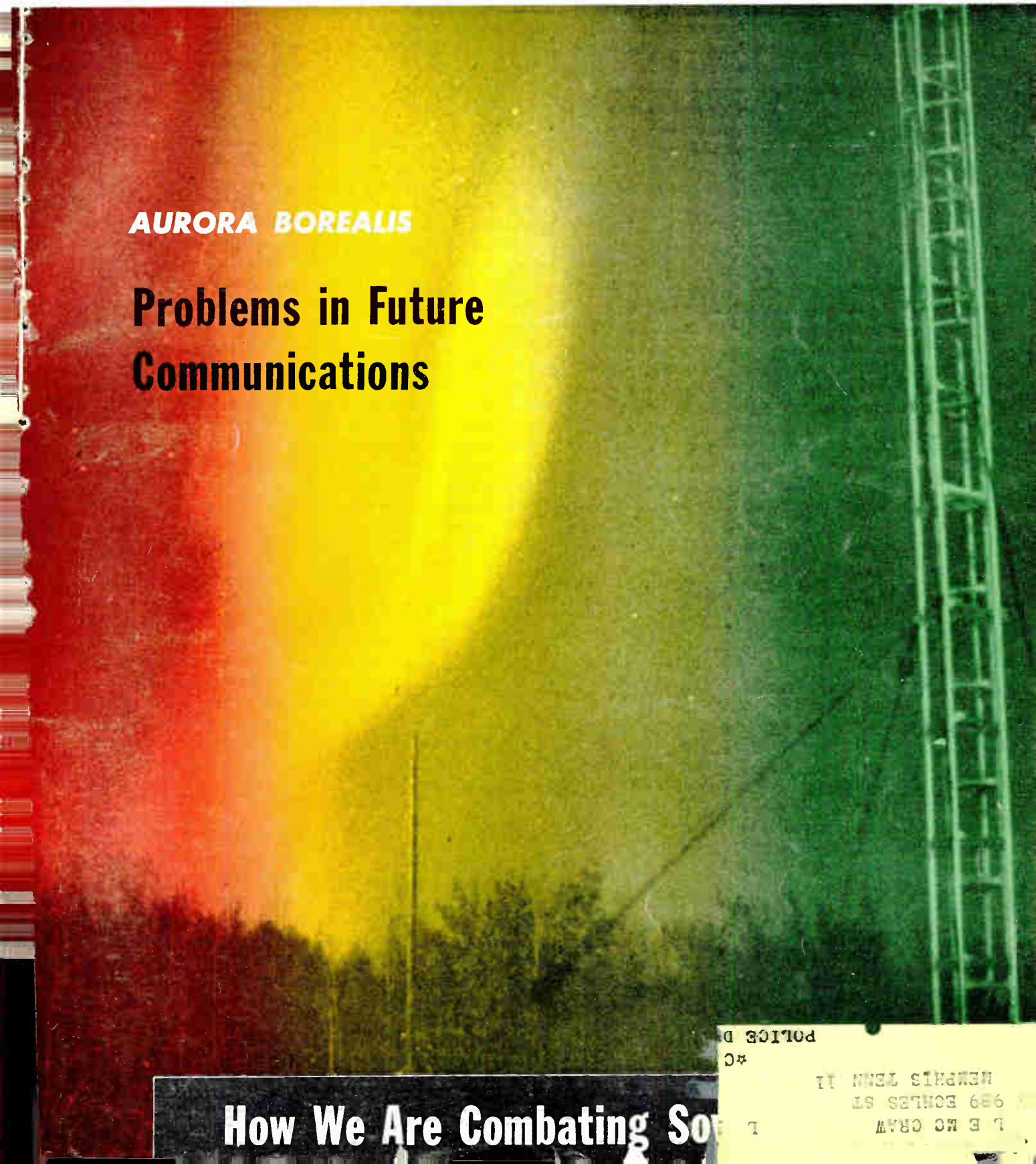
JULY 3, 1959

electronics

A McGRAW-HILL PUBLICATION VOL. 32, No. 27 PRICE SEVENTY-FIVE CENTS



AURORA BOREALIS

Problems in Future Communications

How We Are Combating So

Creative Microwave Technology

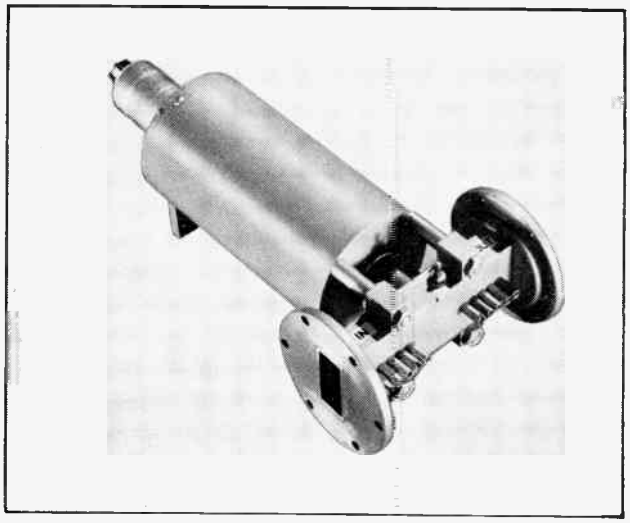
Published by Microwave and Power Tube Division, Raytheon Company, Waltham 54, Mass., Vol. 1, No. 6

NEW 5-WATT TRAVELING WAVE TUBE DESIGNED FOR MICROWAVE RELAY LINKS

The versatile modulation characteristics of this broadband power amplifier are particularly well suited for microwave communication applications. The tube, identified QK-542, is a permanent-magnet focused CW type, operates in the 5,900 to 7,400 Mc frequency range, and has a nominal saturated power output of 5 watts.

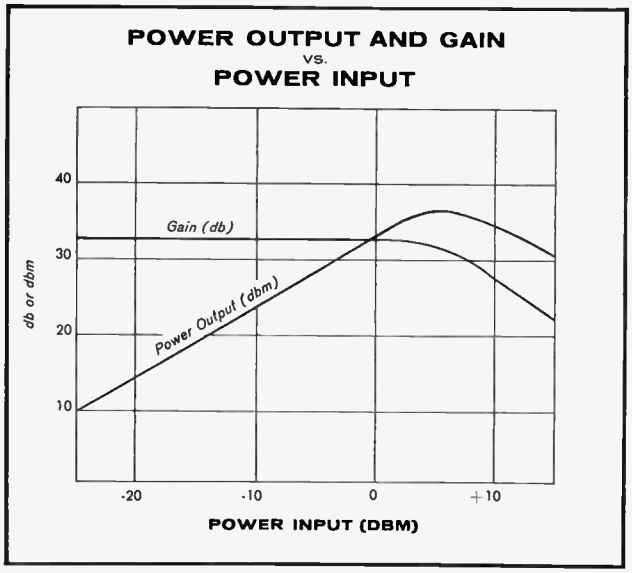
High amplification over a wide range of power levels results in small-signal gain of up to 35 db. A special control electrode facilitates low-voltage pulsed or amplitude modulation.

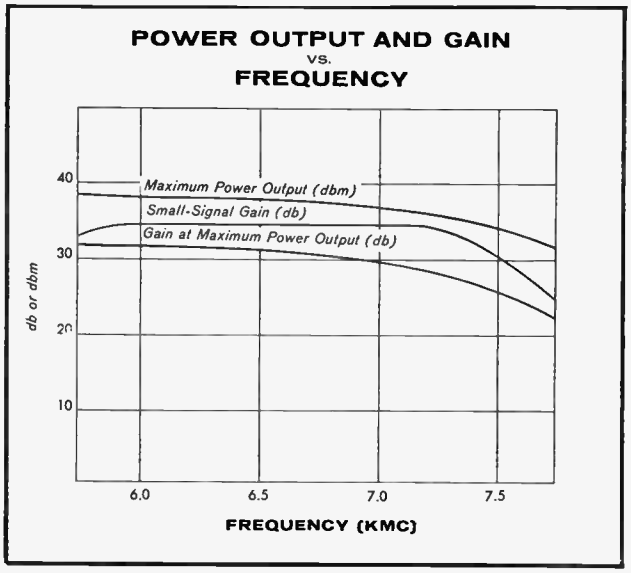
The tube is supplied with an integral waveguide coupler package which accommodates UG 344/U waveguide-type flanges. When supplied with an optional coaxial output coupler package, tube will operate over the 4,000 to 8,000 Mc range.



Typical Operating Characteristics

Frequency Range	5,900 to 7,400 Mc
VSWR (Input and Output)	2.1:1 max.
Small-Signal Gain	32 to 35 db
Gain (Saturation)	25 to 27 db
Power Output	5 watts





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You can obtain detailed application information and special development services by contacting: Microwave and Power Tube Division, Raytheon Company, Waltham 54, Massachusetts

A LEADER IN CREATIVE MICROWAVE TECHNOLOGY

electronics

JULY 3, 1959

A McGRAW-HILL PUBLICATION
Vol. 32 No. 27

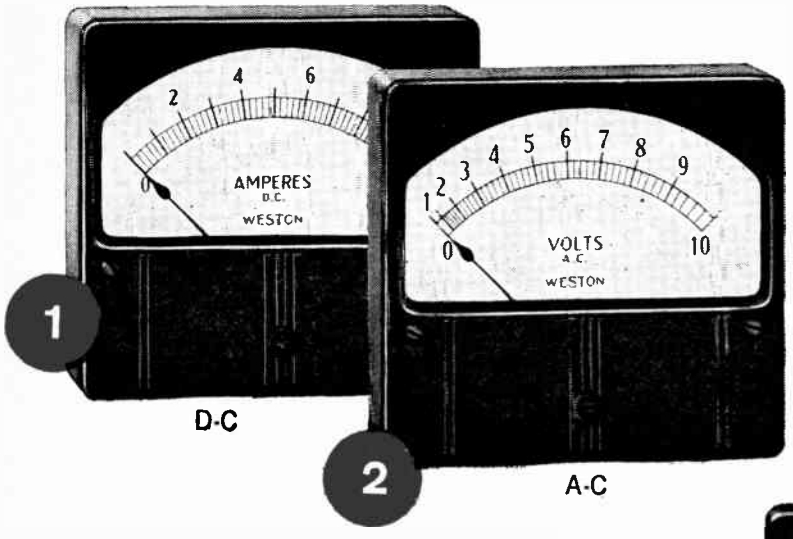
Issue at a Glance

Business

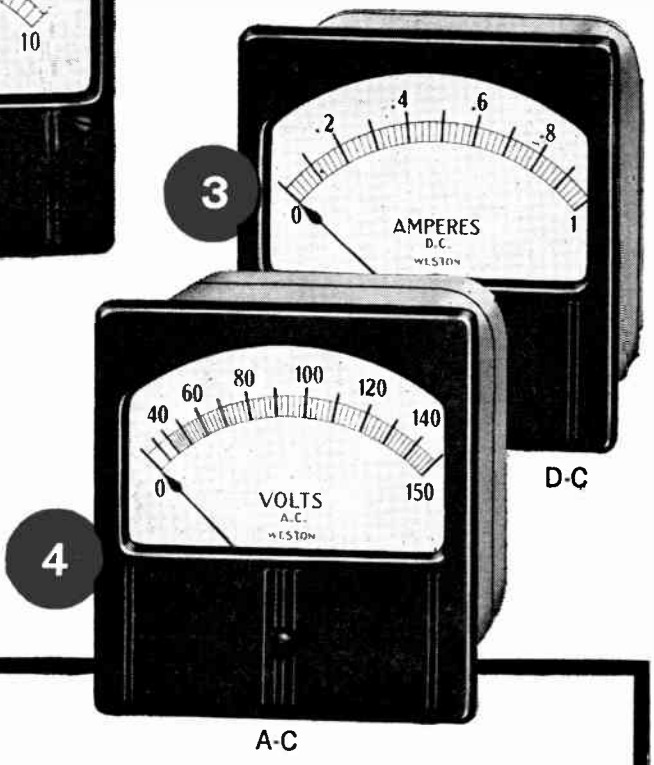
Engineering

Departments

Model 961 Group Instruments



Model 741 Group Instruments



Feature by Feature

THESE WESTON RECTANGULARS LEAD THE FIELD

The well-balanced design, fine appearance and desirable features of these Weston instruments reflect a 70-year tradition of fine engineering and craftsmanship. If you're not already well acquainted with these notable models, look over this check list – you'll not find better value anywhere.

1 2 3 4	Long scales (Model 961 Group: 3.17" . . . Model 741 Group: 3.24" A-C and 3.52" D-C)
1 2 3 4	Excellent natural illumination (self-contained lighting optional)
1 2 3 4	High rated accuracies (Model 961 Group: 2% of full scale value . . . Model 741 Group: 1%)
1 2 3 4	High sensitivities . . . low response times
1 2 3 4	Excellent torque-to-weight ratios
1 2	Dielectric test – 5000 volts A-C
2 4	Group includes A-C rectifier type instruments
1 3	D-C and rectifier type instruments have magnetic shunts for precise adjustment

These instruments are particularly suitable for a wide variety of specialty applications where other than cataloged accuracies are desirable.

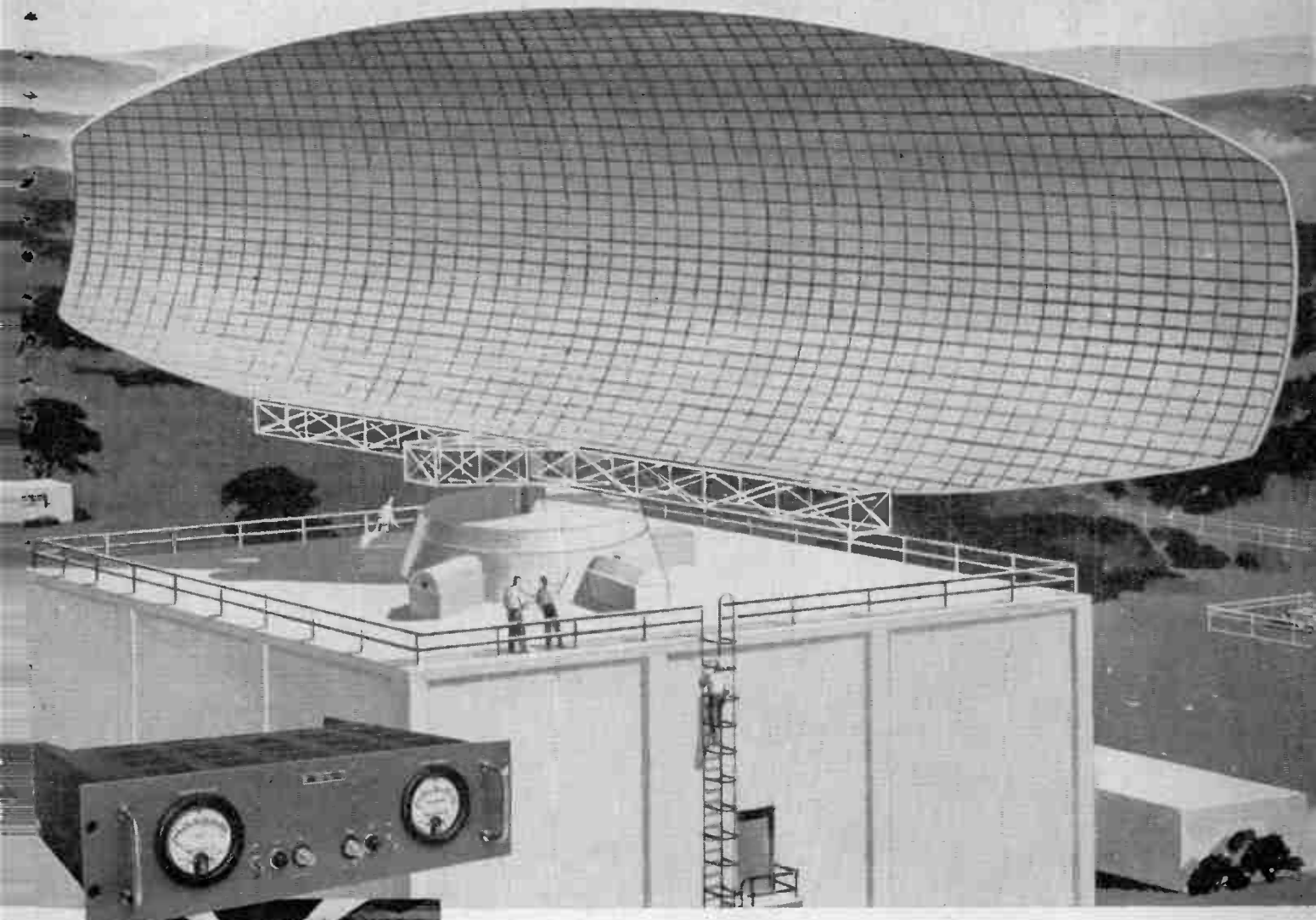
For full information, contact your local Weston representative . . . or write to Weston Instruments, Division of Daystrom, Inc., Newark 12, N. J. *In Canada: Daystrom Ltd., 840 Caledonia Rd., Toronto 19, Ont. Export: Daystrom International, 100 Empire St., Newark 12, N. J.*

WESTON *Instruments*

A DAYSTROM UNIT

WORLD LEADER IN MEASUREMENT AND CONTROL

Lambda Power Supplies specified for newest radar installation



"Off-the-shelf" Lambda power supplies —modified only with special panels, MIL meters and tubes—will be part of the complex radar equipment housed in the 85-foot tower at Thomasville, Alabama, one of four identical installations.

Meet MIL-E 4158 environmental test requirements

Sperry Gyroscope Co., operating under the technical guidance of the Rome (N.Y.) Air Development Center, is producing the new SAGE radar equipment (AN/FPS-35). The power supplies employed to power transmitters and receivers must be able to pass stringent tests.

Sperry's choice: Lambda's COM-PAK,® already widely used as a component in many rocket and missile programs.

All Lambda stock industrial power supplies are made to MIL quality and *guaranteed for five years.* They are pictured and described in a new 32-page catalog. Write for your copy.

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CIRCLE NO. 3 READER SERVICE CARD

electronics

July 3, 1959 Vol. 32, No. 27

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SHOPTALK . . . editorial

TWO IF BY SEA. Navy men frequently warn against preoccupation with defense tactics guarding against possible attack over the North Pole by bombers and missiles, while overlooking an equal menace.

The Soviet Union has about 450 submarines in operation. Most are post-World War II types, snorkel-equipped, with wide cruising ranges. Some probably have missile-launching capabilities.

It is a poorly kept secret that these subs are already probing our off-shore defenses from Hawaii to Cape Canaveral. Missile-launching submarines off both coasts could make every point in the U.S. vulnerable to ballistic missile attack.

How we are gearing up to combat the Soviet submarine menace is a fascinating story. Half the Navy's combatant force is being equipped to detect subs.

First, there is the story of new detecting equipment to supplement conventional sonar and the far-flung hydrophones of the Caesar Curtain (ELECTRONICS, p 15, June 27, '58). These new detectors include sensors that see in the dark and under water, smell out diesel fumes from the air, pinpoint radar signals and other electromagnetic emission.

Almost every plane of our airborne hunter-killer fleet of several hundred patrol planes will be a flying combat information center. Automatic equipment tying in detection devices to the latest electronic navigation equipment, computers and display equipment will translate raw data into position and course signals presented visually to the pilot, enabling him to move in for the kill.

There are challenges aplenty in antisub warfare, too. What about a detection method without the limitations of sonar? Submerged subs can receive very-low-frequency radio signals. Could these same signals set up a pattern in which the presence of a sub would sound the alarm?

Could Navy sub hunters perhaps learn from the geophysicist, who uses magnetometers, seismic equipment, gravity meters, radiation detection gear and earth-current measurements so effectively to locate oil deposits far below the earth's surface?

The field is wide open for our industry to come up with new ideas for Navy's new, rapidly-expanding antisubmarine warfare program.

Associate Editor Mason wraps up the story of challenges and accomplishments in electronic sub hunting in his story beginning on p 20.

Coming In Our July 10 Issue . . .

RADAR INTERFERENCE. The widespread use of radar systems today, and the use of high-power transmitters and sensitive receivers in radar systems, have created a problem of grave concern to defense and air safety officials. Mutual radar interference can disrupt communications, send a target drone off its course, cause an expensive missile test to end disastrously. K. H. Chase and J. L. Pierzga of Sperry Gyroscope Co., in their significant article, describe methods which must be employed to reduce the effects of interference in the frequency and time domains.

ELECTROLUMINESCENT DISPLAY. Use of electroluminescent panels in display devices for readout of numerical and symbolic information presents many unique advantages. Reliability and efficiency are high. R. C. Lyman and C. I. Jones of Westinghouse describe an automatic visual display system, constructed entirely of solid-state elements, which uses electroluminescent elements as planar indicators.

SPRAGUE® RELIABILITY in these two dependable wirewound resistors

MINIATURE

Blue Jacket®

VITREOUS-ENAMEL POWER RESISTORS

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

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

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

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

NEW SMALLER SIZE

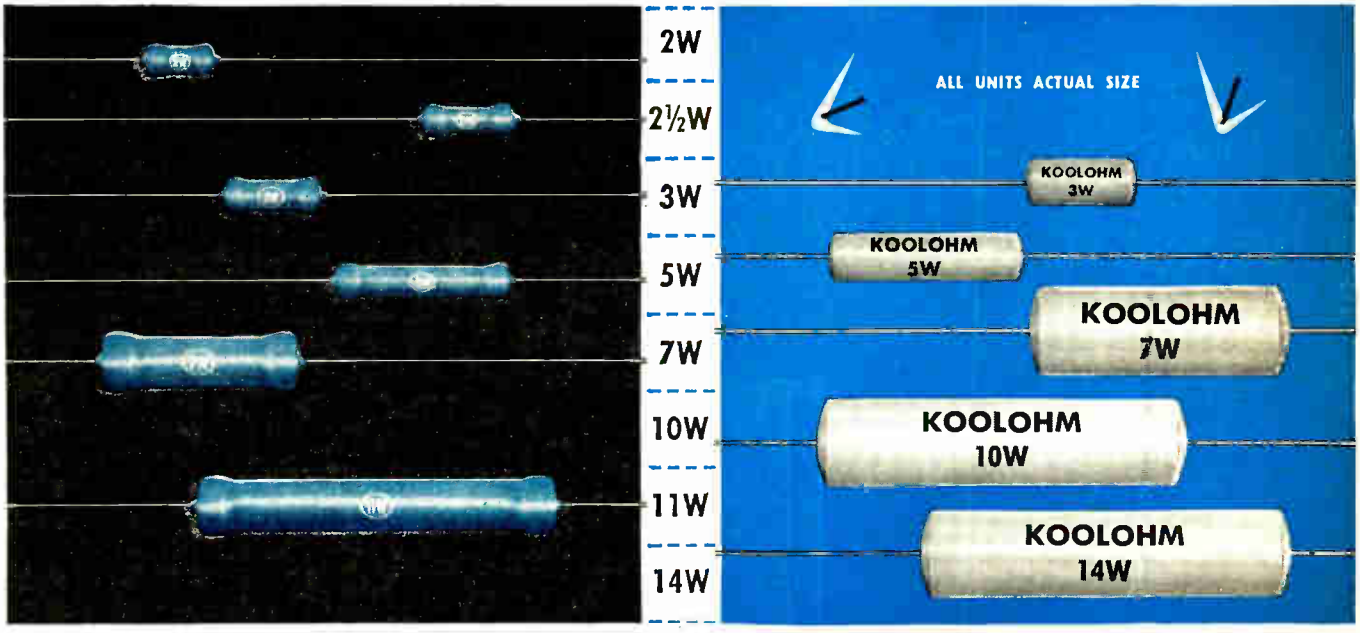
KOOLOHM®

INSULATED-SHELL POWER RESISTORS

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

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

Send for Engineering Bulletin 7300 for complete technical data.



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Who Discovers the Discoverers?

"A professor can never better distinguish himself in his work than by encouraging a clever pupil, for the true discoverers are among them, as comets amongst the stars." CARL LINNAEUS

Somewhere in this mighty land of ours, a gifted youth is learning to see the light of tomorrow. Somewhere, in a college classroom or laboratory, a dedicated teacher is gently leading genius toward goals of lofty attainment. Somewhere the mind of a future discoverer—in science, engineering, government, or the arts—is being trained to transcend the commonplace.

Our nation has been richly rewarded by the quality of thought nurtured in our colleges and universities. The caliber of learning generated there has been responsible in no small part for our American way of life. To our college teachers, the selfless men and women who inspire our priceless human resources, we owe more than we will ever be able to repay.

Yet how are we actually treating these dedicated people? Today low salaries are not only driving gifted teachers into other fields, but are steadily reducing the number of qualified people who choose college teaching as a career. At the same time, classrooms are beginning to get overcrowded. In the face of this, college applications are expected to double by 1967.

This is a severe threat to our system of education, to our way of life, even to our very existence as a nation. Our colleges need help—and they need it now!

HIGHER EDUCATION
KEEP IT BRIGHT

If you want to know more about what the college crisis means to you, and what you can do to help, write for a free booklet to: HIGHER EDUCATION, Box 36, Times Square Station, New York 36, New York.

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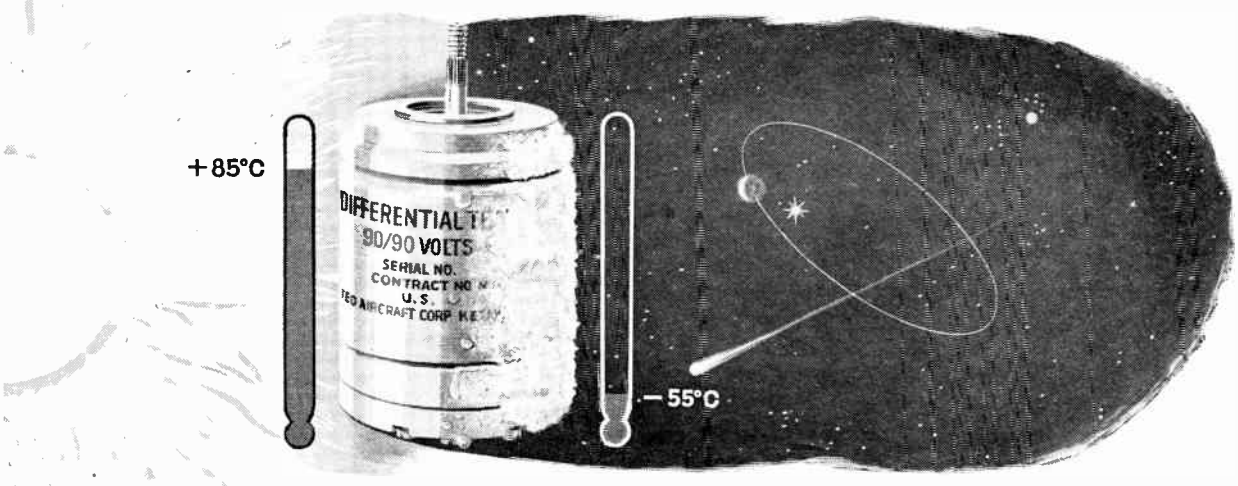
CAN A SYNCHRO MAINTAIN ACCURACY



OVER A WIDE RANGE OF TEMPERATURE?

Synchros have to take punishment. They are often exposed to blistering heat and stratospheric cold . . . and they still must operate accurately.

Naturally, Ketay synchros meet *and surpass* the new MIL-S-20708A ambient temperature requirement of −55° to 85° C. (or to 75° C. for size 23). Even more important, they give you a remarkable 6 minute accuracy *over this whole temperature range.*

Ketay is the *only source* currently manufacturing and shipping a complete line of the new Mil-type synchros. They are available in production quantities in sizes from 8 to 23, with 60 cps units as small as size 15. Because of their superior accuracy, with some units offering 3′ accuracy at room temperature, Ketay synchros one or more sizes smaller than previously required may often be used.

Ketay engineers are working on many advanced environmental and accuracy problems in developing prototype systems, and have an unusual degree of experience in high temperature work. Why not call or write for help in solving your special problems?

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NORDEN Division of United Aircraft Corporation

KETAY DEPARTMENT, Commack, Long Island, N.Y.

Development of klystrons began 20 years ago—at **SPERRY**

Today—in addition to facilities in Great Neck—Sperry has this modern plant and laboratory in Gainesville, Fla. devoted to klystron development.

SPECIFICATIONS:

Frequency . . . 960 to 1215 mc

Peak Power Output . . . 37 kw

Power Gain . . . 30 db

Grid Bias (Neg.) . . . 1% of Beam voltage

Grid Drive (Pos.) . . . 2.1% of Beam voltage

Dimensions . . . 21⅛" x 10½" x 7⅜"

Weight . . . 45 lbs.

. . . and now **SAL 219**

SPERRY'S NEW PULSE AMPLIFIER KLYSTRON FOR AIR NAVIGATION AND TRAFFIC CONTROL

SAL-219 is the latest and most advanced addition to the Sperry family of pulsed amplifier klystrons. Soon going into operational use, this new three-resonator amplifier was developed for current air-navigation-aid applications. And, typical of Sperry's contributions in the tube field, modifications of SAL-219's basic performance characteristics will suit it to a variety of future applications.

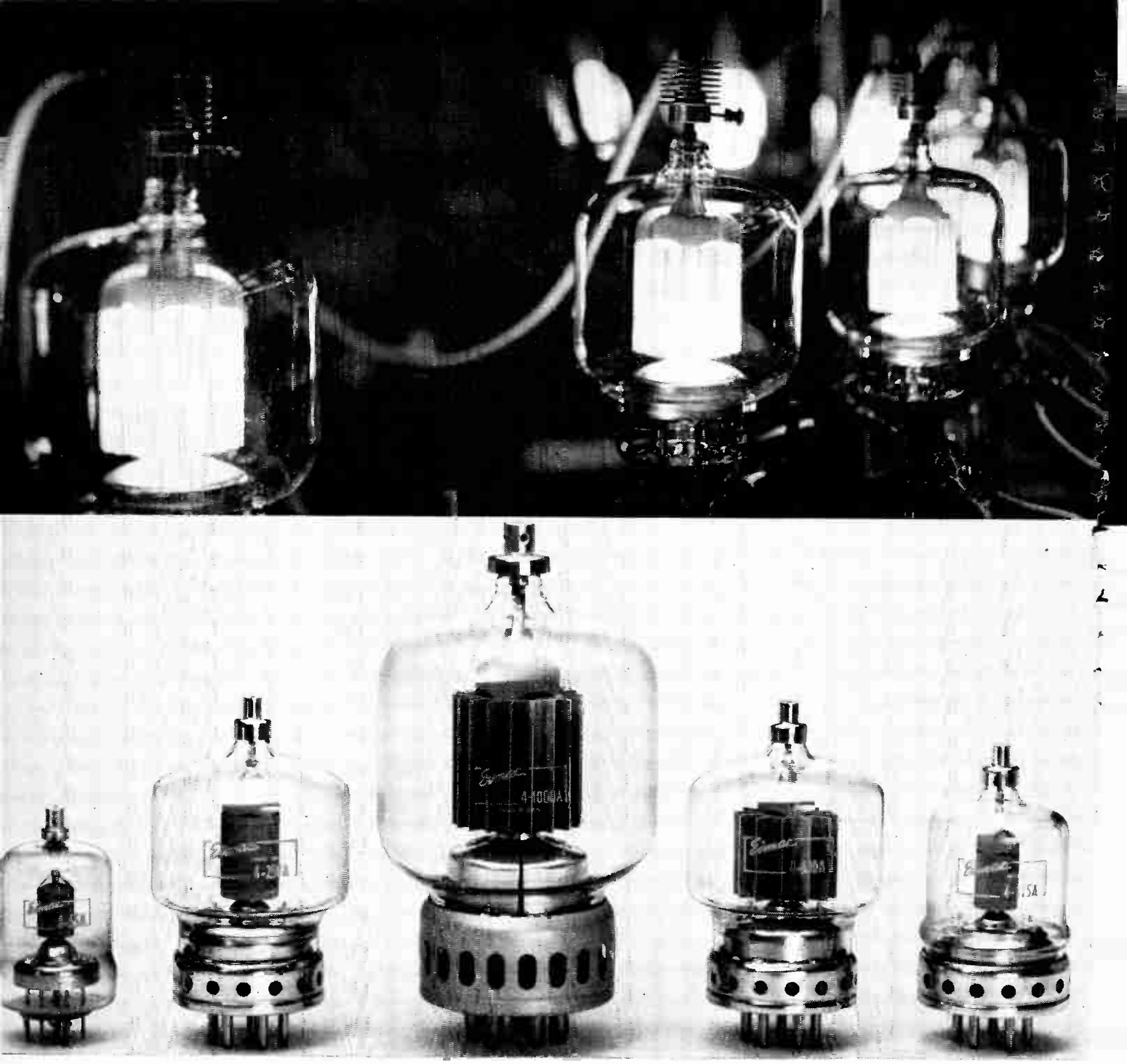
SAL-219 has a high-mu control grid, greatly reducing the required modulator power. A space-charge focused beam reduces weight, size and power requirements by eliminating the need for focusing magnets. A powerful and "clean" R.F. signal can be provided at any frequency through the wide range of 960 to 1215 mc. Integral R.F. cavities are continuously tunable and a ceramic seal, terminated in a standard 1⅝" coaxial connector, easily accommodates the high peak power level of the R.F. output.

Sperry originated this design concept of klystrons for the aeronautical radio navigation frequencies, and has steadily improved the product in terms of cost, size, performance, versatility and life. This design concept can result in tubes useful in other applications. For further information on our development capability or specific microwave tubes, write or phone nearest Sperry district office.

SPERRY

SPERRY ELECTRONIC TUBE DIVISION, *SPERRY RAND CORPORATION, GAINESVILLE, FLORIDA*

Address all inquiries: Gainesville, Florida or Sperry offices in Brooklyn · Boston · Los Angeles · Montreal · Export Dept., Great Neck, New York



EIMAC PIONEERED INTERNAL-ANODE TETRODES— PERFORMANCE LEADERS FOR OVER A DECADE

Developed and introduced to the industry in the mid 1940's, Eimac's line of internal-anode radial-beam tetrodes immediately received widespread and enthusiastic acceptance. Well over a million have been sold since that time. These tubes, quality leaders from the very start, still maintain that position through advanced processing techniques, inherently sound design and continuing concern with production refinements.

Clean electrode design, for example, and the exceptionally hard vacuums achieved on Eimac-developed rotary vacuum pumps, result in consistently reliable tubes with an exceptional ability to withstand high momentary overloads and peak powers. Rugged filament design with high reserve emission contributes greatly to their reliability and long life.

Stable operation at high frequencies is assured by low inter-electrode capacitances and low lead inductances. Driver requirements and associated circuitry are simplified by the high power gain and low driving power requirements of these tube types.

These features, plus other Eimac design innovations such as the Pyrovac* plate and non-emitting grids make Eimac internal-anode tetrodes your logical choice for new equipment designs, as well as tube replacements, when exceptional performance and reliability are required. Most types available for immediate delivery.

*Registered Trademark

EITEL-McCULLOUGH, INC.

San Carlos, California

ELECTRONICS NEWSLETTER

TUNNEL DIODE with performance characteristics similar to those of the parametric amplifier is reported by Radio Corporation of America. Fabricated from a piece of germanium 3/1,000-of-an-inch in diameter, an experimental unit has been operated above 1,000 mc using the negative resistance principle. RCA says potential range of the device is beyond 10,000 mc. Potential use as a memory element for advanced computers is also seen. The company says it is developing new electronic computing techniques that approach the operating limits imposed by the speed of light. Techniques based on microwave principles have reportedly been used to add two digits at a speed of 500 million times a second.

Electronic measurement of human blood flow rate is being developed at the University of California. Process makes use of a magnetic field and the absorption of radio energy by protons of hydrogen atoms in the water contained in the blood.

MULTIBEAM RADAR SYSTEM AN/FPS-7, first in a new high power series, has been delivered by GE's Heavy Military Electronics Dept. to the Air Force for use with the SAGE air defense system. GE says the new system can detect planes at significantly higher altitudes and longer ranges than present defense radars, provides faster target data as well. R-f power is generated by a five-foot high, multimillion-watt klystron tube jointly developed by Rome ADC and GE's Power Tube Dept. "Varifocal" antenna, operating on multibeam principle, feeds several narrow beams instead of one broad beam to a seven-ton antenna. This antenna, which uses a 40 x 18-ft reflector and rotates 360 degrees, then focuses the pulses. Overall system is housed in a 50-ft radome.

Automatic reading of typewritten sheets and conversion of 200 characters per second into electrical signals is accomplished by the Print Reader MX-2021. Development by Intelligent Machines Research division of Farrington Manufacturing Co. has just been announced by USAF's Air R&D Command. Machine will enter information into data processing gear, eliminating keyboard operators. Air Force says 30 such machines could read and process data at a rate of 10 million pages a year.

PACIFICS TELEPHONE CABLE carrying 100 circuits or more is being planned by the American Telephone and Telegraph Co. and the Japanese Overseas Communication Co. (Kokusai Denshin Denwa). The companies have not yet signed a contract and final design details have not been set, but negotiations towards these ends are reported in progress. It is understood that the cable system will consist of a single two-way cable from Hawaii to Japan using rigid repeaters. Such a system could be linked to existing facilities between Hawaii and the West Coast. Development of the system, including the rigid repeaters, is underway at Bell Telephone Laboratories. The present trans-Atlantic twin telephone cable system uses flexible repeaters of American design in its deep-sea portion and rigid repeaters of British design in the shallow-water sections.

MILITARY-CIVIL AIR TRAFFIC CONTROL using joint facilities will be investigated by IBM's Federal Systems division under a Federal Aviation Agency study contract. Both technical and economic factors will be analyzed. Use of radar and other position flight information will be studied; overall data processing and communications needs will be determined. Departments of Commerce and Defense are cooperating. IBM's association with the SAGE defense project suggests the possibility that the use of SAGE for civilian air traffic control might be considered.

Long Island Electronic Manufacturers Council is spearheading a drive to increase the facilities of the Adelphi Research Center, Mineola. Aim: a basic research center of national stature from which industry in the area may profit in the future.

UNATTENDED WEATHER OBSERVATORY that transmits data by means of a teletypewriter system has been developed for the Army by Specialty Electronics Development Corp., Syosset, N. Y. Equipment is housed in a 7 × 7 × 8 ft steel cubicle. It reports in 15 seconds by teletypewriter code the station's identification, air temperature from minus 40 to plus 120 F, dew point temperature, wind direction and velocity, barometric pressure and rainfall; unit can also be equipped with radiation monitoring and warning instruments. Firm says its automatic stations, placed at key points in remote areas, would add substantially to the accuracy of weather forecasts.

