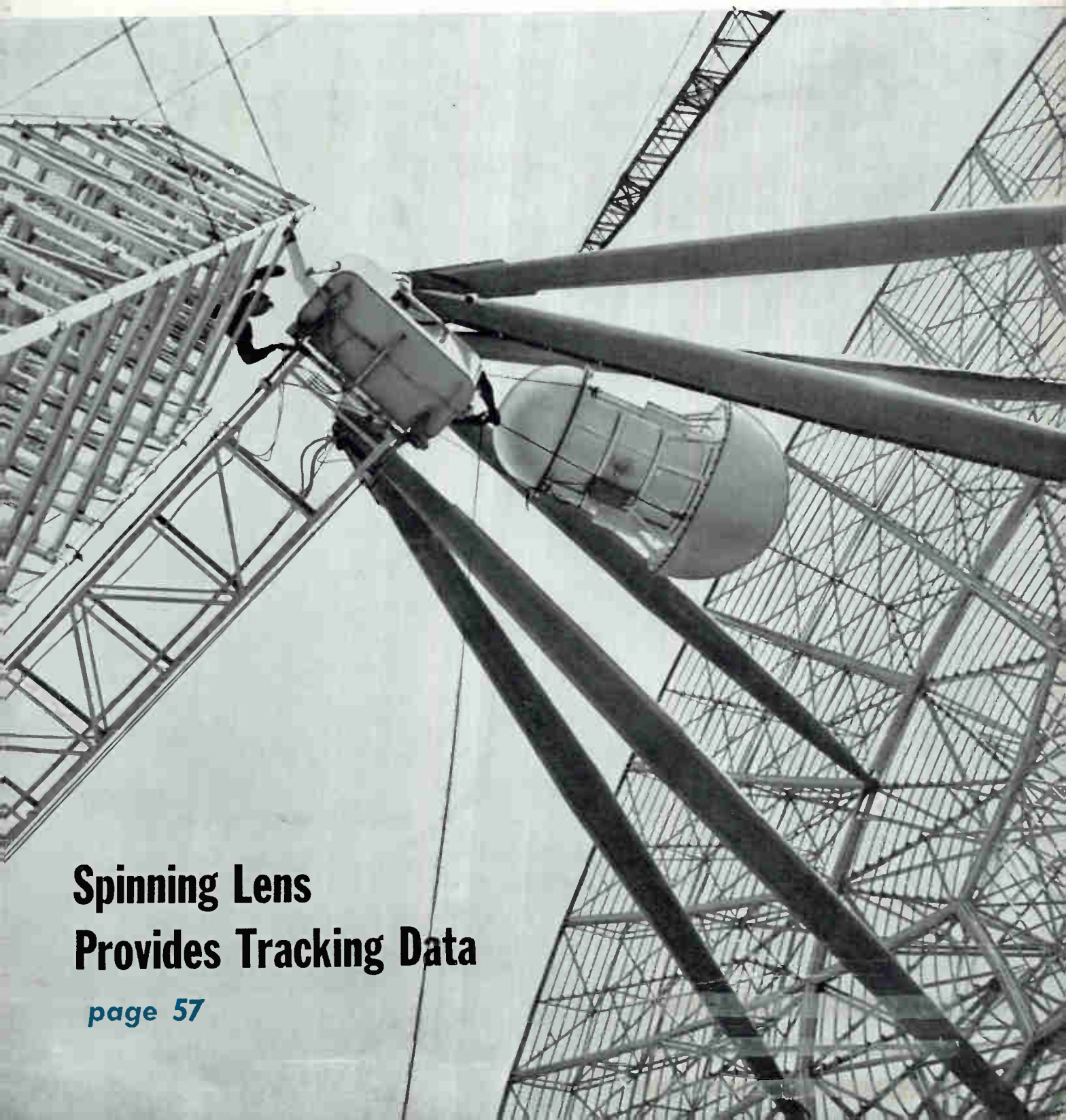
Japan Develops New Computer Logic

page 36

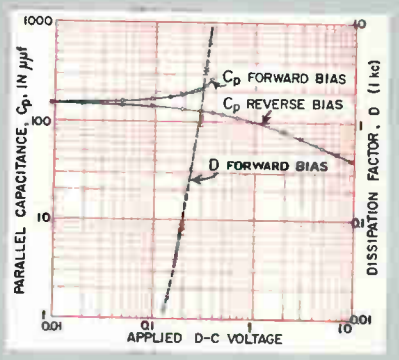
electronics

A McGRAW-HILL PUBLICATION APRIL 15, 1960 PRICE SEVENTY-FIVE CENTS

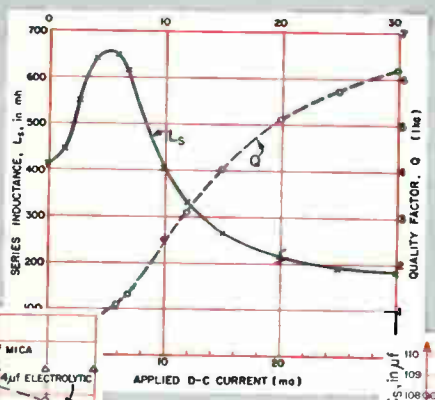


Spinning Lens Provides Tracking Data

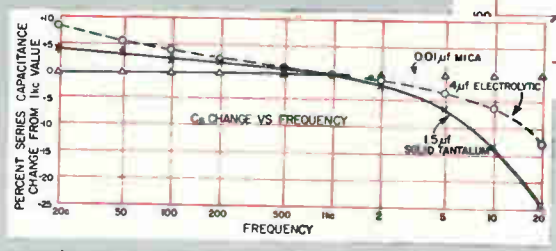
page 57



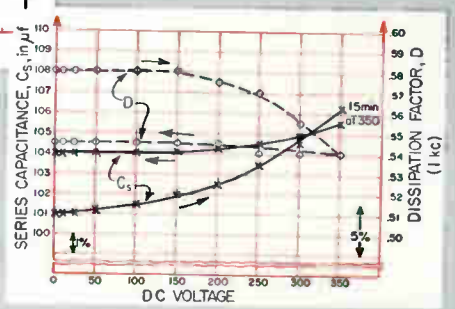
Characteristics of a variable-capacitance diode at 1 kc with forward and reverse biasing.



Behavior of an iron-core inductor at various d-c levels. Measurements made with the Bridge in its "Orthonull" position to eliminate sliding balances which occur when making low-Q measurements.

