard to Life and Dependability, H. Dornheim. "El. Rund." February 1958. 4 pp. Properties and operation of thyratrons and ignitrons are considered and directions for their design given. Measures for life and reliability improvements are outlined. (Germany.)

Diode Counter Calibrates Missile Testing Camera, Samuel E. Dorsey. "El." February 14, 1958. 3 pp. Speed of continuously moving film in shutterless 35-mm camera used for smear photography is calibrated in fps by frequency tachometer. Heart of meter is loaded-diode counter whose amplified output drives pen oscillograph. (U.S.A.)

How to Measure Resonant Cavity Q, Martin G. Kenney. "El. Eq." February 1958. 4 pp. (U.S.A.)



RADAR, NAVIGATION

A Precision Microwave Signal Generator, F. W. Cook. "ATE J." January 1958. 9 pp. This article describes a signal generator covering the frequency range 580 Mc/s to 1220 Mc/s. The output is held constant, at any level set by an accurately calibrated attenuator, by means of automatic level-control circuits. (England.)

An Introduction to Inertial Navigation, E. Large. "Brit. C. & E." January 1958. 6 pp. An electronic and electromechanical system of navigation based on the inertial properties of matter appears to have proved itself now that I.G.Y. earth satellites are in their orbits. (England.)

Ferrite Microwave Detector, D. Jaffe, et al. "Proc. IRE." March 1958. 8 pp. In treating the behavior of the magnetic moments of unbalanced electron spins in ferromagnetic materials under the action of an rf field, second-order terms in the alternating components are usually neglected. It is shown here that retention of certain second-order terms for one component of the magnetization predicts the possibility of using ferrites to detect an amplitude-modulated microwave signal. (U.S.A.)

The Use of Radar Simulators in the Royal Navy, P. Tenger. "J. BIRE." January 1958. 15 pp. The paper describes a synthetic training system developed for the Royal Navy to provide a means of semi-realistic study of tactical problems involving ships and aircraft. (England.)

A General-Purpose Radio-Aids Simulator—for Attachment to a Flight Trainer, Kenneth H. Simpkin. "Brit. C. & E." January 1958. 6 pp. (England.)

Radar Simulators, L. J. Kennard and C. H. Nicholson. "J. BIRE." January 1958. 15 pp. (England.)

The Design of Airborne Doppler Velocity Measuring Systems, F. B. Berger. "IRE Trans. PGANE." December 1957. 19 pp. The nature of Doppler velocity measurement is reviewed briefly. This is followed by a discussion of the basic requirements for obtaining a usable signal for practical systems, which include achieving requisite coherence, fulfilling certain signal-to-noise criteria, and maintaining known functional relationships between measured Doppler frequencies and aircraft velocity. Then, those factors peculiar to over-water operation of Doppler systems are discussed. (U.S.A.)

Principles and Performance Analysis of Doppler Navigation Systems, Walter R. Fried. "IRE Trans. PGANE." December 1957. 21 pp. The fundamental concepts of a Doppler navigation system are described. The theory of operation, design considerations, performance characteristics of navigational computers and heading references. (U.S.A.)

Basic Design Considerations—Automatic Navigator AN/APN-67, M. A. Condie. "IRE Trans. PGANE." December 1957. 5 pp. Some of the considerations involved in the design of the Automatic Navigator, AN/APN-67, are presented along with a description and photographs of the equipment design selected. Characteristics of the Doppler signal are also described. (U.S.A.)

SEMICONDUCTORS

***For Transistor Amplifiers . . . Designing Multiple Feedback Loops, Part I,** Franklin H. Blecher. "El. Ind." April 1958. 5 pp. A criterion of stability is introduced which is useful for calculating the stability margins of multiple loop structures. Part One is directly applicable to circuits which employ junction transistors in the common base configuration. (U.S.A.)

Increasing the Useful Power Output of a Tuned Transistor Amplifier by Increasing its Efficiency. Part 1, L. S. Berman. "Radiotek." Nov. 1957. 4 pp. A transistor has practically no limitations with respect to emission current, and therefore an increase in its useful power output is limited chiefly by the allowable power dissipation. By increasing the efficiency of a tuned transistor amplifier through the use of an additional tank circuit which is tuned to the third harmonic, it is possible to increase the useful power output by more than a factor of 2 in comparison to that available from usual circuit (when the power dissipation is the same in both cases). (U.S.S.R.)

Measurements of the Operating Temperatures of Transistors, H. Beneking. "Arc. El. Uber." Vol. 11, Issue 12. December 1957. 6 pp. Described is a device which permits the determination of the operating temperatures of transistors. The measurement is based on the collector current which flows when the emitter and the base terminals are short circuited. The accuracy obtained for germanium transistors was 0.5°C. This corresponds to about 1 mw for a conventional 50 mw transistor. (Germany.)

High Frequency Tetrode Transistor Circuits, F. Juster. "Elec. Prof." Vol. 3, No. 3. 3 pp. The operational characteristics of transistor tetrodes are described operating in a frequency domain from 10 to 100 mc. A number of basic circuits are given. (France.)

The Effects of Short Duration Neutron Radiation on Semiconductor Devices, W. V. Behrens and J. M. Shaull. "Proc. IRE." March 1958. 5 pp. (U.S.A.)

Circuit Equivalents for Transistors, H. Schenkel. "Radio Rev." Vol. 10. January 1958. 9 pp. Outlined are the various equivalents for transistor circuits, such as common emitter, common base, and common collector operations. Circuits are supported by the mathematical equivalents listed in tables. (Belgium.)

Transistors for Rural Telephone Systems, I. C. Savadelis. "Bell Rec." February 1958. 4 pp.

With future automation in mind, engineers have created voice-frequency and carrier-frequency n-p-n transistors to a very exacting set of requirements for trials of rural-carrier telephone equipment. (U.S.A.)

Theory of Junction Diode and Junction Transistor Noise, A. Van Der Ziel and A. G. T. Becking. "Proc. IRE." March 1958. 6 pp. (U.S.A.)

Electrical Breakdown in p-n Junctions, A. G. Chynoweth. "Bell Rec." February 1958. 5 pp. In semiconductor devices, p-n junctions can "break down," or permit a sudden flow of electricity in the direction that normally shows high resistance. For some time a puzzle to physicists, the mechanism of this phenomenon can now be described as a result of recent research studies. (U.S.A.)

TELEVISION

***For Slide Chains, Color . . . from Black & White,** E. W. Lambourne. "El. Ind. Ops. Sec." April 1958. 4 pp. A novel equipment enables stations to transmit color station breaks adjacent to network color shows. Construction details are given and operational problems, with solutions, are cited. (U.S.A.)

New Applications for Industrial Television, E. F. Spiegel. "Freq." Vol. 12, No. 2. February 1958. 6 pp. The article illustrates new small industrial TV cameras equipped with Zoom lenses, telescopic mirrors, etc. Applications such as inspection of pipes in oil wells, as well as the use of TV cameras for rolling mill operations, are discussed. (Germany.)

Non-Linear Distortion in TV Transmission Systems, J. Mueller. "Arc. El. Uber." Vol. 11, Issue 12. December 1957. 10 pp. Defined are the non-linear distortions in TV transmission systems. The limits of perceptibility of gamma distortions as well as other non-linear distortions are reviewed, and their influence on the television picture quality is discussed. Highlighted are frequency dependent non-linear distortions which may appear on frequency modulated radio links. The effect upon video signals and TV pictures are demonstrated by oscilloscope presentations and in the form of diagrams. (Germany.)

Technical Facilities in Television House, John D. Tucker. "Brit. C. & E." January 1958. 4 pp. (England.)

An Industrial TV Installation, W. Mayer. "Freq." Vol. 12, No. 2. February 1958. 5 pp. The author describes the operation of industrial TV equipment using Vidicon pick-up tubes. Basic operation, required light level, voltage regulation, type of synchronization, interlacing, as well as the transmission of deflection currents from the pulse generator to the camera are discussed. (Germany.)

Resolution Chart Aids TV Camera Focusing, Glen Southworth. "El." February 14, 1958. 2 pp. Optimum electronic focus of television cameras and film chains is effected by scanning bar chart adjusting focus controls for maximum response of peaks on waveform monitor. (U.S.A.)

Closed Circuit TV, W. Taeger. "Freq." Vol. 12, No. 2. February 1958. 2 pp. This article describes briefly the Tekade camera equipment operating interlaced at 625 lines and 25 frames. (Germany.)

The Use of Industrial TV Cameras, R. V. Stoewer. "Freq." Vol. 12, No. 2. February 1958. 6 pp. A number of existing industrial TV installations are illustrated. Highlighted is the use of control of furnaces, glass melts, traffic in cities, and on waterways. In addition, TV equipment for banks and medical research is shown. (Germany.)

THEORY

***VSWR Reduction By Padding,** Henry W. Kasper. "El. Ind." April 1958. 2 pp. Equations and design curves are given for reducing VSWR due to mismatch. (U.S.A.)