SOLAR FLARE EMISSIONS of ultraviolet and x-rays will be studied by the Naval Research Laboratory under a $250,000 National Science Foundation grant. Instrumented Nike-Asp rockets are slated to "explore wavelengths and altitudes at which only rudimentary observations have heretofore been made." Instruments will include Geiger counters to measure x-rays in the 1-10 angstrom range, x-ray detectors for wavelengths of 8-20 and 44-60 angstroms, scintillation counters sensitive to hard x-rays in the 20-500 kilovolt range, and ion chambers sensitive to helium emission lines at 584 and 314 angstroms.

WASHINGTON OUTLOOK

A NEW TONE OF HOSTILITY toward the interests of larger military contractors is developing in Washington.

It is represented by such things as these:

The furor over a so-called "munitions lobby"; the upcoming Congressional probe into employment of retired military brass by contractors; growing opposition to measures such as the Saltonstall Bill to encourage "weapon system" management and negotiated procurement; and new attempts to spur the Pentagon into a greater volume of advertised buying.

Still more antagonism is reflected in the Senate Finance Committee's vote to kill House-passed provisions to liberalize the controversial Renegotiation Act. In renewing the law, which expired June 30, for 2½ years, the committee turned down the House amendments to simplify contractors' appeals from Renegotiation Board rulings.

The Senate committee also called for a broad-gaged investigation of defense procurement policy and of the renegotiation program itself. The new investigation will provide still another sounding-board for lawmakers who want more restrictions on munitions business. Electronics producers who are getting an increasing share of military contracts stand out as the likeliest targets for Congressional criticism.

- **The Defense Dept.'s latest roster** of top military contractors points up the electronic trend in procurement. A greater number of companies essentially in electronics shows up in the top 100 firms. Many other old-line defense producers continue to rate high on the basis of diversification into the electronics industry—such as NAAGM.

  The new roster, which covers calendar 1958, also demonstrates the growing concentration of defense business among fewer companies—providing the industry's Congressional critics with more ammunition. The top 100 contractors accounted for 74 percent of major prime contracts, compared to 69.1 percent in calendar '57.

  Boeing Airplane Co. tops the list, as it did last time, with $1.9 billion worth of prime contracts. Next in line are General Dynamics, General Electric, Lockheed, North American Aviation, AT&T, Douglas Aircraft, Hughes Aircraft, Martin, and Sperry Rand.

  Following are leading electronics companies which rank next: IBM, 11th on the list, $417.6 million worth of contracts; RCA, #15, $356.1 million; Raytheon, #18, $274.1 million; Westinghouse, #19, $271.6 million; Bendix, #21, $243.7 million; ITT, #25, $135.8 million; Burroughs, #29, $107 million; Avco, #31, $102 million; Minneapolis-Honeywell, #34, $86.1 million; American Bosch Arma, #35, $85.4 million; Collins Radio, #36, $84.4 million; Thompson Ramo Wooldridge, #44, $71.9 million; Philco, #46, $71.5 million.

- **The Pentagon is compiling** the first comprehensive listing of retired military brass on the payrolls of defense contractors. Meantime, Sen. Paul Douglas (D., Ill.) has gotten his hands on a preliminary list and has presented it on the floor of the Senate. Douglas' list shows that 88 major contractors employ 721 retired officers with the rank of Colonel or Navy captain or higher.

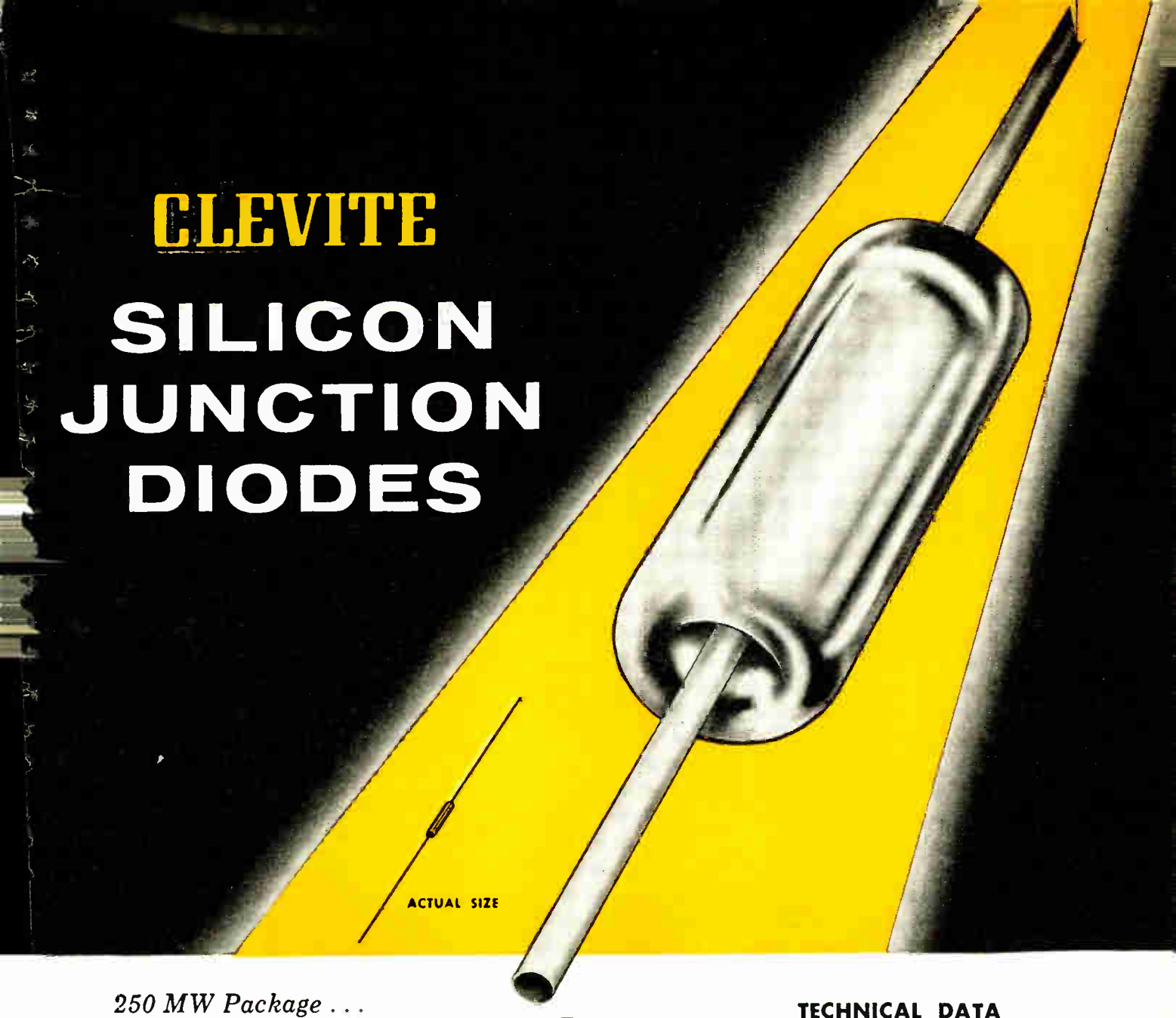
  But Douglas' listing is somewhat exaggerated since it includes career industrialists who hold or have held reserve commissions. RCA's Brig. Gen. David Sarnoff, for instance, is included.

  Here's a rundown of electronics company payrolls: AT&T, 1 retired senior officer; Avco, 4; Bendix, 14; Collins Radio, 5; GE, 35; Hughes, 7; IBM, 3; ITT, 24; Lear, 2; Philco, 17; RCA, 39 (including Sarnoff); Raytheon, 17; Sperry Rand, 12 (excluding Gen. MacArthur); Sylvania, 6; Thompson Ramo Wooldridge, 6; Westinghouse, 33; System Development Corp., 2.

CIRCLE NO. 13 READER SERVICE CARD→

CLEVITE

SILICON JUNCTION DIODES



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Fast Switching and General Purpose Types
Featuring . . .

- **MECHANICAL RELIABILITY** — Rugged, hermetically sealed, subminiature packages. Designed to meet both military and commercial requirements.
- **ELECTRICAL SUPERIORITY** — Excellent high temperature operation . . . thermally stable . . . high forward conductance . . . efficient rectification.
- **PRODUCT UNIFORMITY** — Tight manufacturing controls.

For details, write for Bulletin B217A-1 B217A-2

TECHNICAL DATA

Type	Max. DC Inver. Oper. Voltage	Forward Current @ Specified Voltage	Max. Inverse Current @ 25°C	Max. Inverse Current @ 150°C	Test Volts
1N457	60 V	20 ma @ 1.0 V	0.025 μa	5.0 μa	60 V
1N458	125 V	7 ma @ 1.0 V	0.025 μa	5.0 μa	125 V
1N459	175 V	3 ma @ 1.0 V	0.025 μa	5.0 μa	175 V
1N662	90 V	10 ma @ 1.0 V	20 μa	100 μa (@ 100° C)	50 V
1N663	90 V	100 ma @ 1.0 V	5.0 μa	50 μa (@ 100° C)	75 V
1N778	100 V	10 ma @ 1.0 V	0.5 μa	30 μa (@ 125° C)	100 V
1N779	175 V	10 ma @ 1.0 V	0.5 μa	30 μa (@ 125° C)	175 V

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Electronic Engineering — With a Dimension for the Future

New Rule Checks Traders

SOME ELECTRONICS STOCKS may be among those affected by a new ruling now in operation at the American Stock Exchange on the recommendation of the Securities and Exchange Commission.

The rule is designed to (1) prevent floor traders from buying stock at successively higher prices and (2) restrict the possible impact of trading activities on what SEC terms "active" or "volatile" stocks.

Specifically, the new regulation restricts floor traders from stimulating public interest in a stock by engaging in overly active and concerted buying; and enjoins against aggravating demand on issues susceptible to extreme price fluctuations because of a small floating supply of stock.

The rule imposes the following restrictions on floor traders in a rising market: it prohibits them from buying stocks on their own bids at a price higher than the last sale. It limits the amount of offered stock which floor traders may purchase at a given price if that price is higher than the next preceding different price. Also, after these limited amounts of stock have been purchased, floor traders as a rule will not be allowed to make further purchases at the same or higher prices for a 15-minute period.

The rule, which will remain in effect for six months on an experimental basis, contains a number of exceptions to permit traders under appropriate conditions to help maintain a fair and orderly market.

• **Topp Industries,** Los Angeles, announces acquisition of **U.S. Semiconductor Products, Inc.,** Phoenix, Ariz. The transaction is an outright purchase under which 66,787 shares of Topp common stock, plus $2,800, are being given for the semiconductor manufacturing concern. The 436,000 shares of U.S. Semiconductor will be turned in by shareholders. The firm makes diodes, capacitors and other semiconductor devices, as well as basic silicon materials for infrared applications.

• **Hewlett-Packard Co.,** Palo Alto, Calif., announces completion of its merger with **Dymec Inc.** in the same city. Dymec, which designs and manufactures instrumentation systems, has a current annual sales rate of over $3 million. The company will function as a separate division of Hewlett-Packard with no changes in management personnel.

• **Electronic Communications, Inc.,** St. Petersburg, Fla., has agreed to acquire **Advanced Technology Corp.,** Santa Barbara, Calif., in exchange for 1,000 shares of ECI common stock. Advanced Technology Corp. is owned by a team of research specialists who organized their own company to work in missile systems, space projects and allied activities.

• **General Instrument Corp.,** Newark, N. J., has acquired the **Harris Transducer Corp.** of Woodbury, Conn., on a share-per-share basis. The Connecticut company manufactures electronic and acoustical devices in the field of sonar and other antisub applications.

25 MOST ACTIVE STOCKS

WEEK ENDING JUNE 19

	SHARES (IN 100's)	HIGH	LOW	CLOSE
Sperry Rand	769	25 3/4	24 5/8	25
Raytheon	713	55 7/8	51 1/8	54 3/4
Intl Tel & Tel	616	38 7/8	37	37 3/8
Avco Corp.	604	15 1/2	14 3/4	15 1/8
RCA	501	64 7/8	62 3/8	63 3/4
Gen Electric	477	81 3/8	79	80
Servo Mechan Inc.	468	16 1/8	13 3/8	13 5/8
Texas Instr.	457	136 3/4	124 1/2	134
Gen Tel & Elec	423	66 3/8	64 1/2	65 1/4
Gen Dynamics	396	57 3/4	55	55 5/8
Intl Resistance	391	19 1/4	17 1/8	18 7/8
Zenith Radio	387	131 3/4	125 5/8	127 1/4
Univ Control	297	17 1/8	16 1/8	17 1/8
Elec & Mus Ind	280	7 1/4	6 7/8	7 1/8
Gen Instr	267	31 3/8	28 1/8	29 5/8
IBM	265	443	429	435
Lear	261	14 5/8	13 7/8	14 1/8
Westinghouse	258	93 1/4	89 1/2	91 1/8
Sonotone	250	15 3/4	12 3/4	15
Emerson Radio	237	19 7/8	18 5/8	19 3/8
Philco	232	31 3/4	29 3/4	30 1/8
Burroughs	230	36 7/8	35 1/8	35 1/4
El-tronic	226	1 1/4	1	1 1/4
Standard Coil	217	19 3/8	18 1/8	18 3/4
Beckman	205	60 1/4	56 1/4	58 1/4

The above figures represent sales of electronics stocks on the New York and American Stock Exchanges. Listings are prepared exclusively for ELECTRONICS by Ira Haupt & Co.

Tv Set Outlook Brightens

TV SET SALES in 1959 will climb to the 6.2-million mark, claims Ray B. Cox, consumer products vice president at Hoffman Electronics. Estimate compares with 5.1 million sets sold last year and 6.6 million units in 1957.

However, this year's first-quarter sales (1.4 million), which have accounted for a fourth of a year's total in the past, point to 1959 sales of 5.5 million units.

President of Zenith Radio Co., Joseph S. Wright, also takes a more conservative view of 1959's tv picture: he predicts sales of 5.5-6 million sets this year. He foresees eventual return to annual sales of 7 million or more sets within next few years. Obsolescence of sets-in-use and rising population should provide boost for this year's and future sales.

• **National Carbon Co., division of Union Carbide**, is bullish on portable radio sales. Firm, which makes Eveready radio batteries, expects nearly 5 million portable radios will be sold this year, and that transistor portables will account for nearly 75 percent of these sales. Factory production of portable radios in 1958 was 3.4 million sets, according to Electronic Industries Association.

• **Electronic ovens** using heatless microwaves will be in use in 150,000 homes in the next five years, predicts J. Penn Rutherfoord, manager of Raytheon's Industrial Apparatus Division. Current price of electronic ovens is about $900, down from a price range of $1,200 to $1,400 last year.

By 1965, Rutherfoord forecasts, oven sales will climb to an annual rate of 100,000 units. At that time, he anticipates, retail prices will drop to the $300-$400 level.

• **Aerospace Industries Association** (formerly Aircraft Industries Association), Washington, D. C., issues its 1959 Washington Information Directory. It is a compilation of information on offices and people involved in aviation in the Washington area, including government, industry, publications and associations.

• **Hoffman Electronics** issues additional silicon transistor predictions. (See ELECTRONICS, p 30, May 29, for summary of firm's silicon transistor survey.)

Market research manager James T. Parry estimates following all-industry silicon transistor unit production levels for 1957-1962:

1957— 1.4 million units
1958— 3.2 million units
1959— 7.0 million units
1960—15.0 million units
1961—32.0 million units
1962—69.6 million units

Estimate for 1962 production is a change in Hoffman's previous estimate of 96.6 million units. However, earlier prediction that silicon transistors will account for 24 percent of total transistor unit production in the year 1962 remains unchanged.

• **Average sales** per employee among electronics manufacturing firms was $16,083 in 1958 as against $15,654 in 1957, according to a survey by the Office of Naval Material. ONM found average varies with size of firms. Average for firms with 1 to 50 employees was $13,935, compared with average of $17,189 for electronics companies with more than 5,000 employees.

FIGURES OF THE WEEK

LATEST WEEKLY PRODUCTION FIGURES

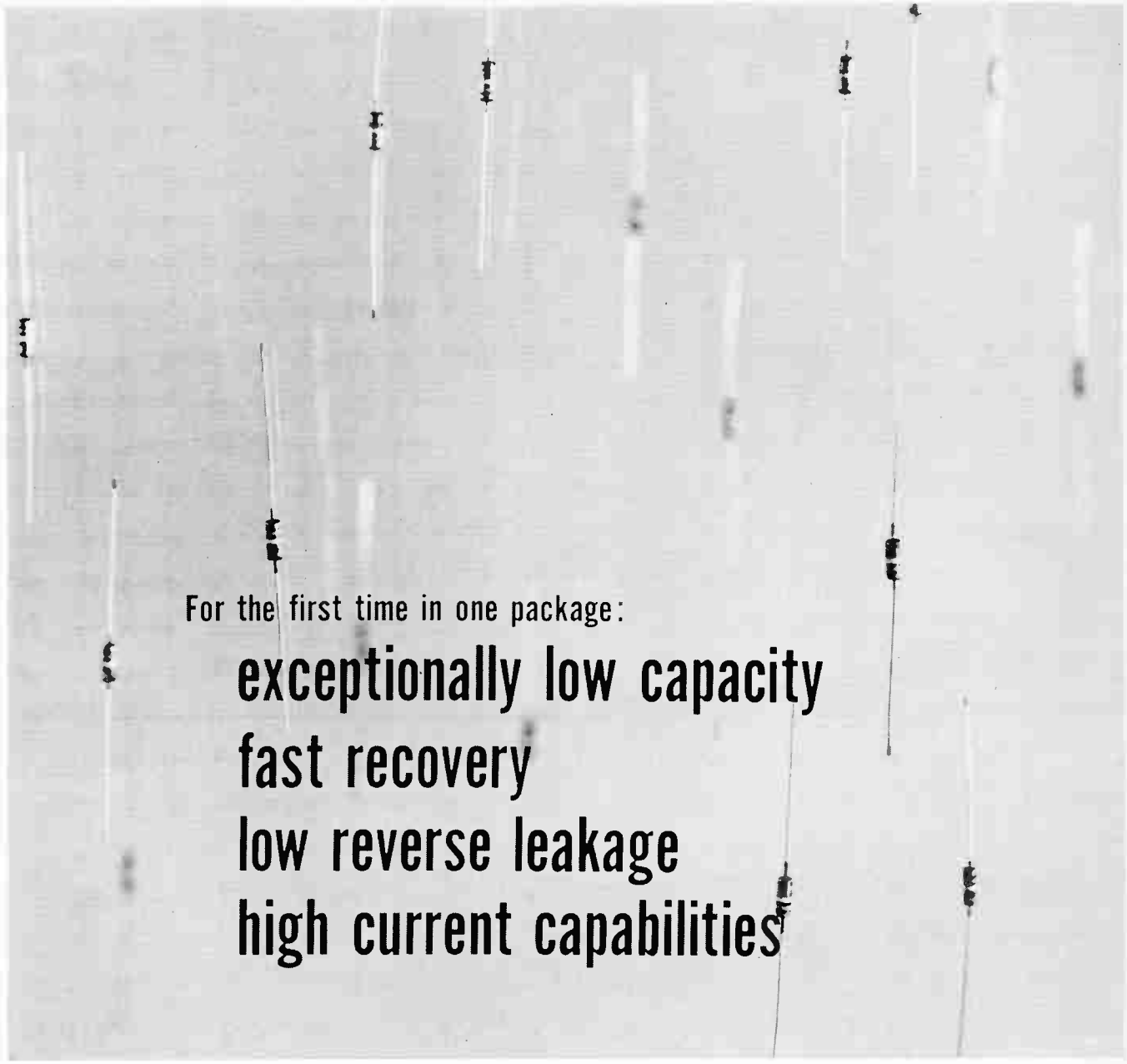
(Source: EIA)	June 12, 1959	May 15, 1959	Change From One Year Ago
Television sets	128,049	98,343	+68.4%
Radio sets, total	299,599	269,812	+84.3%
Auto sets	134,167	119,725	+159.5%

STOCK PRICE AVERAGES

(Standard & Poor's)	June 17, 1959	May 20, 1959	Change From One Year Ago
Electronics mfrs.	93.44	91.81	+75.9%
Radio & tv mfrs.	109.18	106.75	+122.6%
Broadcasters	96.70	101.48	+52.6%

LATEST MONTHLY SALES TOTALS

(Add 000)	Apr. 1959	Mar. 1959	Change From One Year Ago
Rec. tubes, value	$26,047	$35,286	—9.5%
Rec. tubes, units	29,800	39,841	—8.5%
Pic. tubes, value	$13,275	$13,804	+14.5%
Pic. tubes, units	696	717	+18.0%



For the first time in one package:

exceptionally low capacity
fast recovery
low reverse leakage
high current capabilities

100 mA Min. @ 1V Forward Current...0.3 μsec recovery...4 μμf at −2V...that's what you get with the new Hughes computer diodes. With these characteristics, *these diodes will cover practically every major computer switching requirement.*

You can always count on them for top performance. Hermetically sealed in glass envelopes, these Hughes computer diodes have been engineered for extreme reliability under adverse environmental conditions.

For additional information concerning these unique Hughes diodes call or write the Hughes sales office nearest you. They are located at:

Boston, *4 Federal Street; Woburn, Mass.; WOburn 2-4824*
Newark, *80 Mulberry Street; Newark 2, N. J.; MArket 3-3520*
San Francisco, *535 Middlefield Road; Palo Alto, Calif.; DA 6-7780*
Syracuse, *224 Harrison Street; Syracuse 2, N. Y.; GRanite 1-0163*
Chicago, *6120 West North Ave.; Chicago 39, Ill.; NAtional 2-0283*
Philadelphia, *1 Bala Avenue; Bala-Cynwyd, Penn.; MOhawk 4-8365*
Los Angeles, *690 N. Sepulveda; El Segundo, Calif.; OR 8-6125*

Or write, Hughes Products, Marketing Department.
SEMICONDUCTOR DIVISION, NEWPORT BEACH, CALIFORNIA.

TYPICAL SPECIFICATIONS:

Type	Min. E_X (@ 100μA)	Min. Forward Current @ 25°C (@ +1.0V)	Max. Reverse Current (μA) @ 25° C	@ 100° C	Reverse Recovery* Reverse Resistance (R) (ohms)	Maximum Recovery Time (μsec)
1N840	50	150	0.1 @ 40V	15 @ 40V	400 K	0.3
1N837A	100	150	0.1 @ 80V	15 @ 80V	400 K	0.3
1N841	150	150	0.1 @ 120V	15 @ 120V	400 K	0.3
1N843	250	150	0.1 @ 200V	15 @ 200V	400 K	0.3
1N844	100	200	0.1 @ 80V	15 @ 80V	400 K	0.5
1N845	200	200	0.1 @ 160V	15 @ 160V	400 K	0.5

*Measured in JAN test circuit and switched from 30mA forward current to −35V.

TYPICAL CAPACITANCE: C_{-10}=2.2μμf $C_{-1.5}$=4.4μμf C_{-0}=9.0μμf

Operating Temp. Range: −65°C to +150°C Storage Temp. Range: −65°C to +200°C

Creating a new world with ELECTRONICS

HUGHES PRODUCTS

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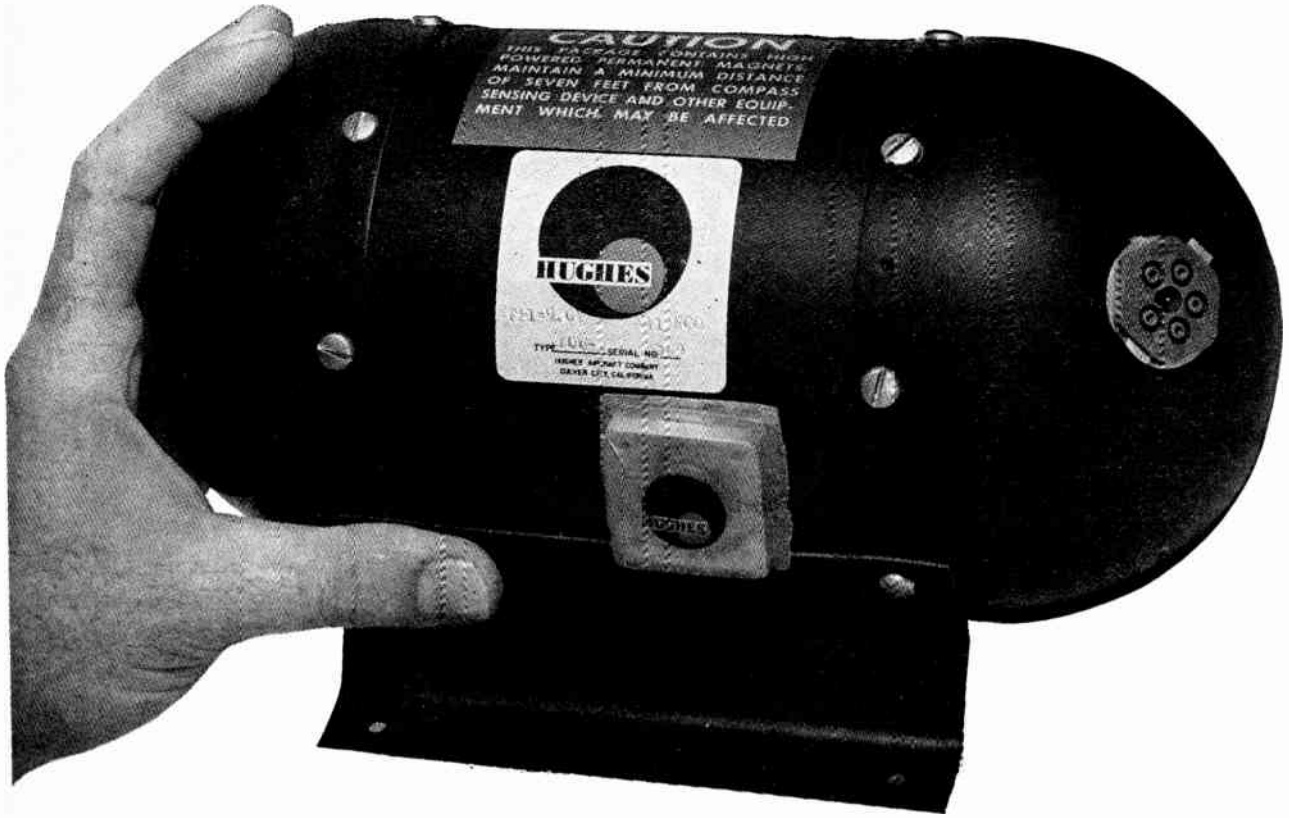

Available from stock...MICROWAVE GENERATORS

Now available for immediate delivery are several high-performance Hughes microwave tubes... including the Model LOU-2 pictured above. This Ku band backward oscillator is completely ready for insertion into a system. The prepackaged LOU-2 tube gives you power output of from 10 to 60 milliwatts over the band ...and tunes the frequency range of 12.4 to 18.0 kmc/sec.

Since the tube is housed in a self-contained permanent magnetic focusing package, no separate power supply for a focusing electromagnet is necessary. Result: you get a lighter and more compact package.

Reliability has been engineered into the tube—and has been proven in more than 2 years of life tests. The package is completely sealed and magnetic structures are potted in epoxy resin.

Developed by the famed Hughes Research & Development Laboratories, the LOU-2 helps solve your problems associated with microwave signal generators, panoramic receivers and spectrum analyzers, frequency scan radars, navigational radars, microwave links, and countermeasures.

Hughes also offers you from stock these other high performance microwave tubes:

S-band traveling wave amplifier—Periodically focused, the type MAS-2A has a peak power output of one kilowatt over a band of 2-4 kmc at duties up to 0.005. The tube has a gain of 30 to 33 db, giving an excess of one kilowatt over most of the band.

S-band backward wave amplifier—Type PAS-2, a voltage-tuned amplifier, features: frequency range 2.4-3.5 kmc, tube noise figures of less than 5 db, crystal protection, spurious input signal elimination, cold isolation greater than 80 db and image rejection.

X-band backward wave amplifier—Featuring a noise figure of 4.5 db, the PAX-1 tube, also offers a 12 MC bandwidth which is electronically tunable over the X-band spectrum.

For additional information please write: Hughes Products, Electron Tube Sales, International Airport Station, Los Angeles 45, California. For export write: Hughes International, Culver City, California.

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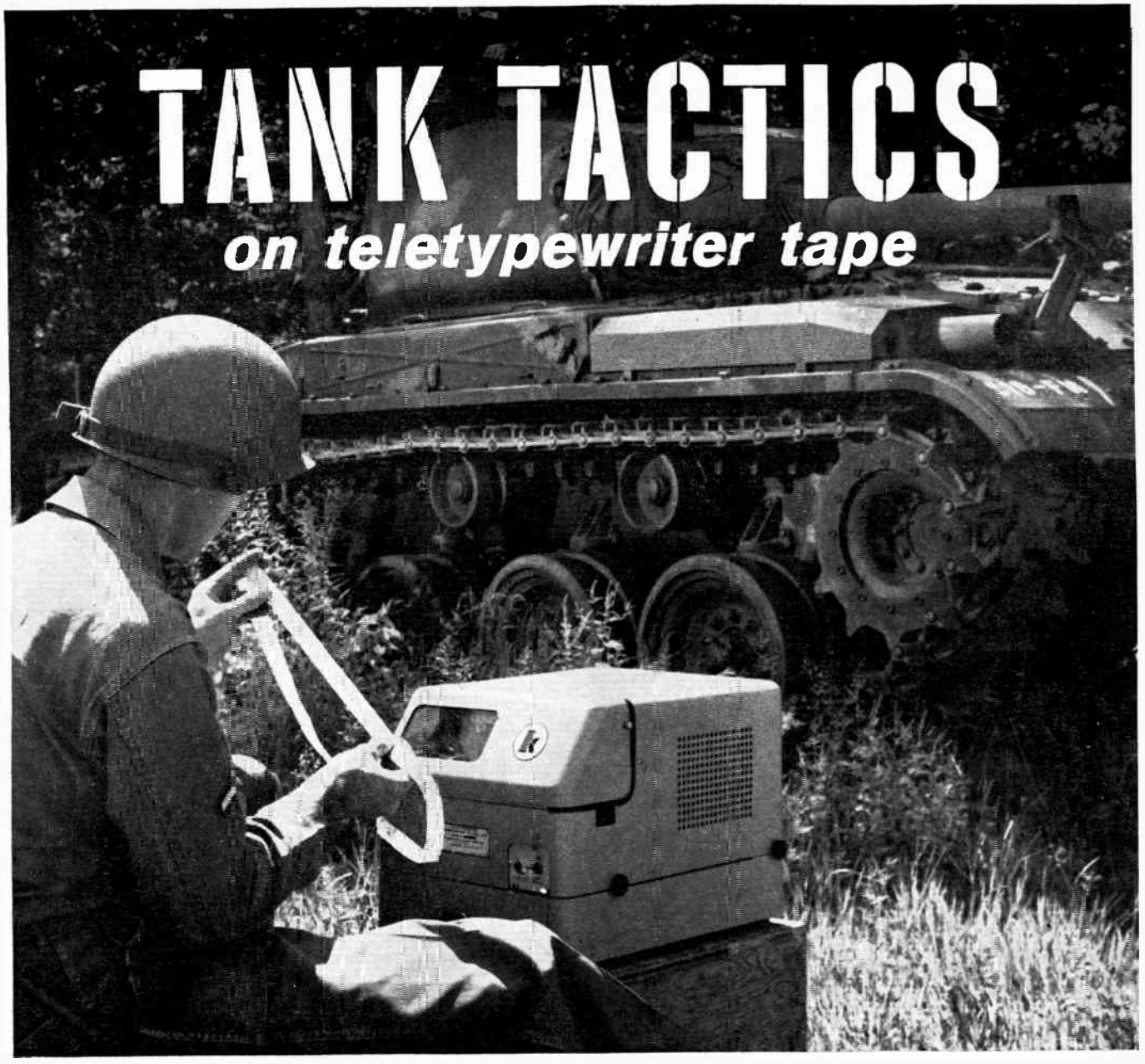


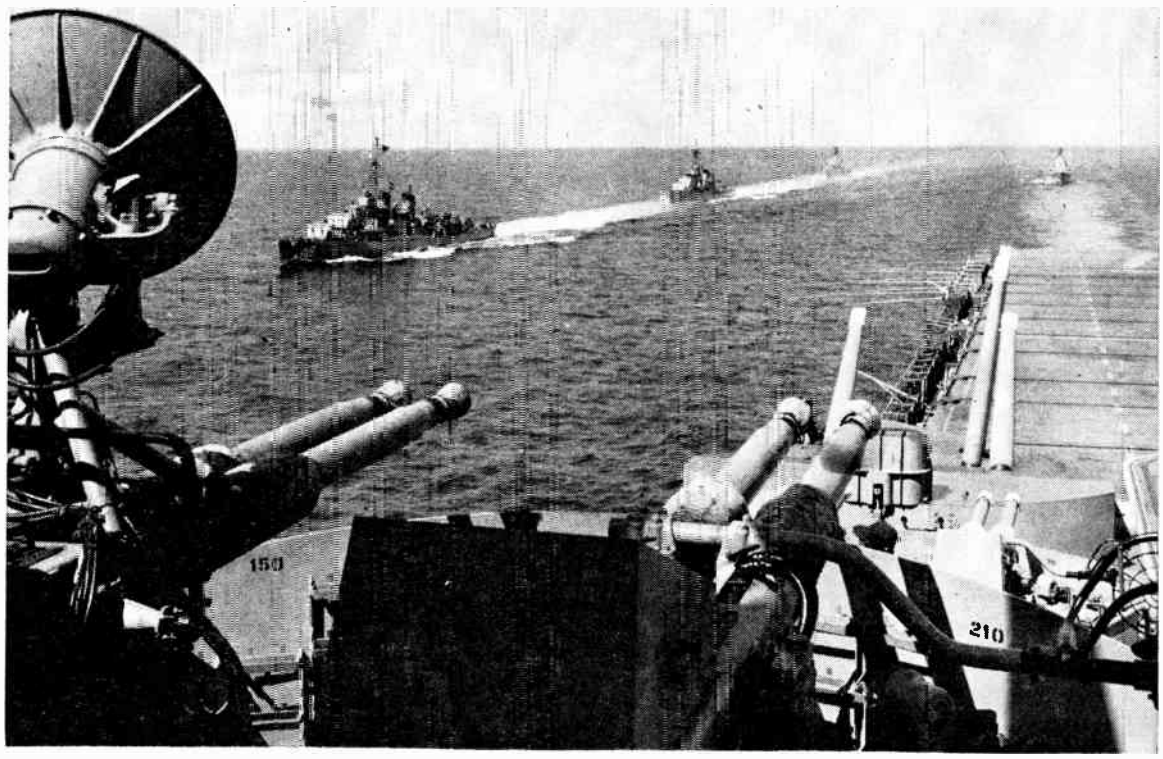
Capable of reception at speeds of 750 words a minute, new Kleinschmidt unit is world's fastest message printer and code puncher

A major breakthrough in mechanical printing! Developed in cooperation with the U.S. Army Signal Corps, this new super-speed teletypewriter is ten times faster than "standard" equipment, five times faster than normal conversation. In future commercial use it could speed operations such as the transmission of telegrams, stock market quotations, and weather reports. It has important applications in the field of integrated data processing. In recognition of its quality, Kleinschmidt equipment is manufactured for the U.S. Army under the Reduced Inspection Quality Assurance Plan.

KLEINSCHMIDT

DIVISION OF SMITH-CORONA MARCHANT INC., DEERFIELD, ILLINOIS

Pioneer in teleprinted communications systems and equipment since 1911



Hunter-killer group of prowling destroyers and antisub warfare carrier, ready to dispatch fixed-wing planes or helicopters

How We're Fighting Sub Threat

Patrol planes can now smell hiding subs. More than half of Navy's fighting force is getting new gear to find and combat underwater craft

THE U. S. NAVY is preparing against the growing enemy submarine menace with new sensing devices that can smell out subs from the air, see in the dark and hear at great distances, ELECTRONICS learns.

More than half of Navy's fighting force is being equipped to detect and combat enemy underwater craft, in addition to their primary missions. More hunter-killer groups are being formed to operate from the surface, underwater, and from the air. The fleet of antisubmarine warfare planes now numbers 720.

The Soviet Union now has about 450 fast submarines in operation, according to Navy estimates. Missiles like our Polaris, launched from any spot near our 6,000 miles of coast lines, could demolish vital areas in the U. S.

The electronics industry is being called on to come up with new devices to implement every phase of the hunt-and-kill operation:

1. Longer range and more accurate devices for detecting and pinpointing enemy subs—it will not be U. S. policy to haphazardly pollute the seas with nuclear weapons.

2. Automatic systems that will compute the sub's location from data received and display it to the striking element.

3. Better guidance systems for torpedos carrying conventional, "clean" warheads.

Types of Devices

One sensing device, called ASH (ELECTRONICS, p 11, June 19), will smell out diesel-powered subs by reacting to air polluted by the diesel's exhaust.

Another sensor, known as JEZEBEL, is new sonobuoy with extra long-range sonar equipment. It is dropped from an aircraft.

Other detectors include electronic countermeasures, microwave receivers, radar, low-light-level tv, (ELECTRONICS, p 20, June 26), infrared scanners and magnetic detectors.

A comprehensive electronic system to digest any detection information obtained—either in or outside of a patrol plane—and present it visually to the pilot, has been developed by Loral Electronics.

A fully-transistorized plotter (photo, facing page) on the pilot's instrument panel will display the moving position of the plane, indicated by a lighted arrow, and that of the sub, shown by a lighted circle. The pilot can head his P5M patrol plane for the target, correcting en route by watching the lighted arrow, and drop mines or magnetically- or acoustically-guided torpedos at the right moment.

The sub's position is obtained by data from the plane's available sensors, evaluated by the crew's tactical director, and fed into the plotter.

The aircraft's position is fed in automatically by the navigation system. Three point-of-reference modes are available for the center of the plotter: the sub, the plane, or a remote ship.

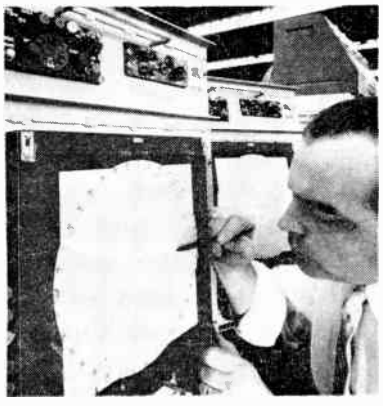
The plotter was developed by Loral with company funds and produced under a $6-million contract.

Integrated Display

The firm is also producing an Airborne Integrated Display System that coordinates the inputs from various detection devices and computes the target position. The information is then transmitted to the pilot's plotter after evaluation by the crew's tactical director. Production contract has amounted to $10 million to date, with an additional $5 million expected.