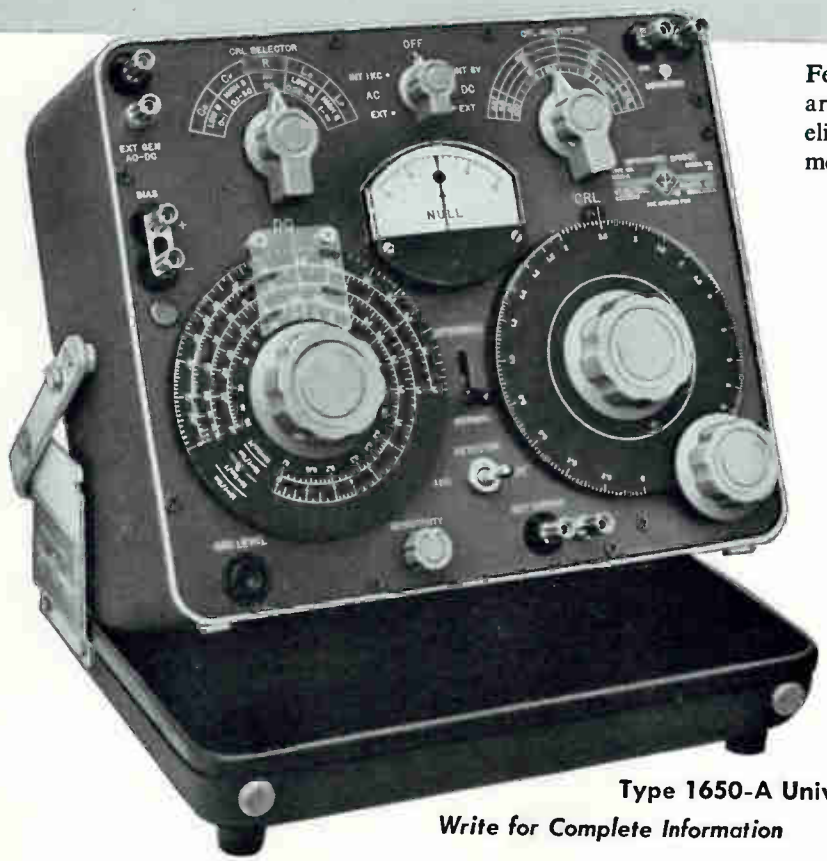


Plot of capacitance change vs frequency for three types of capacitors. External generator used is a G-R Type 1210-C Unit R-C Oscillator.



Variation of capacitance and dissipation factor of an unformed electrolytic as a function of d-c voltage as it is varied to rated voltage and then returned to zero.

These Measurements show why it's called a *Universal* IMPEDANCE BRIDGE



Features *Orthonull*,* a unique mechanical ganging arrangement of the Bridge's variable elements that eliminates sliding balances when making low-Q measurements.