The Principal Problems of Signal Theory and Problems of its Further Development on the Basis of a New Stochastic Model, N. A. Zheleznov. "Radiotek." Nov. 1957. 9 pp. Critical analysis of the properties of the model on which modern information theory is based. It is noted that limitation of the spectrum leads to the complete statistical determinability of the signals; thus is it impossible to form these signals in physically realizable systems. It is shown that the concept of limiting the signal to a stationary process eliminates all types of radio signals. The author proposes a new stochastic model which retains the principal properties of actual signals. (U.S.S.R.)

A Discussion of Network Problems with the Aid of New Symbols, W. Doebke. "Arc. El. Uber." Vol. 11, Issue 12. December 1957. 7 pp. In the conventional form, the line equations contain as system parameters the voltage (u), and the current (i), as well as their derivatives with respect to space and time. To solve these equations, another differentiation must be carried out which, in a number of cases, is quite difficult. These difficulties can be eliminated by using as system parameters two linear combinations of u and i. Some typical examples are illustrated. (Germany.)

The Problem of Synthesizing Linear-Varying-Parameter Dynamic Systems, A. M. Batkov. "Avto. i Tel." Jan. 1958. 6 pp. A method is given for determining the differential equation of a linear-varying-parameter system from a specified pulse transient response. (U.S.S.R.)

Thermoelectric Effects, Frank E. Jaumot, Jr. "Proc. IRE." March 1958. 17 pp. This paper is a review of thermoelectric effects in solids, with emphasis on the practical application of these effects. The basic principles of thermoelectricity are reviewed, the present status of the problem and recent achievements are outlined in terms of specific practical applications, and the present status of the more detailed theoretical treatments is discussed in a nonmathematical fashion. (U.S.A.)

Dynamic Frequency Response of Selective Systems, I. T. Turbovich. "Radiotek." Nov. 1957. 11 pp. Analysis of the dynamic characteristics of any linear system. Simple formulas are given for the computation of the basic parameters of the dynamic characteristics (the position and height of the maximum, the expansion of the band width and the displacement with respect to the static characteristic) of selective systems. It is assumed that the rate of frequency variation is small. The limits of applicability are defined for the computed relationships. (U.S.S.R.)

Principles of Radio Climatology, F. du Castel and P. Misme. "Onde." November 1957. 4 pp. A single meteorological parameter is sought which will account for the variations in level of the electric field in long distance links. (France.)

The Topological Probability Space, and Its Application to Congestion Theory, R. Syski. "ATE J." January 1958. 17 pp. (England.)

On Designing Circuits With Lumped Elements Which Reproduce the Properties of Circuits with Distributed Constants, N. S. Kochanov. "Radiotek." Nov. 1957. 7 pp. The paper analyzes the problem of representing certain irrational and transcendental functions (which express the input impedance of a long line) by means of continuous fractions. The author proves that it is possible to synthesize two-pole and four-pole networks with lumped elements that simulate the properties of long lines both with respect to input impedance and with respect to transfer constant. (U.S.S.R.)

TRANSMISSION

Single Coaxial Pair Self-Supporting Overhead Cables, R. Belus. "Cab. & Trans." January 1958. 7 pp. The self-supporting cable described in this paper has been designed for two purposes: to quickly establish a long distance 60-channel link and to immediately replace a faulty underground coaxial pair. (France.)

The Calculation of Characteristic Impedance by Conformal Transformation, J. C. Anderson. "J. BIRE." January 1958. 6 pp. The basic theory is reviewed and the method is applied to the particular case of a coaxial transmission line with a cylindrical outer and a strip inner. (England.)

Propagation in Discontinuous Periodic Structures and Its Application to Waveguides, M. Jouguet. "Cab. & Trans." January 1958. 14 pp. The author discusses the propagation of unlimited plane waves within a stratified medium in an indefinite space and in a waveguide with an inner laminated structure. (France.)

Coaxial Transmission Lines, S. Mahapatra. "E. & R. Eng." February 1958. 5 pp. Approximate calculations are made for the distributed constants (R, L, G, C) of a coaxial transmission line with the inner conductor of elliptical cross-section. (England.)

TUBES

The Application of a Memory Tube for Transforming Radio Images Into TV Images, A. Verbist. "Radio Rev." Vol. 9. No. 9. December 1957. 3 pp. This is a brief discussion of the basic elements required for transposing a radar image into a 625 line TV picture. An image tube designed by CSF is used for the process. This is a double-electron gun tube with an electro-magnetic deflection system used for displaying the radar picture, and an electrostatic system employed for the video scanning. (Belgium.)

Developmental Position and Method of Operation of Microwave Tubes, III, R. Muller and W. Stetter. "El. Rund." February 1958. 4 pp. Connecting in series a backward-wave tube and a travelling wave tube, high frequency output is constant for a broad frequency band. After describing the operational method of magnetrons in general the special working conditions of magnetron oscillators are dealt with. (Germany.)

R-F Power-Tube Parameter Variations and Their Effect on Transmitter Design, J. A. Jolly and B. Morwood. "El. Eq." February 1958. 4 pp. Normal tube-to-tube variations post compensation problems in design of high frequency transmitter circuits. Typical parameter variations are defined and examples given. (U.S.A.)

U. S. GOVERNMENT

Research reports designated (LC) after the PB number are available from the Library of Congress. They are photostat (ph) or microfilm (mi), as indicated by the notation preceding the price. Prepayment is required. Use complete title and PB number of each report ordered. Make check or money order payable to "Chief, Photoduplication Service, Library of Congress," and address to Library of Congress, Photoduplication Service, Publications Board Service, Washington 25, D. C.

Orders for reports designated (OTS) should be addressed to Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. Make check or money order payable to "OTS, Department of Commerce." OTS reports may also be ordered through Department of Commerce field offices.

Relaxation Behavior of Titanium Alloys, F. J. Gillig, Cornell Lab., Inc. Dec. 1956. 87 pages. $2.25. (PB 121978, OTS) The relaxation phenomena in commercially pure titanium and two of its alloys was studied. A relaxation test unit was developed which can apply initial load quickly and automatically maintain constant strain over long periods. The device, which minimizes relaxation during loading, is useful in the selection of materials for bolts and other applications involving constant strain at high temperatures. From the data provided by the test unit, conclusions were drawn regarding the microstructural effect of grain size variation.

Comparison of Four Methods of Encoding Elevation Information with Complex Line-Inclination Symbols, D. B. Learner and E. A. Allusi, Ohio State U. Nov. 1956. 27 pages. 75 cents. (PB 131001, OTS) This study presents the results of a preliminary investigation of the psychological feasibility of employing coding schemes based on complex line-inclination symbols for encoding information, such as elevation, that may require as many as 50 unique symbol categories. The study is part of a project aimed at establishing psychological principles applicable to the design and operational use of future air traffic control equipment and procedures. Four groups of subjects were tested on the binary, decimal, wheel, and clock coding schemes, each group working with a different one of the four codes. Their speed and accuracy were then measured. Data indicate that the decimal and clock codes were decoded with greater speed than the wheel and binary codes. The wheel code was found inferior to the other three codes with regard to accuracy. Although the decimal and clock codes should undergo further study before being used for encoding elevation information, the data indicate that they are psychologically feasible for such use.

Field and T-F Emission, W. W. Dolan and W. P. Dyke, Linfield College. Jan. 1957. 110 pages. $2.75. (PB 131000, OTS) Considerable progress in the development of the field emission process for application to electronic devices is described in this summary report of four years of research. Field emission of electrons from metals was studied with respect to basic properties, control of stabilization of current, extension of useful life, and possible applications. Stability of the cold cathode under steady applied fields, a limitation which had slowed development of the process, received special emphasis. Through control of environmental factors, stable life was extended to more than 1000 hours at currents in the range of 10 to 100 microamperes. Stability of pulsed emission was enhanced by use of intermediate cathode temperatures to keep the surface smooth and clean. In studies of applications, a rectifier, a transducer, and a voltage regulator were designed and tested. Collateral techniques such as emitter fabrication, electron microscopy, and vacuum practices were refined and reduced to standard procedures.

Precision Instruments for Calibrating Radiometers at 4.3 Millimeters Wavelength, A. I. Reynard, NRL. May 1957. 15 pages. 50 cents. (PB 121947, OTS) Instruments of high precision and flexibility were developed for use in calibrating radiometers at 4.3 wavelength. A hot load which met requirements of a standard noise source was developed. The hot load contained a special furnace which gave a temperature of less than 1°C, a considerable improvement in accuracy. A stable argon discharge tube with an effective temperature of about 10,000°C was designed and calibrated. Other developments were a three-way, remote-control waveguide switch of negligible insertion loss and low VSWR, and a high-precision attenuator with total insertion loss of less than 0.1 db and attenuation in excess of 52 db.

Microscopic and X-Ray Study of Barium Titanate Ceramics, W. R. Cook, Jr., Brush Laboratories Co. July 1955. 44 pages. $1.25. (PB 121342, OTS) A two-year study of factors influencing the variability of electrical properties in barium titanate ceramics is reported. Among the techniques developed during the study was an X-ray diffraction method which identified as little as 4M percent of the phase Ba_2TiO_4 and 3M percent of $BaTi_3O_7$ when present in $BaTiO_3$. Suggestions are made for improving the detection still further. The petrographic method was rated much superior to the X-ray method, although the latter is speedier. For most other purposes, other techniques were superior to petrography for study of barium titanate. A method for completely analyzing the various domain patterns was devised. The "square net" domain pattern was analyzed, and the results demonstrated the adaptability of the domain structure to external and internal stresses. Possible causes of stresses appeared to be impurity atoms, grain boundaries, dislocations, and lattice effects. Based on domain pattern data, recommendations are made for the attainment of maximum electromechanical coupling.