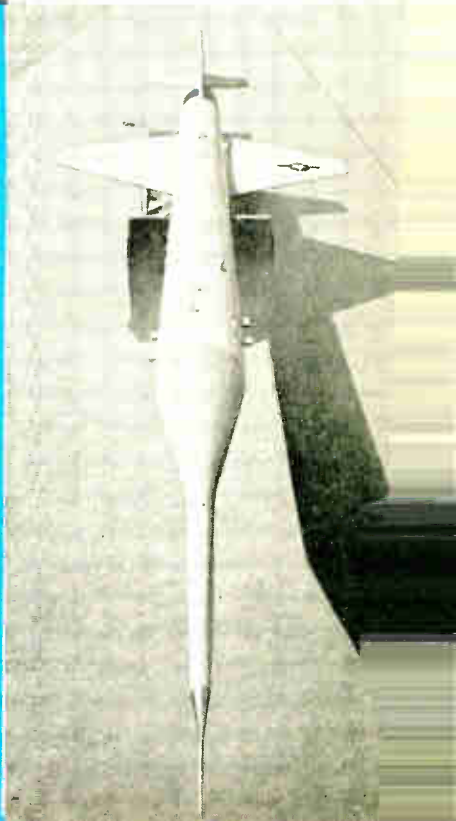
An automatic target information computer that calculates the exact position of a target from data received from sonobuoys has just received a $3-million contract from Navy.

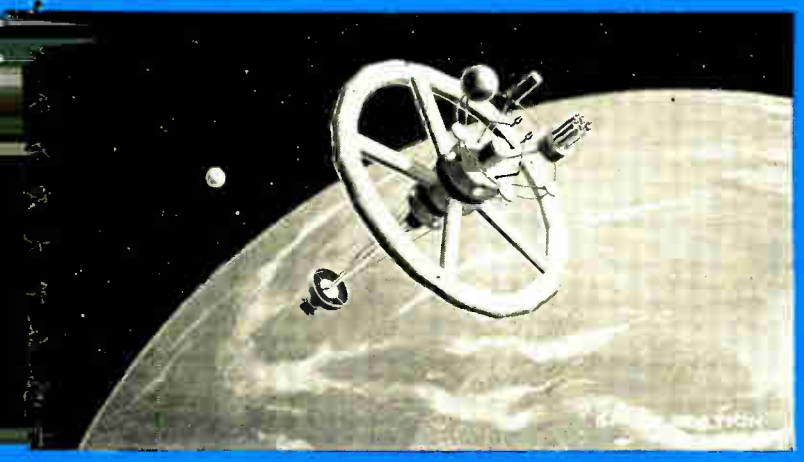
The P5M's navigation system was developed and produced by Loral under a $10-million Navy contract plus a recent additional $3 million. Designated AN/ASA-13, the system is a dead-reckoning device using an analog computer. Wind data can be obtained by dropping a radar reflector on the water and taking drift readings with the plane's radar. Some planes will use Ryan's Doppler navigators for continual position data. Plane position goes from the ASA-13 to the plotter on the pilot's instrument panel.



New ASW plotter shows position of enemy sub in relation to the hunter-killer patrol plane. Units like this one being tested will soon be operational in cockpit instrument panels of Navy planes


DISCOVERER SATELLITE





EXPANDING THE FRONTIERS OF SPACE TECHNOLOGY

■

ADVANCED PROJECTS AT LOCKHEED

POLARIS FBM—Lockheed is missile systems manager for the Navy POLARIS Fleet Ballistic Missile, under the cognizance of the Special Projects Office of the Bureau of Ordnance. Submarine-launched, the POLARIS will travel through three mediums in a single flight: water, air and outer space. With three-quarters of the earth's surface being water, practically no target in the world is outside its range. The solid-propellant POLARIS was *designed with the future in mind*—an approach that the Navy states has cut nearly two years from the original timetable.

DISCOVERER SATELLITE—Designed and built by Lockheed Missiles and Space Division, the first of a series of DISCOVERER satellite launchings was successfully placed in orbit on February 28. Later satellites in the series will carry live animals and their recovery attempted. Valuable data will be obtained on space environment and recovery techniques of major importance to the nation's space program. The DISCOVERER is an Advanced Research Projects Agency program under the direction of the Air Force Ballistic Missile Division, with Lockheed as systems manager.

X-17—The nation's first successful reentry tests were conducted by the Air Force with the three-stage, Lockheed X-17 solid-propellant ballistic missile. The X-17 has pioneered many new techniques and the valuable experience gained from this program has facilitated development of other, inter-service projects, including the Navy POLARIS FBM. The Navy's history-making, 300-mile-high, Project Argus radiation explosions featured the X-17 as the vehicle.

Q-5, KINGFISHER—Developed for the Air Force, and currently being manufactured for the Army, the Kingfisher is designed to simulate enemy attacks to test the efficiency of our various defensive weapon systems. It is equipped with extensive instrumentation to register "kills" without itself being destroyed and can be recovered by parachute and landing spike to be used again, with marked savings in cost.

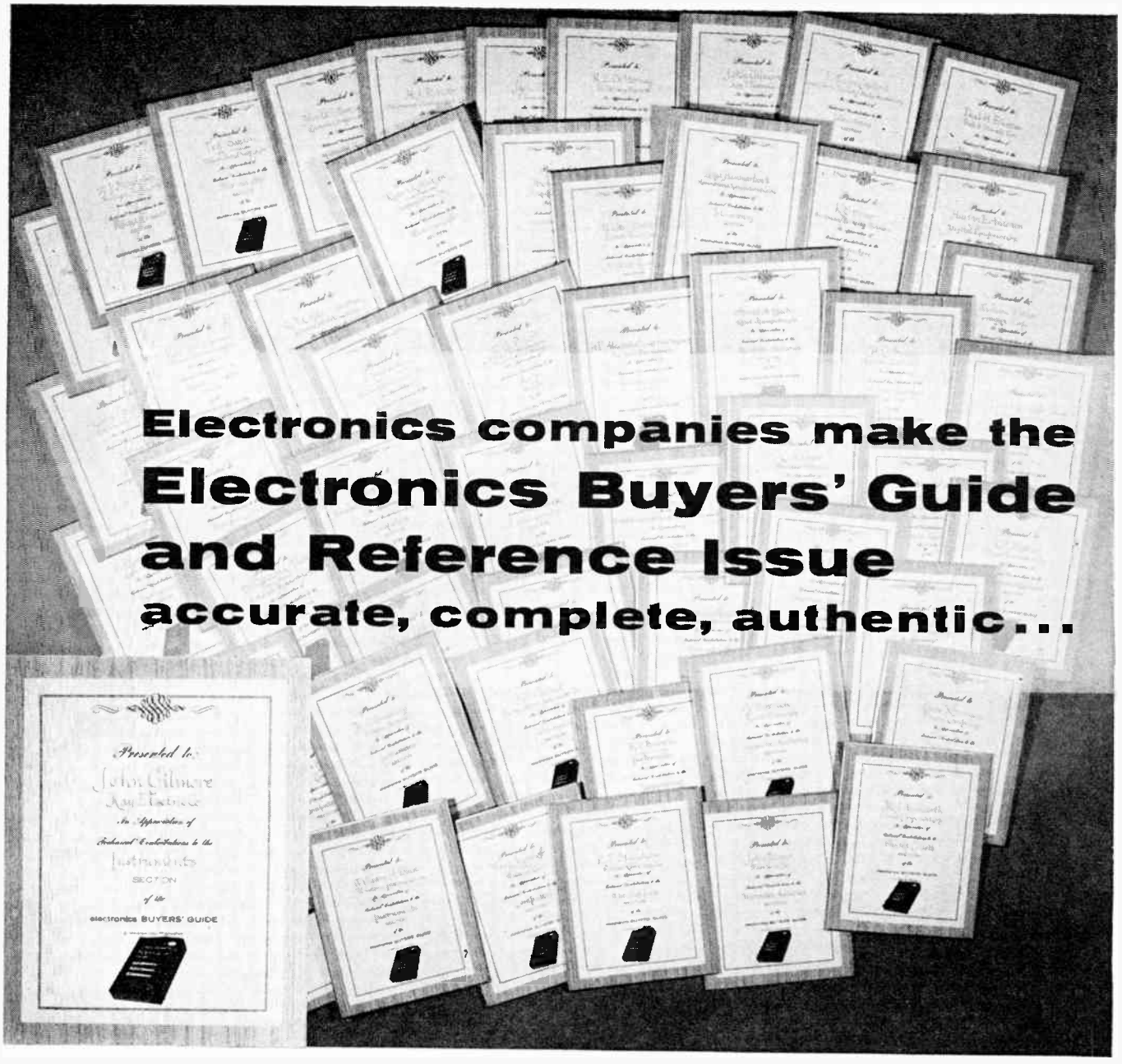
X-7—Lockheed's X-7 recoverable ramjet-engine test vehicle, developed for the Air Force, has established speed and altitude records for air-breathing vehicles and is also recoverable for re-use following flight.

SPACE STATION—An orbiting research facility, to serve as an advance base for space exploration, has been proposed in practical detail by Lockheed's research and development staff. The station would carry a 10-man crew. Prefabricated compartments for the rim of the wheel, the spokes, and the three hubs would be launched separately by means of ballistic missiles and guided into a cluster on the same orbit.

The successful completion of projects such as these requires a bold and imaginative approach to entirely new environments. Lockheed's programs reach far into the future. It is a rewarding future which scientists and engineers of outstanding talent and inquiring mind are invited to share. Write: Research and Development Staff, G-22, 962 W. El Camino Real, Sunnyvale, California. U.S. citizenship required.

Lockheed / **MISSILES AND SPACE DIVISION**

SUNNYVALE, PALO ALTO, VAN NUYS, SANTA CRUZ, SANTA MARIA, CALIFORNIA · CAPE CANAVERAL, FLORIDA · ALAMOGORDO, NEW MEXICO · HAWAII

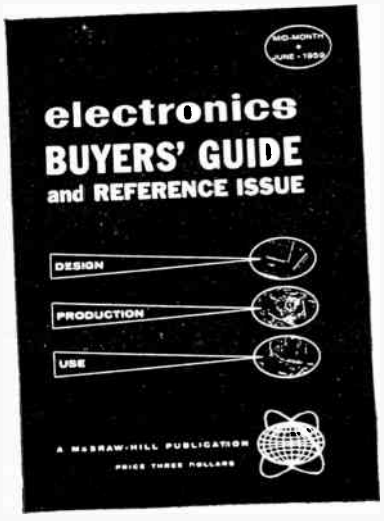


For nineteen years, firms in the electronics industry have made direct contributions to the accuracy, completeness and authenticity of the BUYERS' GUIDE.

Recently, the staff of the BUYERS' GUIDE decided to award plaques to express appreciation to those in the industry who had made direct contributions to improve the product listings. The photograph above represents a few of the awards that have been made.

The awarding of the plaques is but one indication of how the BUYERS' GUIDE evolved over the years . . . a *cooperative effort between the publication and the industry it serves.*

Only through years of experience can a buyers' guide reflect the needs of an industry as complex and dynamic as electronics . . . one more reason why the BUYERS' GUIDE is the ONE accepted product and data book in the field.



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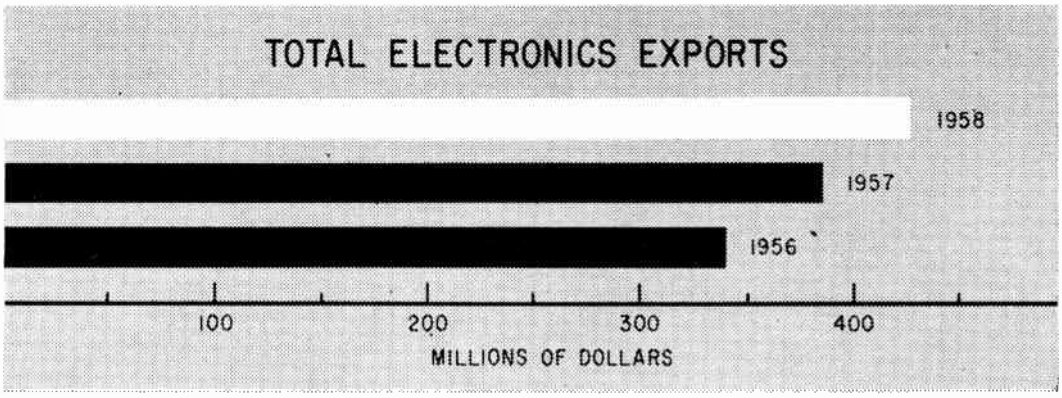


Here's how electronics exports have been growing, but . . .

Are We Missing an Export Bet?

Future export growth is linked to management paying closer attention to international standards problems. Government fails to play a role

INTERNATIONAL STANDARDS are becoming more important than ever to the future of the U. S. electronics industry's growing export trade. Last year that trade amounted to $427 million.

Meetings in Madrid this week to discuss problems in standardization of tubes and transistors underscore the importance of the 33-nation International Electrotechnical Commission in setting these standards.

Reasons for Watching

In the opinion of industry observers close to the IEC, there are three main reasons why American electronics firms should be paying close attention to the work of IEC subcommittees concerned with electronic components and equipment.

1. A meeting of heads of national committees represented in the IEC indicated last April in Paris that technical information regarding standards will be made more available to underdeveloped countries.

U. S. observers feel it is a certainty these nations will be substantially guided by the electronics standards of the IEC. Since these countries represent a burgeoning market for all kinds of electronic equipment, they feel the U. S. electronics industry must be strongly represented in standards deliberations to avoid being out of step and losing trade.

2. The six nations of the European Common Market said they will stick as closely as possible to IEC standards. (ELECTRONICS, p 11 June 12).

3. The North Atlantic Treaty Organization tends to pick up IEC standards when specifying military electronic equipment. Observers think the trend will become more pronounced.

For more than 50 years the IEC has coordinated and unified national electrical and electronics standards by drawing up recommendations upon which the standards bodies of the member nations might base their own standards.

The U. S. is represented by the U. S. National Committee, which is identified as part of the electrical standards board of the American Standards Association.

Supported By Industry

Richard C. Sogge of General Electric, president of the U. S. National Committee, says American participation in IEC meetings is entirely supported by private industry. Other national groups participate wholly or partially with government funds.

This means, he told ELECTRONICS, that in international deliberations over electronics standards the responsibility for U. S. "statesmanship" lies entirely with top management in our industry.

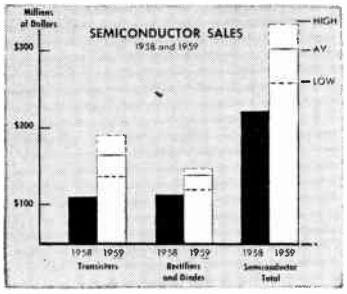
To help bring a maximum of industry "statesmanship" to bear on international standards problems, Sogge appointed a small advisory group of industry associations and engineering organizations to recommend industry action. In this group, Harvey Williams, president of Philco International Corp., and Admiral (Ret.) Frederick R. Furth of ITT represent Electronic Industries Association.

Sogge and others associated with the IEC would also like to see more participation in international standards meetings by government agencies that buy millions of dollars worth of electronic gear, and by the National Bureau of Standards.

Current Madrid discussions of "electronic tubes and valves and analogous semiconductor devices" are being attended by three representatives for U. S. electronics firms, one from EIA. Seven industry men are attending other discussions on "semiconductor devices"; in addition, the chairman of this group is Virgil Graham of EIA.

Tube discussions center mainly around standardizing electrical measurement methods of such factors as interface impedance and vibration. Also of concern to the group are mechanical standards of bases and bulbs.

Semiconductor sessions are discussing nomenclature and definitions, letter symbols, a list of temperatures for essential characteristics and maximum ratings, and other factors.



Paul Petrack takes the stand for electronics

ITT (International Telephone & Telegraph Corp.), Components Division, Clifton, New Jersey is a leading electronics manufacturer of electron tubes, fixed capacitors, silicon power diodes, selenium rectifiers, hermetic seals, miniature switches, and other component parts.

Former Chief Engineer, and present Product Manager for silicon products, Paul Petrack is a market expert for electronics components. His functions require him to determine what products will be in greatest demand (according to the industry's latest technical developments) and what products will be the most profitable to market.

According to the subscription records, electronics is sent to your home. Why?

Because I have more time to read it and more time to digest it.

Does electronics help you create new business for ITT?

Yes, by keeping me aware of new developments in industry, the state of the art, and market potentials for existing products, we are better able to direct our efforts toward meeting our product goals.

What "product image" has electronics conveyed to you over the years?...or, How would you define electronics' position in the electronics industry?

I consider electronics *required reading...it is clear, concise and complete.*

If it's about electronics, it's advertised and read in electronics

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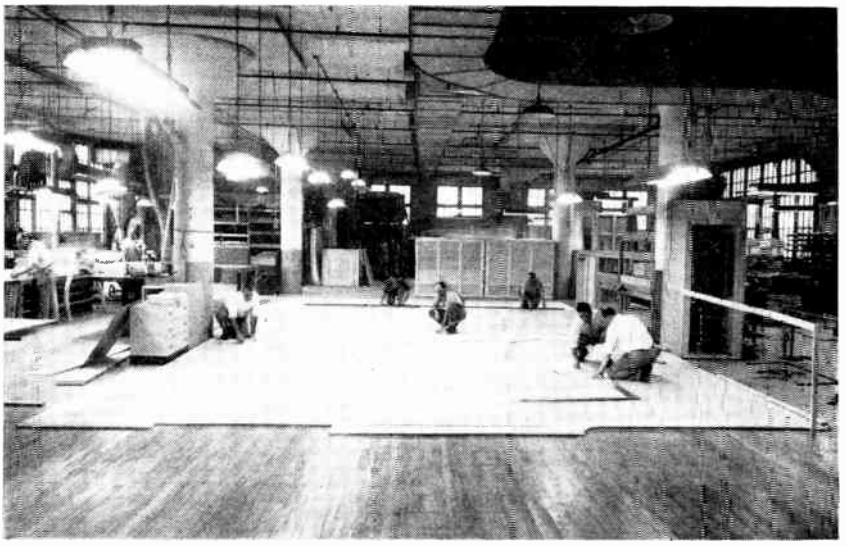
Trade Show Displays Go



More electronics firms are designing their trade show exhibits in modular form (above)—and then setting up as big a display as show requires

TRADE SHOW BUDGETS are growing at a rapid rate in the electronics industry. Latest count on the number of trade shows now held in the U. S. indicates a total close to 5,000—as compared with about 3,000 three years ago.

The display manager of one major electronics manufacturer points out that his firm now exhibits at shows that would have been considered "unlikely areas" not too long ago. The reason given for the change is that electronics has become increasingly important to more people.

Expanding Aims

At one time, the main aim of the electronics exhibitor was to sell within the industry itself. The present aim has expanded to cover other industries and audiences, sometimes even home consumers.

Another changing pattern is in the design of the display.

A typical display in the past often consisted of some sort of panel showing the various products the exhibitor produced. Today's exhibit is usually more elaborate and can often be walked into as well as looked at. It often stresses other aspects of the company operation, not just product line.

With the increased number of trade shows and the change in form of exhibits, display designers are now called upon to create exhibits in modular form.

The modern exhibit is usually made up in cells that can tell all or parts of the company story to fit a given occasion. Also, the modular exhibit can be used as a whole or in portions in accordance with floor space a firm gets at a given trade show.

Although the initial cost of such a display runs high, exhibitors say the adaptability factor saves money in the long run.

Business Leaps 100%

This increased activity has reflected favorably for exhibit display manufacturers. Structural Display Co., Inc., which built over a dozen displays at this year's IRE show, says its business has increased about 100 percent in the past five years, with a good measure of the increase attributable to electronics firms.

Talks with electronics manufacturers indicate that a tighter set of objectives govern the form of a display these days. To fit the pattern of a particular show, an important product item may be put in the

Modular

background to allow some facet, such as community relations, to be stressed.

Mexican Companies Enter U.S. Market

MEXICO CITY—THREE electronics companies in Mexico City are entering the U. S. market with radio sets, vhf high gain antennas and microwave components.

Lenkurt de Mexico, Electro Labs, S. A. and Radio Impulsora Mexicana, S. A. expect Mexico's low labor costs will make profitable export of some products to the U. S.

Radio Impulsora Mexicana has been producing the low cost Comet radio primarily for Mexican consumers, now is exporting it to the U. S. The five-tube set has good tonal quality and receives Dallas stations with clarity in Mexico City. It sells for $10 in the U. S.

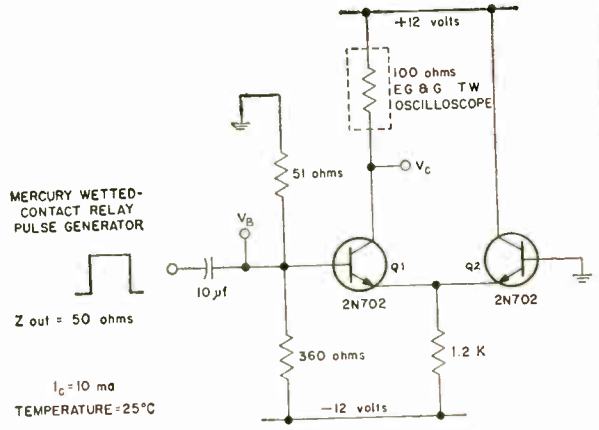
The company is producing 10,000 sets a month and reducing the number of imported parts by expanding its own manufacturing facilities. Some 70 percent of the components are now made in Mexico City.

Making Antenna

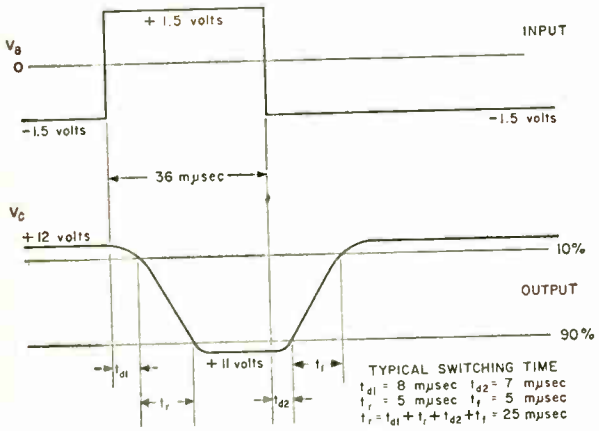
Electro-Labs, Mexican distributor of Motorola equipment, is now manufacturing for export a directional vhf high gain antenna for 150-170 mc operation. Gear costs $250. The company expects to produce other communications equipment soon and to export transmitters, receivers and other antennas and related gear.

Lenkurt Electric, which has been making communications equipment in Mexico since 1956, has just set up an export division of Lenkurt de Mexico. The Mexican subsidiary of Lenkurt plans to ship transformers and microwave components to the U. S. at a rate of 11,000 units a month. An initial shipment of transformers for telephone use has already been made.

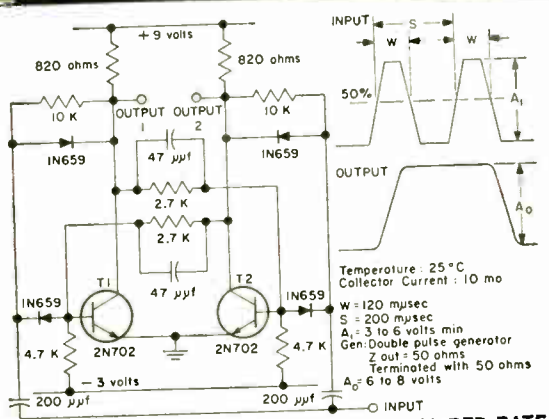
Lenkurt de Mexico hopes to supply communications equipment to a growing export market, starting with countries in Central America for whom surveys have recently been completed.



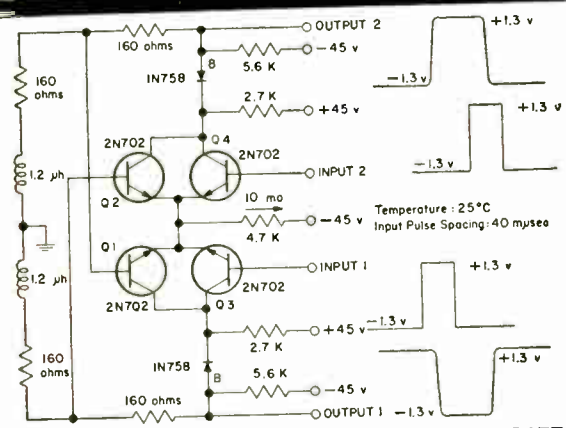
TYPICAL NON-SATURATED LOGIC SWITCHING CIRCUIT



TOTAL SWITCHING TIME NON-SATURATED CIRCUIT



TYPICAL CIRCUITRY FOR OBTAINING 5-MC REP RATE IN SATURATED FLIP-FLOP



TYPICAL CIRCUITRY FOR OBTAINING 25-MC REP RATE IN NON-SATURATED FLIP-FLOP

NEW SILICON

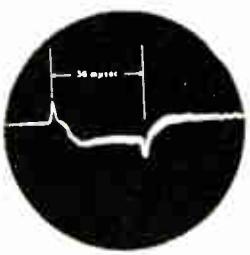
TO-18 PACKAGED DIFFUSED-BASE 'MESA' TRANSISTORS

Now available for your evaluation, the subminiature 2N702 is built specifically for your 5-20 ma transistor logic switching applications.

This newest addition to TI's line of diffused-base 'mesa' transistors features . . .

- **Guaranteed dc beta of 15 to 45**
- **50 mc minimum unity beta frequency (f_t)**
- **Maximum 12 μμf output capacitance**
- **Subminiature TO-18 package**

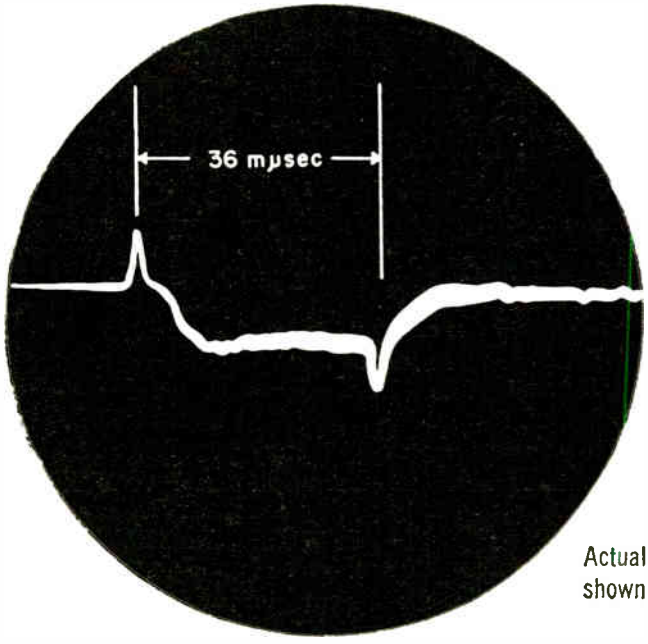
As do all other TI semiconductors, the 2N702 carries a *full-year guarantee* to published specifications. Check the specs at right and contact your nearest authorized TI distributor or your TI sales office for detailed information.



TEXAS

FROM THE WORLD'S LARGEST SEMICONDUCTOR PLANT

25 mμsec SWITCHERS FROM TI



Actual photo of collector wave form as shown on traveling-wave oscilloscope

absolute maximum ratings (25°C)

Collector Voltage Referred to Base	20 v
Collector Voltage Referred to Emitter	15 v
Emitter Voltage Referred to Base	5 v
Collector Current	50 ma
Dissipation (100°C Free Air, Derate 0.5°C/mw)	150 mw

design characteristics at 25°C (except as indicated)

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Un
I_{CBO}	Collector Cutoff Current	$V_{CB} = 10$ v, $I_E = 0$			0.5	μ
I_{CBO}	@ 150°C	$V_{CB} = 10$ v, $I_E = 0$			50	μ
BV_{CBO}	Breakdown Voltage	$I_{CBO} = 10$ μa, $I_E = 0$	20			v
BV_{CEO}	Breakdown Voltage	$I_{CEO} = 10$ μa, $I_B = 0$	15			v
h_{FE}*	DC Beta	$V_{CE} = 5$ v, $I_C = 10$ ma	15		45	
BV_{EBO}	Breakdown Voltage	$I_E = 10$ μa, $I_C = 0$	5			v
V_{BE}*	Input Voltage	$V_{CE} = 5$ v, $I_C = 10$ ma	0.7		1.2	v
C_{ob}	Output Capacitance	$V_{CB} = 5$ v, $I_E = 0$ f = 1 mc		7	12	μ
f_t	Frequency at which h_{fe} is unity	$V_{CE} = 5$ v, $I_E = 10$ ma	50	100		n
V_{CE}* (Sat)	Saturation Voltage	$I_C = 10$ ma, $I_B = 2$ ma			0.6	v

* Tested using pulse measurement.

NOTE: These units meet JEDEC outline TO-18 dimensions. A drawing of this package is attache

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Write on your company letterhea
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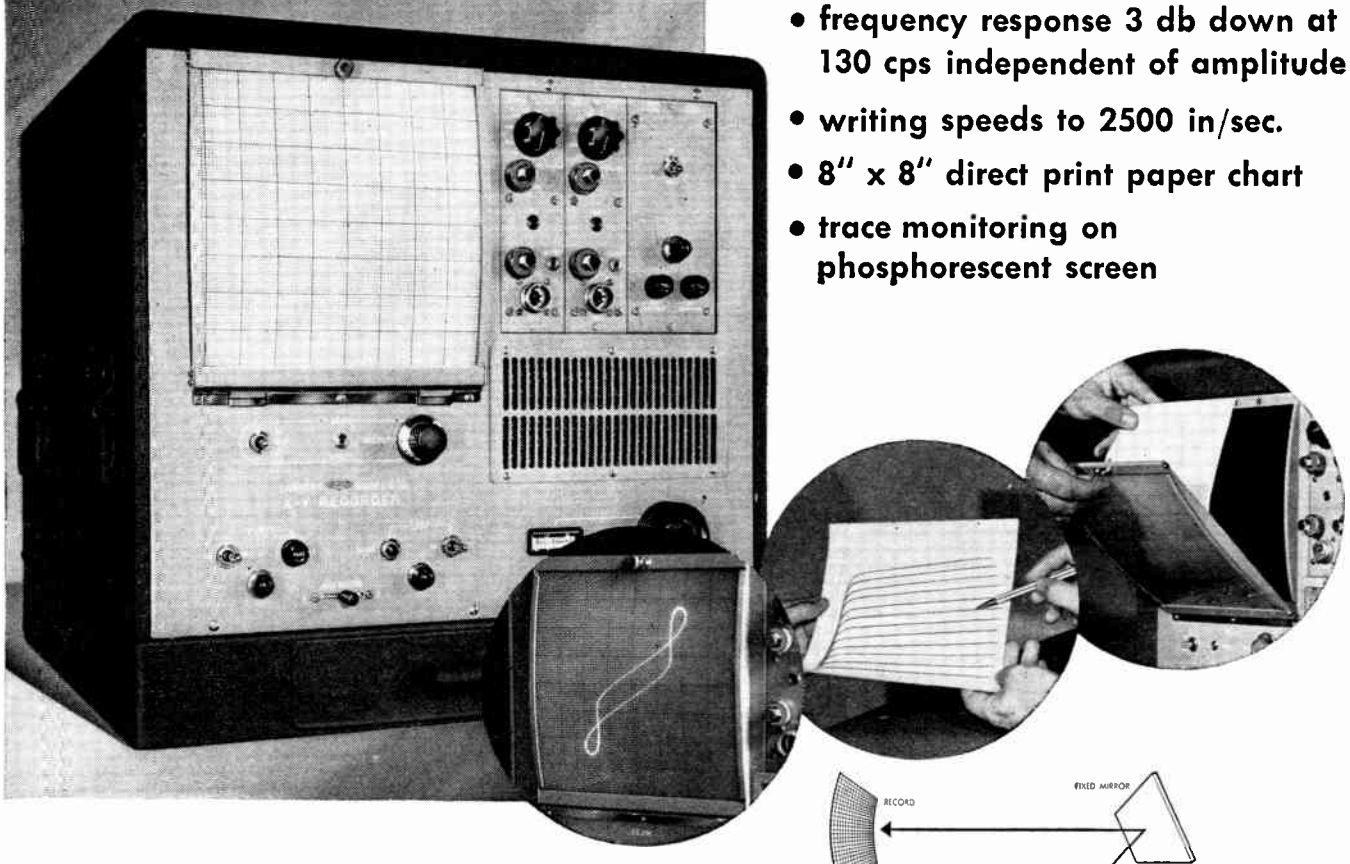
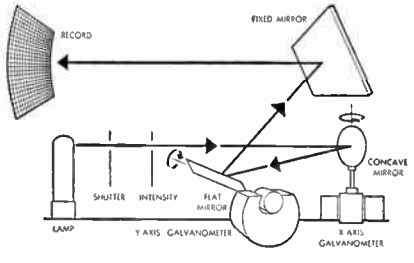
CIRCLE NO. 31 READER SERVICE CARD

100 CPS X-Y RECORDING with immediate readout



THE NEW SANBORN MODEL 670 OPTICAL X-Y RECORDER HAS

- 1% linearity
- frequency response 3 db down at 130 cps independent of amplitude
- writing speeds to 2500 in/sec.
- 8" x 8" direct print paper chart
- trace monitoring on phosphorescent screen



X-Y RECORDING never before possible with electromechanical instruments can now be done with the new Sanborn Model 670 X-Y Recorder. Direct writing on ultraviolet-sensitive recording paper by a beam deflected by optical galvanometers makes possible the combination of fast writing speed and 130 cps frequency response not found in any other X-Y recorder. Transistor characteristics, acceleration and vibration of mechanical parts and events of similar short duration can be recorded with linearity of *1% of full-scale* and at trace speeds as fast as *2500 inches per second*. Square wave response exhibits no greater than ½% overshoot *at any amplitude;* sensitivities as high as 62.5 uv/inch (depending on preamplifier used).

PLOTS OCCUPY AN 8" x 8" RECORDING AREA and can be previewed or monitored on the instrument's phosphorescent screen. An Axis Record switch to print X and Y axes on the record, and a Beam Intensity Control to assure maximum trace clarity, are among the front panel controls provided. An 8" x 8" sheet of the ultraviolet-sensitive chart paper (stored in drawer at base of cabinet) is easily placed on the back of the hinged screen. Brief post exposure in normal room light is the only developing process.

OPTIONAL INTERCHANGEABLE PREAMPLIFIERS for each axis presently include the Model 850-1300B DC Coupling and Model 850-1200 Phase Sensitive Demodulator; a Carrier Preamplifier, High Gain Preamplifier and a time base generator are now in development. Driver Amplifiers are compact, fully transistorized plug-in units with single-ended input and output. Galvanometers are low resistance, low voltage units of rugged, enclosed construction; sensitivity and damping are independent of coil temperature. Accessible, unitized circuitry also extends to the power supplies—a front-panel plug-in for both preamplifiers and a second supply for both driver amplifiers. A built-in blower provides constant, forced filtered air cooling. The Recorder can be rack mounted in 15¾" of panel space, or housed in its own 20" x 20" x 21¼" optional portable cabinet.

Ask your local Sanborn Sales-Engineering Representative for complete information on the Model 670 X-Y Recorder, or write the Industrial Division in Waltham, Mass.

SANBORN COMPANY

INDUSTRIAL DIVISION

175 WYMAN STREET, WALTHAM 54, MASS.

Medaris: 'Not Just Price'

General lists most important factors that win contracts from Army Ordnance Missile Command

DETROIT—The U. S. Army Ordnance Missile Command is not "necessarily looking for the cheapest price alone" in its awarding of contracts, said Major General J. B. Medaris at the second annual Industry Missile and Space Conference here.

"I must emphasize again that foremost consideration is given to the technical ability and capability of the contractor to perform," Medaris said. "Only after this ability has been established to our satisfaction do we consider cost."

Regarding contractor selection, Medaris noted, "our selections must be founded on a cold-blooded and objective appraisal of requirements to be met, the realities of time and money requirements, the contractor's capability and reputation for effective results."

Where Budget Goes

Medaris said "our budget will total approximately two billion dollars in the current fiscal year and will approach that level in the next fiscal year. About 80 percent of the total budget is invested in Army missile systems. About nine percent represents assignments for space work from the Advanced Research Projects Agency. About 1½ percent comes from NASA for space missions."

The Army's top missileman pointed out that by far the largest portion of the funds available to his service is spent in industry. Only a small fraction is retained for Army management and "in-house" development.

"About one quarter of one percent supports my headquarters. Five percent is spent for systems management, including testing and range management. Another five percent is spent in research, engineering, fabrication and technical effort within government agencies, including our own. Eighty-nine and three-quarters percent goes to industrial contractors, or other organizations outside the government," Medaris said.

ABMA alone currently has 492 active contracts with private industry, and 304 contracts in force with other government installations. Since its activation in 1956, the agency has placed approximately 50 contracts for research and experimental effort with more than 30 educational institutions.

These contracts total about $20 million.

Rugged Counter Checks Atomic Cannon

Ruggedized decade counter (circled) built by Burroughs Corp. successfully withstands enormous muzzle blast from Army's 280-mm atomic cannon. Counter is part of muzzle-velocity chronograph which monitors cannon's behavior. Shielded beam switching tube housed inside heavy ring magnet is heart of the unit. Counter resolves pulses up to 110 kc, provides 10 outputs to operate indicator tubes, printed devices or scalers. Instrument was built for Frankford Arsenal

MEETINGS AHEAD

July 30-31: Computers & Data Processing, Denver Research Inst., Stanley Hotel, Estes Park, Colo.

Aug. 17: Ultrasonics, National Symposium, PGUE of IRE, Stanford Univ., Palo Alto, Calif.

Aug. 18-21: Western Electronics Show and Convention, WESCON, Cow Palace, San Francisco.

Aug. 23-Sept. 5: British National Radio & Tv Exhibition, British Radio Industry Council, Earls Court, London.

Aug. 31-Sept. 1: Elemental and Compound Semiconductors, Tech. Conf., AIME, Statler Hotel, Boston.

Sept. 14-16: Quantum Electronics, Resonance Phenomenon, Office of Naval Research, Shawanga Lodge, Bloomingburg, N. Y.

Sept. 15-17: Electronic Exposition, Twin Cities Electronic Wholesalers Assoc., Municipal Auditorium, Minneapolis.

Sept. 17-18: Nuclear Radiation Effects in Semiconductors, Working Group on Semiconductor Devices, USASRDL, Western Union Auditorium, N. Y. C.

Sept. 21-25: Instrument-Automation Conf. & Exhibit, ISA, International Amphitheater, Chicago.

Sept. 23-25: Non-Linear Magnetics and Magnetic Amplifiers, AIEE, ISA, PGIE of IRE, Shoreham Hotel, Wash., D. C.

Sept. 23-25: Residual Gases in Electron Tubes and Related High-Vacuum Systems, International Symposium, Italian Society of Physics, Como, Italy.

Sept. 28-30: Telemetering, National Symposium, PGTRC of IRE, Civic Auditorium & Whitcomb Hotel, San Francisco.