*U. S. Patent 2,872,639

- Completely self contained with built-in 1-kc oscillator and selective null detector . . . powered by four "D" batteries . . . total drain is less than 10 ma, providing 1-year battery life for typical laboratory use.
- Useful for measurements from 20c to 20 kc with external generator.
- Unique cabinet design allows panel to be tilted to any convenient angle . . . closes and becomes a rugged carrying case for complete protection.
- Provision for applying polarization voltages to capacitors, biasing voltages to diodes, and small currents to inductors for measurements at various d-c levels.
- **WIDE RANGES** —
  R: 0.001Ω to 10 MΩ **L:** 1 μh to 1000h
  C: 1 μμf to 1000 μf **D:** 0.001 to 50 at 1 kc
  Q: 0.02 to 1000 at 1 kc
- **ACCURACY** —
  1% for L and C from 20c to 20 kc
  1% for R from 20c to 5 kc
  5% for D and Q (ranges are a function of frequency)

Type 1650-A Universal Impedance Bridge . . . $450

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The first general purpose R-L-C Bridge was our type 650-A which was introduced in 1933. It or successor designs, including the latest type 1650-A, are in use in almost every electronics laboratory and manufacturing plant today.

electronics

APRIL 15, 1960

A McGRAW-HILL PUBLICATION
Vol. 33 No. 16

Issue at a Glance

Business

Engineering

Departments

BASIC BUILDING BLOCKS FROM KEARFOTT

ELECTROHYDRAULIC SERVO VALVE

Kearfott's unique approach to electrohydraulic feedback amplification design has resulted in a high-performance miniature servo valve with just two moving parts. Ideally suited to missile, aircraft and industrial applications, these anti-clogging, 2-stage, 4-way selector valves provide high frequency response and proved reliability even with highly contaminated fluids and under conditions of extreme temperature.

TYPICAL CHARACTERISTICS

Quiescent Flow ..... 0.15 gpm
Hysteresis .. 3% of rated current
Frequency Response
3 db @ 100 cps
Supply pressure....500 to 3000 psi
Temperature-Fluid & Ambient
−65° F to +275° F
Flow Rate Range .... .3 to 10 gpm
Weight ..... 10.5 ounces

Write for complete data.

BASIC BUILDING BLOCKS FROM KEARFOTT

FERRITES

Kearfott's Solid State Physics Laboratory formulates, fires and machines permanent magnet ferrite materials of various compositions. Typical high-efficiency array utilizes Kearfott PM-3 ferrite material with specially designed pole pieces to produce a design both smaller and lighter than other arrays of equivalent magnetic field strength. Because magnets may be custom engineered to specific requirements, user is not restricted to stock magnet types, thereby providing greater latitude in parameters for focusing arrays. Pole pieces may also be provided according to specification, with the added assurance that, because of special Kearfott design techniques, B axial magnetic fields approximately 10% higher than those generally obtained in standard types may be produced.

TYPICAL CHARACTERISTICS

Peak Magnetic Field Strength	1200 gauss
Period	0.560 in.
Length	5.64 in.
Inside Diameter of Pole Pieces	0.400 In.
Outside Diameter	2.0 in.
Weight	3.2 pounds

Write for complete data.

BASIC BUILDING BLOCKS FROM KEARFOTT

INTEGRATING TACHOMETERS

Kearfott integrating tachometers, special types of rate generators, are almost invariably provided integrally coupled to a motor. They feature tachometer generators of high output-to-null ratio and are temperature stabilized or compensated for highest accuracy integration and rate computation. Linearity of these compact, lightweight tachometers ranges as low as .01% and is usually better than ± .1%.

TYPICAL CHARACTERISTICS

	Size 11 (R860)
Excitation Voltage (400 cps)	115
Volts at 0 rpm (RMS)	.020
Volts at 1000 rpm (RMS)	2.75
Phase shift at 3600 rpm	0°
Linearity at 0-3600 rpm	.07
Operating Temperature Range	−54° +125°

Write for complete data.

Miniature Floated Gyro

Precise Angle Indicator

20 Second Synchro

KEARFOTT DIVISION
GENERAL PRECISION INC.
LITTLE FALLS, NEW JERSEY

Midwest Office: 23 W. Calendar Ave., La Grange, Ill.
South Central Office: 6211 Denton Drive, Dallas, Texas
West Coast Office: 253 N. Vinedo Avenue, Pasadena, Calif.

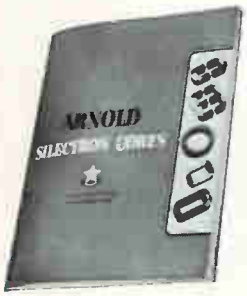
Engineers: Kearfott offers challenging opportunities in advanced component and system development.

7372 C

Arnold Pulse Transformer Cores are individually tested under actual pulse conditions

Here's technical data on

ARNOLD SILECTRON CORES



Bulletin SC-107 A . . . this newly-reprinted 52-page bulletin contains design information on Arnold Tape Cores wound from Silectron (grain-oriented silicon steel). It includes data on cut C and E cores, and uncut toroids and rectangular shapes. Sizes range from a fraction of an ounce to more than a hundred pounds, in standard tape thicknesses of 1, 2, 4 and 12 mils.

Cores are listed in the order of their power-handling capacity, to permit easier selection to fit your requirements, and curves showing the effect of impregnation on core material properties are included. A valuable addition to your engineering files—*write for your copy today.*

ADDRESS DEPT. E-4

The inset photograph above illustrates a special Arnold advantage: a 10-megawatt pulse-testing installation which enables us to test-prove pulse cores to an extent unequalled elsewhere in the industry.