An Experimental Study of Butt-Joined ADP Crystal Plates, B. J. Faraday and D. J. G. Gregan, NRL. Apr. 1957. 28 pages. 75 cents. (PB 121878, OTS) This volume reports a study of resonant piezoelectric transducers designed for the progressively lower frequencies required for long-range sonar detection. In conventional transducers which utilize zxt 45 (45 Z-cut) ammonium dihydrogen phosphate (ADP), the low frequency limit is determined by the transverse dimensions of the mother block from which individual plates are cut. The growth habit of ADP, however, precludes significant accretion in the lateral direction. By butt-joining, or cementing crystal plates end-to-end, greater crystal lengths are produced and proportionately lower frequencies are obtained. Bonded crystals using several types of adhesives were investigated from the standpoint of solvent resistance, mechanical dissipation and strength, electromechanical coupling, dielectric properties, and thermal behavior. The epoxide resins were the only successful bonding agents. Tests indicated that bond thickness should be kept at a minimum and that the bond should be located away from the position of the antinode of stress and strain.

Nonmetallic Ferromagnetic Materials—Part 8: Loss Studies in Ferrites, N. Schwartz and A. P. Greifer, General Electric Co. Dec. 1956. 36 pages. $1. (PB 131052, OTS) Losses and loss mechanisms at small signal levels for a number of polycrystalline ferrites were investigated. The program included an evaluation of samples of known processing history, a pressure, pellet-size study, and a study of the effects of humidity on apparent losses at low signal levels. It was determined that in order to obtain high Q ferrites, the heat work to which the material is subjected must be kept low. In general, however, the material must also be a dense, completely cured body. Temperature coefficients of the magnetic parameters depend on the state of internal stress in the fired sample. When firing temperatures are low, the choice of pressure and pellet size can strongly influence the final state of internal stress.

Design Methods for Magnetic Amplifiers and Saturable Reactors, J. R. Walker and M. Frank, Wayne Engineering Research Institute. July 1956. 628 pages. $9.50. (PB 121765, OTS) This manual was prepared primarily for inexperienced designers of magnetic amplifiers. It contains step-by-step design methods for the standard amplifier circuits. Basic full-wave circuits of the centertap, doubler, and bridge connections are discussed, along with some of the more recent half-wave circuits. Theory of operation of each circuit is presented, including the function of the core and rectifier components and the effects of their properties on amplifier response. A section is devoted to design procedures for the different circuits, and another discusses construction materials and testing procedures.

A Transient-Controlled Magnetic Amplifier, G. Schohan, Naval Ordnance Laboratory. Mar. 1956. 23 pages. 75 cents. (PB 131011, OTS) This report describes development of a two-core transient-controlled half-wave amplifier which duplicates performance of amplifiers normally requiring two or possibly three times the number of components. The amplifier showed a greatly improved drift characteristic and minimized interaction effects of parallel-operated units. The unit is unique in that the single-stage gain is sufficient for any servo applications with no sacrifice in input-impedance level. Its simplicity of design offered excellent promise in applications where drift and interaction effects must be minimized.

Research Services Employing Gold-Bonding Techniques, J. F. Battey, Transistor Products, Inc. Oct. 1955. 115 pages. $3. (PB 121742, OTS) Development of improved electrically bonded transistors through use of gold-bonding techniques is described. The research was aimed at development of a new transistor with improved alpha cut-off frequencies, better uniformity of collector characteristics, low noise figure, and alpha in the range from 0.7 to 2.5. Study of gold-bonded diodes aided in fabrication of good bonds. The report describes some 700 transistors made in the hand, or prototype, stage by the manufacturing techniques developed. The frequency of alpha-cut-off is dealt with at length. It is shown that with the geometry of the bonds, cut-off frequencies of the order of 100 kc/sec could be expected. Suggestions for improved alpha cut-off frequency and collector resistance are given.

Theory, Design, and Engineering Evaluation of Radio-Frequency Shielded Rooms, C. S. Vasaka, U. S. Naval Air Development Center. Aug. 1956. 120 pages. $3. (PB 121927, OTS) Work began in 1946 on design development of an effective radio-frequency shielded enclosure. This report describes research which led to development of the Takedown Cell-Type Screen Room, an improved enclosure for suppression of r-f interference, produced and used by industry today. The applied theory of shielding is presented in a form suitable for use in calculating the shielding effectiveness of various types of enclosures and shielding materials. Graphs and tables facilitate calculations of effectiveness for various shielding metals. Shielding effectiveness information is provided for frequencies as low as 60 cycles per second. A detailed test method is provided for measuring the shielding effectiveness of enclosures over the entire r-f spectrum and in the presence of magnetic fields, electric fields, or plane waves. Also listed in the report are typical costs of various types of shielded enclosures and power line filters, and the commercial suppliers of the enclosures. Among the uses described for the Screen Room is the r-f calibration and alignment of electronic equipment. R-f susceptibility of equipment can also be determined, and spurious radiation of receivers and transmitters tested. Of particular interest to industry, the enclosure can be applied to production testing and quality control of electronic devices.

PATENTS

Complete copies of the selected patents described below may be obtained for $.25 each from the Commissioner of Patents, Washington 25, D. C.

Transistor-Detector, #2,807,718. Inv. A. G. Chressanthis and F. Mural. Assigned Philco Corp. Issued September 24, 1957. The amplitude-modulated signal is detected in the collector load impedance which is high for the modulating and low for the carrier signal. An AGC signal is derived from a resistor in the emitter lead and a subsequent low-pass filter. Thus the transistor is effective to provide amplification, detection and an AGC signal.

Electron Multiplier, #2,807,741. Inv. N. C. Fulmer. Assigned Allen B. Du Mont Laboratories, Inc. Issued September 24, 1957. A plurality of targets, each having an anode, is disposed along the axis of an electron beam. A plurality of dynodes encircles the axis of the beam.

Apparatus for the Electrical Storage of Digital Information, #2,807,749. Inv. F. C. Williams, and T. Kilburn. Assigned National Research Development Corp. Issued September 24, 1957. A CR beam successively scans selected elemental areas of a charge-retaining screen during successive time intervals. The degree of beam focus can be varied during one time interval, the beam can be switched on and off and deflected.

Noise Elimination in FM Recording, #2,807,797. Inv. W. E. Shoemaker. Assigned California Research Corp. Issued September 24, 1957. An auxiliary signal is recorded simultaneously with the FM signal and applied to a substracting network simultaneously therewith. Amplitude control for the auxiliary signal in response to the difference signal is provided. This arrangement permits to elimination of noise caused by variations in the relative velocities of the original record and the rerecording or display.

Wave Generator Circuits, #2,808,464. Inv. B. S. Vilkomerson. Assigned Radio Corporation of America. Issued October 1, 1957. The frequency generated by a vertical deflection squedging oscillator in a television receiver is by a composite signal. This composite signal is derived by superposing a received vertical synchronizing signal and a control signal harmonically related to the horizontal deflection circuit operating frequency.

Color Television Camera Switching System, #2,808,455. Inv. R. C. Moore. Assigned Philco Corporation. Issued October 1, 1957. A plurality of color TV pick-up signal channels are selectively connected by a switch to an additional channel. Each signal channel contains a marker signal indicative of the time of occurrence of the color information which is selectively attenuated in the additional channel. The output of the additional channel is fed to a master channel in which a marker signal is added.

Temperature-Compensated Semi-Conductor Signal Amplifier Circuit, #2,808,471. Inv. W. H. Poucel and J. W. Woestman. Assigned Radio Corporation of America. Issued October 1, 1957. The temperature stabilized transistor circuit contains a T-network consisting of two resistor in tandem between the base and the collector electrode and a specified temperature dependent impedance connected between the common terminal of the two resistors and ground, the emitter electrode being also grounded. The magnitudes of the various elements are prescribed.

Audio Frequency Amplifier with Varying Frequency Characteristic, #2,808,472. Inv. W. D. Meewezen. Assigned North American Philips Co., Inc. Issued October 1, 1957. Each tube in the two-tube positive feedback amplifier is provided with a plate and a cathode resistor. Signals are derived from both plates and both cathodes by a phase shifting network connecting the cathode and plate of the first tube to the grid of the second tube and the cathode and plate of the second tube to the grid of the first tube. The two phase-shifting networks have substantially different time constants.

Receiver Circuit, #2,808,507. Inv. F. L. Pawlowski. Assigned Motorola, Inc. Issued October 1, 1957. The control signal for the noise squelck system in an FM receiver contains a component which is derived by first selecting the noise frequency energy in the frequency range above the signal frequencies at the limiter output.

Cathode-Ray Amplifier, #2,808,526. Inv. D. W. Davis. Assigned International Telephone and Telegraph Corporation. Issued October 1, 1957. An image storage screen is disposed adjacent the anode of a C.R. tube which storage screen is bombarded by electrons from a gun. An additional electron source coaxially surrounds the beam and the electrons emitted thereby are directed by an electrode system from their radially inward direction toward the storage screen to flood the same.