Sept. 30-Oct. 1: Industrial Electronics Symposium, AIEE, PGIE of IRE, Mellon Inst., Pittsburgh, Pa.

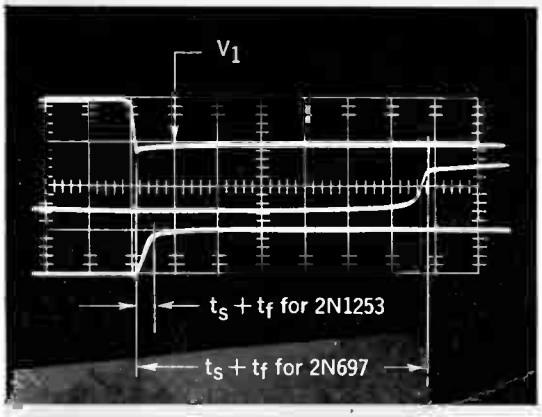
Oct. 5-7: Communications Symposium, National Conf., PGCS of IRE, Hotel Utica, Utica, N. Y.

Oct. 12-15: National Electronics Conference, IRE, AIEE, EIA, SMPTE, Sherman Hotel, Chicago.

Mar. 21-24, 1960: Institute of Radio Engineers, National Convention, Coliseum & Waldorf-Astoria Hotel, N. Y. C.

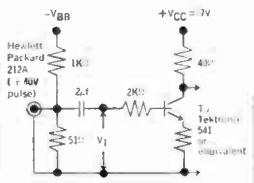
There's more news in ON the MARKET, PLANTS and PEOPLE and other departments beginning on p 72.

New from Fairchild
LOW STORAGE SILICON TRANSISTORS



Comparison of storage-and-fall-time performance between the new Fairchild 2N1253 and Fairchild's 2N697. The 2N1253 has performance otherwise equivalent to the 2N697 plus the additional advantage of low storage. An actual Polaroid photo is shown. Scale is 0.2μsec. per oscilloscope division. Scope was a Tektronix 543 with 53/54S plug-in giving a rise time of 15mμsec.

CIRCUIT USED IN COMPARING 2N697 AND 2N1253



NOTE.
V_{BB} is adjusted to make V_1 = 30V during turn on and V_1 = -10V during turn off.

TENTATIVE SPECIFICATIONS, 2N1252 AND 2N1253

ABSOLUTE MAXIMUM RATINGS (25° C)

V_{CER}	–	Collector to Emitter Voltage ($R \leq 10\,\Omega$)	20 v
V_{CBO}	–	Collector to Base Voltage	30 v
V_{EBO}	–	Emitter to Base Voltage	5 v
Total Dissipation	at Case Temperature 25° C		2 watts
	at Case Temperature 100° C		1 watt
	at 25° C Free-Air Ambient		0.6 watts

ELECTRICAL CHARACTERISTICS (25°C)

SYMBOL	CHARACTERISTIC	MIN.	TYPICAL	MAX.	TEST CONDITIONS
h_{FE}	D.C. pulse current gain 2N1252	15		45	I_C=150mA V_C=10V
	2N1253	30		90	
V_{BE} SAT.	Base saturation voltage		1.0V	1.3	I_C=150mA I_B=15mA
V_{CE} SAT.	Collector saturation voltage		0.8V	1.5V	I_C=150mA I_B=15mA
h_{fe}	Small signal current gain at f=20mc	2.5	5.0		I_C= 50mA V_C=10V
C_{ob}	Collector capacitance		30μμf	45μμf	I_E= 0mA V_C=10V
I_{CBO}	Collector cutoff current		0.1μA	10μA	V_C= 20V T = 25° C
			100μA	600μA	V_C= 20V T =150° C
$t_s + t_f$	Turn-off time		75mμs	150mμs	I_C=150mA I_{B1}=15mA I_{B2}= 5mA R_L=40Ω, 10ms pulse

Fairchild's 2N1252 and 2N1253 provide the guaranteed shorter total switching time necessary for direct-coupled transistor logic circuits (DCTL) *in combination with the inherent reliability and power dissipation that silicon mesa construction affords.*

75 mμseconds is typical storage-plus-fall time at 150 ma collector current on these new devices; 150 mμs. is guaranteed. For low level operation, typical storage time is 35 mμs. for $I_C = I_{B1} = I_{B2} = 10$ ma. This performance makes them usable for saturating type logic circuits and high-current-level saturating switching circuits. A few of the many applications are magnetic core drivers, drum and tape write drivers, high-current pulse generators and clock amplifiers. They also provide extra safety factor in less critical applications.

To achieve high reliability, these transistors are preaged at 300° C, a temperature that would destroy most other types. This preaging time at 300° C accomplishes a stabilization of characteristics equivalent to thousands of hours of operation at junction temperatures as high as 175° C.

For full information, write Dept. A-7.

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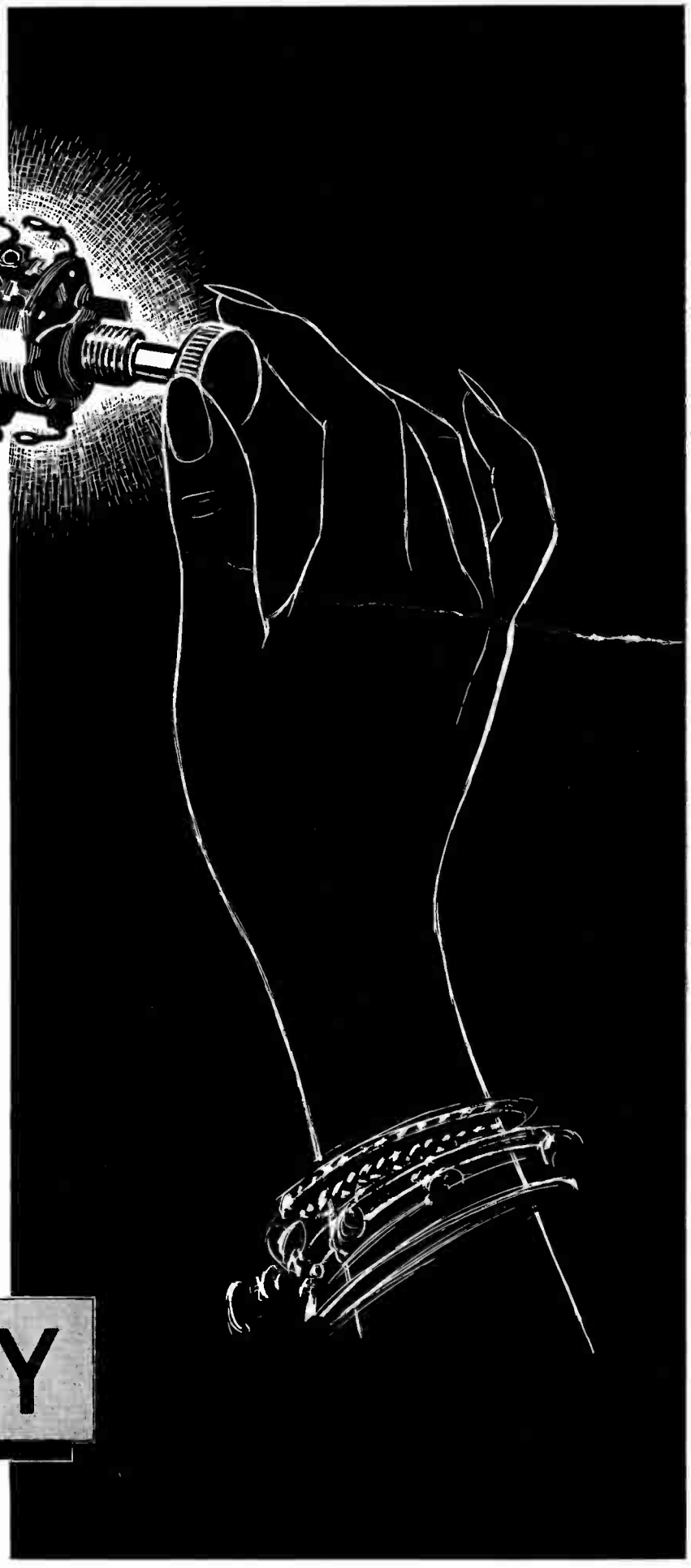


New Precision in Stereo Control

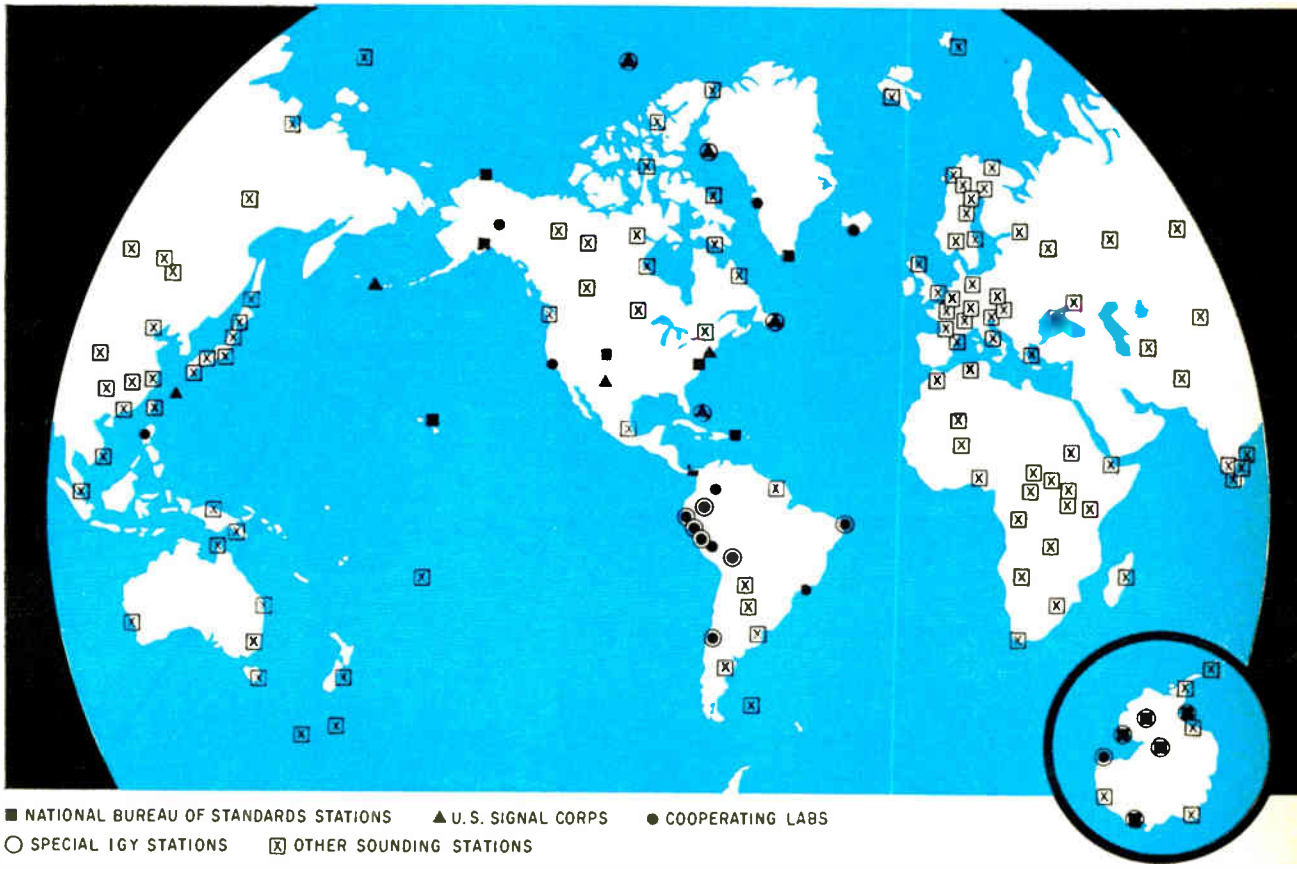
We have developed a new approach to a one-knob control for dual stereo amplifiers. It gives far greater precision of match and track than you may have thought possible. On typical systems we have developed control packages based on a db or voltage conception which deliver matching and tracking coinciding in volts throughout the useable range of the control.

This is equivalent to approximately 5% resistance match and track. In contrast, "standard" 20% tolerance controls when ganged may be 40% out of track between match points, while the matching and tracking of the Mallory units is tailored to the individual requirements.

We welcome the opportunity to discuss this new idea . . . to engineer a control package for your system . . . to develop new match and track specifications with you.

P.R. MALLORY & CO. Inc.
MALLORY

P. R. Mallory & Co. Inc.
Frankfort, Indiana



Network of over 100 stations measured ionosphere characteristics during the International Geophysical Year

What we learned from the IGY

Communications of the Future

By **FRANK LEARY**, Associate Editor

"The results of the IGY—both the great body of data and the remarkable discoveries—are themselves a prologue, for they raise new and provocative questions in the very act of answering old questions . . ."
Hugh Odishaw
National Academy of Sciences

TWO YEARS ago, 30,000 scientists and technicians, aided by about the same number of volunteer workers, embarked on what has been called the greatest international cooperation in modern history.

These researchers, representing 66 nations, began on July 1, 1957, to make a series of simultaneous scientific probings into the earth and its environment. The investigation, called the International

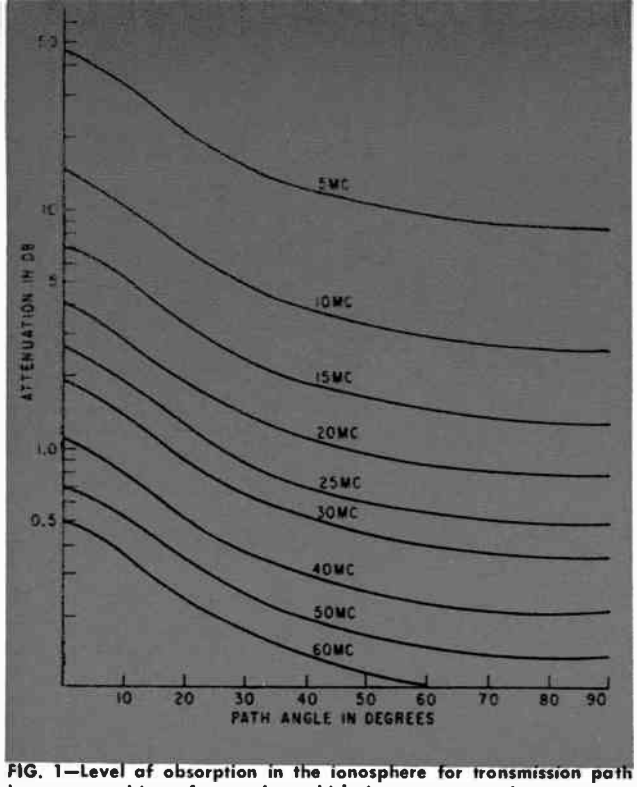


FIG. 1—Level of absorption in the ionosphere for transmission path between earth's surface and a vehicle in space, assuming sun overhead, no sunspots

Geophysical Year, ended with the end of 1958.

Some researches are being continued into 1959 as an international cooperation, and a world survey of magnetic effects is scheduled for the period of relative solar inactivity in 1963.

OBJECTIVE—The primary objective of the IGY was to gather data in three general scientific areas, covering eleven fields. One area, consisting of the three fields of seismology, gravity and longitude-latitude determination, concerned the earth itself. Another area included meteorology, oceanography and glaciology, and covered the processes governing the earth's heat and water budget, weather, climate, and events in the lower atmosphere and at the earth's surface.

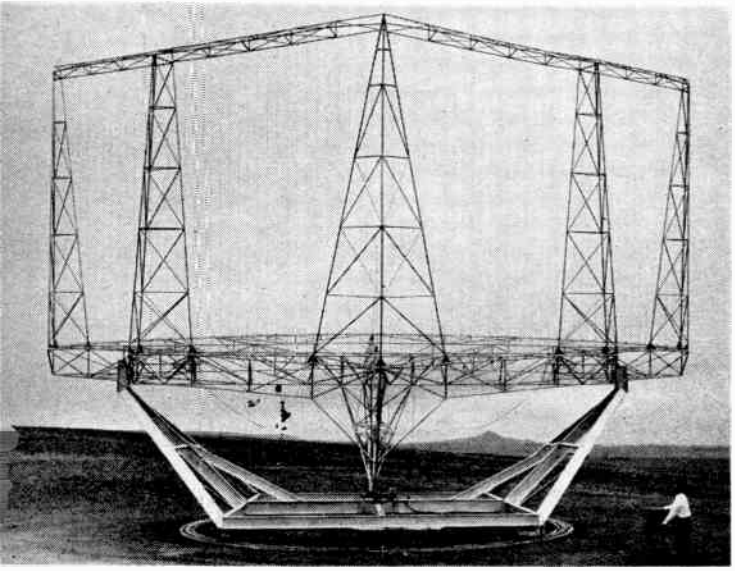
The remaining five fields—solar activity, aurora-airglow, cosmic rays, geomagnetism and the ionosphere—were concerned with the earth's outer environment: the upper atmosphere, the sun and stars, space itself.

Three World Data Centers were set up to receive the tons of data taken during the 18-month period. In these centers now reposes the material for a world-wide picture of the movement of air masses, the behavior of weather, the earth's magnetic field, the ionosphere.

Information arising from the research into the outer environment of the earth is of great specific value to the communications technology, including not only message traffic but also radar, guidance, navigation, telemetry and other data transmission.

In the space age, the field of communications faces a new problem: what is good for earth traffic is sometimes exactly wrong for earth-to-space traffic. Conditions that cause absorption or refraction sometimes help earthbound communications, but may seriously hinder communications between the earth and satellites or free-travelling space vehicles.

ATMOSPHERE EFFECTS—The atmosphere absorbs and reradiates r-f energy to a greater or smaller degree, causing the wavefront either to lose



Steerable reflector at University of Colorado is one of two making up radio interferometer for galactic noise measurements

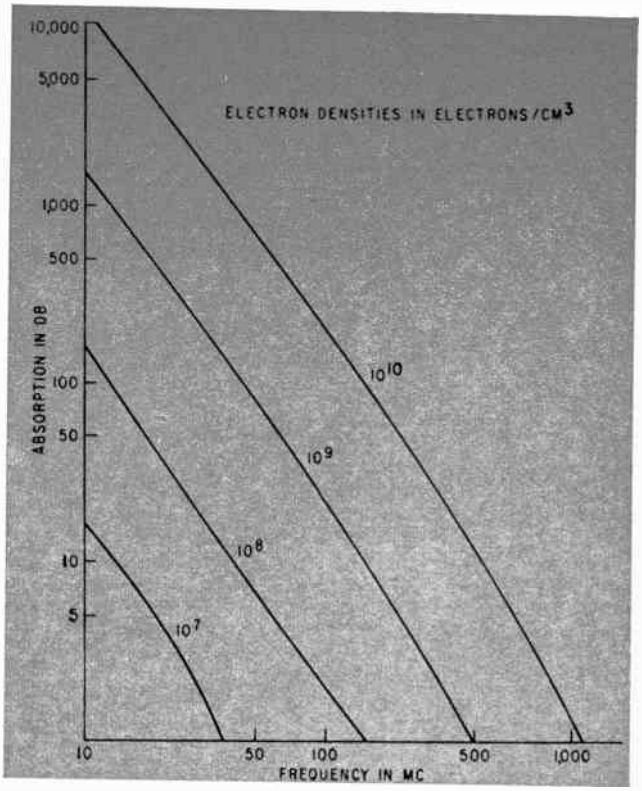
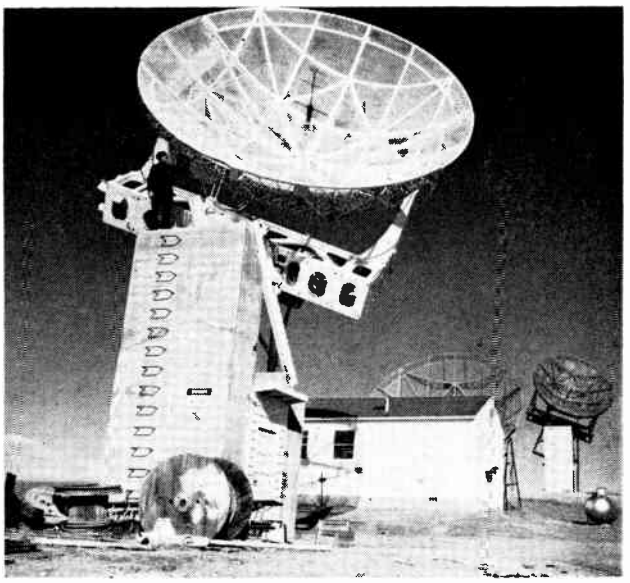
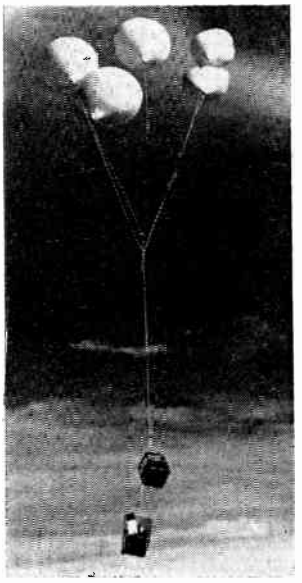


FIG. 2—Theoretical absorption of r-f energy in auroro as a function of frequency



Solar radiometer at Gunbarrel Hill, Colo., monitors radio noise from sun for National Bureau of Standards. Reflector is a 25-ft dish



Balloon-borne instruments were widely used by U. S. Navy in meteorological researches and in ionosphere and cosmic-ray experiments

energy or coherence, or to be refracted. This phenomenon is useful in surface communications (as, for example, in tropospheric ducting), but can cause trouble in extraterrestrial communications.

Refraction disturbs any technique that relies on Doppler principles or phase comparisons, and makes radioastronomy measurements difficult in low- and high-frequency bands. Waves in the vhf band and above are free of absorption and scattering effects above the troposphere (tropospheric ducting is relatively independent of frequency).

Atmospheric noise may place serious limitations on extraterrestrial communications from low-altitude stations. The highest noise levels are found over land in tropical regions, with levels falling off rapidly above 50 deg of latitude.

A receiver located in a space vehicle or satellite would experience less noise interference than a ground receiver, since the ionosphere tends to shield atmospheric noise. The shielding is not complete, however, and the value of the shield falls off rapidly as the noise frequency rises above the penetration frequency of the ionosphere.

SOLAR ENERGY—One of the chief outcomes of IGY investigations has been the correlation of many earth phenomena with variations in the sun's energy. The 18-month period of the investigations was chosen to coincide with a maximum of sunspot activity. The sun obligingly started producing flares and sunspots on the morning of July 1, 1957, reaching a peak of activity in February and March of 1958. Worldwide observation by over 100 patrols kept constant watch on the sun at every moment of the 18 months.

Analytical studies of solar data currently being undertaken will help catalog the effects of solar disturbances on the upper atmosphere and on geomagnetic disturbances. Already, measurements of the sun's surface magnetic field show a strength associated with sunspots as much as 8,000 times the earth's field at the equator. Periodic reversal of magnetic polarity of the sun's South Pole, and fluctuations in intensity at its North Pole, show the same cyclical tendency as the sunspot cycle, with a three-year lag. Scientists at the Mt. Wilson Observatory believe these variations are due to large-scale circulation patterns in the sun's surface.

Flare activity associated with sunspots is of great importance to such terrestrial phenomena as magnetism, auroras and the ionosphere. Flares spew out streams of charged gas which may envelope the earth, ionizing the atmosphere as it strikes, producing X-rays and auroras. Ionization increases r-f absorption in the ionosphere, causes abnormal electrical currents in the upper atmosphere which disrupt surface fields by induction.

IONOSPHERE EFFECTS—Radio energy can be both absorbed and refracted by the ionosphere. Below the penetration frequency of the F-layer (or the G-layer when it is present), the path is bent, and the index of refraction continuously varies. At frequencies substantially above the penetration frequency—which normally lies in the region between 30 and 50 mc—the energy is merely attenuated and the index of refraction does not vary substantially from 1.

Attenuation is caused by loss of energy to the free electrons in the ionosphere, and is therefore a function of electron density in the ionosphere. Figure 1 illustrates the frequency dependence of r-f absorption in the ionosphere. Under normal conditions, absorption loss is small at frequencies above the penetration frequency, but in interplanetary communications even this small loss may cause serious problems.

During periods of great solar activity, the ionization of the upper atmosphere rises and both absorption and path deviation become more pronounced. Deviation errors, which would have their most serious effect on tracking and guidance sys-

Table I—Chronology of a Magnetic Storm

2/9 2108 Flare of magnitude 2-plus observed in southwest quadrant of the sun
2112 Loud solar noise on 458 mc noted, followed by other bursts on other frequencies
2257 Radio noise fades
2302 Flare subsides
2/11 0126 Fredericksburg magnetograph records major disturbance; horizontal trace jumps 117 γ
0130 Interruptions in radio circuits to Europe. Aurora begins in auroral belt
0159 Major peak of storm hits. Horizontal trace jumps 500 γ at Fredericksburg, more than 2,000 at Alaska. Aurora begins to spread south. Power circuits in north central states fluctuate, sometimes as much as 320 v. Radio circuits to Europe abruptly fade.
0201 Serious interruptions on Western Union cables
0202 AT&T cable almost useless; earth potential at west end goes from 2,650 v through zero to peak in opposite direction. Aurora spreading
0212 Earth currents subside, start to stabilize. Cables back on but spotty. Aurora seen brightly and clearly in New York, Washington, points south
0245 AT&T loses radio contact with South America
0300 RCA loses radio contact with Tangier
0400 RCA loses radio contact with relay station in Paramaribo; aurora visible 20 deg north of equator
0620 Sharp drop in magnetic disturbance; cosmic noise drops at Boulder; X-ray bursts observed over Minneapolis
0630 RCA back in touch with Paramaribo
0800 RCA back in touch with Tangier; aurora subsiding
1200 Direct circuits to Europe operating; worst of storm past

tems, are inversely proportional to the square of frequency.

FARADAY FADING—Another serious problem in trans-ionospheric communications is the Faraday effect. Moon-radar experiments have shown that the polarization plane of r-f energy rotates as it passes through the ionosphere, producing a slow fading.

Faraday fading is most intense a few hours before sunrise. In one moon-radar experiment, the plane of polarization of the receiving dipole had to be continually adjusted; in a six-hour period, the plane was rotated a total of 10 radians.

The effect varies inversely as the square of frequency, is affected by both the earth's magnetic field (not a constant value) and the distribution of ions in the ionosphere. It is most marked at the lowest penetration frequency.

Meteor-trail interference, while in most cases probably not great enough to intercept or absorb a ground signal, can shift its angle of arrival at destination, cause multipathing, and interfere with Doppler measurements. This effect varies inversely with the square root of frequency.

Ionospheric storms affect earth magnetism, sometimes quite seriously. Electron density at lower levels increases, which results in more r-f absorption and at higher frequencies. The second F-layer rises. Sporadic E-layer patches may reach densities as high as 10^7 electrons/cm^3.

In the ionized gases of the ionosphere, collisions between electrons and ions or molecules can produce r-f noise. Radio noise at 46, 72, 500 and 3,000 mc has been reported.

AURORAS—Protons and other ionized particles ejected by the sun hit the upper atmosphere and cause visible radiation. The earth's magnetic field guides the particles into the two belts, circling the magnetic poles, where most auroras are seen. During flares and other unusual solar disturbances, the

Magnetic Storms Destroy Communications

THE EFFECT that a solar disturbance can have on electromagnetic phenomena on earth is clearly demonstrated by the great magnetic storm of February 11, 1958.

At 2108 universal time on Feb. 9, a spectacular flare erupted on the face of the sun. Four minutes later, loud solar noise was reported on several vhf and uhf frequencies. An hour and 45 minutes later, the noise faded, and five minutes after that the flare subsided.

At 0126 on Feb. 11 (26 hours, 24 minutes later), a magnetic storm hit the earth, blanketing the whole surface within seconds with abnormal magnetic phenomena.

Within the next half hour, a flaming aurora had spread from the auroral zone southward. Peak of the storm occurred about half an hour later, at 0159; during that peak, the earth's potential at the terminal of AT&T's North Atlantic cable fluctuated violently.

The abnormal earth currents subsided quickly, but by 0400 a complete radio blackout had cut off the U. S. from the rest of the world. The storm began to ebb at 0520, faded still more between 0600 and 0700 but was not declared over until 1500 Feb. 12.

Table I lists the key events in the storm. Figure 3 shows the magnetogram trace for the horizontal magnetic component from Fredericksburg (Va.) Observatory for the first hour of the storm. The peak that extends off the chart exceeded 500 gammas; in Alaska at the same moment, the needle was shoved off the page by a peak reading conservatively estimated to have been in excess of 2,000 gammas.

Figure 4 shows cosmic-noise absorption in the ionosphere measured at Boulder, Colo., correlated with the major fadings of the magnetic storm starting at 0620 Feb. 11. During the moments when the storm slackened off, cosmic noise also dropped dramatically. At the same time, a balloon flight over Minneapolis measured sharp increases in X-radiation.

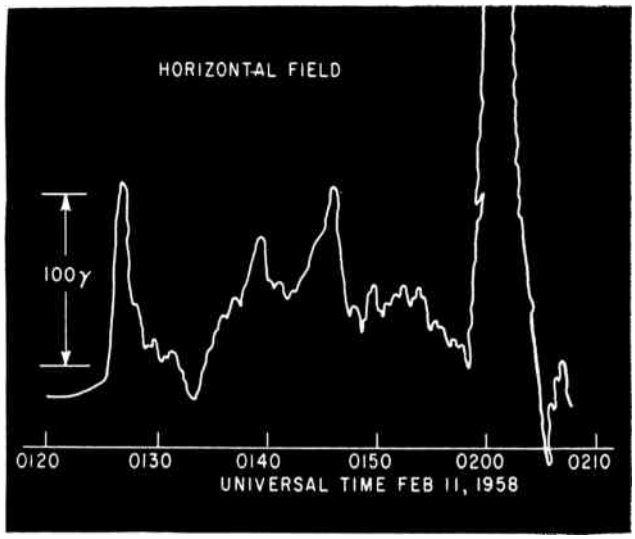


FIG. 3—Onslaught of a great magnetic storm. At Fredericksburg Observatory, magnetogram jumps 117γ at 0126, more than 500γ at 0159

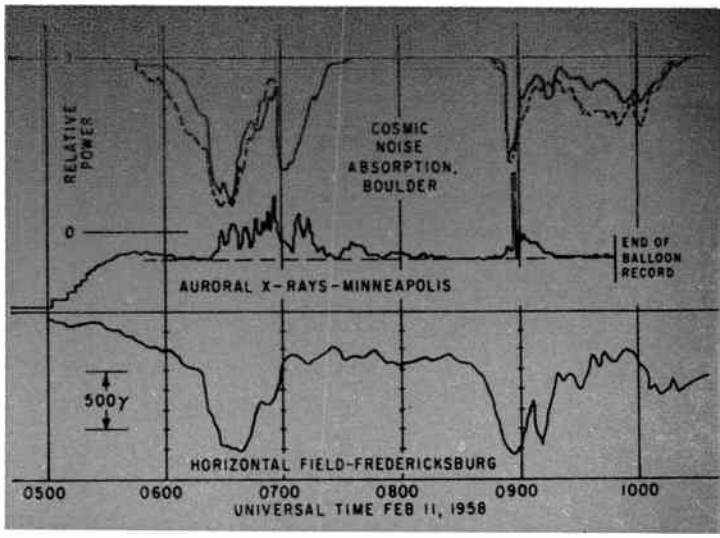


FIG. 4—During two ebbings of the storm (bottom line) cosmic noise at 18 mc drops at Boulder, Colo. (top line), and X-ray bursts are measured over Minneapolis

auroras may spread to much lower latitudes, sometimes as far south as Cuba. An auroral sky is practically opaque to r-f energy, as the attenuation levels given in Fig. 2 show.

Auroras usually occur in the same part of the sky as the ionosphere—from 60 miles up to as high as 600 miles. Red and blue auroras are generally caused by protons, the nuclei of hydrogen atoms. Green auroras, the most common type, are due to atomic oxygen in the low altitudes, and the unusual flaming red auroras are associated with atomic oxygen at higher altitudes in the neighborhood of the ozonosphere (the level of the atmosphere characterized by 10-millibar pressure).

Solar disturbances of the type that cause auroral displays can quadruple the electron density in the D-layer of the ionosphere. The effect may last several hours, during which times vhf signals are absorbed in the ionosphere. Severe magnetic storms have resulted in more or less spotty absorptions up to 1,000 mc, with serious absorption up to 100 mc.

Auroral absorption varies inversely as the square of frequency. Echoes from auroras have been clearly detected (10 db above noise) at 400 mc, and also at 12 and 800 mc. Echoes are usually Doppler-shifted, sometimes as much as several hundred cycles, the direction of shift being dependent on the type of aurora.

VAN ALLEN RADIATION—The Explorer satellites led to the discovery of an intense radiation belt in the high atmosphere. A Pioneer space-probe in a 38-hour flight went up 63,000 miles and provided data on two belts, one 1,400 to 3,400 miles up, the other between 8,000 and 12,000 miles. James Van Allen and his associates at the State University of Iowa suggest that the two belts are caused by charged particles ejected from the sun and temporarily trapped in the earth's magnetic field.

The more penetrating components of Van Allen radiation may be either electrons or protons. If electrons, the equivalent radiation dosage is 10 roentgens per hour; if protons, 100. These figures compare with the maximum safe dosage of 0.3 roentgens per week.

Between the belts, radiation drops to a safe level. Similarly, the region beyond the second belt is safe; the ability of the earth's magnetic field to trap particles drops off beyond 18,500 miles.

Some researchers suggest that auroras may be caused by leakage from the Van Allen belts, as also some X-radiation may be. The manmade aurora observed late last summer during nuclear tests may have been caused by a distortion in the earth's external magnetic field during a high-altitude nuclear or thermonuclear blast, which permitted leakage from the belt.

COSMIC NOISE—Antennas in outer-space communications systems will act as radiotelescopes, and the incidence of galactic noise becomes a serious problem. Cosmic noise is by no means constant; some stars—notably such hot bodies as Alpha in Virgo and the nebula in Orion—are noisier than others.

Generally speaking, the quietest part of the sky is toward the galactic pole, becoming noisier toward the equator, with the most noise emanating from along the galactic plane on a line pointing toward the center of the galaxy.

Below penetration frequency, the ionosphere tends to shield the earth from cosmic noise, although the shield is not a complete one.

Thermal processes in the stars are responsible for the noise. The sun, too, emits r-f energy from its chromosphere and corona, with lower frequencies coming from the corona. Magnitude of solar and stellar noise is a function of temperature; a noise burst from a solar flare may be 1,000 times as great as the noise from a normally quiet sun.

Using Magnetic Circuits

Size and weight reduction are obtained in design of pulse generator by using transistors and new core materials. Reliability is also increased

By **ARTHUR KRINITZ,** Department of Electrical Engineering, Servomechanisms Laboratory, Massachusetts Institute of Technology, Cambridge, Mass.

RECENT ADVANCES IN MAGNETIC MATERIALS are put to good use in this radar pulser. Transistor drive and high-permeability, high-saturation flux-density cores are used to obtain a small, light weight design. Applications might be airport surveillance or boat radars, but other uses are also possible.

Magnetic discharge and pulse shaping networks are used instead of thyratrons or vacuum tube amplifiers. Transistorizing the drive circuit further increases reliability.

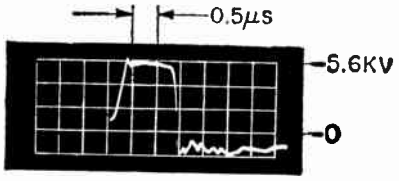


FIG. 1—Generator output pulse. Peak power of the 1-μsec pulse is 24-kw

The output waveform and the output of a magnetron when driven with this pulse are shown in Figs. 1 and 2.

Transistor Driving Circuit

The pulse generator consists of a square wave oscillator, driver circuit, two-section magnetic discharge circuit and a two-section pulse forming network. These functions are indicated on the schematic diagram, Fig. 3.

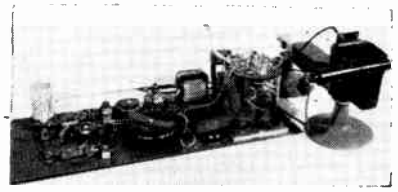
Two medium power transistors and a magnetic core are used in the square wave oscillator. Similar to d-c to d-c converters, the 1,700 cps oscillator is highly efficient and its square wave output is well suited to switching the power transistor of the driver circuit. The circuit of transistor Q_1 determines the operating voltage of the oscillator transistors and thus controls frequency. This control is adjusted for best operation.

Driver transistor Q_1 is a low voltage, high current device with switching time of 15 to 30 μsec. With square wave drive it operates as a switch, being either full ON or full OFF. Since current is low in the OFF state, and voltage across the transistor is low in the ON state, dissipation is low and occurs mainly during the brief switching time. Transistor limitations are maximum allowable current in the ON state and maximum allowable voltage in the OFF state.

Magnetic Discharge Network

The magnetic circuit takes the low voltage, low power pulse from the driver circuit and compresses the pulse into a high power output. Energy is not added during this process but pulse duration is decreased from about 300 μsec to about 1 μsec.

Figure 4 shows the magnetic paths of the saturable elements during the pulse forming process. The bias circuit has brought the reactors to the zero points on the B-H curves. At t_0 the driver transistor of Fig. 3 is switched from OFF to ON and a voltage step is applied to charging inductor L_1 and the primary of T_1. The reactors then travel path 0-1-2 (Fig. 4),



Breadboard generator showing reactor oil bath and magnetron load. Metal panel is 19 in. long

with T_1 acting like a transformer and T_2 being driven further into the saturation region. The circuit beyond T_2 is effectively decoupled and T_3 is not affected by the actions of T_1 and T_2. Capacitor C_1 of Fig. 3 is reflected into the primary of T_1 and the resulting transient is the step response of a high-Q RLC network. The effect of the first interval is to charge C_1.

At t_3 the driver transistor is turned OFF. The voltage on C_1 now takes T_1 along path 2-3-4. During the same interval the excursions of T_2 and T_3 act to discharge C_1 and charge C_2. The tank circuit during this time is essentially a short circuit. The next interval—t_4-t_5-t_6—is the discharge time of C_2. Reactor T_3 operates along path 4-5-6 (Fig. 4C), and the load is connected by

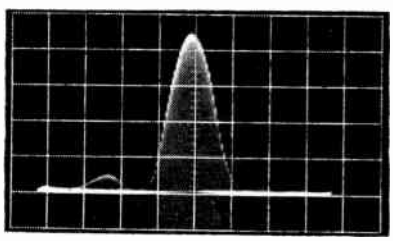


FIG. 2—Output spectrum from 2J42 magnetron

To Pulse Radar Sets

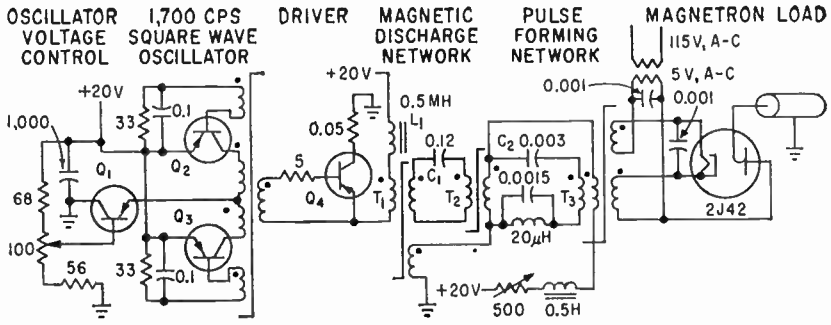


FIG. 3—Square loop magnetic cores are used with transistor drive to generate and shape pulses

transformer action.