For example, Arnold 1 mil Silectron "C" cores—supplied with a guaranteed minimum pulse permeability of 300—are tested at 0.25 microseconds, 1000 pulses per second, at a peak flux density of 2500 gausses. The 2 mil cores, with a guaranteed minimum pulse permeability of 600, receive standard tests at 2 microseconds, 400 pulses per second, at a peak flux density of 10,000 gausses.

The test equipment has a variable range which may enable us to make special tests duplicating the actual operating conditions of the transformer. The pulser permits tests at .05, .25, 2.0 and 10.0 microsecond pulse duration, at repetition rates varying anywhere from 50 to 1000 pulses per second.

This is just another of Arnold's facilities for better service on magnetic materials of all description. ● Let us supply *your* requirements. *The Arnold Engineering Company, Main Office & Plant, Marengo, Ill.*

ARNOLD

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BRANCH OFFICES and REPRESENTATIVES in PRINCIPAL CITIES
Find them FAST in the YELLOW PAGES

electronics
April 15, 1960 Vol. 33, No. 16

Member ABP and ABC

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CROSSTALK . . .

THE POLARIS STORY. The Polaris fleet ballistic missile system is now two giant steps closer to becoming an operational weapon. The entire system was successfully test fired recently from the *USS Observation Island* into the Atlantic Ocean and the missile's final assembly plant, at Charleston, S. C., became a going concern.

More than $2.7 billion has already been appropriated for the system through this fiscal year, and another $1 billion is expected for fiscal 1961.

Associate Editor Mason recently flew down to the assembly facility, built on a resurrected swamp near Charleston, with Rear Adm. W. F. Raborn, Director of the Special Projects Office. After a thorough inspection of the installation, Mason describes in his article, p 32, the $15 million in permanent electronic checkout gear in the plant, future plans for Polaris and also how Navy plans to communicate with submerged submarines around the world.

NEWS IN NEW MEXICO. More often than you realize, stories are sparked by you, the reader. An example this week is the article on p 41.

It all started with a reader's letter. In effect, he asked: "The electronics industry is hopping in New Mexico . . . have you looked lately?" Immediately is better than lately. So two McGraw-Hill World News correspondents went to work. Peter Mygatt took the Sante Fe-Los Alamos area. Bill Hesch began checking in Albuquerque. In a few days their information was on its way, air mailed, to New York. Then Associate Editor Emma assembled the facts into story form. We hope you agree the result was worth the special effort. We think it was.

Coming In Our April 22 Issue . . .

MONOPULSE RADAR. In recent years a major effort has been directed toward developing and improving monopulse tracking radars. Reason for this is the advantages offered by monopulse over other basic tracking techniques, such as sequential lobing and conical scan.

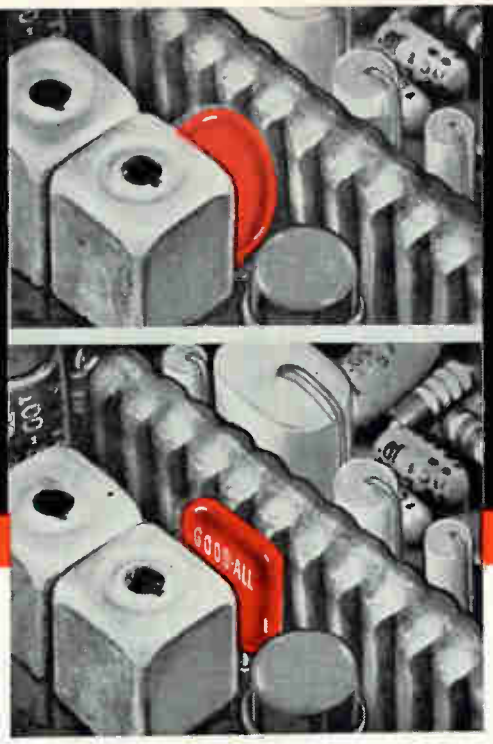
In our next issue, the principles of monopulse operation are explained in an informative article by J. H. Dunn and D. D. Howard of the Naval Research Laboratory in Washington. Basic monopulse, conical scan and sequential lobing techniques are described and compared on the basis of the image plane concept of microwave optics. You'll learn about two actual monopulse radars and their major advantages, which include greater antenna gain for given aperture size, higher angle sensitivity and resolution capability, and immunity to amplitude noise.

Between them, Dunn and Howard bring 28 years of radar experience at NRL to their article. At present, Dunn is head of the Radar Division's Tracking Branch, where he is responsible for the conception, analysis and development of new tracking systems. Howard, who holds several patents in radar and related fields, is head of the specal systems and radar statistics sections of the Tracking Branch.

INDUCTANCES FOR SOLID CIRCUITS. One stumbling block to the development of microminiaturized circuits has been presented by inductance coils (ELECTRONICS, p 39, Mar. 4). Next week, M. Schuller and W. W. Gartner of U. S. Army Signal Research and Development Laboratory in Fort Monmouth, N. J., show how an inductive negative-resistance semiconductor diode can be used to build a coilless L-C resonant circuit having a voltage-tunable bandwidth.