Color Image Production Apparatus, #2,809,233. Inv. E. O. Keizer. Assigned Radio Corporation of America. Issued October 8, 1957. The color television screen is made up of a plurality of groups of horizontally oriented line elements of repetitive different colors. The kinescope beam describes an undulatory pattern on this screen, normally of a width equal to a color sequence. A tracking signal is derived from the screen which may cause the beam to skip during a raster a portion of successive groups of color lines and to scan a succeeding raster along paths including the skipped portions.

Transistor Circuits, #2,809,239. Inv. R. S. Nielsen. Assigned Sylvania Electric Products, Inc. Issued October 8, 1957. A self-biasing network is inserted into the emitter-base circuit of a small-signal reproducing transistor circuit. This circuit comprises a series resistor and capacitor, the emitter electrode being connected to their common junction. The emitter electrode is instantaneously forward conducting, and the impedance values are related to provide a positive circuit determinant when the emitter electrode is forward conducting.

Squelch Circuit, #2,809,289. Inv. L. M. Harris and J. E. Evans. Assigned General Dynamics Corp. Issued October 8, 1957. The combined intelligence-modulated signals and random noise signals are heterodyned with a local frequency-modulated oscillation. The frequency-modulating keying signals are used to recover the combined i.f. signal only when the intelligence-modulated signal is present.

Function Generator, #2,809,290. Inv. J. W. Kee. Assigned Vitro Corporation of America. Issued October 8, 1957. Two equal-frequency signals A and B of varying amplitudes are combined by first heterodyning signal A to result in a signal B of different frequency. Signals B and C are simultaneously amplified and then separated according to frequency, the amplified signal C being used as a gain control voltage so that the output at the original frequency is proportional to the signal B and inversely to the signal C, i.e., to the original signal A.

Transistor Circuit, #2,809,304. Inv. A. H. Dickinson. Assigned International Business Machines Corp. Issued October 8, 1957. The anode of a tube is connected to the base of a transistor which is normally biased positively with respect to the emitter. Positive freeback is applied to the tube grid. When the tube conducts, it biases the emitter base negatively with respect to the emitter. Negative input pulses are simultaneously applied to the tube grid and to the transistor base.

Color Television Reproducing Systems, #2,810,013. Inv. H. R. Lubcke. Issued October 15, 1957. Three separate electron streams impinge on a three-phosphor television screen. Two of the electron streams are individually interrupted at a rate approximating the time interval required to excite one of the phosphors, the rate of interruption of a first stream being most rapid and that of the second stream being less rapid.

Television Receiver, #2,810,014. Inv. W. K. Squires. Assigned Sylvania Electric Products, Inc. Issued October 15, 1957. The sound modulated intercarrier signal has a carrier frequency equal to the frequency difference between the video and sound carriers. At least one stage of the common video and sound carrier channel amplifies the sound modulated intercarrier signal.

Automatic Antenna Tuner, #2,810,070. Inv. W. A. Yates. Assigned ACF Industries, Inc. Issued October 15, 1957. An antenna tuning component is variable in a single direction to tune the antenna circuit to resonance. A voltage peaking circuit receiver is fed by the antenna and in turn is connected to the grid of an electron tube. The electron tube actuates a relay which controls the antenna tuning component to establish resonance.

Transistor Circuits, #2,810,080. Inv. R. B. Trousdale. Assigned to General Dynamics Corp. Issued October 15, 1957. The base and emitter electrode of a transistor are normally biased to cut-off by a suitable current flow through a rectifier. The operating signal renders the transistor conductive, while the rectifier is connected to serve as a low-impedance return for the transistor current.

Cathodes for Electron Discharge Devices, #2,810,088. Inv. D. MacNair. Assigned Bell Telephone Laboratories, Inc. Issued October 15, 1957. A heated hollow body is arranged inside a highly evacuated envelope. The body is closed except for an electron exit aperture and its inside is coated with an electron emissive material. Opposite the aperture is arranged an electron accelerating electrode. A high density electron beam is obtained.

Voltage Regulator, #2,810,105. Inv. W. H. Henrich. Assigned Sorenson & Co. Issued October 15, 1957. The cathode of a diode is directly heated by the load current. A double triode trigger circuit is connected to the diode to generate a series of pulses the width of which is proportional to the load terminal voltage. These pulses are fed to the control grid of an electron tube connected in series between the fluctuating input and the regulated output.

Single Sideband Transmitting and Receiving Unit, #2,808,504. Inv. K. L. Neumann, N. L. Barlow and Chas E. Schneider. Assigned Radio Corporation of America. Issued October 1, 1957. In the transmitter, a first modulator combines the audio signal with the output of a crystal oscillator of comparatively low frequency. A first mechanical filter passes one sideband to a second modulator using a crystal oscillator of medium frequency. The sum frequency is applied to a modulator combining it with a high frequency crystal oscillator output; the difference frequency is derived. A corresponding receiver, deriving frequencies from the same three crystal oscillators is associated with the transmitter.

Receiver Circuit, #2,808,507. Inv. F. L. Pawloski. Assigned Motorola, Inc. Issued October 1, 1957. The squelch system for an FM receiver accentuates the higher frequencies between the discriminator and the limiter. A high pass filter, passing frequencies above the modulating range, is coupled to the limiter and provides a first control voltage to be combined in opposite polarity with the limiter output to be used as squelch control.

New Products

VSWR AMPLIFIER

A transistorized VSWR Amplifier, battery-operated, has been developed. Model 441 is the answer to lab problems created by voltage fluctuations. An unusual feature provides full

sensitivity over the expanded vswr scale and eliminates the need for switching attenuation range when going from normal to expanded scale. The noise level (less than .02 μv. equivalent) and amplifier gain remain the same in the expanded position. Sensitivity is 0.1 μv at 200 ohms, over the full scale. A protective circuit permits any switching operation or cable connection without danger to the bolometer. NARDA Microwave Corp., 160 Herricks Rd., Mineola, L. I., N. Y.

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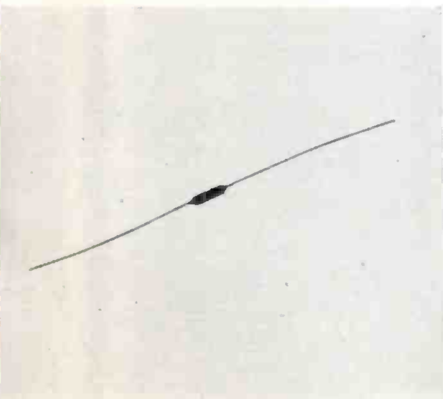
MINIATURE RESISTOR

A 1/8th watt deposited carbon resistor with standard coating (DCX-1/8) has a resistance range of 25 ohms to 1 meg. This precision, subminiature resistor has a diameter of 3/32 in., a length of 5/16 in. Will meet or exceed MIL-R-10509B. The deposited carbon resistors line includes 10 resistors in sizes from 1/8 to 2 watts.



The company also manufactures complete lines of plastic encapsulated and hermetically sealed deposited carbon resistors. Electra Manufacturing Co., 4051 Broadway, Kansas City, Mo.

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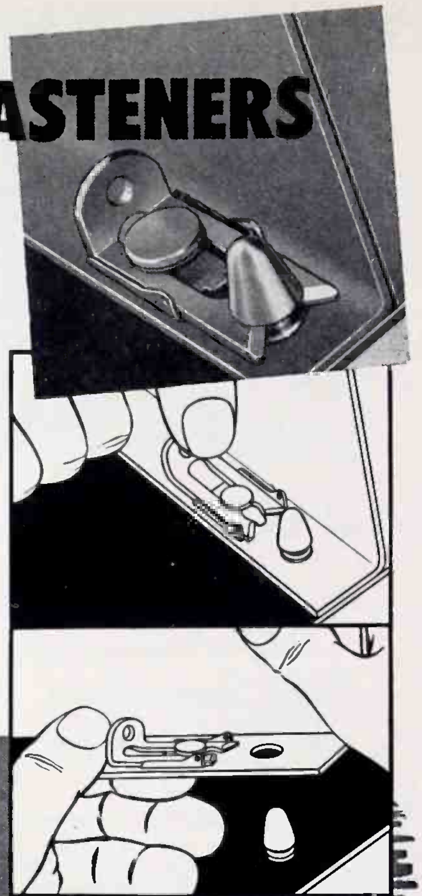
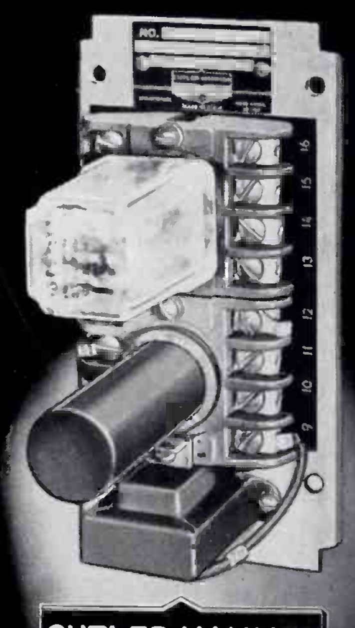
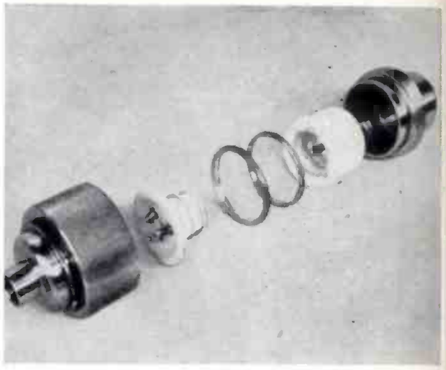