The magnetic discharge circuit forces C_1 to discharge more rapidly than it charges; similarly for C_2. The pulse therefore becomes taller and narrower as it passes from stage to stage.

The pulse forming network is in two sections. One section is the tank circuit of Fig. 3 and the other consists of C_2 and the saturated inductance of T_2. The combination is a two-stage, linear, pulse forming network of the Guillemin type.

Core Reset and Bias

Following each pulse, the bias circuit resets the reactors to the zeros of Fig. 4, preparing the network for the next pulse. During the reset operation the reactors are not saturated and therefore act as transformers. Transformed voltages thus appear across the corresponding capacitors and it is these voltages which actually reset the cores.

When the charging time of any reactor is short compared with the reset time available, the voltage developed on the capacitor during reset will be small and thus have little effect on the charging cycle. But the charging time of C_1 is approximately equal to the reset time of T_1. Voltage induced on C_1 therefore has an important effect on the charging cycle. This problem is analyzed in detail in Appendix I of reference (1).

The bias inductor is used to keep bias current constant. Its impedance must be large compared to any impedance in the associated mesh. Bias winding ampere-turns must be large enough to reset the core and also overcome coercive force. Magnetic network design can be based on core volume and hysteresis loss considerations or on eddy current loss considerations. Theoretical work shows that using more than two to four stages would not generally be worthwhile.[1]

Experimental Generator

A breadboard version of the generator is shown in the photograph and its characteristics are listed in Table I.

Power dissipation is the transistors is low and, with typical heat sinks, they can operate in air without special cooling. The driver transistor, for example, operates at about two-thirds its rating. Dissipation in the magnetic networks is higher, especially in T_2 and T_3. These two cores are mounted on heat sinks and placed in an oil bath. The oil acts as both heat sink and insulator.

Main losses in the generator are hysteresis loss, eddy current loss, copper loss, and dielectric loss in the capacitors. Eddy current loss can be reduced by using thinner magnetic materials. One- and two-mil laminations were used in the generator but ½-mil and ¼-mil materials are available. An additional five percent improvement in efficiency can be obtained from a better designed oscillator and bias circuit. Ultimately, an efficiency of 60 to 65 percent should be possible.

Jitter in the generator output pulse is less than 0.05 μsec when a storage battery is used for the power supply. Any ripple in the supply will increase the jitter.

Output power can be increased by using several power transistors in the driver circuit. Characteristics of recently developed solid-state thyratron-like rectifiers indicate these could be used instead of—or in conjunction with—the power transistor of the driver circuit.

Research was supported by M. I. T. Servomechanisms Lab and by USAF, Weapons Guidance Lab, Wright Air Development Center, under Contract No. AF 33(616)-5489, Task No. 50688.

Table I—Experimental Generator Characteristics

Repetition frequency	1,700 cps
Peak output power	24 kw
Peak output voltage	5.6 kv
Pulse width	1 μsec
Average output power	40 watts
Efficiency (including d-c adjuster circuits, oscillator and bias)	50 percent
Weight (including heat sinks, oil bath, filament transformer and 2 lb mounting panel)	10 lb

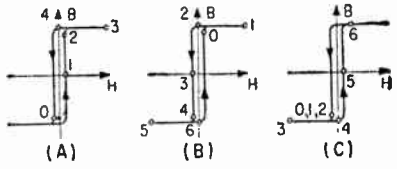


FIG. 4—Path of operation of T_1 (A), T_2 (B) & T_3 (C)

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Using Divider Vernier

Locally generated pulses can be easily synchronized with pulses from WWV to set clocks associated with frequency standards. Changes in the period of pulses from counter-type frequency dividers are made with precise vernier. Drift of frequency standard with time is rapidly determined

By **ERNEST F. WILSON,** Edgerton, Germeshausen & Grier, Inc., Boston, Massachusetts

SLIGHT AND PRECISE changes in the period of the output pulses of binary-counter type frequency dividers can be made without modification of internal feedback paths. Such changes permit setting clocks associated with primary frequency standards by varying the period of a locally generated 1-second pulse to bring it into step with the 1-second pulse received from radio station WWV.

A new technique for changing the period eliminates the complexities of feedback-path modification in the dividers while maintaining the advantages of multistable dividers. Basically, a vernier change in the counter division ratio is obtained either by adding or deleting input pulses. Thus a cycle from output pulse to output pulse is completed with more or fewer input pulses than are normally required by the division ratio.

Lowering the division ratio by insertion of extra pulses is quite common, raising the ratio is not. A cascade of four binaries can be made to count by 17 by the addition of a gate generator and a gate of proper length. The addition of a single binary stage with feedback paths will accomplish the same result. However, a change in count can be made only by changes in the feedback paths. Switching transients occurring when these changes are made can cause random and undesirable steps in the time of a recurrent output pulse. On the other hand, gate timing can be made to cause a count ratio change with no such deleterious results.

Figure 1 is a block diagram of the elements necessary to lengthen the output pulse. The pulse source delivers pulses to the divider through the open INHIBIT gate. The divider is composed of M stages of division by R. As a result an output pulse is produced by R^M input pulses.

A change in output period is produced by closing the switch. An output pulse causes the gate generator to close the INHIBIT gate and enables the input pulses to pass through the AND gate into the N-count storage. The N-count storage is an N-stable device producing an output pulse which terminates the gates after receipt of N input pulses, restoring the circuit to normal operation until the next output pulse activates the gate generator again. As a result, the divider receives its required R^M pulses only after $R_M + N$ input pulses. Thus the new output pulse period is increased from R^M to $R^M + N$ input pulse periods.

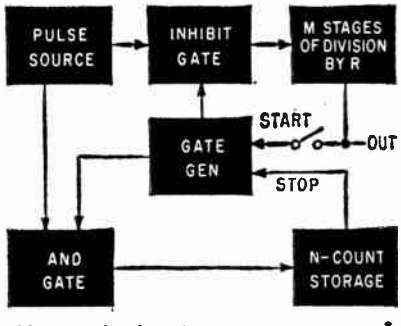


FIG. 1—Pulse lengthening requires use of storage unit

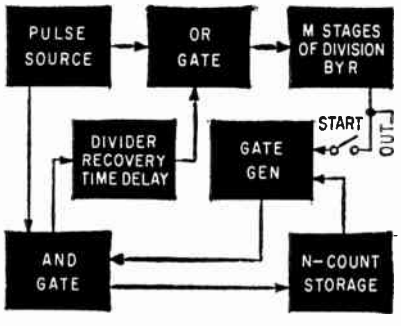


FIG. 2—Pulse shortening uses time-delay unit and OR gate

The change in circuitry necessary to produce precise output pulse period shortening can be seen by comparing the block diagram of Fig. 2 with that of Fig. 1. Essentially, the only change is the replacement of the INHIBIT gate by the OR gate. In practice, both the OR and INHIBIT gates are left in the circuit at all times; switches are used to route the output from the gate generator to the proper gate.

Gate shortening is effected as follows: the closed switch (Fig. 2) allows the output pulse to start the generation of the gate. The gate causes input pulses to be routed to the N-count storage. In addition, the pulses from the AND gate are supplied through a delay to an OR gate and thus to the divider. The gate generator is terminated, just as for pulse lengthening, by the pulse produced from the N-count storage after receipt of N counts.

Pulse Shortening

The shortening is produced by the insertion into the divider of N pulses between the regular pulses. To make the upper frequency limit of the circuit as high as possible, the extra pulses are inserted as soon as possible after the first stage of the divider recovers from triggering by a regular input pulse. This minimal delay results in a maximum frequency of operation of one half the maximum frequency of the first-

To Synchronize Pulses

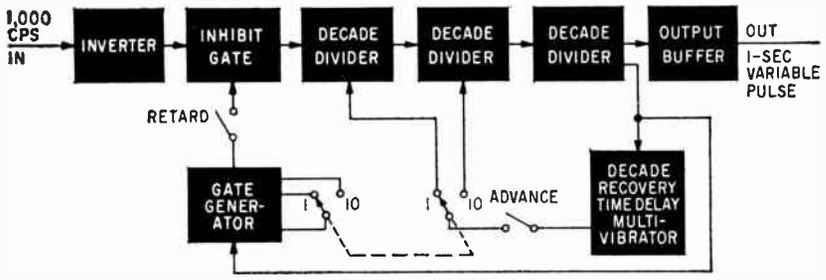


FIG. 3—Switches select both the amount and direction of pulse period variation

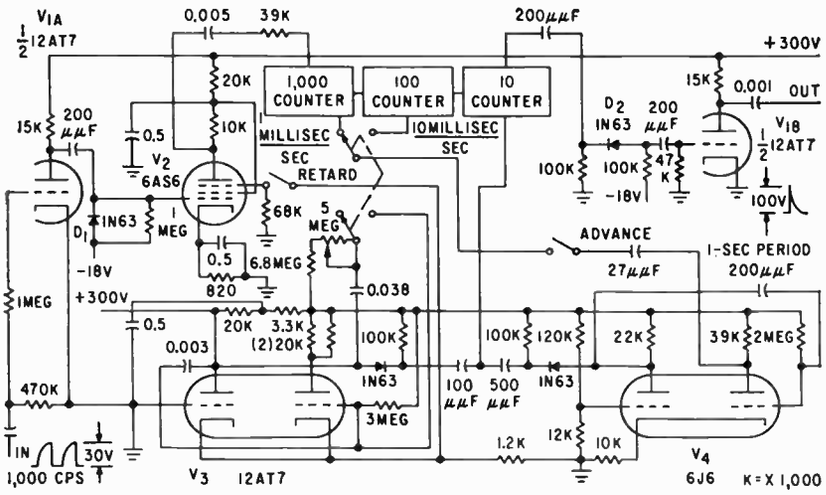


FIG. 4—Instrument can use any type 10-stable divider in the counter circuit

divider stage.

Insertion of N extra input pulses into the divider allows it to complete its count of R^M in $R^M - N$ input-pulse periods and results in a shortening of the output-pulse period by N input-pulse periods.

The circuitry is standard except for the gate generator. Although this circuit could be an ordinary bistable multivibrator, it must have provision to set it in a particular state after power application. In practice, the desired result is obtained by use of a monostable multivibrator with a period longer than any value of N input pulse periods to be expected. The bistable circuit is needed only if the divider is to be used for some application in which the input pulses would be irregular.

Practical Circuit

The block diagram of Fig. 3 and the circuit diagram of Fig. 4 show a practical application of this technique.

The pulse source is the 1,000-cycle output of a frequency standard. The input waveform is such that amplification and inversion by V_{1A}, differentiation by the coupling circuit between V_{1A} and V_2 and clipping by D_1 produce an adequate pulse for driving the decade counters. Tube V_2 is the INHIBIT gate, which normally allows pulses to pass to the conventional 10-stable dividers. The diode D_2 and V_{1B} are used to provide a clean output and to buffer the load from the counters.

Gate generator V_3 is a monostable multivibrator. Here the practical circuit differs slightly from the block diagram of Fig. 1. Instead of using the AND gate and N-count storage, the gate is terminated by the normal timing of the multivibrator. The multivibrator period is either 1.5 milliseconds or 10.5 milliseconds to provide values of N of one and 10. By deleting one or 10 input pulses the resultant gate produces an output-pulse period of 1,001 or 1,010 milliseconds.

To shorten the period, V_4 provides the necessary divider recovery time delay. The AND gate, the OR gate and the N-count storage are not readily apparent, but for this particular case in which R is 10 and N is one or 10, proper routing of the pulse from V_4 allows the divider to perform the storage.

For the case of $N = 1$, there is no reason to use the AND gate to select one input pulse. Instead, the output is delayed by the necessary divider-recovery time and applied to the OR gate inherent in the first stage of the first decade.

For the case of $N = 10$, insertion of the pulse into the OR gate at the input of the second decade essentially uses the first decade as the N-count storage. The end result is the same as inserting 10 extra pulses into the OR gate of the first decade and storage is obtained without additional circuitry.

Synchronizing Clock

The clock to be set is driven by the same 1,000 cps from the frequency standard as is the frequency divider. The frequency divider's 1-second output normally triggers a comparison oscilloscope sweep. The audio output of a receiver tuned to WWV is applied to the vertical plates of the oscilloscope. By use of the vernier switches, the 1-second trigger to the oscilloscope can be advanced or delayed until the 1-second pulse waveform of WWV appears in coincidence with the start of the trace. The number of sweep traces multiplied by the precise variation of the frequency-divider ratio will give, to the nearest millisecond, the amount of drift of the frequency standard over the period between coincidence adjustments.

Once the output of the divider is set to coincide with the seconds pulse from WWV, it may be used to set the hands of the clock to zero by use of a mechanical differential in the gear train driving the clock.

			oscillator
Type of Signal Input	0 to 5 volts 0 to −5 volts ±2.5 volts	0 to 15 mv 0 to 100 v	E—generally limited to 20 v swing

Commutators for Airborne

Alarm Circuit Warns of

Audible alarm system allows central placement and gives distinctive indication of fault location in digital computer and data processing equipment. Simple, flexible circuits simulate horn, collision, battle stations sounds

By STANLEY FIERSTON
Sylvania Electronic Systems Division, Sylvania Electric Products, Inc., Needham, Mass.

FLEXIBLE MONITORING EQUIPMENT is needed to operate and test today's large scale data processing systems. Indicator lamps are normally used for this function but they have several disadvantages. These disadvantages can be severe if a system has many units spread over a wide area or if circuit faults are infrequent. The audible alarms proposed have generally been too complex, too inflexible, or have required voltages not normally available in transistorized circuits.[1] The audible alarm discussed here overcomes these disadvantages and produces distinctive sounds.

Horn and collision signals are generated by the electronic circuits shown in Fig. 1. The two sounds are used to monitor two circuits. Mixing the two signals produces a battle stations sound which is used for a third monitor.

Alarm Circuit Operation

Switch S_5 controls the alarm, selecting the circuit to be monitored and the output signal. With S_5 in position 2, an alarm trigger pulse will activate the one-shot multivibrator. The AND circuit passes the battle stations signal through to the audio amplifier and speaker. The one-shot multivibrator resets after a suitable time and closes the AND circuit, thus silencing the alarm. Positions 3 and 4 of S_5 are similar to position 2 but monitor different circuits, and produce horn and collision signals. No one-shot multivibrator is needed in position 4 since the trigger signal is not a short pulse.

Other positions of S_5 connect to selected points in the monitored system. Pulses with audio frequency components on distinctive pulse trains are listened to directly. These signals give an experienced operator useful information about

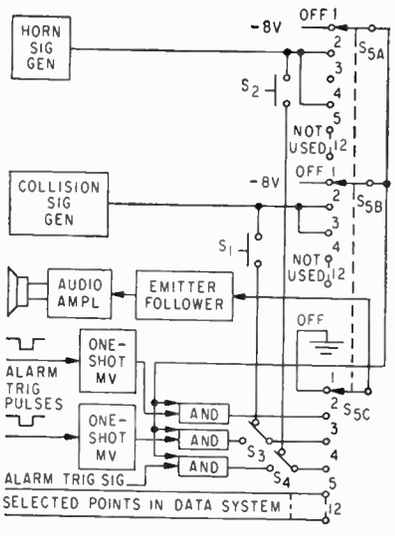
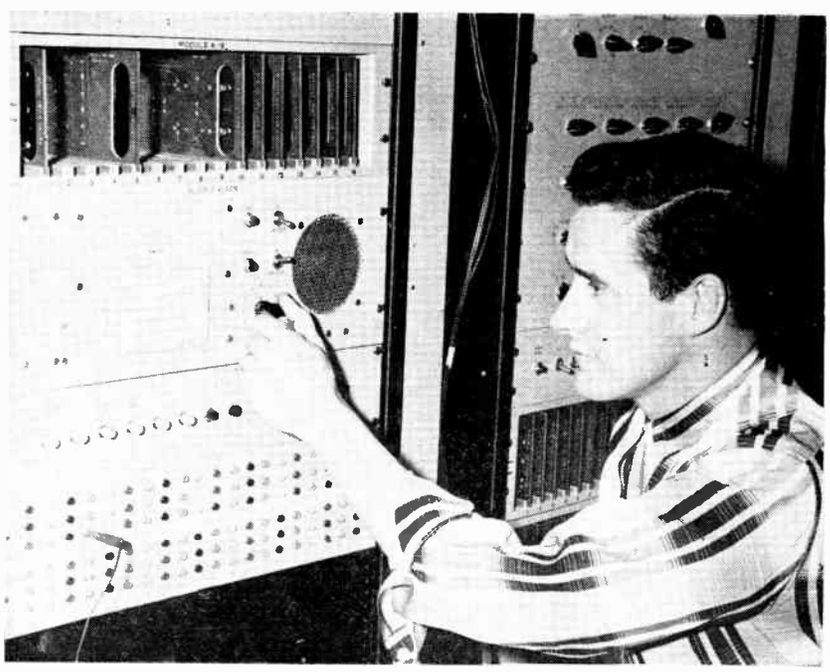


FIG. 1—Alarm system generates sounds electronically



Operator is shown selecting the channel to be monitored. Circuits are identified on cardboard tab

Faults in Digital Systems

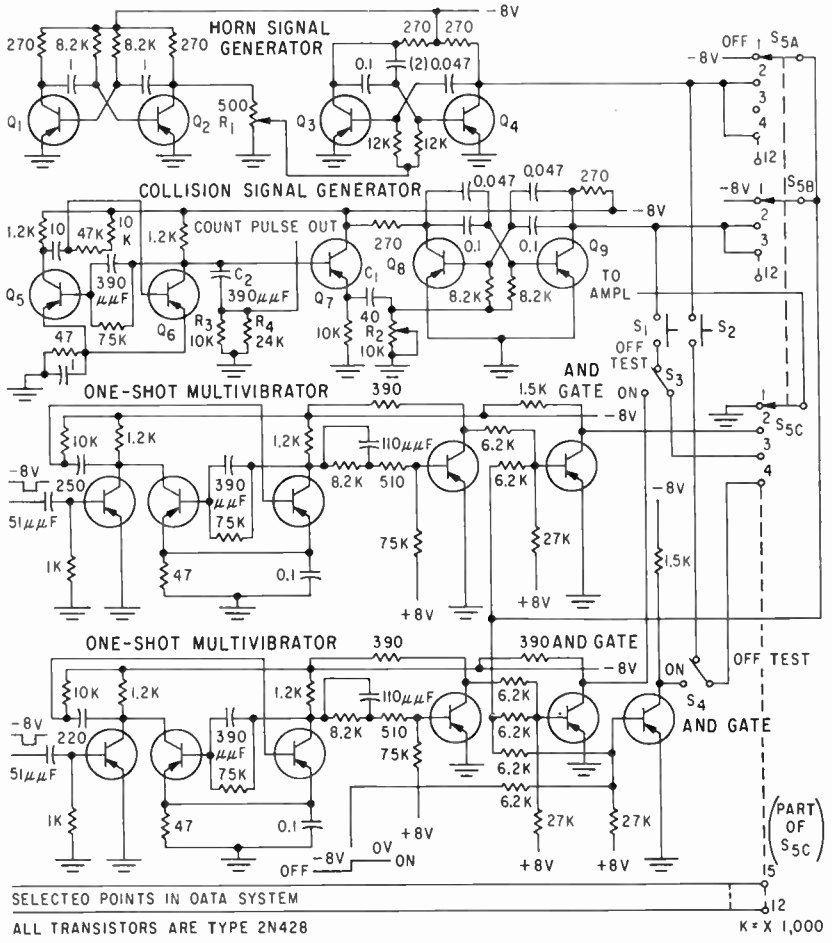


FIG. 2—Horn signal generator uses two multivibrators; collision signal is generated with multivibrator and pulse generator. Mixing the two sounds produces battle stations signal

the system.

The one-shot multivibrators used for positions 2 and 3 could be replaced by flip-flop circuits. The flip-flops maintain the alarm signals until manually reset.

Switches S_1 through S_4 are used for testing the signal generators and for silencing an alarm.

Alarm Signal Generator

Figure 2 is a schematic diagram of the alarm. A low frequency multivibrator Q_1 and Q_2 is combined with a high frequency multivibrator Q_3 and Q_4 to generate the horn signal. The rough sound produced by the square waves is deliberately increased by the unequal timing capacitors used in the Q_3 and Q_4 circuit. Frequency of the Q_3 and Q_4 multivibrator can be controlled by changing the bias voltage. Potentiometer R_1 controls the bias and is set to give the desired sound.

The collision signal is generated in a similar way. High frequency multivibrator Q_8 and Q_9 is similar to Q_3 and Q_4. Circuit Q_5 and Q_6 forms a 2-cps, highly unsymmetrical, free-running pulse generator. Emitter follower Q_7 couples the output pulse to differentiating circuit R_2-C_1.

Output of the differentiator is an exponentially varying signal of 2 cps which controls the bias of the Q_8 and Q_9 circuit and thus its frequency. The actual sound developed by the generator depends on the differentiator and multivibrator time constants and the pulse rate. Component values shown in Fig. 2 tend to produce a birdlike sound. Other values can produce a sound similar to a navy collision signal.

A second differentiating circuit R_3 R_1 C_2 gives a narrow 2-cps pulse for use in other parts of the data system.

Alarm signals are fed to an emitter follower and then to an audio amplifier, both of which are conventional circuits. A variable resistor in the emitter follower provides a convenient volume control. The audio amplifier schematic is shown in Fig. 3.

Applications

Highly specialized circuits are not needed since the alarm uses standard pulse circuits found in most data processing systems. Only a few circuits are required and the alarms can be placed at desired points. Extra connecting cables are not needed since the volume can be set to give the required area coverage. Many other distinctive sounds can be generated by changing the R-C constants of the multivibrators. This flexibility is an obvious advantage over mechanical alarms such as bells and horns. The various parts of the alarm can be packaged into small plug-in modules.

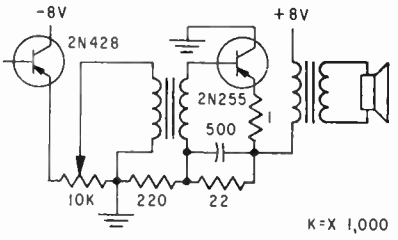


FIG. 3—Audio amplifier uses conventional circuits

The author thanks John Malcolmson for his assistance in the construction and testing of the alarm.

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Radio-Frequency Circuits

Ten-kilovolt 250-kilocycle alternating field generator partially ionizes fuel gas in initial stages of thermonuclear fusion process that converts gaseous plasma to helium. Generator design and method of coupling generator to stellarator plasma are considered along with variable load effect of plasma

By **RODGER L. GAMBLIN,** Project Matterhorn, Princeton University, Princeton, N. J.

ULTIMATE OBJECTIVE of a stellarator is to raise deuterium or deuterium and tritium gas to a thermonuclear ignition temperature near 10^8 C and extract energy as the gas converts into helium.[1,2]

To accomplish this objective a specially twisted magnetic field of 50,000 gausses or greater is created in a space that is filled with fuel to be heated. A high-frequency alternating electric field is then applied along the magnetic lines of force to break down or partially ionize the gas and subject it to the actions of subsequently applied electric and magnetic fields. A d-c electric-field pulse or ohmic-heating pulse applied along the lines of force and the resulting currents induced in the gas complete ionization and bring the gas temperature to near 10^6 C. Further heating is accomplished by coupling the plasma to various pulsed r-f fields and varying the strength of the confining field at specified places and in ways that energy transfer takes place into the plasma.

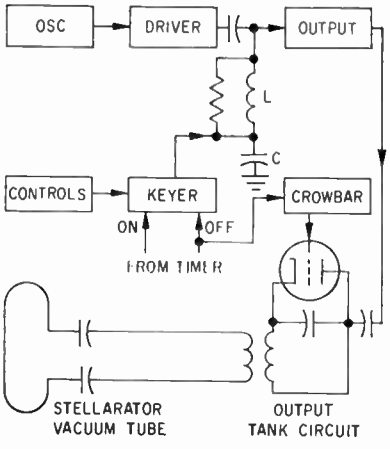


FIG. 1—Block diagram of stellarator breakdown generator

Initial breakdown of the gas in the stellarator is performed by the B, for breakdown, generator, which is a 10-kw 250-kc unit. Because of the special coupling and timing problems presented by the stellarator, this generator differs from others of its general class.

Breakdown Problems

The vacuum chamber of the B3 stellarator, which in operation contains the gas to be heated, consists of a stainless steel tube approximately 5 cm in diameter and 650 cm long. A ceramic insulating section 1 cm long prevents the tube, which closes upon itself, from shorting out any applied parallel electric field.

The coupling of the B generator to the plasma presents a problem. Creation of the confining field, involving over 50,000 gausses in the chamber defined by the vacuum tube, results in relatively large stray magnetic fields near the stellarator.

A usual method of coupling the electric field of the B generator to the gas would be by a ferromagnetic core looping the vacuum tube; this method is undesirable because the above stray fields tend to saturate the core. The stainless steel vacuum tube shares flux linkages with the plasma, however, and can be used as the primary of a transformer. Primary inductance in this case is low and of the order of 4.4 microhenries. This latter method has the advantage of making the plasma inductance appear lower as seen from the transformer input.

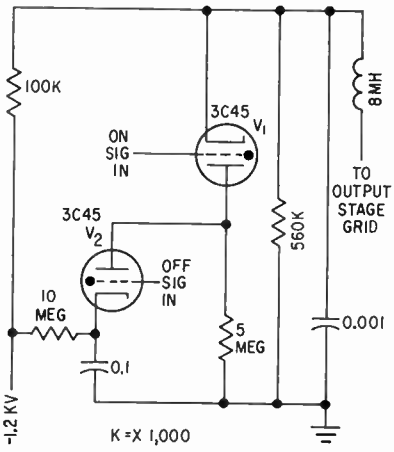
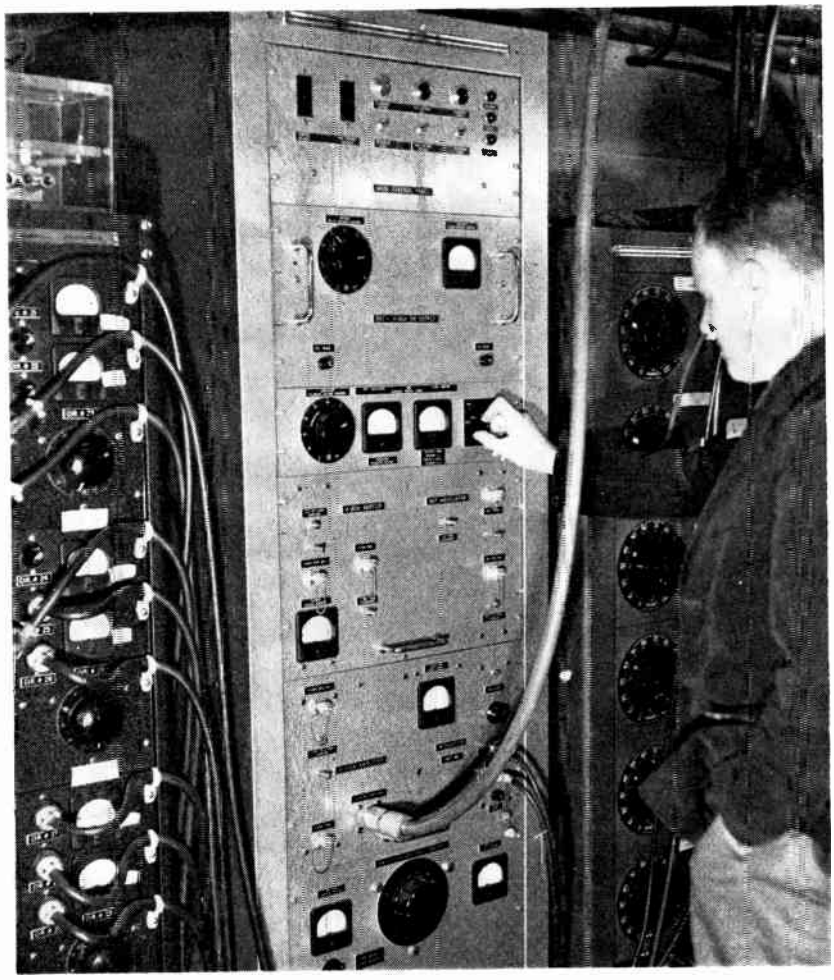


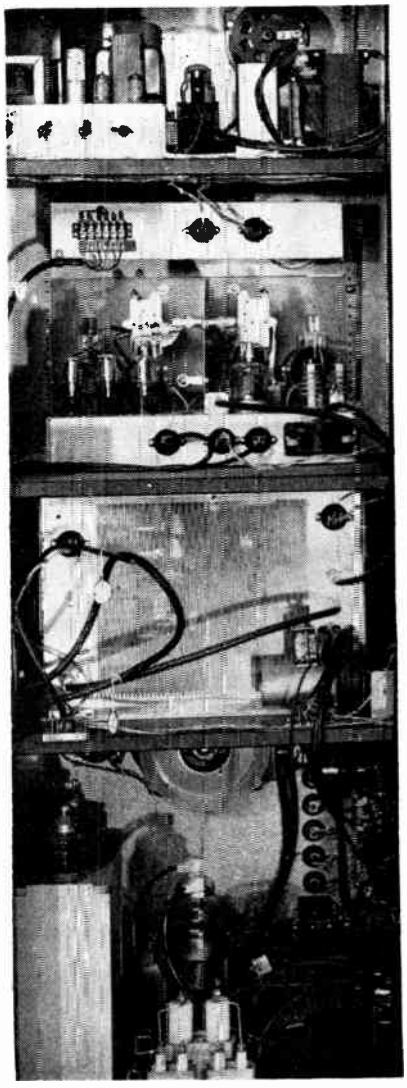
FIG. 2—Simplified schematic of keyer

A second problem of the stellarator breakdown arises through the necessity of measurements on the gas. Under certain conditions of gas mixtures and pressure, diffusion of particles takes place across the magnetic lines of force in the vacuum chamber during the breakdown period. To measure the properties of this diffusion, it is desirable to have a minimum rise and fall time of the r-f envelope and to have the r-f pulse spaced in time with a minimum jitter relative to other stellarator operations.

A third problem of the stellarator involves the variability of the load comprising the plasma. Before breakdown the B generator sees as its load the primary inductance of the vacuum tube. After breakdown, the load changes to a resistance of small magnitude in series with a small inductance which represents the leakage flux in the annular re-

for Plasma Physics





Inside view (right) and outside view (above) of gas breakdown generator. Cable from front panel feeds output tank circuit located at stellarator

gion between the plasma and the vacuum-tube wall.

Load inductance varies with the diameter of the plasma and load resistance varies from an open circuit to values less than a few tenths of an ohm. A diagnostic requirement is that the voltage during a pulse should be, as far as possible, independent of load so the r-f source impedance need not be a variable in data analysis.

B Generator

Figure 1 shows the basic block diagram of the B generator. The master-oscillator power-amplifier system was chosen primarily for constant voltage output.

As the plasma load changes, its inductance also tends to change. If the grid drive of the output tube is of constant frequency, the change in inductance can be used to partially compensate for the resistive change. If the master-oscillator frequency prior to breakdown is too low relative to the output stage tuned circuit, the output tube will face an inductive impedance that is lower in absolute magnitude than if the output were resonantly tuned. When, however, the presence of a plasma lowers the inductive component faced by the output tube, the system comes into tune and greater power is available to drive the plasma load.

This system also offers relative stability and reliability compared to an oscillator and faster rise time than a grid-keyed oscillator.

Output Stage

The B3 stellarator is a pulsed machine with an on time of approximately 5 millisec and off time of nearly 30 sec. Since the ratio of on to off time is so low, thermal dissipation in operating components tends to be negligible.

The ultimate rating on the capabilities of tubes is the maximum filament emission and peak rated voltage. Thoriated-tungsten filaments at normal operating temperature are capable of approximately 0.08 amp per watt of filament power. If the filament voltage is increased by 10 percent, the emis-

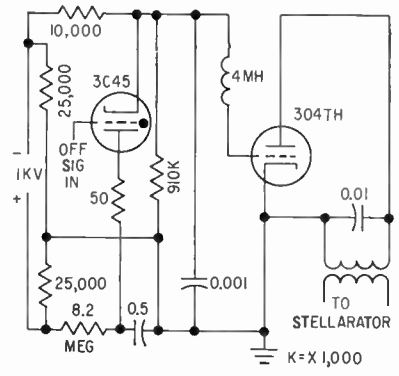


FIG. 3—Simplified schematic of crowbar

sion capabilities increase to 0.160 amp per watt at the expense of a somewhat shortened life. Though of only 250-w rated plate dissipation, which in normal r-f operation would limit its power capabilities to less than 750-w output, the 4-250-A tube has a peak filament emission of 11.6 amp and a d-c pulse plate-voltage rating of 10 kv. To obtain tube characteristics over this range, published data is expanded by scaling voltages by an appropriate factor and multiplying the current by this factor to the three-halves power.

Because of space considerations the B generator must be located at a considerable distance from the stellarator. If the output tank circuit were in the cabinet containing tubes and power supplies and the leads to the stellarator were long, the impedance of the coupling cable would be an appreciable part of the load and the voltage level at the stellarator would be too low. The tank circuit is, therefore, placed in a shielded box in the vicinity of the stellarator and connected to the main cabinet through relatively long leads.

To prevent the B generator coupling from shorting out the ohmic-heating pulses, blocking capacitors are included in the leads from the output tank.

Keying

Keying of the output stage is accomplished by the circuit shown in Fig. 2.

Two timing pulses from the master sequential timer of the stellarator signal the B generator on and off. When thyratron V_1, which is initially nonconducting, is pulsed on it connects the grid lead of the output tube through a resistor to ground. The output tube voltage rises from −1,000 v to an operating level of −200 v, permitting it to be driven by the driver.

In the off condition the negative voltage on the output is enough to override the continuous drive from the buffer stage. Choke L and bypass C (Fig. 1) isolate the keying circuit from the r-f grid drive.

The off pulse from the timer triggers thyratron V_2 which discharges the negatively charged capacitor in its cathode through the grid leak resistor. An inverse voltage is produced on thyratron V_1 for a period long enough to cause it to become nonconducting.

Thyratron V_2 becomes nonconducting from current starvation as the charging supply for the capacitor in its cathode has a 5-megohm impedance. The resistor in parallel with the isolation choke in Fig. 1 damps out ringing when either the off or on pulse is triggered.

Crowbar Stage

Even if the output tube is cut off instantly, the voltage will decay in the output in accordance with a time constant determined by its Q. A low-Q output circuit for fast decay time would involve the use of a higher power tube for on operation. A crowbar circuit is used to cut off the oscillator in the tank circuit sharply.

The crowbar circuit, shown in Fig. 3, consists of a tube with a plate hold-off rating comparable to the peak instantaneous output-tank voltage. During the on period this tube is biased off, but at the end of the pulse its grid is driven to +500v and the tube becomes a low impedance across the tank. It then damps out oscillation within a cycle or two.

The keyer for this system is similar to that of the output-stage grid-keyer system.

General Circuit Features

The oscillator and driver of the master-oscillator power-amplifier system are shown in Fig. 4. They operate continuously and are of conventional design.

The output-stage plate and screen supply is a high-impedance output voltage-doubler circuit capable of charging a 5-μf storage capacitor to 10 kv. The screen supply consists of a bleeder and storage capacitor.

The B generator has been in operation at Matterhorn for a period of two years with a minimum of trouble.

The basic design of the generator was the joint work of George Klingaman, N. W. Mather and the author. It was supported under contract AT(30-1)-1238 with the Atomic Energy Commission.

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(2) J. M. Carroll, Our Stake in Thermonuclear Power, ELECTRONICS, p 75, Dec. 19, 1958.

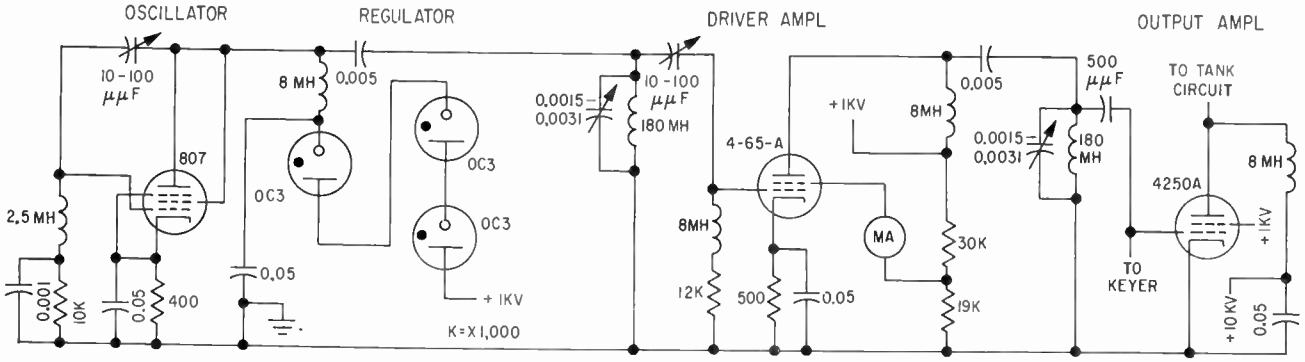


FIG. 4—Three series-connected gas-discharge tubes regulate master-oscillator plate-supply voltage

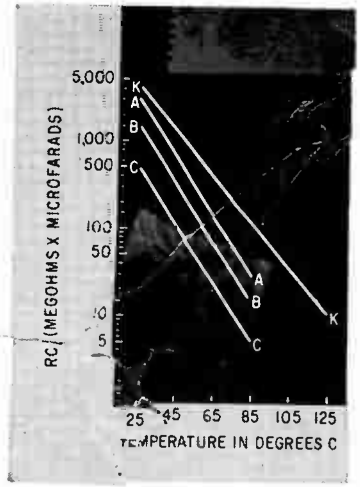


FIG. 1—Recommended minimum insulation resistance for various characteristics (impregnants)

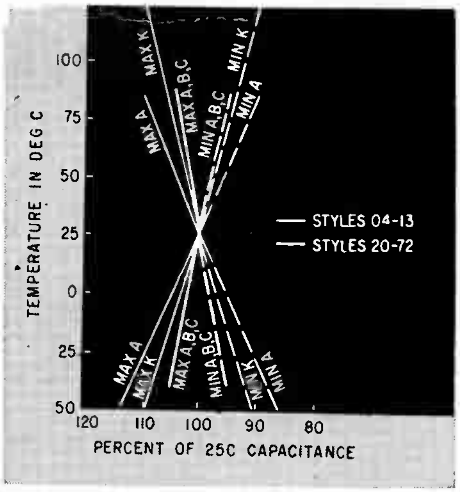


FIG. 2—Recommended capacitance as function of temperature and characteristic for the two classes of styles

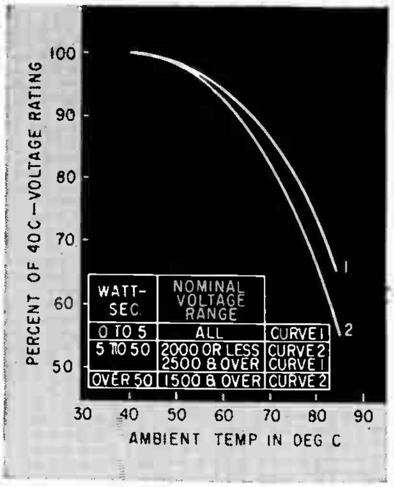


FIG. 3—Recommended voltage ratings as functions of temperature. Watt-seconds $= CE^2/2 = (\mu f \times kv/2)^2$

Paper Capacitor Ratings

NEW RECOMMENDATIONS for metal encased fixed paper d-c capacitors have been issued by Electronic Industries Association. Table I gives standard capacitance ratings recommended for standard voltages. Styles 04-13 have cylindrical cases with wire terminals; 20-29, tubular cases with wire terminals, and 40-72, other case and terminal styles. Recommended effect of temperature on ratings is covered in Figs. 1, 2 and 3. Details on performance, case and terminal configurations and ratings within each style are contained in RS-218, April, 1959, available from EIA's Engineering Department in New York.—G.S.