GOOD-ALL 601PE
CAPACITORS

"fit" like a disc
PLUS...



...Temperature STABILITY

Identical to high quality tubular capacitors and far superior to that attainable with high capacity discs.

MILITARY APPLICATIONS—Widely used in military equipment; also well suited to high quality civilian instrumentation where space is critical.

Tailored for TRANSISTORS

Wafer-thin shape..permits great flexibility in tight chassis layouts. The 601PE is competitive in price with ceramic discs in the range of .1 MFD and above.

SPECIFICATIONS

Insulation Resistance—Greater than 75,000 megohms when measured at 100 volts D.C. at 25°C. for a maximum of 2 minutes.

Capacity Tolerance—Standard tolerance is 20%.

Winding Construction—Extended foil (non-inductive) MYLAR Dielectric.

Lead Variations—Formed or straight leads.

Dissipation Factor—Less than 1% at 1,000 cycles per second at 25° C.

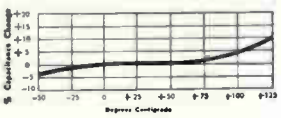
Dielectric Strength—100 volts D.C. for 1 to 5 seconds through a minimum current limiting resistance of 100 ohms per volt.

Temperature Range—May be operated at full rated voltage to 85° C. Derate to 50% when operating at 125° C.

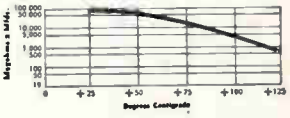
DIMENSIONS 50 VDC Rating

CAP. (MFD)	A	E	F
.01	.310	.187	.562
.022	.359	.187	.562
.033	.531	.191	.406
.047	.531	.203	.453
.068	.531	.218	.500
.1	.650	.235	.525
.15	.671	.260	.650
.22	.728	.306	.687
.33	.812	.312	.750

Capacitance Change vs. Temperature



Insulation Resistance vs. Temperature



TYPE **602** with **PLATFORM BASE** also available

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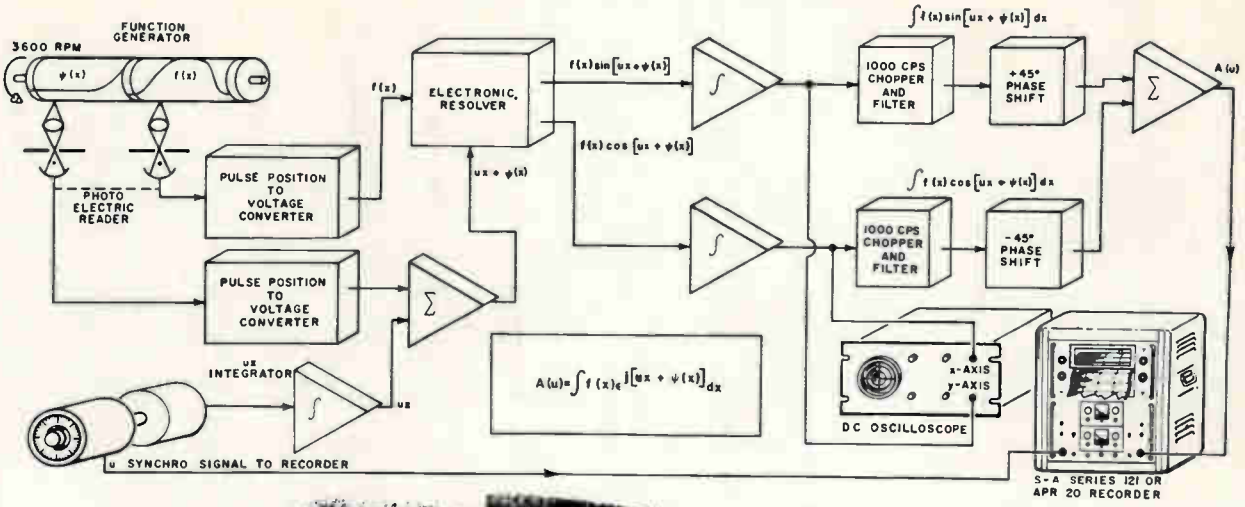
Simplified block diagram of Model CF-1. Amplitude and phase input functions are plotted on graph paper for presentation. Integration is observed on a dc oscilloscope. Absolute magnitude is recorded on any S-A Series 121 or APR 20 Antenna Pattern Recorder with a logarithmic response.