New Products

SPECIAL CONNECTORS

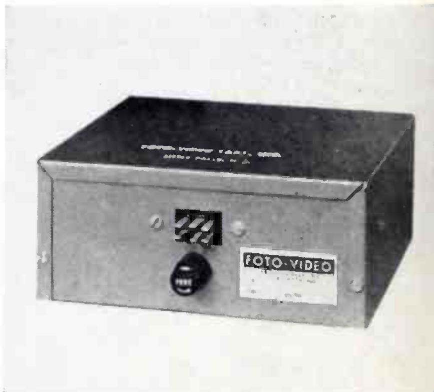
A series of special application connectors designed for use in environmental conditions of high temperature, altitude and radiation are available. The one shown is a nonpolarizing connector for 3 #8AWG wire, metal jacketed and mineral insulated cable. It is of special value where it may be necessary to frequently and quickly connect and disconnect large conductors. It has met environmental tests of 1,000° F., 100,000 ft. plus altitudes, 560 v. corona starting voltages and 960 v. flashover voltage. Concentric ring design eliminates alignment problems. AMP Inc., Harrisburg, Pa.



Circle 240 on Inquiry Card, page 117

POWER SUPPLY

The V-41A 27 volt transistorized regulated dc supply operates over a wide range of input voltages. Regulation of the supply is less than 0.5% over an input range of 22 to 30 volts. The current rating of the supply is 2 amperes, and the regulation against load changes is also less that 0.5%.



Special circuitry for stabilizing the reference, contributes in an important manner to power supply long-term stability. Foto-Video Labs., Inc., 36 Commerce Rd., Cedar Grove, N. J.

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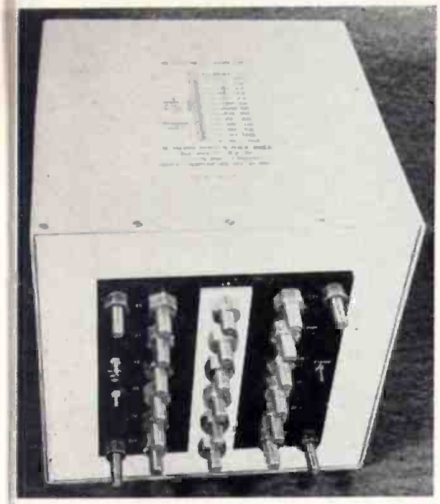
New Products

HIELDED TRANSFORMER

Unusual in the fact that it features 0 db shielding, the transformer is lso unique in other respects. It has ratio accuracy of 0.01% with a hase angle error not exceeding 2



ninutes. Output voltages range from .2 to 230 v., and performance is naintained for any condition of loading, from open circuit to 100 w. total f loads on all windings. Approximately 500 separate conductors in eries and parallel combinations are ssembled in a Litzendraht type cable n order to achieve the proper degree f each winding among all the others. sborne Electronic Corp., 712 S. E. lawthorne Blvd., Portland, Ore.

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DIGITAL VOLTMETER

Digital Voltmeter, Model DVA-500, combines the E-I Universal Power Module and 5-digit Switch Module to produce a 5-digit voltmeter which has an accuracy of 0.01%, ±1 digit. The DVA-500 has a range of 0.0001 to 999.99 volts with an input of 1,000 megohms on the 10 volt scale, and 11

megohms on other scales. Automatic features include ranging, polarity and calibration. Stability is better than 0.01%. Electro Instruments, Inc., 3794 Rosecrans St., San Diego, Calif.

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Reliability

(*Continued from page* 104)

carded. The reliability of the new second mode becomes $R_2 = 0.21$. The overall reliability, R, remains the same, but system design is reduced significantly. This leads to (1) a re-evaluation of the mode sequence hierarchy for better system design, and (2) determination of those components which require first reliability improvement or should have the highest reliability. For example, a failure in Group E would eliminate five out of six modes from operation and so greatly reduce system reliability.

This analysis also can be employed, together with actual operation field data, to (a) give true reliability of the system, and (b) show the progress in reliability improvement. To do this, one substitutes appropriate reliability data obtained from the field for the theoretical numbers indicated in Fig. 3.

Nature of Reliability Computation

In an analysis of system reliability it is desirous to arrive at a graph of system reliability as a function of time. In the multimoded fire control system in the example, it is assumed that a pre-operational maintenance check was made to assure that the system functions properly when it is turned on for combat operation.

This is defined as time $t = 0$.

Then, as system operation continues, the probability that the system will remain fully operable decreases.

The analysis outlined in this paper has determined the reliability at a specific point ($t = 15$ hours) along this operational curve. In effect, we have taken a photograph of the system at a specific time and computed its reliability. In order to obtain a full picture of the system reliability, it is necessary to compute the reliabilities for various values of t. This is shown in Fig. 4 in which P and R are plotted as functions of operating time, t, assuming an exponential reliability model of the form $exp(-t/T)$ for each component, where T, the mean time to failure, is different for each component. T was determined from the known reliability of each component at 15 hours. Then using this calculated value of T, the reliabilities were determined for all t.

In any physical system, it would be better to set up the reliability data collection to give the mean time to failure directly.

A curve of R_1, the reliability of the first mode, as a function of time is included to show the reliability gain of a moded system over a system consisting of one mode of operation.

Conclusions

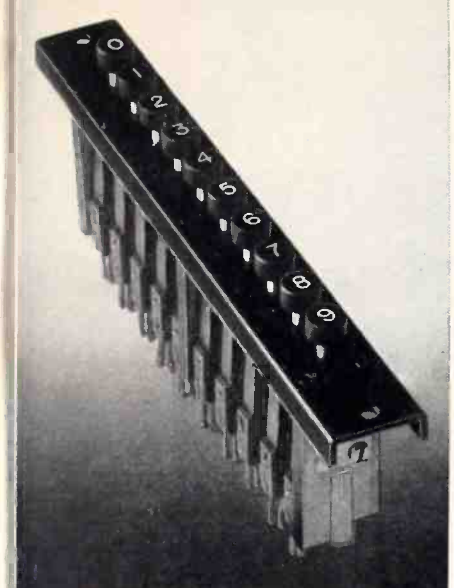
The purpose of this article has been to outline a technique for determination of the reliability of a multi-moded system. Criteria were established for evaluating the multi-moded concept of reliability in a way suitable for the application of probability theory and the methods of mathematical statistics.

The main emphasis has been that, given the reliability data for each component, it is possible to compute the reliability of a multi-moded system. However, the component reliability data, if not available from actual field/factory experience, must be obtained from other sources.

We have given an example in Fig. 4 where the reliability data would follow an exponential law. It should be noted, however, that the reliability of a multi-moded system can be estimated in other ways. For example, in an airborne fire control system, one could use for indices: percentage of test flights on which missions are accomplished, percentage of attempted radar lock-ons which are completed successfully, and required ground maintenance hours per operating flight hours.

In addition to the approach to reliability outlined in this paper, methods have been discussed by Rosenblatt[6] and Elmaghraly,[7] which make use of information about the interdependence among components.

In the final analysis, however, the



specific system under consideration will be the prime factor in the determination of the criteria to be established in defining and evaluating reliability.

A tacit assumption made is that in modal operation the switch and operator are considered 100 percent reliable. Since this is not so, an additional derating is necessary to take this factor into account. This derating can be handled easily in a way similar to the E – values, and may be appreciable in many cases.

Acknowledgments

We want to thank John Baugher, who contributed significantly in the early phases of this work.

References

1. R. Gordon, "Optimum Component Redundancy for Maximum System Reliability," Operations Research, Vol. 5, No. 2, April, 1957.

2. H. Blanton, "Reliability—Prediction Technique for Use in Design of Complex Systems," IRE New York Convention Record, 1957.

3. F. Moskowitz and J. B. McLean, "Some Reliability Aspects of Systems Design," IRE New York Convention Record, 1956.

4. For example, Aeronautical Electronic and Electrical Laboratory Report #NADC-ED-N5661, 10 August 1955.

5. It is appreciated that the product rule gives only an approximate value for mode sequence reliability since component interactions are omitted. However, without field failure data, this method may be employed as a first approximation.

6. J. R. Rosenblatt, "On Prediction of System Performance from Information on Component Performance," Proceedings Western Joint Computer Conference, 1957, pp. 85-94.