Table 1—Voltage and Capacitance Values Recommended by EIA for Fixed Paper D-C Capacitors

Capacitance in Microfarads (A Signifies Recommendation for Inclusion within Style Group 04—13; B, within Style Group 20—72, and C, within Both Groups)

Rating in Volts	75	60	55	50	45	30	25	20	18	15	14	13	12	10
100														
200														
400														
600				B			B	B		B			B	B
1,000										B			B	B
1,500										B			B	B
2,000										B			B	B
2,500	B		B				B	B					B	B
3,000		B			B			B					B	
4,000						B		B				B		
5,000									B			B		
6,000											B			B
7,500														
10,000														
12,500														

Rating in Volts	9	8	7	6	5	4	3.5	3.3	3	2.5	2	1.5	1.2	1
100						B					B			A
200											B			A
400														A
600		B		B		B					B			B
1,000		B		B		B					B			B
1,500		B		B		B					B			B
2,000		B		B		B					B			B
2,500		B		B		B					B			B
3,000		B		B		B					B			B
4,000			B	B		B					B			B
5,000		B		B		B					B			B
6,000					B	B					B			B
7,500	B		B						B		B			B
10,000					B		B				B	B		B
12,500								B		B			B	B

Rating in Volts	0.75	0.68	0.5	0.47	0.33	0.25	0.22	0.15	0.1
100		A		A	A		A	A	C
200		A	B	A	A	B	A	A	C
400		A	B	A	A	B	A	A	C
600		A	B	A	A	B	A	A	C
1,000			B	A	A	B	A	A	C
1,500			B			B			B
2,000			B			B			B
2,500			B			B			B
3,000			B			B			B
4,000			B			B			B
5,000			B			B			B
6,000			B			B			B
7,500			B			B			B
10,000			B			B			B
12,500	B		B			B			B

Rating in Volts	0.068	0.05	0.047	0.033	0.022	0.02	0.015	0.01	0.0068	0.006	0.0047	0.0033	0.003	0.0022	0.0015	0.001
100			A	A	A	B	A	C	A	B	A	A		A	A	C
200	A		A	A	A		A	B	A		A					
400	A	B	A	A			A	A				A				
600	A	B	A	A	A	B	A	C	A	B	A	A	B	A	A	A
1,000	A	B	A	A	A	B	A	C	A	B	A	A	B	A	A	A
1,500		B				B		B		B			B			

Standard Capacitance Tolerances

0.001μf	+60% −25%
0.003, 0.006 and 0.01μf	+40% −20%
0.02, 0.05 and 0.1μf	+20% −20%
0.25, 0.5 0.75 and 1μf	+20% −10%
styles 04-13	±10% (K) ±20% (M)
Above 1μf	+10% −10%

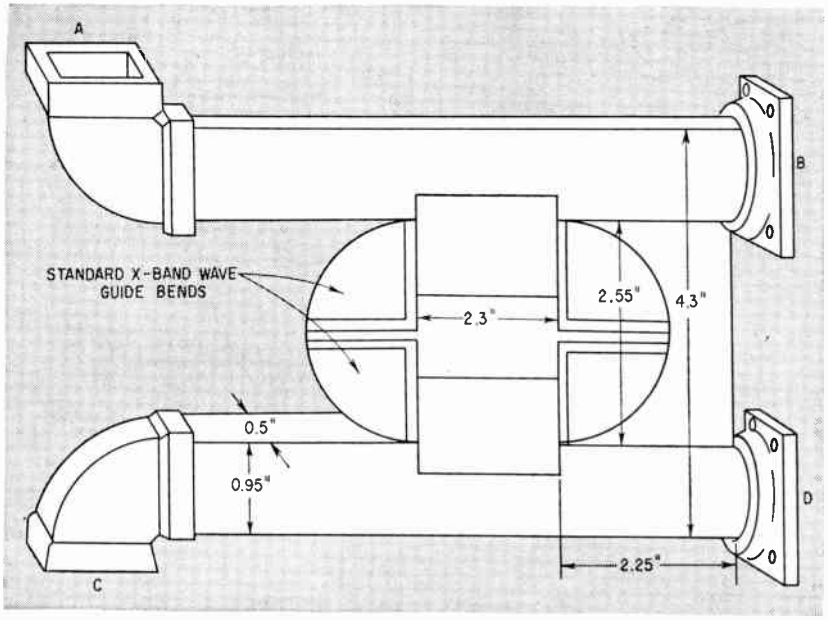
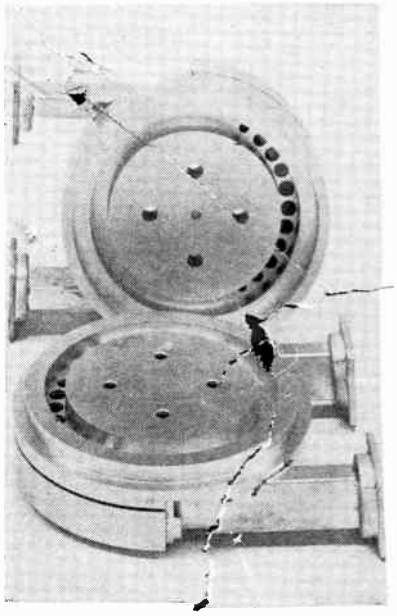


FIG. 1—Sketch of an X-band model of resonant ring diplexer constructed of standard wave guide components



Interior view of disk-type resonant ring diplexer showing coupling arrangement

By T. H. MORIARTY*, Melpar, Inc., Falls Church, Va.

Resonant Ring Diplexing

For simultaneous transmission and reception on a single antenna, a diplexer constructed of symmetrical directional couplers and a resonant ring provides excellent isolation between transmitter and receiver in forward scatter communications systems

HIGH GAIN REQUIREMENTS of antennas for forward scatter communication systems result in large and expensive radiating elements. Diplexers are designed to permit simultaneous transmission and reception on a single antenna, thereby greatly reducing the space needs and high cost of such systems.

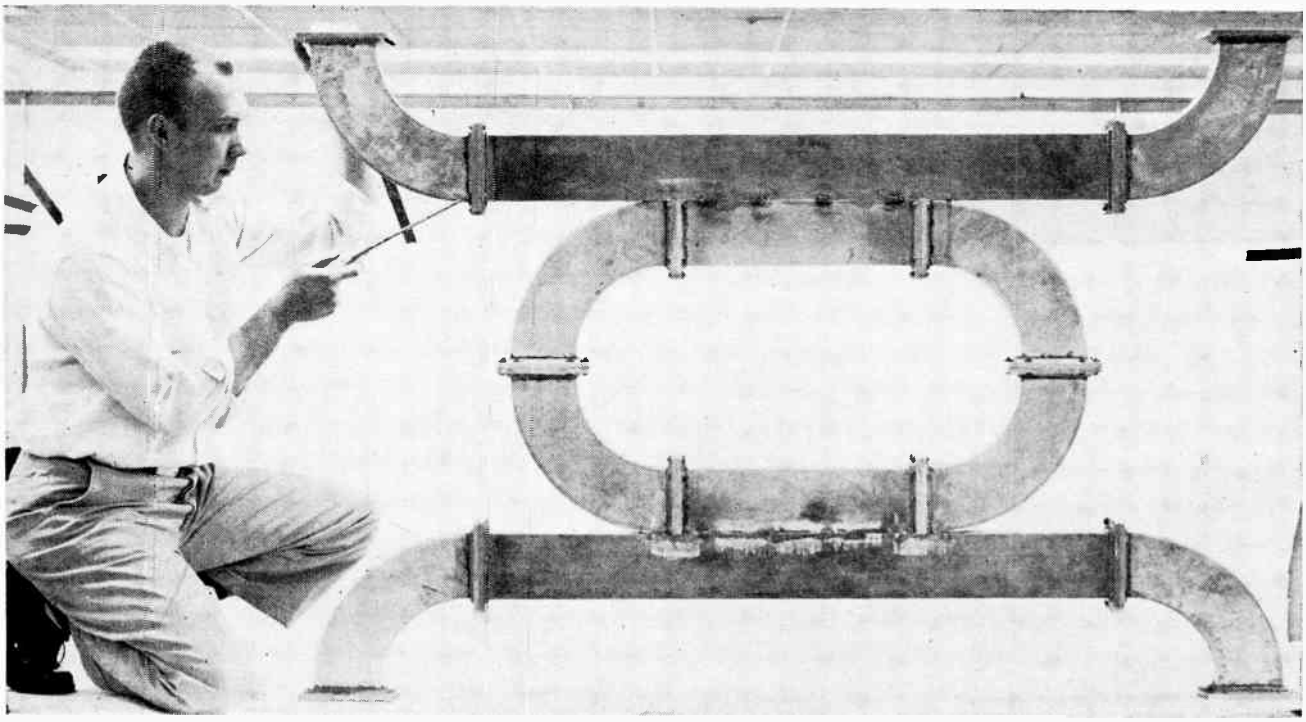
In permitting simultaneous transmission and reception on a single antenna, the diplexer must provide sufficient isolation of the receiver from the transmitter. This is difficult to achieve because of the large difference existing between the levels of transmitted and received signals, approaching 200 db in cases.[1] Consequently, the signal emanating from the transmitter at the receiver frequency must be attenuated to a level less than that of the minimum detectable signal. With care, the spurious output from the transmitter at frequencies removed from the carrier by a few percent or more can be held to 100 or 150 db below carrier level. Thus for satisfactory diplexing, it is usually necessary to provide an additional attenuation.

Diplexing Devices

Diplexing techniques of forward scatter systems utilize either branching filters, lumped circuit elements, or polarization devices. Lumped circuit elements are used only in low-frequency ionospheric scatter systems; polarization devices are feasible only in the higher frequency tropospheric scatter systems. However, r-f branching filters are used for diplexing purposes in both ionospheric and tropospheric scatter systems. Coaxial-type branching filters are used with frequencies as high as 1,000 mc, while the wave-guide type is used as low as 750 mc.

A new diplexing technique has been developed which is based on the use of symmetrical directional couplers in conjunction with a resonant ring. The diplexer is a four-port device which can be tuned to resonate at any frequency within a given band. Tuning can be achieved

* Now with Page Communications Engineers, Inc., Washington, D. C.



Though developed primarily for X-band service, the principles involved in design of the resonant ring diplexer can be applied to other frequencies, as demonstrated by this scaled-up S-band version

in Forward Scatter Systems

either by varying the effective broad dimension of the guide or the effective length of the ring. At resonance, the ring couples the receiver signal from a main feed line which is connected to both the transmitter and the antenna. A second directional coupler is located symmetrically on the ring with respect to the first coupler.

Energy coupled by the first coupler is coupled out of the ring by the second coupler into another feed line. The receiver is connected to one end of this feed while a load is connected to the other end. At the transmitter frequency, an isolation of 50 to 60 db is achieved by this device. Isolation of 20 to 30 db is achieved between the receiver and the transmitter spurious signal at the receiver frequency. A number of these devices can be used in combination to provide additional isolation between the transmitter and the receiver at the transmit frequency and at the spurious receiver frequency signals from the transmitter. The resonant ring also has application as a conventional filter, a multiplexer, a multicoupler, and a television diplexer.

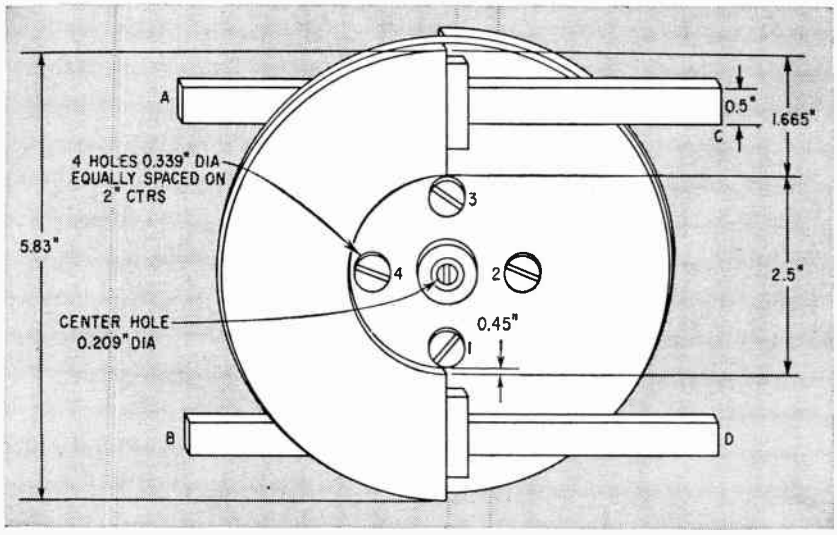


Fig. 2—Sketch shows overall dimensions of disk-type resonant ring diplexer

Chief Problem

The principles underlying the resonant ring diplexer have been discussed in the literature.[2, 3] The diplexer development described here is concerned largely with X-band wave guide in the 8,000 to 10,000 mc range. The chief problem in obtaining a diplexer with low loss on the receiver side is the determination of an optimum array of coupling holes for the directional

couplers in the device.

An X-band wave guide model of the resonant ring diplexer is shown in Fig. 1. The ring section of the diplexer is designed to have a total length which is an integral number of wavelengths at the desired resonance frequency. The diplexer, which is a symmetrical device, has four ports as shown in the figure. Power fed in at *C* at the resonant frequency of the ring couples through the ring and is taken off at *A*. This transfer of power simulates the condition at which the incoming signal from the antenna is coupled to the receiver. For a power input at *C* at a non-resonant frequency, all of the power emerges at *D*. This condition simulates the flow of transmitter power to the antenna. For this arrangement, the receiver input is taken off at *B*. A measure of the isolation between transmitter and receiver at the transmitter frequency, is then the difference in power level between ports *C* and *B* in db.

Preliminary tests show that isolation ranging from 48 to more than 62 db can be obtained between these ports for the 9,200- to 9,900-mc range. The resonant-ring diplexer has the additional feature that (for power input at *C*) any spurious component of the transmitter frequency which occurs at the receiver frequency is coupled into the ring but taken off at *A*, which is isolated from the receiver port at *B*.

In-line Array

Best results for the diplexer shown in Fig. 1 are obtained with coupling having an in-line array of seven holes in each coupler. The sizes of the holes are tapered to the extent that the holes on each end have a diameter of 11/32 in., while the remaining five holes have a diameter of 3/8 in. The optimum center-to-center spacing between holes is 0.431 in. The wall thickness of the coupler is 0.05 in.

Larger values of isolation can be achieved by connecting two or more of these diplexers in the proper combination.

The test data on this model show that resonant points occur at 8,155, 9,010 and 9,950 mc over the 8,000- to 10,000-mc band. The 900-mc spacing between resonant points is obtained with a ring path length of 5 wavelengths at 9,000 mc. The test data also show that the insertion loss between the antenna and the transmitter at the transmit frequency is of the order of 0.2 db. The loss between the antenna and receiver at the receiver frequency of this model averages 1.5 db.

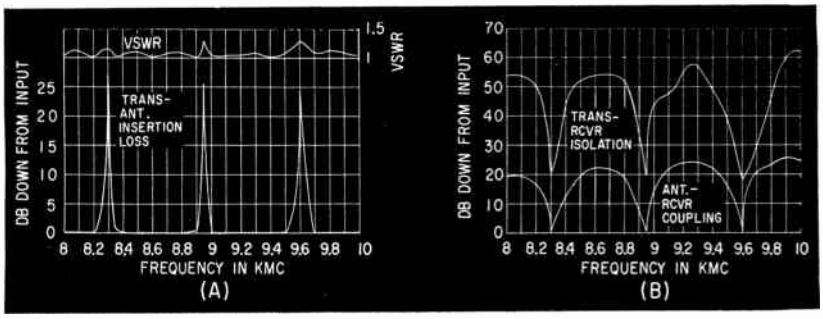


FIG. 3—Performance curves for disk-type diplexer. (A) shows vswr and insertion loss characteristics. Curves in (B) indicate isolation between transmitter and receiver and coupling between antenna and receiver

Disk Diplexer

A disk type ring diplexer is shown in Fig. 2. Tuning of this ring is accomplished by varying the distance between the two disks which form the rectangular waveguide path.

The coupling arrangement which gives the best results consists of an array of 13 coupling holes with a diameter of 11/32 in. except for the two end coupling holes. These end holes are each 9/32 in. in diameter and provide a slight taper to the coupling hole array. The center-to-center spacing between holes is 0.431 in. as before, and the wall thickness is 0.05 in.

The disk type resonant ring diplexer can be tuned over half the range between resonant points by increasing the broad waveguide dimension from 0.96 to 0.98 inches. However, insertion losses are introduced by the tuning and these losses have not been completely evaluated. The tuning effect is obtained by changing the broad waveguide dimension with shim stock inserted between the two halves of the circular diplexer.

Data shown in Fig. 3 are typical of those recorded for the disk type ring. In plotting these data, port *C* is considered the transmitter input and it is also taken as the zero loss reference level for power. Port *D* is then the antenna input. At frequencies for which the ring is not resonant, all of the transmitter power goes to the antenna at port *D*. Under these conditions, it can be seen from Fig. 3A that the power loss between *C* and *D* is much less than 1 db in most cases. However, at the three resonant frequencies (8.3506, 8.9527, and 9.6021 kmc), power from the transmitter couples through the ring and emerges at port *A*. At these points the transmitter power at the antenna is down by 27 db, while the power loss between *C* and *A* is only 0.6 db. At these frequencies most of the power is transmitted through the ring.

These data indicate a 0.6-db insertion loss between the antenna and the receiver at the receiver frequency. Insertion loss between the antenna and transmitter at the transmit frequency is of the order of 0.1 db with a vswr of about 1.06. Curves showing the values of isolation and coupling achieved with this diplexer are shown in Fig. 3B.

The author would like to acknowledge the advice and assistance of J. P. Shelton, F. B. Facchine, and R. Glass.

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(2) F. S. Coale, A Traveling-Wave Directional Filter, *Trans IRE*, MIT-4, p 256, Oct. 1956.

(3) J. P. Shelton, Forward Scatter Communication Systems Diplexers, Melpar, Inc. Phase II Final Report, Air Force Contract AF 30(602)-1530, Rome Air Development Center, April, 1957.

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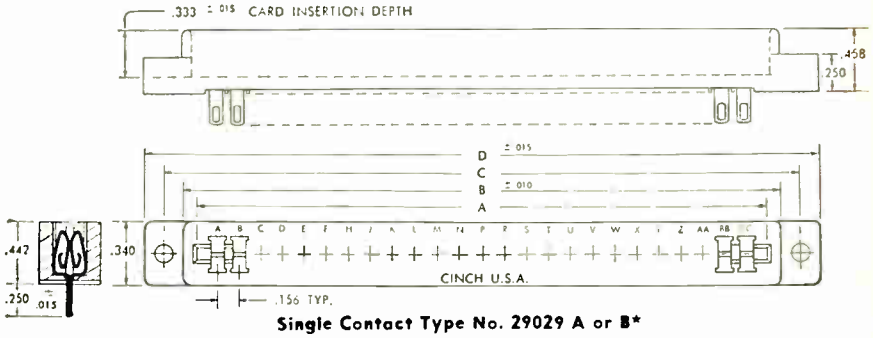

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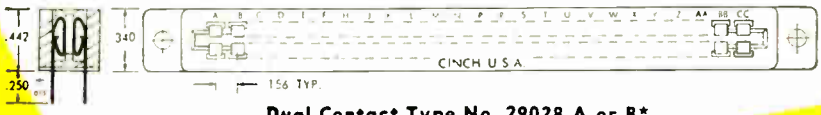
Made in 6 through 25 contacts inclusive. Designed for nominal 1/16" printed wire board, either single or two sided copper. A polarizing contact made of brass, Sel-Rex gold plated, can be placed in any contact position. Insulation material is of glass filled Diallyl Phthalate (Type GDI-30 per Mil. M-19833). Contacts are of Beryllium Copper or Phosphor Bronze with Sel-Rex gold plate .00003 minimum. Terminals are mounted on .156" centers. Mounting holes are .128" dia.



Dual Contact Type No. 29028 A or B*

Made in 12 through 50 contacts in multiples of two. Designed for nominal 1/16" printed wire board, copper clad on both sides.

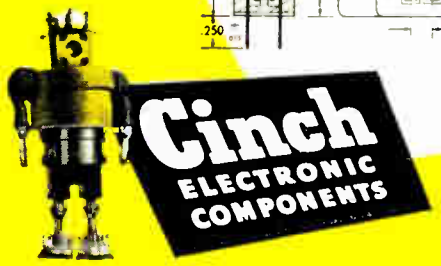
Contacts, polarizing contact, insulation and mounting holes are the same as described for No. 29029.

*A—Phosphor Bronze Contact *B—Beryllium Copper Contact

Insulation is among the best available from both the electrical and mechanical standpoints.

Contacts are especially designed for minimum printed circuit card wear, low insertion force and positive contact with the printed wire board.

The lack of sharp radii in the contact design makes it possible to offer this contact in either Beryllium copper or Phosphor Bronze. Due to the use of heavier material in the contacts the tails are more rigid than those in similar connectors that are presently available.



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In ordering use bose number, 29029 or 29028, followed by the number of contacts, then contact moteriol ond then the letter indicoting position of the polorizing contact. For exomple 29029-12-A-E, or 29028-16-B-E.

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ECOMMENDED WITHSTANDING VOLTAGE:		
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ltitude 3.4 HG. 50,000 ft. (adj. terminals)	675	900
ltitude 1.3 HG. 70,000 ft. (adj. terminals)	450	640

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easured with nominal thickness rinted wire board.	
sulation resistance	5000 Megohms Min.
sulation resistance (immediately after 6 hours at 90-95% R.H. and 40°±2° per	100 Megohms Min.

Single Contact Type No. 29029

BASE NO.	NUMBER OF CONTACTS	DIMENSIONS A	B	C	O
29029	6	1 098	1.239	1.531	1.785
29029	7	1 254	1.395	1 687	1.941
29029	8	1 411	1.552	1 844	2 098
29029	9	1 567	1.708	2 000	2 254
29029	10	1.723	1.864	2.156	2.410
29029	11	1 879	2 020	2 312	2.566
29029	12	2 036	2.177	2.469	2 723
29029	13	2.198	2 333	2 625	2 879
29029	14	2 348	2.489	2 781	3 035
29029	15	2 504	2 645	2 937	3.191
29029	16	2 661	2 802	3 094	3 348
29029	17	2.817	2.958	3.250	3.504
29029	18	2 973	3 114	3 406	3 660
29029	19	3 129	3.270	3 568	3.816
29029	20	3 286	3.427	3.719	3.973
29029	21	3 442	3 583	3 875	4.129
29029	22	3 598	3 739	4 031	4.285
29029	23	3 754	3.895	4.187	4.441
29029	24	3 911	4 052	4 344	4.598
29029	25	4 067	4 208	4 500	4.754

Dual Contact Type No. 29028

BASE NO.	NUMBER OF CONTACTS	DIMENSIONS A	B	C	O
29028	12	1 098	1 239	1 531	1.785
29028	14	1.254	1 395	1.687	1.941
29028	16	1 411	1 552	1 844	2 098
29028	18	1 567	1 708	2 000	2.254
29028	20	1 723	1.864	2 156	2.410
29028	22	1.879	2 020	2 312	2.566
29028	24	2 036	2 177	2 469	2.723
29028	26	2.192	2 333	2 625	2 879
29028	28	2 348	2 489	2 781	3 035
29028	30	2.504	2 645	2 937	3 191
29028	32	2 661	2 802	3 094	3 348
29028	34	2.817	2.958	3 250	3 504
29028	36	2 973	3.114	3 406	3 660
29028	38	3 129	3 270	3 562	3.816
29028	40	3 286	3 427	3 719	3 973
29028	42	3 442	3.583	3.875	4.129
29028	44	3 598	3 739	4 031	4.285
29028	46	3.754	3 895	4.187	4.441
29028	48	3 911	4.052	4 344	4.598
29028	50	4.067	4 208	4 500	4.754

Radar's Running Rabbits

By **RICHARD A. WALL,** Motorola Inc., Systems Research Laboratory, Riverside, Cal.

WHEN A SEARCH radar (a victim) is exposed to pulse interference from another radar or pulse source (a culprit) whose pulse repetition frequency is nearly equal to a multiple or submultiple of its prf, a running rabbit type of interference pattern appears on the victim's ppi.

Typical patterns are shown in Fig. 1A, where the victim prf is just below the culprit's. In Fig. 1B the victim's prf is slightly higher than the culprit's.

Sometimes radars are operated in close proximity so that complete elimination of the interference is not feasible. By closely examining running-rabbit patterns and applying nomographs that describe running-rabbit parameters, a victim can determine the prf of the culprit, thus getting a clue that helps determine the culprit's identity.

Nomograph Derivation

The charts in Fig. 2 and 3 are derived from equations that express parameters of running rabbits. When the prf's of both radars are nearly equal, $f_c = f_r \pm RS_1$ applies, where f_c = prf of culprit in pulses/sec, f_r = prf of victim in pps, R = azimuth scan rate of victim radar in rps, and S_1 = spirals/revolution of victim ppi.

When the radar prf's are not approximately equal, $f_c = q/p(f_r \pm RS_1)$ applies, where q is the number of spirals that are generated simultaneously and p is the number of the ppi sweep that occurs with the appearance of a spiral group, counting sweeps from the appearance of the previous spiral group.

If azimuth scan rate is variable or unknown, a stopwatch can be used to determine S_2, the number of spirals appearing in

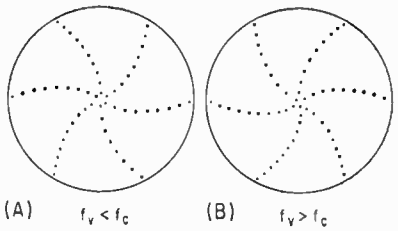

FIG. 1—Running-rabbit patterns

T_2 sec. These terms modify each of the equations listed above to obtain $f_c = q/p(f_r \pm S_2/T_2)$.

Assume that two radars interfere with each other and blanking circuits are not feasible. Pulse rates are about 1,600 pps. Interference is to be constrained to a recognizable number of spirals. What is the maximum difference in pulse rates that prevents more than four spirals from appearing in a 5-sec interval?

Align a straightedge between the number of spirals (4) and the reciprocal of the time (0.2) as shown by line A of Fig. 2. Maximum allowable difference is 0.8 pps. This value dictates stability and accuracy limits of the timing generators.

The number in the right-hand axis is either the scan rate or the reciprocal of the number of sec in which a desired number of spirals appears.

Interference on a 20-rpm display causes nine spirals in two revolutions of the display. Spirals appear three at a time, each group consisting of blips that occur every fourth ppi sweep. If the victim pulse rate is 480, what is the interfering rate?

Values of q (3) and p (4) determine the right-hand point of the line in Fig. 3. Interfering frequency is about 360 pps.

Since there are 4.5 spirals/rev, 4.5 fixes the left-hand point of line B in Fig. 2. Right-hand point of line B is 0.33 rps. Line B intersects −1.5 pps (minus because of a Fig.-1B pattern). Thus 358.5 pps is the exact value of the culprit prf.

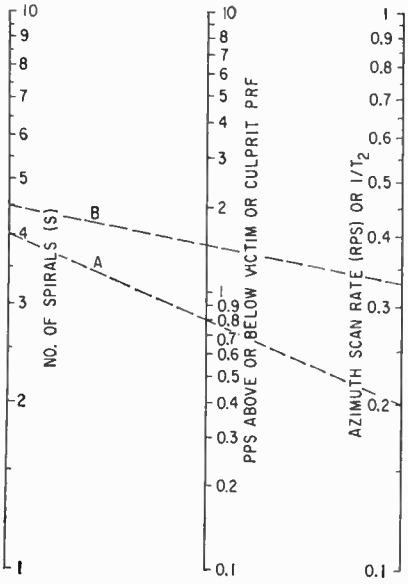

FIG. 2—Differences between prf's is function of S and either scan rate or $1/T_2$

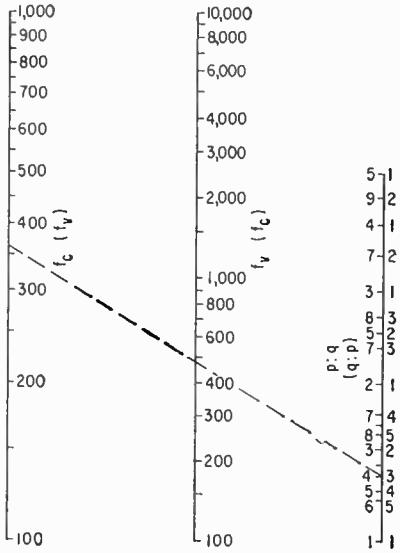

FIG. 3—Fractional-frequency relationship between victim and culprit radars

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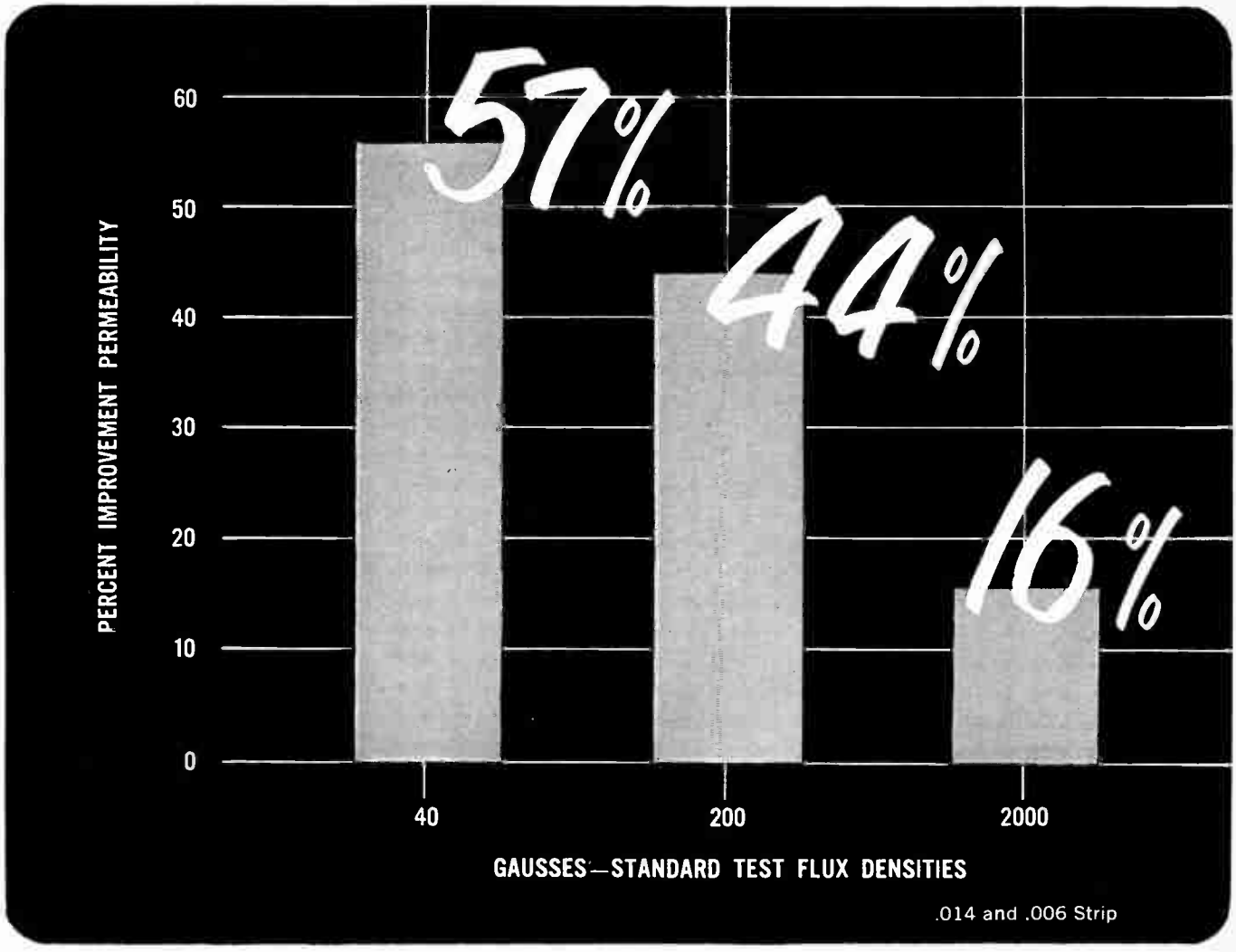

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Plasma Study May Open Radio Bands

FURTHER INSIGHT into nuclear fusion and a bonus of generating and amplifying frequencies between the microwave and infrared ranges may be the results of recent experiments. The research program led to successful reproduction in the laboratory of one of the ways in which the sun generates and amplifies radio signals powerful enough to be picked up millions of miles away by radio telescopes.

California Institute of Technology engineers conducted the study with support of the Office of Naval Research and the Army Signal Corps.

Corona

Certain features of the sun's outer atmosphere, or corona, were simulated and were able to amplify radio signals 100 to 1,000 fold. Success of the experiments verifies a long-held theory of one of the ways in which the sun produces the roaring hiss which has been picked up by radio telescopes. Previous attempts to substantiate this theory had failed.

The research began three years ago by developing vacuum tubes containing a plasma which was at a lower temperature but the same density as the corona atmosphere. Temperature of the corona, several million miles above the sun's surface, is estimated to be 1,000,000 F. However, the engineers decided it was not necessary to attempt to duplicate the corona's high temperature to produce the amplification process.

Amplification Mechanism

It was believed that one of the key mechanisms for producing the sun's radio signals came from outbursts of particles from the solar surface and that these caused radio noise signals to be amplified as they went through the corona en route to outer space.

In the experiments, mercury gas was introduced into the vacuum tube and an electric current was passed through it. This formed the plasma of the gas, similar to the sun's corona. The plasma is formed when the temperature of a gas is raised to the point at which its atoms start coming apart. The first symptom is when electrons break loose from their atoms and dart about freely in the gas.

The vacuum tubes are designed so that a continuous beam of electrons can be fired through them. Some previous researchers also had fired beams through the plasma in hopes of generating radio waves. However, because they did not send the electron beam through the plasma in high frequency bunches, they failed.

In the present program this was done in two different ways and success was achieved with both methods. The high-frequency energy was applied on the beam and also on the plasma. In both instances, the plasma jiggled with jelly-like oscillations as the electron beam was shot through it.

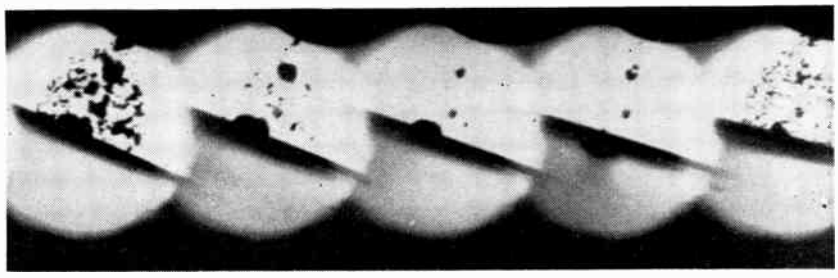
In passing through the jiggling two inches of plasma, the high-frequency waves were amplified up to 1,000 times. In effect, the jiggles intensified the waves of electrons in the beam.

Applications

This method of amplification is actually not too efficient. Man has developed other ways to amplify radio signals more effectively. However, the investigation opens the possibility of using the electron beam to find out more about plasmas—the so-called fourth state of matter (with solid, liquid and gas) —which are involved in developing nuclear fusion power. One idea would be to shoot electron beams through different plasmas and observe how the plasmas change the beam. Another would be to look for radio signals generated when the beam interacts with the plasma in a related but different fashion.

The group is also investigating the possibilities of using the mechanism to develop amplifiers and oscillators at higher radio frequencies than now possible—frequencies between the microwave and infrared ranges. These would be useful in the diagnosis of plasmas intended for fusion energy research, in research on molecular structure and to open up possible new radio communications bands.

Fast Camera Shows Metal Fatigue



Collapse of cavitation bubbles against surface of plastic bar generates damaging strain waves. Electronic techniques control Ellis camera at Calif. Institute of Technology to get exposures of about 1/20μsec with intervals of 1/200 millsec between photos. Four photos at left show progressive stages of collapsing cloud of bubbles, with fourth picture catching strain wave in plastic (shadow bulge below surface of plastic and by fainter shadow fanning out below it). Right photo shows new cloud of bubbles forming. Continual pounding of collapsing bubbles fatigues toughest metals

Circuit Substitutes As Larynx

EXPERIMENTAL artificial larynx has been announced by Bell Laboratories for persons who have lost their voices through surgical removal or paralysis of their vocal cords. Great impetus to development of the device was given by the National Hospital for Speech Disorders.

With limited difficulty and training, patients are said to be able to use the electronic larynx to speak

Vital equipment in this Jupiter missile is protected 24 hours a day, month after month, by a specially designed Ellis and Watts refrigerated-type Dehumidifier. In the various compartments of the Jupiter missile this E-W Unit constantly maintains perfect environmental conditions during long periods of standby and storage. Without this specialized Dehumidification Unit, moisture and condensation could cause deterioration of vital equipment and one of our most important weapons would never even get off the ground !