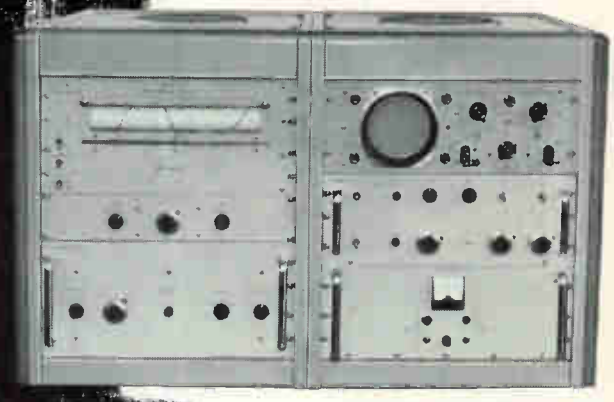


To solve

$$A(u)=\int_{-1}^{1} f(x)\,\epsilon^{j[ux+\psi(x)]}\,dx$$

investigate the new

S-A FOURIER INTEGRAL COMPUTER



Model CF-1

A sophisticated solution to the vexing problem of solving bounded Fourier integrals quickly and accurately, Scientific-Atlanta designed the Model CF-1 especially for the antenna design engineer.

The computer has broad general application including determination of the far fields of aperture antennas from the distribution of the field in the aperture, the far fields of arrays from the magnitude and phase of the currents in the elements, the frequency spectra of voltage pulses, and other physical problems involving Fourier transforms and their inverse transforms over finite limits.

PRICES

Model CF-1 Fourier Integral Computer . . . $9,000

Model APR 22 Antenna Pattern Recorder (logarithmic response) . . . $4,300

Consult your nearby S-A engineering representative for more information. Or you may write directly to the factory for complete specifications. Address Dept. 18-3.

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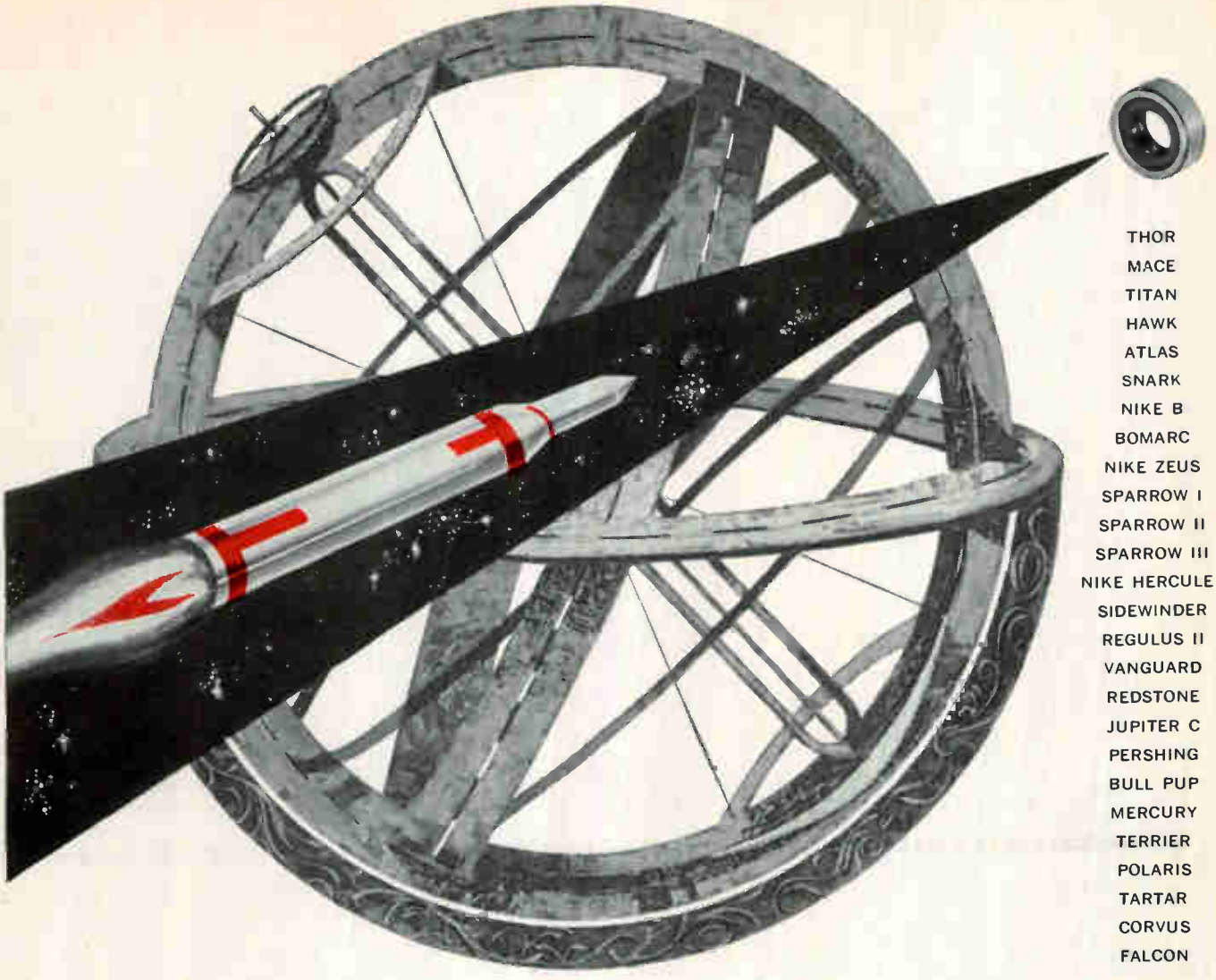

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SPARROW III
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N.D. Adds New Dimensions To High Speed Gyro Rotor Bearings!