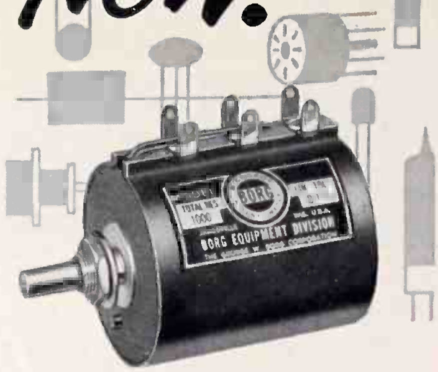
7. S. E. Elmaghraly, "A Generalization in the Calculation of Equipment Reliability," Cornell University, School of Electrical Engineering, Res. Rep. EE 319; Nov. 15, 1956.

Army's "Sergeant" Missile Operational

First details on the U. S. Army's new solid-propellant "Sergeant" missile, successor to the four-year-old Corporal, were announced last month jointly by the Army, Jet Propulsion Lab of Caltech, and Sperry Gyroscope Co.

A surface-to-surface ballistic guided missile, Sergeant is described as being highly accurate and reliable under all operating conditions. It can be quickly emplaced and fired by a very small crew.

Overall length of Sergeant is approximately 30 ft. It is designed to carry nuclear warheads and its highly advanced guidance system is invulnerable to any known means of enemy countermeasures.

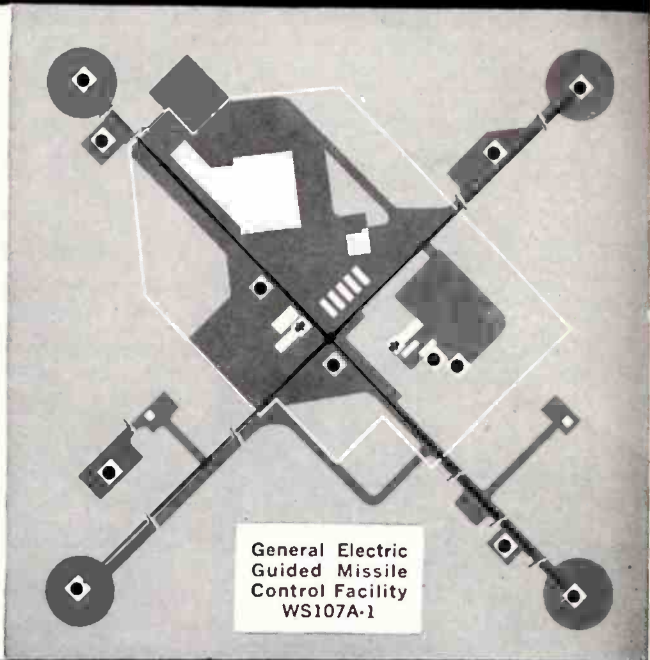


GRADUATE EE'S: GENERAL ELECTRIC DISCLOSES HIGH PRIORITY PROGRAM FOR ATLAS

GUIDANCE SYSTEM. MANY POSITIONS OPEN IN ELECTRONIC MISSILE TECHNIQUES=

ACCURACIES ON ORDER OF 1 PART IN 10 MILLION

required for portions of G.E.'s ICBM ATLAS Guidance System



General Electric Guided Missile Control Facility WS107A-1

Delivering an ICBM over a > 5000 mile trajectory into the target area demands a guidance system of unprecedented accuracy—and this is the calibre of the electronic system General Electric engineers are creating for ATLAS.

But achieving designated accuracies and reliabilities in the laboratory is not enough. *These high standards must be maintained in actual operational environments, with virtually no interruption or degradation.*

CAREERS IN STEP WITH THE FUTURE

Engineers who join the Missile Guidance Product Section of G.E. are doing more than hastening development of one of the nation's most urgent programs—guidance for ATLAS. As Manager of the Section Richard L. Shetler states: *"With this job behind us, there will remain no significant obstacle to the practical guidance and navigation of other space vehicles."*

PROGRAM ACCELERATION OPENS UP WIDE RANGE OF POSITIONS IN:

Systems analysis, evaluation & integration
Systems and component reliability
Transistorized circuits, pulse circuitry, IF-Video circuits
RF and Microwave components & plumbing
Communications control devices
Doppler radar design & development
Digital data processing techniques, data transmission involving D & D of ground-based & airborne antennae, transmitters, receivers; application of transducers, transponders, etc.
Test operations, including planning, range instrumentation & test execution; development & application of automatic test equipment

If you feel that your special skills and interests fit you to work in any of the above areas, why not write us in detail? Qualified candidates will be invited to visit our facilities to meet with technical managers and gain first hand knowledge of the living advantages of our locations at Syracuse and Utica, N. Y.

Write in complete confidence to Mr. E. A. Smith, Room 3-D

MISSILE GUIDANCE PRODUCT SECTION

GENERAL ELECTRIC

Court Street, Syracuse, N.Y.

PROFESSIONAL OPPORTUNITIES

Reporting late developments affecting the employment picture in the Electronic Industries

Design Engineers • Development Engineers • Administrative Engineers • Engineering Writers
Physicists • Mathematicians • Electronic Instructors • Field Engineers • Production Engineers

Lockheed Aircraft Opens N. Y. Hiring

The Missile Systems Division of Lockheed Aircraft Corp. has opened a new office in New York City to recruit more than 600 engineers and scientists.

A total of more than 3000 technical people—both engineers and scientists—will be hired throughout the U. S. during 1958.

The Missile Systems Division, which has plants at Sunnyvale, Palo Alto and Van Nuys, Calif., is prime contractor and missile systems manager for the Navy's Polaris fleet missile, and also holds contracts for a number of other advanced missile projects.

The New York office is at 405 Lexington Ave. Lockheed Aircraft Corp. has corporate offices at the same address.

College Failure Rate Nears 40% of Classes

About 6 out of every 10 who enter college graduate, 4 of them from the institutions in which they first enrolled, according to a study just completed by the U. S. Office of Education.

About one out of 4 students who enters college drops out by the end of the first year. This is about equal to the total who drop out during the following 3 years combined.

One-fifth of those who drop out of college permanently were in the top 20 per cent of their high school graduating class. U. S. Commissioner of Education Lawrence G. Derthick called this "a distressing waste of talent."

NEW TRANSISTOR PLANT

General Transistor has purchased 125,000 sq ft plant, and 10 acres in Woonsocket, R. I., for their new plant. Here mutual congratulations are offered by A. T. Schmidt, Industrial Dev. Foundation of Woonsocket, R. I.; Gov. Dennis J. Robert, and General Transistor's Arnold Malkan and Frank Pennucci.

Paraplegics Inc. Faces Over 90% Personnel Cut

Employees of Paraplegics Manufacturing Co., Inc. have been advised that substantial cutbacks from their major customers necessitate a 90% reduction in their working force.

According to pres. Dwight D. Guilfoil, the manufacturers for whom his company produces electrical and electronic sub-assemblies used in the automotive, television and telephone fields are unable to make commitments for resumption of production during the coming months since their own production schedules are so greatly reduced.

FOR MORE INFORMATION . . . on positions described in this section fill out the convenient inquiry card, page 99.

MAXIMUM SALARY REPORTED FOR UNDERGRADUATE FACULTY MEMBERS, 10 MONTHS AND UNDER, 1957-58

Institutions	Public				Private			
	Professor	Associate	Assistant	Instructor	Professor	Associate	Assistant	Instructor
Universities	$19,400	$12,000	$10,000	$8,000	$21,000	$11,500	$8,300	$6,500
Liberal arts	15,000	10,500	9,100	8,000	16,300	9,500	8,600	7,500
Teachers	10,500	9,000	8,400	7,600	7,000	6,200	6,100	5,100
Junior colleges	9,400	7,800	7,000	9,700	11,800	9,300	6,000	8,700

60,000 "Professionals" Have Immigrated to U. S.

Almost 60,000 immigrants classified as professional, technical and kindred workers entered the U. S. for permanent residence during the fiscal years 1953 through 1956. They represent slightly over 6 per cent of the 900,000 total immigrations for those years.

Some 12,600 of the professional workers were engineers or natural scientists. Only a small portion, about 7 per cent, of all professional workers entered the country with a first-preference quota visa, authorized to personals of specialized skills whose services are urgently needed in this country.

Immigration to the United States, All Immigrants and Professional, Technical, and Kindred Workers, Fiscal Years 1953 through 1956

Fiscal year	All immigrants	Professional, technical and kindred workers: Number	Percent of all immigrants
1953	170,434	12,783	7.5
1954	208,177	13,817	6.6
1955	237,790	14,109	5.9
1956	321,625	18,995	5.9
Total	938,026	59,704	6.4

Source: United States Department of Justice, Immigration and Naturalization Service, Annual Report of the Immgration and Naturalization Service, for the fiscal year ended June 30, 1956.

Engineers constituted the largest occupational segment of the 60,000 in the group of professional immigrants. Then follow in order, nurses, teachers, physicians and surgeons. The separate occupations of technicians, such as designers, draftsmen, and radio operators, each represented a small proportion of the total but when counted together outnumbered the teachers.

Over 40 per cent of the professional group came directly from Europe, with the U. K. and Germany providing the largest numbers. Canada, however, outnumbered any European country as a source of immigrants in this group, although a large proportion of the Canadian emigrants were not natives of that country.

New York, California and Illinois were the most popular choices of this group as destinations.

The Reader Reacts—

Comments on "Writing" . . . . .