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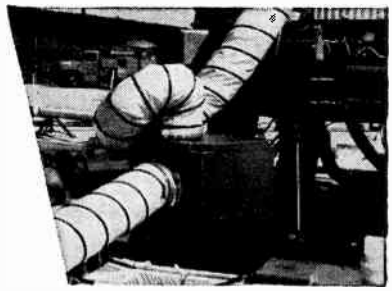

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conversationally. It is especially effective when conversing over the telephone.

Using a finger-operated combination push-to-talk switch and inflection control, the user can easily control pitch of his artificial voice, giving his speech a natural sounding quality previously unobtainable.

Operating Principle

The underlying principle of the new artificial larynx is a transducer held against the throat. Self-contained and cylindrically shaped, it measures only 1¾ inches in diameter by 3½ inches long—sufficiently unobtrusive for the user.

Included in the package is a modified telephone receiver serving as the throat vibrator or transducer, a transistorized pulse generator with pitch control and a battery power supply. To miniaturize the artificial larynx, experimental units were built using modular techniques. However, by using printed-circuit techniques it is anticipated that an even more compact unit can be built.

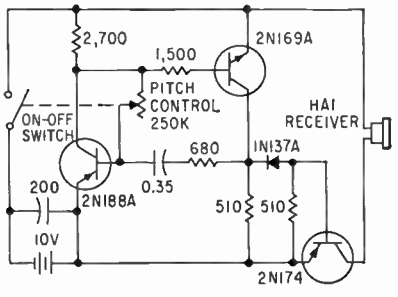


FIG. 1—Multivibrator and single-ended output amplifier provide good compromise between maximum output power and minimum current drain

In operation, the user presses the vibrator against his throat. Switching on the pulse generator with his finger, he transforms vibrations transmitted into his throat cavities into speech sounds by normal use of the articulatory mechanisms—throat cavity or pharynx, tongue, mouth, teeth and lips.

Output speech volume is equal to that of a person speaking at a normal conversational level, though the sound is a bit buzzy and mechanical. Nevertheless, the frequency spectra of vowel sounds show that the frequency range transmitted into the person's throat is sufficient for satisfactory production of such sounds. Users of the new device can achieve

a sentence intelligibility of 97 percent or more, depending on their experience.

Circuit

Because the artificial larynx requires an economical, self-contained power source, parameters had to be adjusted to yield maximum acoustic output with minimum current drain. Accordingly, two transistors are used in a relaxation oscillator whose frequency is controlled by a variable resistor and whose pulse width is determined by a feedback network, as shown in Fig. 1.

Output is a negative pulse which occurs at a frequency of about 100 cps. This repetition frequency may be varied from about 100 to 200 cps by a rheostat which the user operates by pressure on the push-to-talk switch—or inflection control—while speaking, thus changing the pitch of his voice. For use by women, the frequency range is adjusted to 200 to 400 cps, to correspond with the normal range of a woman's voice.

A third transistor acts as a single-ended power output stage that amplifies the pulses applied to it from the relaxation oscillator. A diode isolates the multivibrator from the power amplifier input impedance during the period between pulses and is necessary for stable operation. Because a large pulse is required for sufficient acoustic power output at low frequencies, the oscillator drive circuit has heavy current requirements.

Two 5.2-v mercury cells in series provide the power necessary to operate the device continuously for a period of about 12 hours. These batteries have a 250-ma hour rating with maximum permissible current drain of 25 ma. With push-to-talk operation such as the patient requires, 12 hours of continuous operation should be equivalent to several days or even weeks of normal talking.

An alternative to using the self-contained mercury cells for powering the artificial larynx is a small a-c power supply which can be fed from a normal wall outlet at home or in the office. When the artificial larynx is plugged into the power supply, its batteries are disconnected from the circuit.

Power Divider Splits Signal N-Ways

By ERNEST J. WILKINSON, Electronics Dept., Missile Systems Lab., Sylvania Electronic Systems, Waltham, Mass.

IN THE FIELD of phased arrays, there are many applications for a simple, compact power divider which splits a signal into n equal parts where n may be odd or even. At the Sylvania Missile Systems Laboratory, an experimental eight-way power divider has been built which preserves equality of phase and amplitude of the outputs independent of frequency, and also provides isolation between outputs over a limited range of frequencies. All terminals are matched to their respective loads over the same band.

The power divider has a minimum isolation of −27 db between any pair of output terminals, an output vswr of 1.6, and an input vswr of 1.2.

The power divider, shown in Fig. 1, consists of a coaxial line in which the hollow inner conductor is split into n equal splines of length $\lambda/4$. One end of each spline forms an output terminal connected to the other output terminals by resistances R_x. The other end of the splines are shorted together at the input end of the power divider, and then tapered down to a standard connector to reduce discontinuity capacitance.

Power entering the input terminal divides symmetrically at the junction of the splines and travels along the equilength transmission lines formed by each spline and the outer shell to provide equiphase, equiamplitude signals at the output terminals independent of frequency.

Cables here shown being connected to power divider, lead to elements in helical antenna array

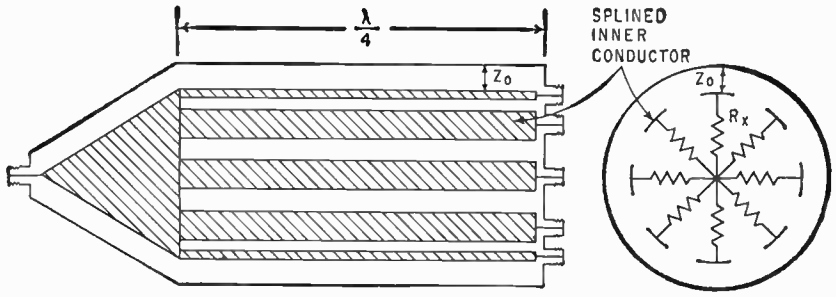


FIG. 1—Schematic shows construction of N-Way Hybrid Power Divider

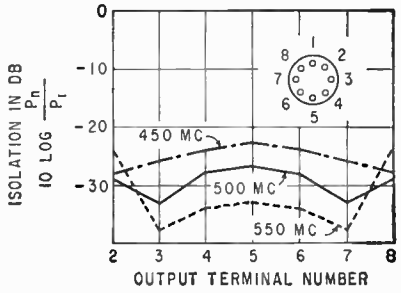


FIG. 2—Plots of isolation between output terminals

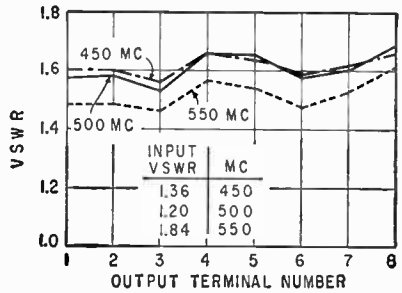


FIG. 3—Voltage standing wave ratio at output terminal

If a signal is reflected back into one of the output terminals, a portion of it travels back to the common junction where it splits up between the generator and the n-1 remaining outputs, the remainder of the reflected signal being coupled directly to the other outputs through the resistors.

The two signals are made to cancel each other by proper choice of R_x and the characteristic impedance Z_o of the line formed by each spline and the outer shell.

The conditions for isolation are $Z = \sqrt{n}\, R_o$ and $R_x = R_o$ independent of n.

Isolation and Vswr

Figures 2 and 3 show the isolation and vswr characteristics. Isolation is a minimum of −27 db at the design frequency of 500 mc. Figure 2 shows that isolation between output terminals is not uniform at all frequencies but tends toward uniformity between 450 and 500 mc. Isolation is given with respect to terminal 1. The isolation between a pair of output terminals at all but the center frequency can be shown to be dependent upon the shunt impedance of the short circuited line formed by the corresponding pair of splines. In general, the lower this shunt impedance, the less the isolation. Because of the geometry of the power divider, splines 1-2 cannot have the same characteristic impedance as 1-3, 1-4 or 1-5 and therefore the shunting effect is different for each. At the frequency for which the splines are a quarter wavelength long, however, each shorted line has an infinite impedance independent of its characteristic impedance, and all terminals behave alike from an isolation standpoint.

Other factors which complicate

after routing, clip and save

a continuing series on technical topics of specific interest to engineers

Folio 59-5 REFERENCE DATA FILE SANGAMO

Important factors in specifying toroidal inductors

The powdered molybdenum permalloy toroidal inductor is finding increasing use in today's complex electronic equipment. Excellent magnetic stability, superior temperature stability, high Q values, and small physical size are but a few of the outstanding features which explain the popularity of molybdenum permalloy toroids. To fully realize the advantages of these inductors, the components application engineer must accurately specify those parameters which are of critical importance in a given application. "Under-specification" may result in a component which fails to give adequate performance in the circuit. "Over-specification", on the other hand, may result in a component of extremely high cost. An understanding of the factors involved in the design and manufacture of toroidal inductors at Sangamo will enable the components application engineer to effectively judge the consequences of his specification in relation to the cost and performance of the final product.

THE EQUIVALENT CIRCUIT of a toroidal inductor is illustrated in figure 1.

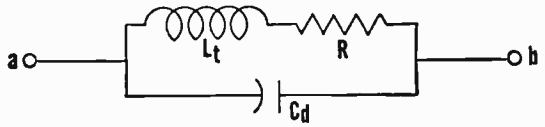


FIGURE 1

L_t is the so-called "true inductance" of the toroid and is assumed to be constant at all frequencies. R represents the sum of copper losses and core losses which increase with frequency. C_d, the distributed capacitance, approximates the capacitance between turns of the winding and between the winding and core. Due to the fact that the dielectric constant of the insulation on the windings and on the core itself is not constant with frequency, the distributed capacity will also vary with frequency. This variation, however, is usually small and may be neglected in the following discussion.

THE APPARENT INDUCTANCE (L_a) is the equivalent inductance between terminals (a) and (b). As might be expected, the apparent inductance varies with frequency. If R is neglected the expression for L_a becomes:

$$L_a = \frac{L_t}{1 - \omega^2 C_d L_t}$$

Inductors for single frequency or resonant circuit applications are usually specified in terms of apparent inductance. The standard tolerance on L_a is 1% or one turn whichever is greater.

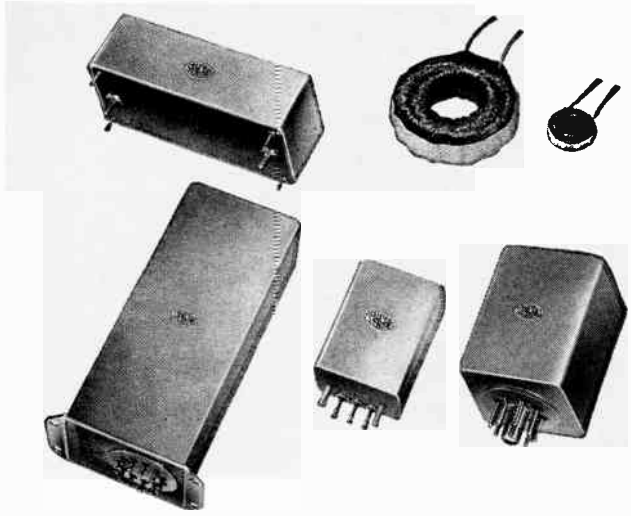
THE Q FACTOR is usually specified in lieu of R since most applications are concerned with the ratio of inductive reactance to equivalent resistance. The accepted method of specifying Q is to set a limit on minimum Q at the operating frequency or over a range of frequencies. Normally, the Q of a given design at a given frequency will vary some 20% between units. Where direct current flows through the inductor it may sometimes be desirable to set a limit on the d-c resistance as well as on Q. Analysis of the equivalent circuit, assuming constant R, shows that:

$$Q_{equiv} = \frac{\omega L_t}{R} - \omega R C_d - \frac{\omega^3 L_t^2 C_d}{R}$$

From the above equation one may deduce that anything which increases the distributed capacitance must necessarily reduce the Q.

DISTRIBUTED CAPACITY becomes most important in wide band or multiple frequency applications, since C_d will determine the variation of L_a with frequency. The majority of users do not find it necessary to specify C_d. Where C_d must be specified, the accepted method is to set a limit on the maximum allowable distributed capacitance. An alternative method of specifying C_d is to set a tolerance on the apparent inductance to be measured at two different frequencies (usually corresponding to the upper and lower frequencies encountered in a given application). The design engineer controls the C_d by varying the method of winding the inductor. In decreasing order of capacity he may choose 1) random continuous windings; 2) progressive winding, or segmented winding. Unfortunately, winding costs increase as distributed capacity decreases. Wax or varnish impregnation will increase the distributed capacity. In applications where it is necessary to insure that L_a be reasonably constant over a wide frequency range, it is also usually desirable that L_a be reasonably constant with temperature and with time. These features are best achieved using a stabilized core, a low capacity winding, and an unfilled hermetically sealed enclosure. In this way, the undesirable effects of impregnation may be avoided.

REQUIREMENTS FOR STABILITY OF INDUCTANCE with temperature, with a-c voltage level, and with direct current are additional factors which will influence the cost and the size of a given inductor. Temperature stabilized cores are available only in certain core sizes and are, of course, more expensive than the standard unstabilized cores. High values of a-c voltage and direct current will lead to larger cores and increased cost.



The Sangamo design engineering department is ready to discuss your inductive components problems. Typical examples of specialty components designed and produced by Sangamo are described in engineering bulletin series IC-260. Address: Sangamo Electric Company, Inductive Components Section, Springfield, Illinois.

SC-59-5

SANGAMO ELECTRIC COMPANY, Springfield, Illinois

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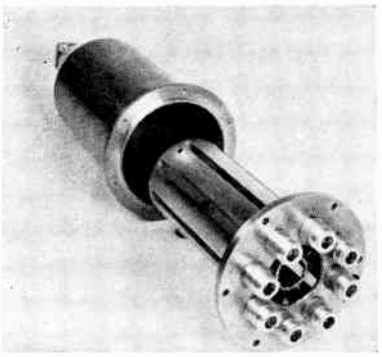


Power divider used at Sylvania's Missile Systems Laboratory in connection with a phased array program

the situation are the finite diameter of the line which may be appreciable in wavelengths causing the center frequency to be slightly below that for which the length of the splines is $\lambda/4$, and the reactive nature of the resistors used.

The 50-ohms resistance found to work best at 500 mc was a parallel combination of three 150-ohm one-half watt composition resistors. At all frequencies the ratio of power out at any output terminal to the power into the divider was checked and found to be −9db.

High-Definition Photomultiplier

DESIGNED specifically for use when exceptionally high definition is required in scintillation counting and nuclear-radiation spectrography, the 56AVP Mullard tube is now available in limited quantities from Mullard Ltd., London.

In the 56AVP, transit time differences under typical operating conditions are kept down to 0.3 millimicroseconds, an improvement of about 100 times over normal types of tube. As a result, the width of the output pulse delivered by the tube can be as little as 2 millimicroseconds at half height, and the rise time of the same duration.

Electron Optics

Reduction of transit time differences is due largely to a specially-designed input electron-optical system consisting of photocathode, a focussing electrode, an accelerator and a deflector plate.

The photocathode is curved so that the path lengths to the first multiplier stage are about equal for electrons leaving any part of its

useful area. The focussing electrode and accelerator concentrate the electrons into a single narrow path, and compensate for inequalities in their initial velocities. The deflector plate directs the electrons onto the first of the secondary cathodes.

Table I—Photomultiplier 56AVP

PHOTOCATHODE, end-viewing	
Min. useful dia	42mm
Peak spectral response	4,200A ±300A
Average sensitivity	50μamps/lumen
MULTIPLIER	
Min. gain at total v of 2kv	10^8
Max. peak anode current	1A
Aver. anode sensitivity at 2kv	5,000A/lumen
Dark current at 10^8 gain	<5 μamps
Output pulse at 2 kv	
rise time	2 millimicrosecs
width at half height	2 millimicrosecs
MECHANICAL	
Max overall height	190mm
Max seated height	175mm
Max diameter	55mm
Base	20-pin

Uniformity of transit times to the first multiplier stage is maintained throughout the tube by careful shaping of the secondary cathodes, and by additional focussing electrodes, situated between each multiplier stage, which progressively narrow the electron beam from stage-to-stage despite the rapid growth in the number of electrons.

The peak anode current provided dispenses with an external amplifier. The very high anode currents delivered by the tube are made possible by a 14-stage multiplier that incorporates opaque, silver magnesium secondary cathodes.

Ferrite Isolator

THE FIRST of a new line of ferrite isolators for radar systems and laboratory uses is available from the Solid State Electronics Department of the Motorola Military Electronics Division at Phoenix, Arizona.

The ferrite isolator is for 6,575 to 6,875-mc C-band applications. Isolation loss is 40 db, insertion loss 1 db, and the vswr is 1.2. The unit is rated for a nominal ambient temperature range of 130 to 160 F, weighs two pounds, and is five inches long.

Extra Cation Unit Purifies Water

DEMINERALIZED WATER of 18 to 20 million ohms purity is obtained for semiconductor device processing, through use of an additional cation exchanger, reports Bogue Electric Manufacturing Co., Paterson, N. J.

City water is processed in 6 steps. Additional chlorine is added since the amount in tap water is insufficient to oxidize organic matter. An activated carbon filter absorbs chlorine and removes color resulting from organic material.

The water flows through cation and anion exchangers, then through a second cation unit to prevent alkalinity. It is now rated at 1 million ohms and is slightly acidic. This water is stored in a stainless steel tank and is used in relatively large quantities for general rinsing. Capacity of the system is 20 gallons a minute.

Polishing Unit

Smaller amount of final rinse water is provided by a mixed bed demineralizer polishing unit consisting of polystyrene resin and quatenary amine beads in a glass column, producing 18 to 20 million ohm water. Since the unit is supplied million-ohm water, it will last about 2 years under normal demand.

Details of demineralizing systems will vary depending on local water conditions. A flow diagram for a 75 gpm semiconductor plant system, also built by Bogue's Belco Industrial Equipment Division, is shown in Fig. 1.

City water is filtered by Cape May sand and gravel (round particles prevent excessive packing) and 10 by 20 mesh activated carbon.

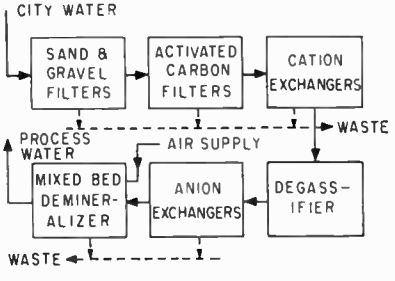
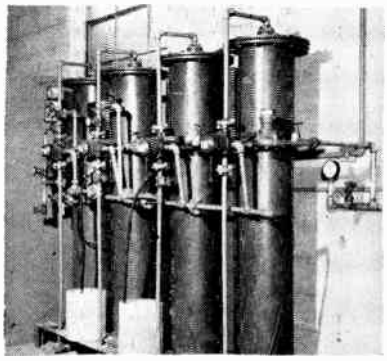
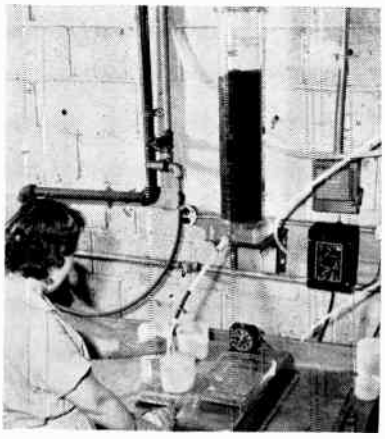


FIG. 1—Flow diagram of water purifying system used in semiconductor plant



Activated carbon, cation, anion and cation units (from right) of 20 gpm system



Mixed bed demineralizer (right photo) in glass tank supplies final rinse water

The cation exchangers contain polystyrene resins. The degasifier removes carbon dioxide to increase the capacity of the divinyl benzine (weak base) anion exchanger. A strong base material may also be used in the anion exchanger.

The mixed bed demineralizer contains polystyrene resin and quatenary amine. To regenerate the mixed beds, the lighter cation material is separated hydraulically from the anion material. They are treated and remixed, using air.

The system contains 2 of each filter, 3 of each type of demineralizer and 1 degassifier. The additional units provide uninterrupted service capacity during regeneration.

Backoff Protects Crystal Wafers

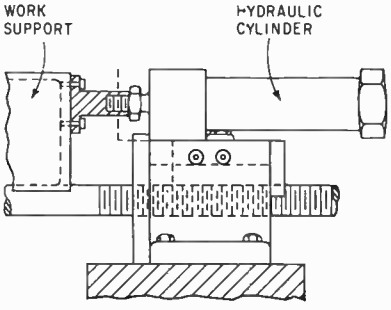
AUTOMATIC BACKOFF mechanism is used in an automatic semiconductor crystal slicing machine recently developed by Fitchberg Engineering Corp., Fitchburg, Mass. The backoff (Fig. 1) prevents imperfections in the crystal surface.

After the spindle makes the plunge cut, the hydraulic cylinder backs the entire work support (including the indexing mechanism) 0.01 inch away from the wheel. The spindle can then be raised without marking the crystal. The cylinder also takes out backlash in the indexing mechanism while the cut is being made.

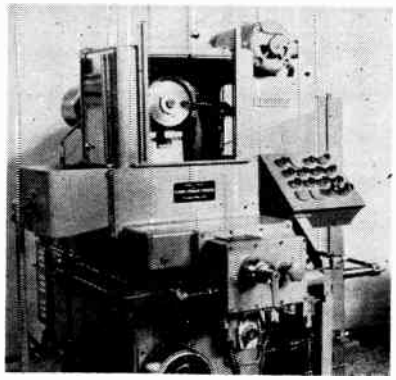
Spindle speed is controlled up to 9,200 rpm by a Variac. Cutting wheel downspeed is regulated by a flow control valve which can be locked after adjustment. An oversized precision spindle is used to reduce diamond wheel wear. The machine's weight, 2,800 pounds, helps prevent vibration.

The machine is being used by Sylvania Electric Products, Inc., Woburn, Mass. Cutting performance reported by Jack Robertson, supervisor of germanium preparation, is: wafer thickness can be adjusted from 0.025 to 0.007 inch, ±0.0005 inch. Wafers are uniform and do not break.

Two wafers may be sliced at a time from ingots up to 4 inches long. The ingots are oriented and mounted on a steel plate with adhesive. Diamond wheels from 0.01



Mechanism which backs cutting wheel away from crystal's cut surface



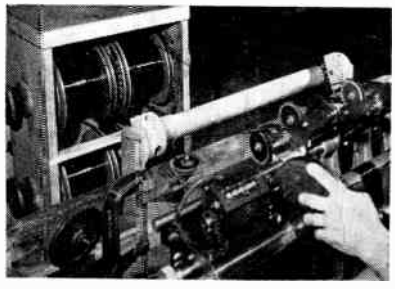
Automatic crystal slicer. Wafers drop into wire basket not seen

to 0.020 inch thick are used. The coolant is water mixed with a water-soluble oil. Continuous coolant flow is provided by a constant displacement pump.

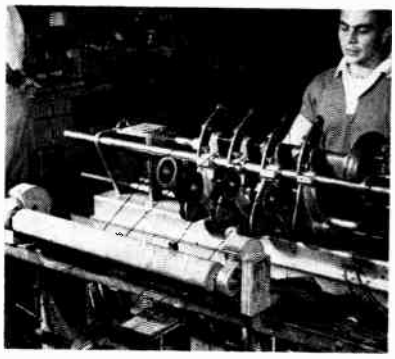
Tension Box Assists Square Wire Winding

MULTIPLE-WINDING of large square magnet wires is less difficult when the wire is pretensioned and oriented before it is brought into winding position. Twisting of the wire is prevented.

Magnetic Amplifiers, Inc., New York, N. Y., uses the setup shown with a stock multiple winder. In addition to time and labor saved, all coils in a group are balanced,



Roller lines up wires coming from tension box



Roller and pulleys set for multiple winding of 4 coils

with the same tension, number of turns and spacing, improving product reliability.

The reels of wire are mounted on rollers in a sturdy wooden box. Strapping is bent around the rims of the reels and snugged to the box with turnbuckles. This provides an adjustable pretension on the wire.

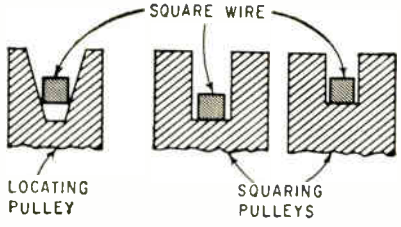
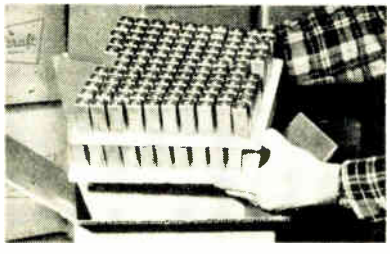


FIG. 1—Types of pulleys used with square wire

The wires are passed under a wooden roller which brings the wires in at approximately the same angle. The wires then pass through locating and squaring pulleys mounted on the winder's automatic tensioning arms (Fig. 1).

The pulleys are demountable so they can be changed to accommodate different wire sizes. There can be clearance in the pulleys, but not enough to allow wires to twist.

Foam Plastic Trays Handle Small Parts



Tray is placed over prongs of 116 components

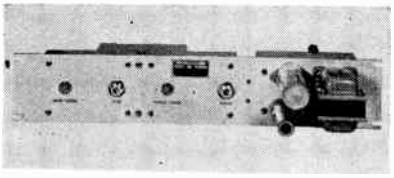
PACKAGING TRAYS of expanded polystyrene do triple duty for Coilcraft, Inc., Cary, Ill. They provide for in-plant handling, lightweight cushioning in shipping packages and handling in customers' plants.

Coils, transformers and other small parts are stacked in a shallow box with prongs up. Foam tray is placed over the prongs and pressed down with a block.

Trays shown are by Polyfoam Packers Div., Glo-Brite Foam Plastics Products, Chicago, Ill.

On The Market

UHF Preamplifier low noise



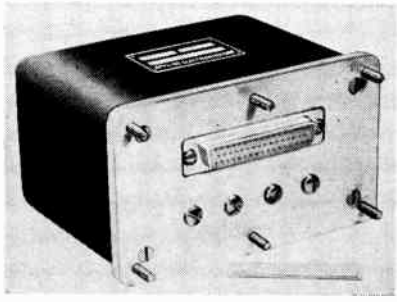
RIXON ELECTRONICS, INC., 2414 Reedie Drive, Silver Springs, Md., announces a uhf preamplifier with a noise figure of 4-5 db and a 20 db gain at an operating frequency of 400-500 mc. Model AP-710-1 is designed to operate with a 50-ohm source and load impedance. Unit uses two MIL-type GE subminiature ceramic planer triodes (type 7077) in a two-stage grounded-grid configuration. The compact amplifier package (19 by 3½ in.) includes a self-contained power supply.

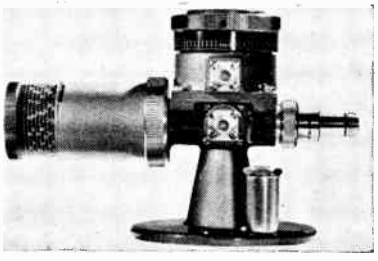
CIRCLE NO. 200 READER SERVICE CARD

Multicoders weigh 2¾ lb

APPLIED ELECTRONICS CORP., P. O. Box 43, Metuchen, N. J., has available a series of low level telemetry multicoders in any standard IRIG switching configuration for pam and pdm systems. Equipment is designed to withstand missile environments and features all solid state circuitry, an a-c coupled amplifier, no power inverter and uses a standard form of sampling switch with an electronic speed regulator. The switch is hermetically sealed. A mixed high and low level system is available for 90 channels utilizing a synchronized electronic commutator for the high level section.

CIRCLE NO. 201 READER SERVICE CARD





S-W Detector coaxial

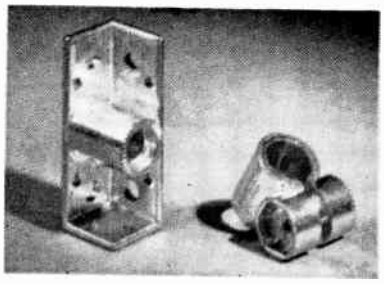
POLYTECHNIC RESEARCH & DEVELOPMENT CO., INC., 202 Tillary St., Brooklyn 1, N. Y. Designed to obsolete huge 8-ft units, the type 219 coaxial standing wave detector measures impedance and vswr from 100 to 1,000 mc. The rugged, low-cost unit provides direct reading of vswr; direct reading of reactive component sign; adaptability to most coaxial lines, including the LT and the new TNC series; and matched load for self-calibration is also supplied.

CIRCLE NO. 202 READER SERVICE CARD

Encoder Assembly small, lightweight

DATEX CORP., 1307 So. Myrtle Ave., Monrovia, Calif. Resolving shaft positions to 1 part in 10,000 can now be obtained with the CG-701 geared encoder assembly. Designed for use where minimum size and weight are important, the assembly uses two shaft position encoders and a gear box. The encoder used on the input shaft provides 1,000 positions of the least significant digit per 360 deg rotation. Because the disk of this encoder is coupled directly to the input shaft, accuracy is that of the encoder used (±1 count). This input unit is then geared 10:1 to a 10-position encoder.

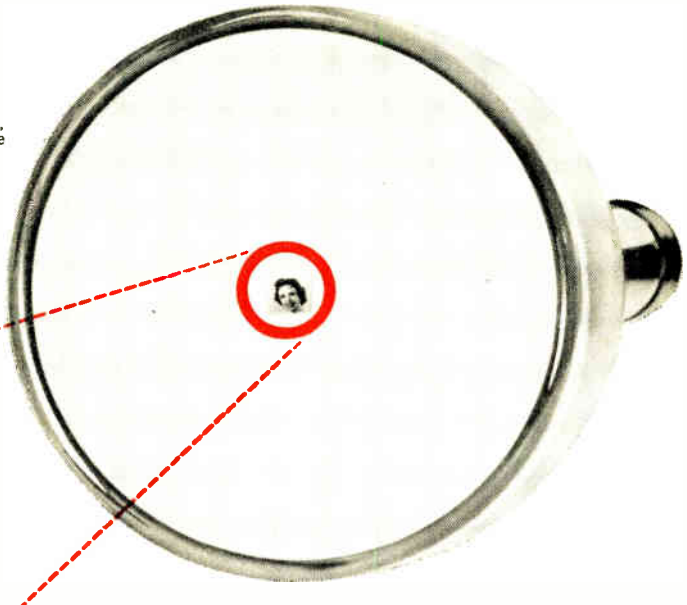
CIRCLE NO. 203 READER SERVICE CARD



Clamp Fastener structural unit

VERSA-LOC CORP., Southern Blvd., Chatham, N. J., introduces Versa-Loc, a versatile laboratory and industrial device for building, mounting, supporting, holding or clamping. It is a structural system consisting basically of a mounting angle and a clamp. The clamp is available in four variations: for ½ in. rod or tubing, ¼ in. or ⅜ in. pipe, and for ⅜ in. BX (fitted with a rubber grommet to insulate and protect the wires at the cable exit). The angle is provided with tapped holes on two sides for mounting micro

Actual size,
3-inch ultrahigh-resolution tube



Now... 262 Square Inches of information in 1/20 Square Inch!

New CBS ultrahigh-resolution tubes, for example, can compress into 0.047 square inch all the detail on a 21-inch picture tube screen. This is twice the resolution previously attainable . . . resolution far beyond the capabilities of the unaided human eye and modern printing. And the closest yet to the resolution of modern photographic film.

MANY APPLICATIONS NOW POSSIBLE Many new and advanced applications become practical in strip radar • photo reconnaissance • visual indication • photo reproduction • information transfer • industrial and medical closed circuit TV • remote data pick-up • information conversion • etc.

12 CBS UHR TUBES IN PRODUCTION

These tubes offer a choice of four resolution levels . . . three screen sizes . . . and three screen phosphor characteristics. They are even more rugged and dependable than standard oscilloscope tubes. And they can be supplied with interchangeable yoke, focus coil and video driver stage to achieve maximum resolution. Check the table for summary data. Write for complete technical Bulletin E-330 and information regarding your particular application.

TYPE NUMBER	RESOLUTION (Lines per Inch)	SPECTRAL COLOR	PERSISTENCE TIME
3AVP5	1500	Blue	Very Short
3AVP11	1000	Blue	Short
3AVP16	500	Near UV	Very Short
3AWP5	2000	Blue	Very Short
5CQP5	1500	Blue	Very Short
5CQP11	1000	Blue	Short
5CQP16	500	Near UV	Very Short
5CRP5	2000	Blue	Very Short
7AVP5	1500	Blue	Very Short
7AVP11	1000	Blue	Short
7AVP16	500	Near UV	Very Short
7AWP5	2000	Blue	Very Short

More reliable products through Advanced-Engineering

CBS® tubes

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

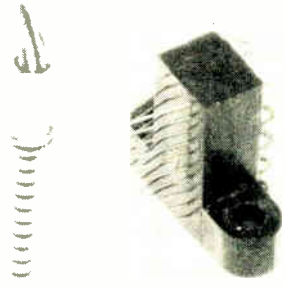
type switches, and with mounting holes for No. 10 screws. It serves both as the jump-off point and as an end point mounting device.

CIRCLE NO. 204 READER SERVICE CARD

Display Tube compact unit

WESTINGHOUSE ELECTRONIC TUBE DIVISION, P. O. Box 284, Elmira, N. Y., announces a new nine-pin display tube (7AUP4) designed for airborne and monitor applications. The 7-in. diameter tube features a small ¾-in.-diameter neck for decreased deflection power. Overall length is 8¾ in. and tube is of the electrostatic focus, magnetic-deflection type. Deflection angle is 70 deg. The tube has a P-4 phosphor and a metal-backed screen and can be furnished with a potted anode lead.

CIRCLE NO. 205 READER SERVICE CARD



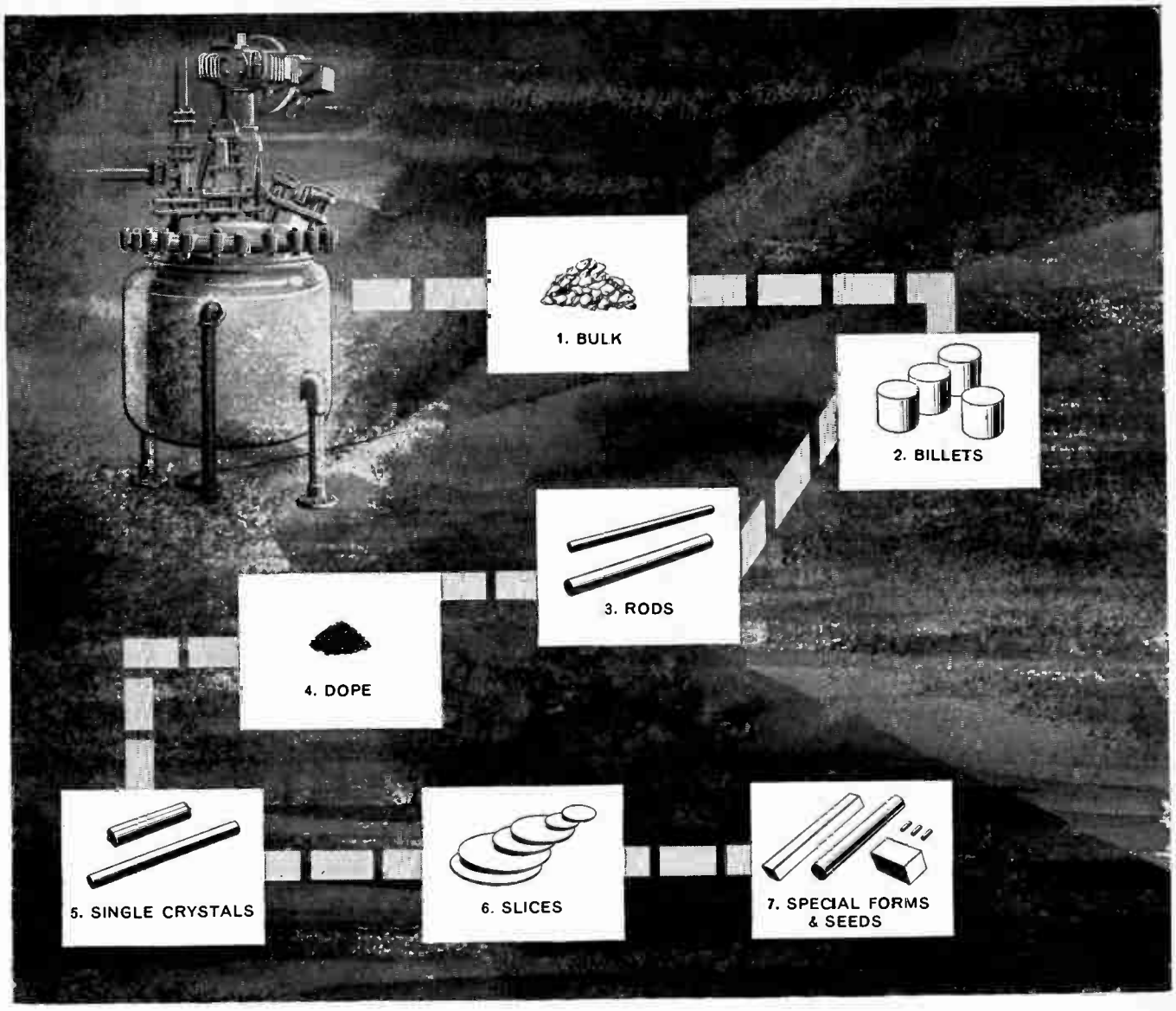
Slip Rings small size

POLY-SCIENTIFIC CORP., Blacksburg, Va., has established new standard lines of slip rings. The AC258 line, one to ten rings, has o-d of 0.081. The AC263 has o-d of 0.220, range of one to 37 rings. Both use coin gold rings, stainless steel backshafts and Poly-Scientific formulation plastics. Companion brush blocks are available for either line.

CIRCLE NO. 206 READER SERVICE CARD

Microminiature Pot high precision

DEJUR-AMSCO CORP., 45-01 Northern Blvd., Long Island City 1, N. Y. A new ½-in. precision pot features a one-piece metal case and bearing design eliminating any need for special assembly precautions. These components are completely enclosed



SILICON... *any way you want it!*

Is there any good reason why you shouldn't obtain all forms of silicon you want from a *single* source?

Up to now the answer to that question was simple: No one firm offered a complete silicon supply facility.

But that is no longer true because from Allegheny you can now obtain silicon in every form. Here are the facts:

1. BULK — The bulk polycrystalline silicon you get from Allegheny comes in four grades, three semiconductor, one solar. Each requires a minimum of doping, exhibits a high degree of uniformity and shows a significantly low boron level.

2. CAST BILLETS — Cut to charge size for Czochralski furnaces and in standard sizes up to 2″ in diameter.

3. CAST RODS. — For float zoning, you get uniformly dense cast rods in standard sizes up to 1″, with lengths entirely dependent on your requirements.