At speeds up to 24,000 RPM precision rotor bearings in inertial guidance and navigational systems are highly critical components. Early research and development in design and manufacturing at New Departure is solving the problem and thus winning vital roles for N.D. integral rotor bearings in missile projects. For example, "B" Series bearings with separable inner ring developed by N.D. are helping set performance records in such inertial guidance systems as the AChiever.

New Departure is also supplying high-precision rotor bearings for the inertial guidance system in Polaris.

These bearings, through advanced manufacturing techniques, exacting inspections and controlled environmental tests, backed by 50 years of laboratory testing experience, give precision and uniformity far above the most precise industry standards. They promise new performance and *reliability* for the submarine-launched IRBM.

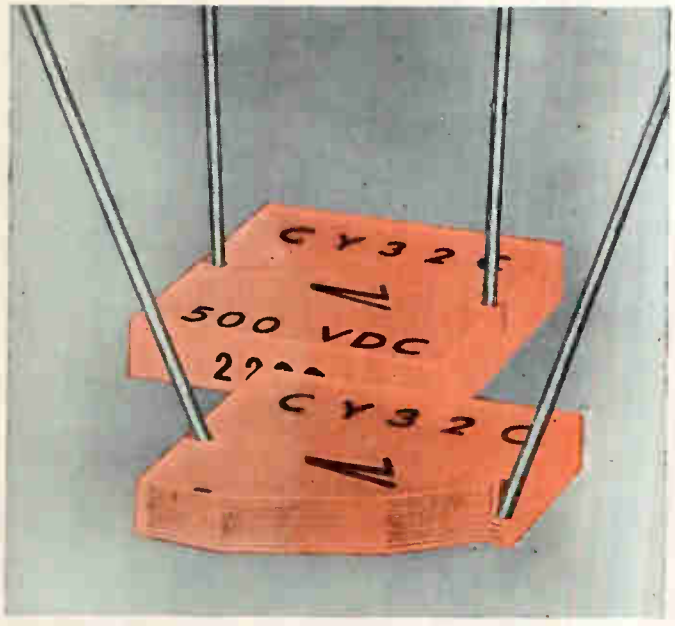
You can look to improved *performance* and *reliability* when you include an N.D. Miniature/Instrument Bearing *Specialist* in early design level discussions. Call or write Department L.S., New Departure Division, General Motors Corporation, Bristol, Connecticut.

NEW DEPARTURE

MINIATURE & INSTRUMENT BALL BEARINGS

proved reliability you can build around

...in any environment, silicones protect



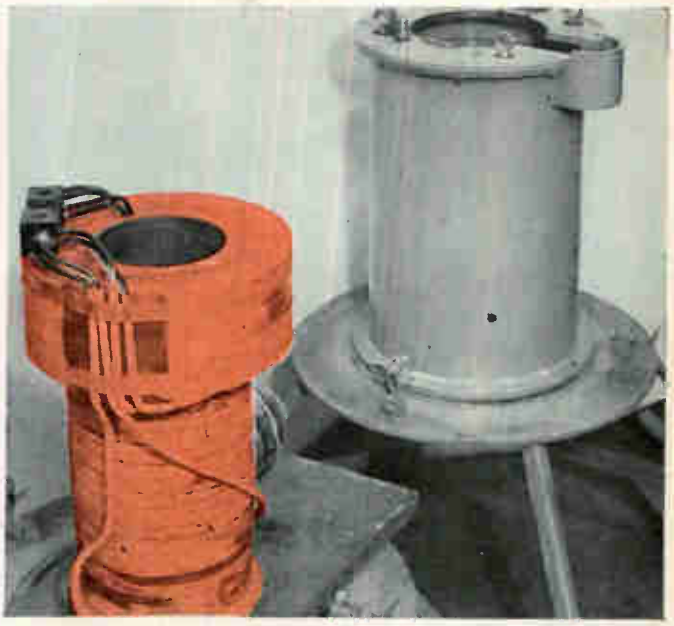
Fluid Short-Stop Deflects Moisture

Employed in many airborne guidance, tracking, computing, and telemetering units, "Vitramon" Capacitors are porcelain-bodied to resist adverse conditions such as heat and humidity. But Vitramon engineers realized that only a small amount of condensation on the porcelain could cause leakage paths and lead-to-lead shorts. They solved the problem by dipping each capacitor in Dow Corning silicone fluid. The micro-thin coating is moisture-repellent . . . durable. The silicone surface "beads" water, preventing condensed moisture from forming a conductive film.