Two of our previous articles, "Engineers, Do Your Own Writing" and "Engineers Should Write," caused a considerable stir in the technical writing field. Here the "writers" get their chance to tell the other side of the story.

" . . . to use in College English"

Editor, ELECTRONIC INDUSTRIES:

The article "Engineers Should Write!" by W. O. Hadlock (Jan. 1958) was especially good. I would like to request permission to reproduce this article (with credit to Electronic Industries, Mr. Hadlock and R.C.A.) for possible use by classes in English 31 ("Technical Report Writing") at Indiana Technical College here in Fort Wayne.

James A. McInnis, Engineer
WANE Radio Division
Indiana Broadcasting Corp.
1205 Fort Wayne Nat'l. Bank Bldg.
Ft. Wayne 2, Ind.

"Engineers dwell on minutiae . . ."

Editor, ELECTRONIC INDUSTRIES:

Everyone can agree with John L. Kent's contention that engineers should be able to do their own writing. ("Engineers, Do Your Own Writing," Dec. 1957.)

But . . . !

How many really facile writers are there among engineers? Mr. Kent agrees that there are too few.

What, then, do we do about the others? Perforce we supply writers to complement the engineer, save his time, and permit him to concentrate in fields where his productivity is high.

It does not follow that writers are but technicians. The contention is an affront to all earnest writers. The statement should be reversed: technicians (if one means by that those whose knowledge of science is limited to the screwdriver level) do not rate the term "technical writer." Since his major premise is false, Mr. Kent cannot with validity conclude that ghosted reports inevitably include errors.

Nor should he imply—as a desirable quality — that engineer-written reports will be more complete. Engineers are prone to dwell on minutiae. Work of high scientific competence goes unrecognized when presented in such a sea of detail as to swamp the reader.

Scope, pace, and perspective are necessary qualities in a definition of good writing. If the engineer lacks these qualities, if he is not himself a good writer, how better can he acquire these talents than by association with one assigned to give wings to his words and works?

A writer worthy of the term is no mere semicolon expert, but a professional ranking with such other specialists as senior engineers or project chiefs. The writer must elicit pertinent information from the most inarticulate of engineers—to do so requires a very considerable technical knowledge in the engineer's field. From an input whose S/N ratio is often low, the writer must distill all that is significant. He then reorients the information in a manner comparable to a pulse-shaping circuit. His output is a report tailored to his audience. His challenge is to compel reader attention so that those "too busy" to read reports will read his. His mission is to ensure appreciation of the work reported, understanding of the problems encountered, full enjoyment by the customer of all the benefits inherent in the equipments or research bought. These factors are primary determinants of the employing company's prestige. They contribute mightily to a writer's motivation and satisfaction.

Harold A. Holbrook
Technical Writing Section
Raytheon Mfg. Co.
Wayland Laboratory
Wayland, Mass.

"Mr. Kent . . . a substitute?"

Editor, ELECTRONIC INDUSTRIES:

Having just read Mr. John L. Kent's article "Engineers, Do Your Own Writing" (December, 1957), I must confess it contains a few points that would upset a competent technical writer.

Basically, Mr. Kent is correct in stating that engineers would do well to learn to write. (I would add the word "better" to that, since many engineers I have known are fair to good writers.) However, he has failed to make a distinction between the type of material written. For example, he implies that even the writing of experiment reports are farmed out to "substitutes", a position that would be untenable to any sane engineer.

I would also contest Mr. Kent's statement that a technical writer would not be capable of catching obvious technical errors. One criterion we have used to define a technical writer is that he must be of sufficient technical competence to be able to rewrite (if necessary) material without distorting the technical content.

Mr. Kent goes on to imply that technical writing is done by "technicians" and personnel not technically trained. This comes as a surprise not only to me (B.Ch.E. '49, and for five years a full-time technical writer) but will undoubtedly surprise other engineers who have sufficient writing ability to become professional technical writers.

There are numerous other points in Mr. Kent's article that are open to question, but the most significant is Mr. Kent's own position: as a person very active in the technical writing field, does he consider himself a technician and a substitute for the real thing?

John V. E. Hansen
Past President, Boston Chapter
Society of Technical Writers
5 Margo Rd.,
Brighton 35, Mass.

"You forgot something . . .!"

Editor, ELECTRONIC INDUSTRIES:

You forgot something! In the articles "Engineers, Do Your Own Writing" by John Kent (Dec. 1957) and "Engineers Should Write!" by W. O. Hadlock (Jan. 1958), you ignored the booming and almost ubiquitous profession of Technical Writing. Most engineering firms have not.

My company, an electronics research, development and manufacturing organization, is an example. We employ a score of professional writers who complement rather than usurp the function of our engineers. These men are not the "substitutes" to which you, Mr. Kent, refer. They are vital participants in our programs, men whose efforts enable us to make more efficient use of our engineering talent and, at the same time, produce publications that are more complete, readable, accurate and presentable.

The four advantages which Mr. Kent maintains are realized if an engineer does his own writing: accuracy, completeness, prestige and service to his profession; none of these is sacrificed on the altar of efficiency. Our reports are complete and accurate because our writers are technically competent to insure these qualities. Furthermore, they are aesthetically able to endow the facts with balance, coherence, clarity and orderliness. Our engineers lose no prestige, because their efforts are acknowledged in our reports, along with those of the writer, when these reports are published. As for service to his profession, does an engineer do his profession a disservice when he accepts collaborative help which not only enables him to furnish a superior record of his achievements, but also leaves him more time for engineering?

Does an engineer contribute less to his profession by sharing a byline with a writer whose help enables the engineer to do more engineering and to have, as a result, more engineering achievements to write about? I think not. Furthermore, most of our engineers also think not.

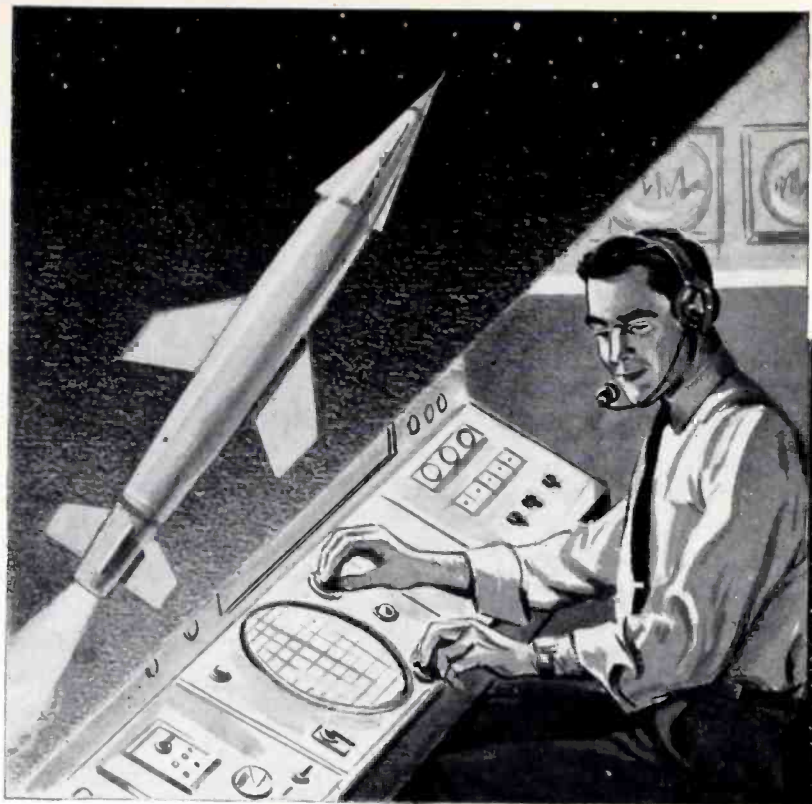
Let's face it: Most engineers do not enjoy writing. Furthermore, they do not know how. True, they took a few courses as undergraduates, probably passed them, but when the instructor was talking about split infinitives and parallel constructions, they were thinking about split atoms and parallel circuits. Given a report to write, they will procrastinate to the point where they will finally have to throw together a literary atrocity that will not only lack the accuracy and completeness that Mr. Kent points out as being so essential, but also lessen rather than enhance their personal prestige, and contribute little if any service to their profession.

There is more, infinitely more, to writing than the mere recording of facts. Facts must be balanced for emphasis, blended for coherence, consolidated for unity. The words which describe them must be selected with the same care and precision an engineer uses in selecting his components; the ideas which embody them must be tied together, smoothly and subtly, as a transformer ties together two subassemblies of different voltages. And in technical writing there are other considerations: specifications; printing; photography; composition; artwork; reductions; typography; binding. Show me an engineer who knows these things and is willing to do them, and I will agree with Mr. Kent's principles.

There is, it seems to me, a dangerously popular misconception about writing: everyone can put words on paper; writing is words on paper; Q. E. D. writing is easy. But, except to a bountifully blessed few, good writing is the product of painful, exacting processes of which few engineers are either intellectually or personally capable.

Messrs. Kent and Hadlock are, perhaps, among these chosen few. Finding it easy to write well, they feel the task is not much more

(*Continued on page* 170)



"Writing"

(*Continued from page* 170)

formidable for the average engineer. But it is. And beg, plead, entreat, exhort, cajole as you will, show the average engineer a pencil and he will respond to it like an ostrich does to danger.