4. MASTER DOPING ALLOYS — These are made from extremely pure silicon, using 99.999% or better elemental dope. They are alloyed in different ranges, and in homogeneous lots of sufficient size to allow for long term standardization in your production doping procedures.

5. SINGLE CRYSTALS — Custom processing of single crystals is a basic service from Allegheny. We will dope to your specifications and grow in Czochralski or float zone furnaces, again depending on application.

6. SLICES — You can get slices to meet any surface requirement since Allegheny has both the know-how and facilities for slicing, lapping, and finishing. And 100% testing is your assurance that the slices completely meet your specifications.

7. SEEDS & SPECIAL FORMS — You tell us your mounting and other physical requirements and we will provide the shapes and forms, cut ultrasonically. All seeds are oriented optically to ½° (or better) to the (111), (110), or (100) plane.

Analyze your current silicon supply arrangements. Consider that *only* Allegheny provides every form of silicon you need. Doesn't it look like now is a good time for you to get all the facts from the people at Allegheny? Write, wire, or phone.

producers of semiconducting materials for the electronics industry

ALLEGHENY

ELECTRONIC CHEMICALS CO.

207 HOOKER-FULTON BLDG., BRADFORD, PA.
252 NORTH LEMON STREET, ANAHEIM, CAL.

by unique molded covers with integrally cored, solid terminals that cannot loosen or transmit solder, resin or other foreign matter into the unit. Completely sealed covers and "O" ring sealed shafts are available for maximum resistance to corrosive environmental conditions. Multifinger precious metal contact brush is another exclusive feature.

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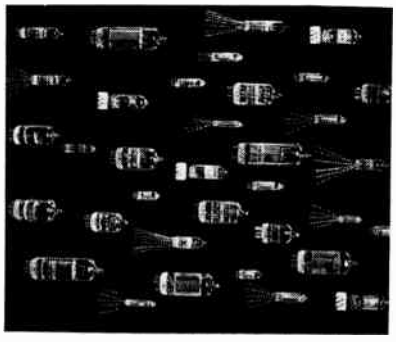

Small Tubes expanded line

SONOTONE CORP., Elmsford, N. Y. Illustrated are some of the approximately 100 types of electronic tubes now available. The expanded line includes miniature and subminiature tubes for commercial, military and entertainment purposes. Three of the reliable types —6J4WA, 5840 and 5639—are manufactured under the U. S. Army Signal Corps RIQAP (Reduced Inspection Quality Assurance Program), monitored by the U. S. Army Signal Supply Agency.

CIRCLE NO. 208 READER SERVICE CARD

Foil-Wound Coils many applications

SYLVANIA ELECTRIC PRODUCTS INC., Ipswich, Mass., has introduced a line of foil-wound coils for electronic equipment, offering greater application flexibility than conventional wire-wound coils. The new wafer coils are particularly suitable for use with twt's, klystron electromagnets, maser devices, and beamed-deflection magnets. The wafer coil's thinner insulating layer, combined with copper or aluminum foil, makes possible greater heat and space utilization efficiencies. The new coils can be

Al Mitchell takes the stand for electronics

I. Allen Mitchell is President and a founder of United Transformer Corporation, a company which placed its first advertisement in electronics more than 25 years ago.

United Transformer manufactures 700 stock items for virtually every application in the electronics field. Mr. Mitchell is a graduate engineer who entered college at the age of 14. At 16 he was the chief engineer of a transformer company and at 18 the director of engineering.

Do you, Mr. Mitchell, directly or indirectly influence the purchase of electronic equipment for your organization?

Naturally, I do.

Do you use the electronics BUYERS' GUIDE as your source book for electronic purchases?

Yes. I keep it available in my office at all times.

How long have you been a subscriber to electronics?

Since the day of its inception.

Why have you continued to pay for electronics when you can receive ten other electronic publications free?

To me electronics has a peculiarity. It has excellent technical coverage. It has the most pages of advertising, and naturally I want to keep abreast of the industry in terms of the products shown in the ads.

For a number of years your company has reserved the inside front cover of electronics for its sales messages. What is behind this decision?

Basically, we are a key manufacturer in our field for engineering products. As such we prefer to maintain a prestige position in the prestige magazine of our industry.

If it's about electronics, read it in electronics

electronics

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ABC ABP

CIRCLE NO. 104 READER SERVICE CARD

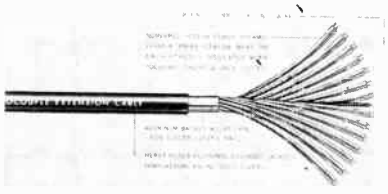
used in multiples. Tube appendages and r-f connectors can pass directly through the windings of the coil, which is impossible with wire-wound coils.

CIRCLE NO. 209 READER SERVICE CARD

Silicon Rectifiers two types

COLUMBUS ELECTRONICS CORP., 1010 Saw Mill River Road, Yonkers, N. Y., announces magnetic amplifier and high voltage type silicon rectifiers produced by the double diffusion process. Both are available in hermetically sealed, axial lead, top hat design. The magnetic amplifier types feature extremely low leakage and low forward drop for use in circuits where extremely low reverse currents are of prime consideration. Features of the high voltage types include use for h-v power supplies, h-v blocking applications and clipping circuits.

CIRCLE NO. 210 READER SERVICE CARD



Extension Cable multiconductor

THERMO ELECTRIC CO., INC., Saddle Brook, N. J., has developed Thermo-Cable, a new type of polyvinyl insulated multiconductor cable for 6 to 56 pairs of thermocouple conductors. It is much easier to handle and less expensive to install than individual pairs of thermocouple extension wire. Its outer polyvinyl chloride jacket resists moisture, abrasion, heat, and chemical action. Each conductor is color-coded according to ISA recommendations. Thermocouple pairs are numbered alike and lie next to each other.

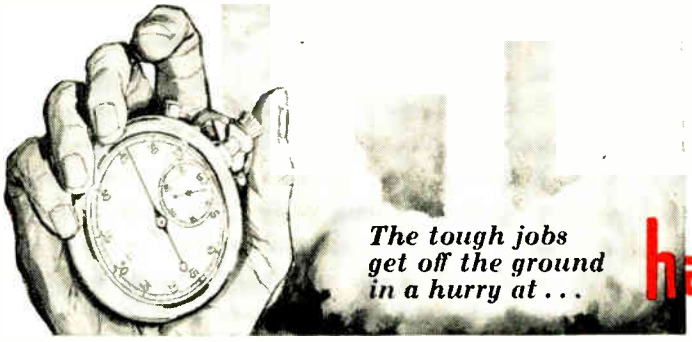
CIRCLE NO. 211 READER SERVICE CARD

Preset Counter versatile unit

C&K COMPONENTS, INC., 101 Morse St., Newton 58, Mass. Model 37 counter is designed for use (1) as a preset counter for a wide variety

Our most potent weapon in the battle of time:

QRC*



The tough jobs get off the ground in a hurry at . . .

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Chicago 24, Ill.

In advanced military electronics research, the ability to do the job *isn't good enough.* The job must be done *reliably* and *on time.*

Hallicrafters' QRC program was originated to provide not only the finest of engineering facilities and people, but the flexibility required for immediate, crash effort on critical electronics problems.

Hallicrafters has provided our military forces for the past six years with a Quick Reaction Capability that has played a major role in helping to win the battle against time.

* Quick Reaction Capability: Refer to Air Force Reg. No. 80-32

Qualified Engineers: new contracts have created openings. Contact William F. Frankart, Director of Engineering.

CIRCLE NO. 79 READER SERVICE CARD

TELEMETERING ENGINEERS NEEDED

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the major source for telemetering systems and components, offers you a unique opportunity to fully use your ability with a rewarding future as a qualified engineer.

Have you had two or more years experience in the design of VHF or UHF transmitters?

. . . in airborne packaging?

. . . in transistor circuitry?

If you have, we want to talk to you.

Please send resume to **W. C. WALKER**
ENGINEERING EMPLOYMENT MANAGER

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DIVISION OF BENDIX AVIATION CORPORATION
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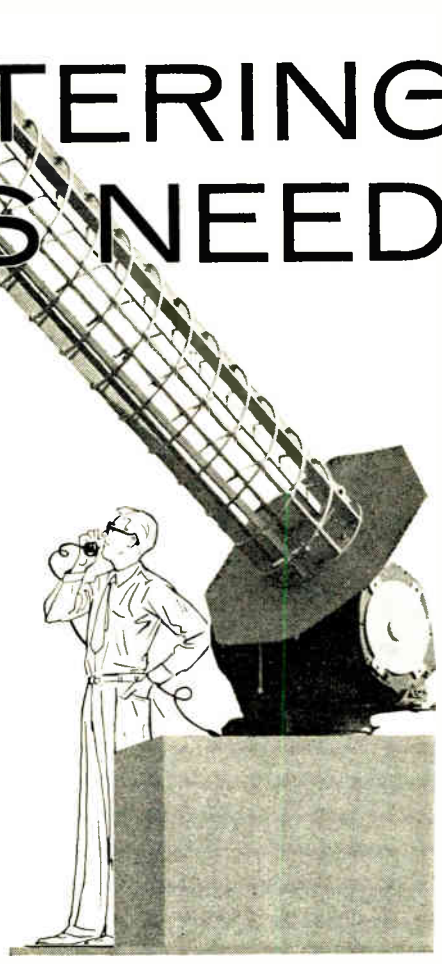


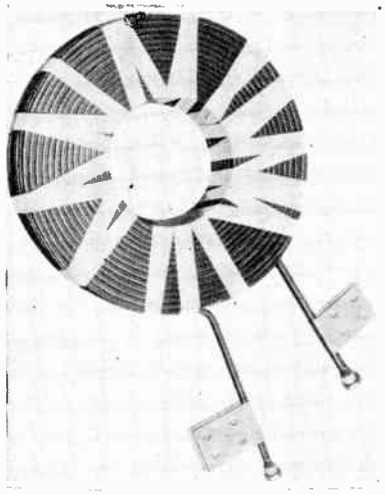
of counting, batching and sorting applications; (2) as a pulse rate divider and variable pulse rate generator; and (3) as a variable pulse delay unit. Through the use of completely transistorized magnetic core circuitry, it requires less than 1 w under normal operating conditions. Standard unit provides a count range of 1 to 10,000 at counting rates up to 110 kc.

CIRCLE NO. 212 READER SERVICE CARD

Potentiometer high megohm

INTERNATIONAL RESISTANCE CO., 401 N. Broad St., Philadelphia 8, Pa., announces a new stable pot for trimmer applications, with resistance values to 500 megohms. High insulation resistance is assured by the design of the molded base and use of first quality materials throughout. The new pot is recommended for use in timing or control circuitry, instrumentation, and applications where a high-range control is necessary.

CIRCLE NO. 213 READER SERVICE CARD

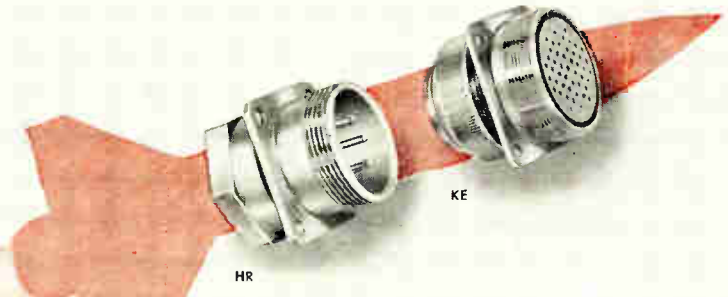


Solenoids water-cooled

NOTHELFER WINDING LABORATORIES, INC., P. O. Box 455, Trenton, N. J., has introduced water-cooled solenoids that produce high-intensity magnetic fields. They are designed to develop 140,000 ampere-turns and dissipate 50 kw of d-c power for these and similar applications. Nothelfer furnishes polyphase transformers, rectifiers, saturable reactors and manual or automatic

NEW

CANNON PLUGS



For greatest reliability in the hot spots

NEW **HR** SERIES

1000°F continuous duty type

The most advanced design to protect against extreme heat, nuclear radiation and moisture formation. Moistureproofing on these connectors is accomplished by means of ball cone seals on mating surfaces. Available in production quantities in wide range of MS-type shell styles and sizes. Two to 24 contacts per shell. Wide variety of insert patterns that mate with standard MS types. A modification of the HR series, rated at 650°F continuous duty, is also available.

Write today for Technical Bulletin T-111

NEW **KE** SERIES

Moisture-resistant firewall type

First plug to satisfy both high-temperature requirements for fireproof Class MS-K connector and vibration-proof, moisture-proof requirements of MS-E Class. Meets 2000° flame test specified in MIL-C-5015—stands up under 400°F continuous operation. Fluorinated silicone seals for moisture-proofing improve resistance to oil and skydrol hydraulic fluid. Two basic shell types for conduit and wire bundles. Wide variety of insert arrangements and shell sizes in long and short types.

Write today for Technical Bulletin T-98

27,000 KINDS TO CHOOSE FROM!

Call on Cannon for *all* your plug needs. If we don't have what you want, we'll make it for you—whether you need one or a million. We're ready to help you at any stage—from basic design to volume production—with the largest facilities in the world for plug research, development and manufacturing. Write us today about your problem. Please refer to Dept. 377.

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Where Reliability for YOUR Product is Our Constant Goal.

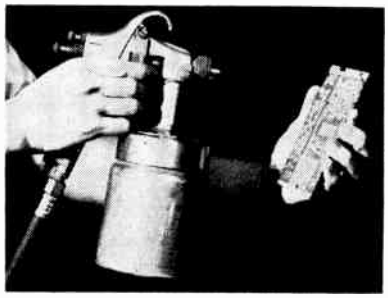
Factories in Los Angeles; Salem, Mass.; Toronto; London; Melbourne; Paris; Tokyo. Representatives and distributors in all principal cities. Please see your Telephone Yellow Book or write factory.

control as required. Detailed information and prices will be furnished upon receipt of specifications.

Impregnant for coils, windings

COLUMBIA TECHNICAL CORP., 61-02 31st Ave., Woodside 77, N. Y., has introduced a new, one-component, fast air-drying coil and winding impregnant. HumiSeal type 1B12 is outstanding for the preservation of original values of Q, inductance and self-capacitance in coils and ferrite cores. It lends good mechanical support to coils and windings. It is solderable. Type 1B12 is an excellent humidity proofing coating applicable on components operating between −60 C to 130 C.

CIRCLE NO. 214 READER SERVICE CARD



Surface Coating high temperature

EMERSON & CUMING, INC., Canton, Mass. Eccocoat C26 is a clear epoxide surface coating. It can be used continuously at 500 F and for short periods up to 600 F. Surface resistivity is above 10^{15} ohms at room temperature and remains about 10^{14} even at 500 F. It is used for coating p-c boards, electronic circuits and components, metals and ceramics.

CIRCLE NO. 215 READER SERVICE CARD

Zener Diodes double anode

U. S. SEMICONDUCTOR PRODUCTS, INC., 3540 W. Osborn Road, Phoenix, Ariz., has developed a medium power double anode silicon Zener diode for clipping, pulse forming, and voltage regulating applications with lower T_c. Stainless steel cases measure 0.290 in. long by 0.250 in. diameter, with choice of

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"During the last twenty years we have had dramatic evidence of what massive research can accomplish. Every thinking American today is acutely aware that our future welfare depends upon this vital activity.

"But sound higher education is the prerequisite of good research; it is vitally important that our higher education be constantly improved, beginning with our secondary schools. Higher education is the only means with which we can mine our most valuable natural resource: the creativity of the human mind in all fields, social and cultural as well as scientific.

"By supporting the college of your choice in its efforts to provide the best possible faculty and physical facilities, you are investing in the one tool with which to shape favorably the future of America."

If you want more information on the problems faced by higher education, write to: Council for Financial Aid to Education, Inc., 6 E. 45th Street, New York 17, N. Y.

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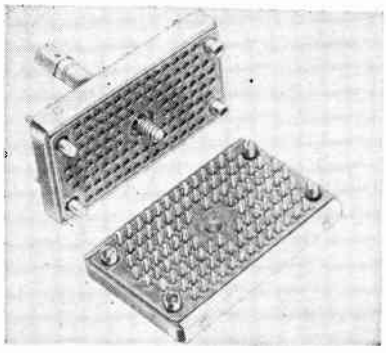
axial leads or stud mount. Zener voltages from 7½ v to 35 v and temperature coefficients from 0.038 percent to 0.066 percent per deg C, together with abrupt breakdown, provide the flexibility needed for superior performance in commercial and military applications.

CIRCLE NO. 216 READER SERVICE CARD



Small Connectors center screwlock

DEJUR-AMSCO CORP., 45-01 Northern Blvd., Long Island City 1, N. Y. Series 1900 miniature rectangular pin and socket connectors are designed for heavy duty applications in aircraft and electronic equipment. A double lead thread action center screwlock assures positive locking action of mating units. Closed entry socket contacts provide increased reliability and maintain a low millivolt drop under constant and uniform insertion pressure.

CIRCLE NO. 217 READER SERVICE CARD

Missile Programmer weighs 2.65 lb

RATIGAN ELECTRONICS INC., 425 W. Cypress St., Glendale 4, Calif., announces a missile programmer designed to operate in environmental conditions as outlined in MIL-E-5272. Unit consists of 13 isolated channels, having an operational time of 35 min., with a time accuracy characteristic of ±20 millisec. Vibration characteristics exceed 20 g's from 10-2,500 cycles in the white noise region. Current capabilities of the contacts are approximately ½ ampere at 115 v inductive. Approximate size of the unit is 2⅜ in. by 3 in. by 6 in.

CIRCLE NO. 218 READER SERVICE CARD

Literature of

MATERIALS

Silicone Products. General Electric Co., Waterford, N. Y. A new 8-page catalog, CDS-129A, highlights the company's major silicone products and their uses.
CIRCLE NO. 225 READER SERVICE CARD

COMPONENTS

Coaxial Cable Connectors. Dage Electric Co., Inc., 67 N. Second St., Beech Grove, Ind. Catalog 401 is presented as a guide to the user of coaxial cable connectors. It lists all the military types and many special types manufactured by the company. Several aids to the buyer and engineer are included.
CIRCLE NO. 226 READER SERVICE CARD

Motors. Rotating Components, Inc., 267 Green St., Brooklyn 22, N. Y., has published a catalog showing a complete line of small a-c motors and rotating devices according to military and commercial specifications.
CIRCLE NO. 227 READER SERVICE CARD

Transistor Specification Chart. General Transistor Corp., 91-27 138th Place, Jamaica 35, N. Y. Brochure G-100 is a 4-page illustrated folder with a chart insert opening to 18 by 32 in., printed both sides, with tabulated specifications on the company's most popular EIA-registered transistor types.
CIRCLE NO. 228 READER SERVICE CARD

EQUIPMENT

Instrumentation. Computer Measurements Co., 5528 Vineland Ave., North Hollywood, Calif., has released a new 12-page 2-color digital instrumentation catalog. Thirty-two instruments and accessories are described.
CIRCLE NO. 229 READER SERVICE CARD

Power Supplies. Del Electronics Corp., 521 Homestead Ave., Mt. Vernon, N. Y. A new line of compact, high voltage power supplies for a wide variety of applications,

the Week

is illustrated and described in a recent brochure.

CIRCLE NO. 230 READER SERVICE CARD

Impulse Counters. Landis & Gyr, Inc., 45 W. 45th St., New York 36, N. Y. Small Sodeco panel-mounted predetermining impulse counters are described in a new bulletin.

CIRCLE NO. 231 READER SERVICE CARD

Panel Instrument. Weston Instruments, Division of Daystrom, Inc., Newark 12, N. J. Circular 01-109-A contains specifications and typical ranges for the 1751/1752 model panel instrument.

CIRCLE NO. 232 READER SERVICE CARD

High Vacuum Engineering. Veeco Vacuum Corp., 86 Denton Ave., New Hyde Park, N. Y. A 20-page brochure describes the 4-in. building block components and 4-in. modular high vacuum systems.

CIRCLE NO. 233 READER SERVICE CARD

Data-Gathering System. Stromberg Time Corp., Thomaston, Conn., has published a brochure describing its new Transacter system for gathering data in the factory and communicating this data instantaneously to a centrally located data processing center.

CIRCLE NO. 234 READER SERVICE CARD

V-R Power Supplies. Kepco Laboratories, Inc., 131-38 Sanford Ave., Flushing 55, N. Y. A recent brochure gives some basic data on the Hybrid series of voltage regulated power supplies, design of which incorporates the best respective features of transistor and vacuum tube circuitry.

CIRCLE NO. 235 READER SERVICE CARD

FACILITIES

Data Control. Epsco, Inc., 588 Commonwealth Ave., Boston 15, Mass. A new 2-color, 24-page brochure is filled with photographs and data about the company, its facilities and products.

CIRCLE NO. 236 READER SERVICE CARD

MacDonald: a dual talent

BELIEF that good engineers don't make good administrators is proved wrong by the accomplishments of Hazeltine Corporation's William A. MacDonald. Company directors asserted their confidence in his dual talents last April by electing him president in addition to the chairmanship of the board which he has held since 1957.

Proof of MacDonald's abilities in guiding the company's progress was shown by the announcement last month of a two-for-one stock split, the third in Hazeltine's 35-year history.

Appropriately enough, the vigorous, brawny MacDonald observes his 35th anniversary with the firm this year. He started in 1924 as chief engineer for the then new-born organization. Under his leadership, the firm has grown from a modest patent licensing concern to a $62 million operation.

The most striking characteristics of the Hazeltine president are his great enthusiasm for his work and his first-hand knowledge of the people who work with him. They all call him "Mac," and it's not forced. The keen technical mind he inherited from his Scottish ancestors is leavened with a refreshing sense of humor.

Callers are sometimes treated to the experience of having Mac pull a short length of red carpet from an office closet and roll it out on the floor as they enter.

MacDonald got his start in electronics in 1913 when he began working for Marconi Wireless at the age of 16. Prior to World War I he worked for Western Electric. In France during the war years, he became an associate of then Captain E. H. Armstrong with whom he worked on the first superheterodyne receiver. After the war he became an engineer for the Signal Corps, later joined RCA before going to Hazeltine.

He steered the company into military electronics at the beginning of World War II, calling on specialist firms to team up with Hazeltine in research and development of war material. The idea he established of forming a number of companies into a team to work in concert on government contracts was a forerunner of today's systems management concept.

Mac put much of his own personal effort into war work and includes in his exploits a visit to the Pacific war theatre at the Navy's invitation to see at first hand the equipment his team made for the war effort. America's first IFF system was developed and produced under his management plan. A certificate of merit for his wartime contributions holds a place of honor in his office.

MacDonald has been granted 110 patents both here and abroad. He is a fellow of the IRE. He spends his spare time at his favorite hobbies, needlepoint tapestry and a small farm on his Long Island home.

Name Pardue to New Position

DAN R. PARDUE has been named to direct the development program for Flow Measurements Corp., which was recently formed to produce thermal and ultrasonic flow meters and is closely associated with Weinschel Engineering, specialists in precision electronic testing equipment. The new corporation is located in the Weinschel Building, Kensington, Md.

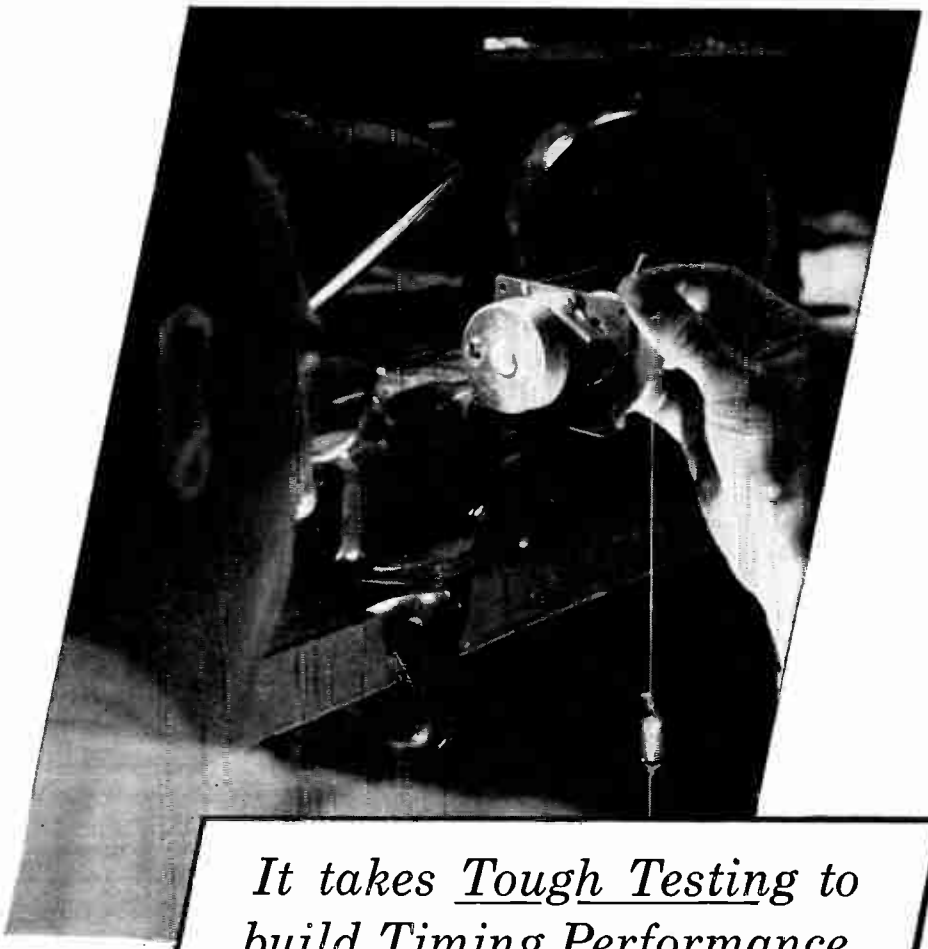
Pardue joined Weinschel Engineering in September 1958. He was previously employed for six years at the National Bureau of Standards.

Resdel Appoints Siegmeth V-P

APPOINTMENT of Alfred J. Siegmeth to the position of vice president in charge of engineering and manufacturing for Resdel Engineering Corp., Pasadena, Calif., is announced. He was formerly director of engineering responsible for electronic engineering and development.

In his new position Siegmeth assumes direction of both the engineering and manufacturing of the company's increasing line of products. Resdel designs and manufactures advanced instrumentation systems and subsystems for missiles and space vehicles.

(Continued on p 92)



It takes Tough Testing to build Timing Performance

When you buy a Haydon Timing Motor or Timing Device, you buy high quality and superior performance, because every production model and every new design has *proved* itself by passing the toughest, most exhaustive series of tests that our engineers can devise.

Quality control at Haydon starts with a careful inspection of all in-coming materials. It continues throughout production — with all parts and assemblies gaged, inspected or physically tested after every operation that can affect the performance of the finished motor or device. Final step is an inspection of completed motors and timing devices. All units are performance tested for many hours under varying conditions and are checked for quiet operation. Percentage samples of each lot are checked for torque rating, timing accuracy, and accuracy and alignment of gears and shafts. In addition, all new designs and periodic samplings from production are subjected to special "life endurance" tests in which hundreds of units are run continuously under various load conditions. In some instances, units have now been running ceaselessly for more than 10 years . . . proving their ability to perform *millions of cycles without failure!*

When you submit your timing problems to Haydon, you can be certain that our teams of engineers and other Timing Specialists have the experience, knowledge and facilities to supply devices designed, produced *and* tested to meet your needs exactly and perform according to your specifications.

For further information, write now, outlining your timing requirements.

Haydon
AT TORRINGTON

DIVISION OF
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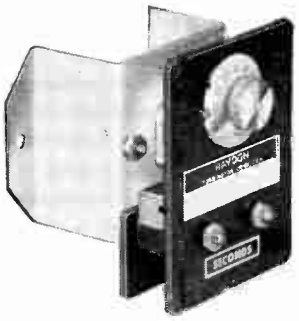
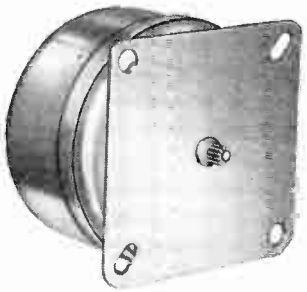
Headquarters for Timing



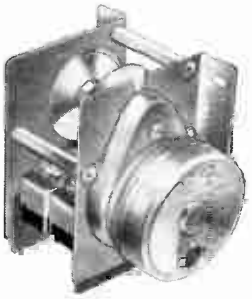
TIME DELAY TIMER

Provides time delay in ranges up to 9.5 minutes. Ideal for such applications as the protection of power tubes and/or operating preset operating cycles. Available in 120 or 240 volt, 50 or 60 cycle current.



400 CYCLE MOTOR

These split phase motors provide the military an accurate approach to timing control for military applications. Rotor speed is 3,000 RPM at 400 cycles, 115 volt normal. Two models are available — Heavy Duty with 18 gram millimeters torque at the rotor, and the Miniature with 5 gram millimeters at the rotor. These motors may be applied to Haydon gear trains if desired.



CYCLE TIMER

These units repeat a set cycle or sequence of operations as long as the motor is energized. Available in a wide choice of speeds, a broad range of timing intervals, and with a wide range of enclosed single pole, double throw switches for 120 and 240 volt operation, for 50 and 60 cycles.

Fleming Takes High ISA Post

LAWRENCE FLEMING, head of test instrument development at Southwestern Industrial Electronics Co., Houston, Texas, has been appointed assistant director of the Missile/Space Group of Instrument Society of America.

The ISA group manages all society activities in the missile and space instrumentation field, and sponsored papers given at the ISA fifth annual flight test instrumentation symposium in May.

News of Reps

Servo Dynamics Corp., Somersworth, N. H., appoints **Jay Stone & Associates** of Sunnyvale, Calif., as its sales rep in northern California and Nevada.

Robert K. Mikkelson has joined **E. V. Roberts and Associates,** Los Angeles rep firm, as branch manager of the Albuquerque, N. M., office.

Technitrol Engineering Co., Philadelphia, Pa., manufacturer of pulse transformers, delay lines and computer equipment, has appointed the **Hilker Co.,** Winston-Salem, N. C., as sales rep for the areas of North Carolina, Tennessee, South Carolina, Georgia, Alabama and Mississippi.

Weinschel Engineering, Kensington, Md., recently appointed **Airep**

Engineering Co. of Dallas, Texas, as sales engineers for its precision electronic testing equipment. Airep will cover Texas (except for El Paso County), Oklahoma, Arkansas and Louisiana.

Sol Predeger has joined **John J. Kopple Associates**, manufacturers' reps of Mt. Vernon, N. Y. He will be sales rep in greater New York and New Jersey for all the lines handled by the organization.

Yarbrough Sales Co. of San Marino, Calif., has been appointed exclusive west coast sales and engineering rep for Accurate Specialties Co., Inc., Woodside, N. Y. Rep firm will cover the entire state of California.

Mid-Eastern Electronics, Inc., Springfield, N. J., announces the appointment of **Naylor Electric Co., Inc.**, Syracuse, N. Y., as sales rep for its line of power supplies, special test equipment and ultra-high resistance measuring instruments in western New York State.

David G. DeHaas, former manager of the J. T. Hill Co., has organized his own electronic manufacturers' rep agency, the **David G. DeHaas Company**, in San Diego, Calif.

George H. Weiland of Flushing, N. Y., is named eastern rep for Designers for Industry, Inc., Cleveland, Ohio. He will direct sales activities for DfI in southeastern Connecticut, lower New York, and northern New Jersey.

The Jack Berman Co. of Los Angeles, Calif., is appointed sales rep for Columbus Electronics Corp., Yonkers, N. Y., manufacturer of double diffused silicon rectifiers and other semiconductor devices. Berman organization and its branch office in Phoenix will provide representation in southern California, Arizona, and in Clark County, Nevada.

Babcock Relays, Inc., Costa Mesa, Calif., names **Carlson Electronic Sales** of Chicago, Ill., as its rep in northern Illinois, southern Wisconsin and northern Indiana.

COMMENT

Parametrics

We wish to thank you for your review in your article "Looking Ahead in Engineering" (p 125, Mar. 13) of our new proximity switch the Proxor.

In keeping with your high standards, we wish to call to your attention the misspelling of our company name...

R. E. JOHNSON
PARAMETRICS
COSTA MESA, CALIF.

The name of reader Johnson's company was incorrectly given as Paramagnetics.

Diodes and Rectifiers (Cont'd.)

(Re: Your editorial comment to the letter from Harold M. Honig, p 124, May 8): The comment was a general statement to the effect that there was no potential difference between a diode and a rectifier, and that the latter appears to describe a function rather than a device.

The difference between these two items will be clear if Federal Cataloguing Handbook H6-1 is consulted. The full names involved are SEMICONDUCTOR DEVICE (1), DIODE and RECTIFIER, METALLIC. The (1) in the first item name means that a basic concept for SEMICONDUCTOR DEVICE has been developed and is published in the handbook.

It will readily be seen that a difference does exist between the two full item names, and further, if only the terms *rectifier* and *diode* are considered, then it is understandable that a conflict between the two terms can exist.

The item names and definitions were developed during a joint military services and industry conference at New York in October 1955. Because of the reference to Federal Cataloguing Handbook H6-1 in Mr. Honig's letter, it was felt that an explanatory comment would be in order, inasmuch as this headquarters is directly concerned with the material appearing therein.

JOSEPH H. UTZ
DIRECTORATE OF SUPPLY, AMC
WRIGHT-PATTERSON AFB, OHIO

The definitions given in H6-1 for the two highly specific terms mentioned by reader Utz do differ

markedly, of course. But our comment—that a rectifier is a special class of diode—still holds. A copper-oxide rectifier is a type of diode; so is a selenium rectifier; and silicon or germanium diodes can certainly be used to rectify alternating currents. A diode is a device with two elements; rectifying is its sometime function.

Our mailbag brings us another note on the same subject:

In considering standardization with respect to the symbols for diodes and rectifiers, please consider our present conventions, which are admittedly functional rather than device symbols.

A diode, as a detector, is a sink, and is shown with the + sign at the anode; while a rectifier is a source, with the + sign at the cathode . . . except by the people who don't get this distinction and make their own fielder's choice.

DONALD H. ROGERS
JERROLD ELECTRONICS
PHILADELPHIA

Challenge of Space

(The special report "The Challenge of Space," p 65, Apr. 24) is an excellent summary and you can be proud of it.

I would like to see a series of articles further reviewing the technical problems and assembly data on each of the fields. Further, I would like to see a series on the application of communications with particular emphasis on the use of satellites as adjuncts or auxiliaries to earth-service communications.

As you know, I consider that this will be the first commercial use of space travel, and that it will occur in the relatively near future.

R. P. HAVILAND
GENERAL ELECTRIC
PHILADELPHIA

. . . I wish to compliment you highly on this lucid, concise and very understandable presentation of a subject so interesting to us all.

Since I am in charge of a department in direct contact with our schools and universities, and have a knowledge of their needs, I believe that your article would be invaluable for use in science classes . . .

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John Mitchell, Asst. Chief Engineer: Mobile and Portable Communications Products

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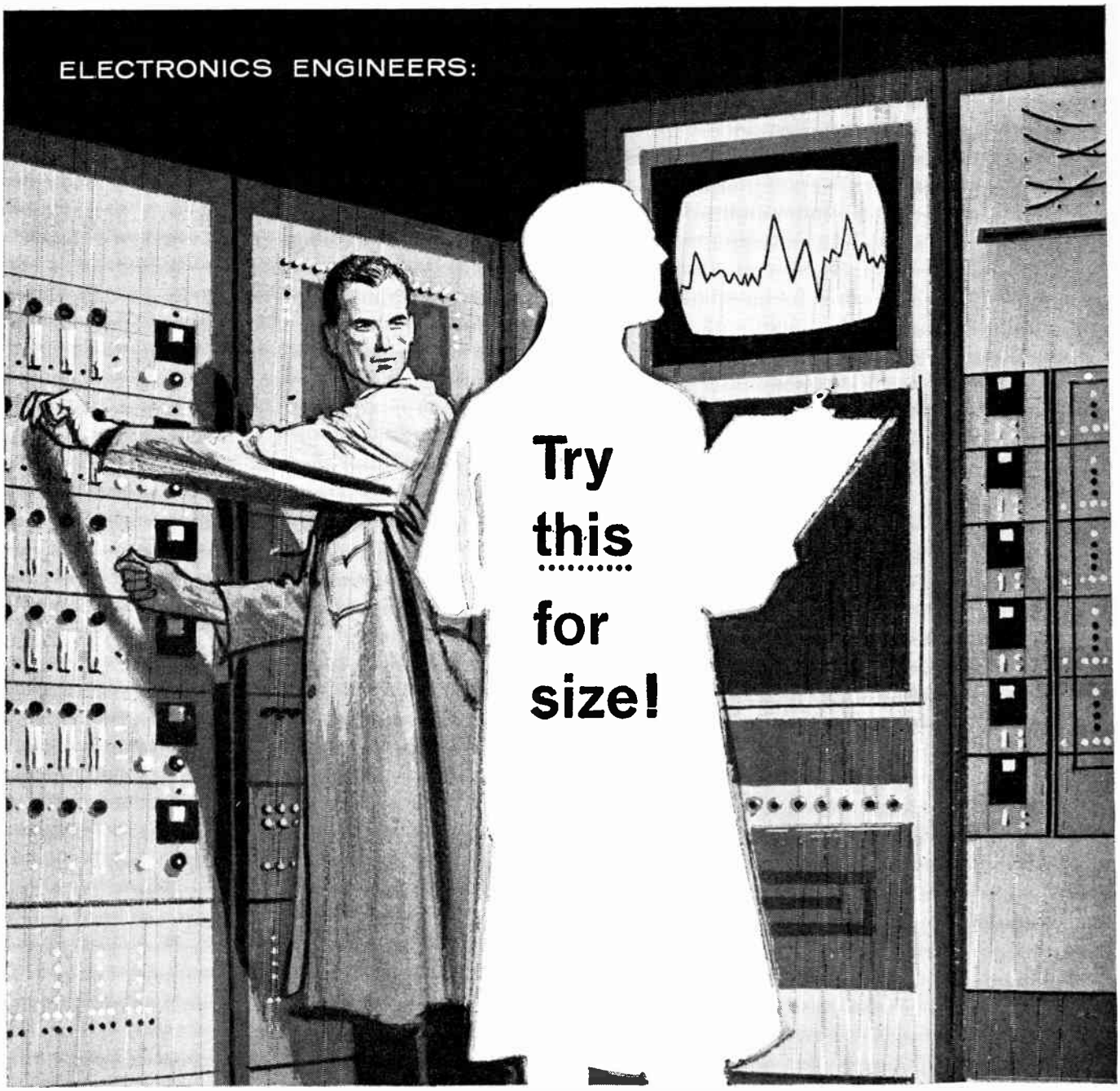

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