Why not, then, put the pencil in the capable hands of members of what Mr. Holt McAloney, Director of Public Relations, Ford Instrument Company, acknowledges as ". . . a vital profession in our modern highly technical world . . ."?

Yours in better technical communications.

John Fallon, Editor
Technical Publications Dept.
Sanders Associates, Inc.
Nashua, N. H.

Cathodoluminescence

IN comparison with the extensive literature on crystalline phosphors, there has been relatively little systematic study of vitreous luminescent systems. Nevertheless, it has long been known that a variety of glasses exhibit bright luminescence emission under ultraviolet or other optical excitation and that many of these are also luminescent under cathode-ray and x-ray excitation.

For several years the Naval Research Laboratory has researched luminescence in glass, and the results have been applied to such uses as radiation dosimetry.

During the NRL research into cathodoluminescence of inorganic glasses, particular attention is being paid to Vycor glass, activated with manganese, cerium, or copper impurity. Transparent screens consisting of these activated glasses show, respectively, an orange-yellow, deep-blue, and bluish-green cathodoluminescence. Brightness levels are sufficient to permit observation of cathode-ray tube traces under normal ambient room light and with normal tube operation. NRL researchers J. H. Schulman and R. J. Ginther feel that cathodoluminescence of inorganic glasses merits further study from both basic and practical viewpoints.

Industry News

Henry A. Correa is serving as Vice President for foreign operations of ACF Industries, Inc. following his recent election.

Myles S. Spector joined American Geloso Electronics, Inc. as Sales Manager. Mr. Spector was formerly President of Insuline Corp. of America.

Dr. Fred P. Adler has been appointed Manager, advanced planning staff for systems development laboratories of Hughes Aircraft Co.

F. P. Adler

C. L. Burgess

Carter L. Burgess has been elected President of American Machine & Foundry Co. Mr. Burgess was formerly President of Trans World Airlines.

Robert Markens joined Allied Radio Corp. as Controller.

R. E. Kirby is now Manager of Westinghouse Electric Corp.'s electronics operation in Baltimore, Md.

Dr. Winston E. Kock is now General Manager of the Research Laboratories Div., Bendix Aviation Corp. **Arthur C. Omberg** has been General Manager of the Missiles Section of the Products Div.

W. B. Wight is Manager of the newly-organized Materiel Dept., ElectroData Div., Burroughs Corp. Other ElectroData appointments . . . **Lee Moulton** has been named Manager of Field Engineering Training, replacing **Leland W. Brown** who has been appointed Los Angeles District Field Engineering Manager.

Karl E. Heller will now serve as Sales Manager for Helipot Div., Beckman Instruments, Inc. Other Beckman appointments . . . **Stanford B. Spracklen** to Associate Director of Research and Engineering for Process Instruments Div.; **James E. Stewart** to Senior Chemist in Infrared Applications and **Don W. Carle** to Chief Project Engineer of the Gas Analyzer Section, Scientific Instruments Div.

(*Continued on page* 172)

Industry News

(Continued from page 171)

Irwin A. Binder is the Vice President for manufacturing of The Ramo-Wooldridge Corp. Mr. Binder was formerly Assistant General Manager of the Tapco Plant of Thompson Products, Inc.

L. J. Francisco becomes Assistant General Manager of the Plastics and Resins Div., American Cyanamid Co. and **J. A. Healy** succeeds Mr. Francisco as Vice President, sales and advertising, for Formica Corp., a subsidiary.

Harold A. DeMooy is now Manager, Receiving Tube Operations, RCA Electron Tube Div. Other RCA appointments . . . **Edwin A. Speakman** to the newly-created post of Manager of Planning for Defense Electronic Products; **James F. Cooper** to Manager, Industrial Sales, Electron Tube Div.

David R. Hull has been appointed Vice-President for defense programs of the Raytheon Mfg. Co.

D. R. Hull

C. R. Lane

C. Robert Lane has been named Eastern Regional Manager of Andrew Corp. Mr. Lane was formerly Regional Manager for New York and the New England states.

Dr. Bennett S. Ellefson has been appointed Senior Vice President, Engineering and Research, Sylvania Electric Products Inc. Other Senior Vice Presidents appointed . . . **Robert E. Lewis**, Argus Cameras and Semiconductor Products; **Howard L. Richardson**, Electronic Systems and Special Tubes.

Joseph S. Dec will now serve as Production Manager of ESC Corp. Mr. Dec was formerly associated with A. B. Du Mont Labs.

Abraham I. Dranetz has been appointed Vice President of Gulton Industries, Inc. Mr. Dranetz will assume the responsibilities of General Manager of the newly created Glennite Instrumentation Div.

Industry News

John M. Nisbet has joined Philco Corp.'s Government and Industrial Div. as Sales Manager of the "TRANSAC" Computer Dept.

Dr. Henry W. Marsh will now serve in the capacity of Director of Sonar Systems Development at Avco Mfg. Corp.'s Crosley Div.

Donald Allen Fraser has been named field service Sales Manager of the Military Operations Div. of A. B. Du Mont Labs., Inc.

D. A. Fraser

L. J. Shioleno

Lewis J. Shioleno is now General Manager of the Electronics Div. at Erie Resistor Corp.

Joseph M. Looney, Jr. has been elected President of the Technology Instrument Corp. of California.

H. Myrl Stearns, Varian Assoc., **David L. Bell**, P. R. Mallory & Co., Inc., **George M. McGrew**, Midland Mfg. Co., Inc., **Harold C. Booth**, Bomac Labs., Inc., **Richard T. Orth**, Sanders Assoc., Inc., **Arnold Malkan**, General Transistor Corp., and **Edwin W. Peterson**, RCA Communications, Inc. have been enrolled in the Business and Defense Service Administration's unit of the National Defense Executive Reserve in the Dept. of Commerce.

I. Tunis Corbell has been appointed Manager of Microwave Design Engineering for GE's Communication Products Dept. **Lee L. Bushong** has been promoted to Manager of Manufacturing Equipment Development in the Semiconductor Products Dept.

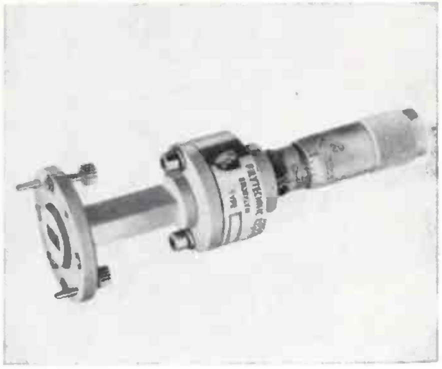
Ernest Paskell has joined the Delco Radio Div., Semiconductor Dept. as supervisor of the pilot line operations at the North plant. Mr. Paskell was formerly Assistant Division Chief of the Battelle Memorial Institute.

George B. Kelly is now filling the new position of Vice President-Marketing for the Hoffman Laboratories Div. Mr. Kelly was formerly associated with the Douglas Aircraft Co.

New Products

SLIDING SHORTS

The new "sliding shorts," which can be accurately adjusted to any reactance, are available in frequency ranges from 12.4 to 75 KMC/s. With short-circuit vswr's of up to 100:1

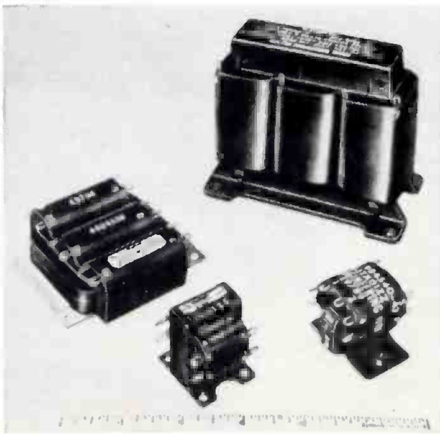


they are the most useful terminating impedances in waveguide measurements, apart from matched loads. The units consist of a section of waveguide in which a short-circuiting plunger can be moved by means of a micrometer drive. This is a non-contacting short of the two-section coaxial-filter type. Five types are available. Polytechnic Research & Development Co., Inc., 202 Tillary St., Brooklyn 1, N. Y.

Circle 254 on Inquiry Card, page 117

TRANSFORMERS

Reduced size combined with extreme reliability at ambient temperatures from 125° C to 175° C are obtained with improved Epseal encapsulated power transformers. The new units employ a unique coil construction and special high temperatures insulations which permit far greater miniaturization and reduce temperature rise. 10,000-hour life in 125° C ambients can be obtained, with even higher temperatures to 175° C available in



shorter life applications. Units approved to MIL-T-27A Grade 5 Class T Life X specifications. Electro Engineering Works, Inc., 401 Preda St., San Leandro, Calif.

Circle 255 on Inquiry Card, page 117

ELECTRONIC INDUSTRIES Advertisers—April 1958

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BIRTCHER CORP., THE, INDUSTRIAL DIV. 163
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Memamadun (he was the only survivor) was brought before Cleopatra.

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Memamadun stifled a yawn.

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"Why not?" the queen asked, stroking Julius' head.

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