CIRCLE 289 ON READER SERVICE CARD

This Resin Is As Good As Its Bond

The Osborne Electronic Corporation makes, among other things, specialty transformers for airborne electronic systems. Look hard and you'll see an Osborne unit in the Jupiter Ground Support Equipment control box on the facing page. At the center of each Osborne transformer is a coil bobbin which must have maximum mechanical and electrical strength in minimum thickness to allow maximum copper content in the core window area. Normal tolerance is ±.015. In addition, they must withstand temperatures from —65 C to over 200 C, be free of voids or pinholes. Osborne engineers have found the most economical way of producing top quality silicone-glass laminate coil bobbins of special sizes and shapes for their custom transformers is by winding glass tape on a mandrel, then saturating it with Dow Corning solventless resin applied by paint brush. Dow Corning resin cures with heat; no pressure needed. It provides the high physical strength to resist heavy wire winding pressure.



Silastic® Insulates Beyond The Call

This giant Klystron focusing coil, a product of Varian Associates, is destined for a vital role in space-age electronics. Designed for 5000 hours minimum life, it operates at 1650 watts input and is cooled by liquid heat-exchange. *Inlet* coolant temperature is 125° C!

Where does Silastic, the Dow Corning silicone rubber, fit in? It's over, under, and around every layer of the coil. A paste form of Silastic is coated on each successive winding and over the copper cooling coils as well. Dielectric strength, resiliency, and resistance to heat and moisture are essential. The coil must withstand water immersion tests, vibration tests, a shock test of 10 G's for 15 cycles of 11 micro-seconds each, and environmental testing which includes severe thermal cycling.

CIRCLE 290 ON READER SERVICE CARD

CIRCLE 291 ON READER SERVICE CARD

CORPORATION MIDLAND, MICHIGAN

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This unique "extra" fifth digit...

...provides 100% over-ranging...ten times greater resolution at decade voltage points where other 4-digit voltmeters change ranges and lose one full digit of resolution.

The KIN TEL Model 501 4-digit, over-ranging digital voltmeter measures DC from ±0.0001 to ±1000.0 volts with 0.01% ±1 digit (of reading) accuracy. An extra fifth digit in the left decade indicates "0" or "1" to provide ten times greater resolution at decade (1, 10, 100) voltage points than standard 4-digit voltmeters. Ranging and polarity indication are entirely automatic. The measured voltage, decimal point and polarity symbol are displayed on an in-line readout in a single plane–no superimposed outlines of "off" digits.

An adjustable sensitivity control permits decreasing sensitivity to allow measurement of noisy signals. Ten-line, parallel input printers can be driven directly, and converters are available for driving other types of printers, typewriters, and card or tape punches. The input may be floated up to 25 volts DC above or below chassis ground with no degradation in performance, and up to 250 volts DC with slight decrease in accuracy. Stepping-switch drive coils are energized with DC as in telephone-type service to provide long, trouble-free operation.

The 501 is one of a complete line of KIN TEL digital instruments. Others include AC converters, AC and DC preamplifiers, ratiometers, and multi-channel input scanners.

IMPORTANT SPECIFICATIONS

Display...Six decades display 5 digits (Left digit "0" or "1" only), decimal point, polarity symbol. Ranging and polarity indication are automatic. Projection system readout employs bayonet-base lamps with 3000-hour minimum life rating. Readout contains no electronic circuitry and can be remotely mounted.

Automatic Ranges...±0.0001 to ±1000.0 volts DC in four ranges: 0.0001 to 1.9999; 02.000 to 19.999; 020.00 to 199.99; 0200.0 to 1000.0

Accuracy...0.01% ±1 digit (of reading).

Input Impedance...10 megohms on all ranges at null.

Reference Voltage...Chopper-stabilized supply, continuously and automatically referenced to standard cell.

Stepping-Switch Drive...DC voltage within stepping-switch manufacturers rating applied by transistor drive circuit at rate of approximately 20 steps per second.

Controls...Three: on-off; sensitivity; and mode of operation (standby, normal, print auto, print remote).

Printer Drive...Built-in for parallel input printers. Automatic or remote.

Dimensions and Net Weights...Control unit: 45 lbs, 5¼" H x 19" W x 16" D. Readout: 10 lbs, 3½"H x 19"W x 9"D.

Price: $2995

KIN TEL manufactures electronic instruments for measurement and control, and closed circuit TV. Representatives in all major cities. Write for detailed literature or demonstration.

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ELECTRONICS, INC.

BUSINESS THIS WEEK

Government May Set Minimum Wage Next Year For Workers Making Functional Components

Labor Department is now considering last week's arguments of labor and management at hearings designed to help the government decide on a minimum wage for workers making functional components such as resistors, capacitors, relays and switches. **It may be a year before the Labor Department proposes a minimum wage.** Then both sides will have 30 days to file remarks and request another hearing before the rate goes into effect.

Ruling will be one of several affecting the electronics industry, which will be made under the 1936 Walsh-Healy Act (ELECTRONICS, p 31, Jan. 8; p 44, Mar. 25). Law provides for a floor on pay rates on government contracts of $10,000 and higher, aims to prevent one company from underbidding another on the basis of lower wage rates.

Union spokesmen asked last week for a minimum wage of $1.35 an hour. Industry asked for $1 and said 102 out of 400 firms surveyed in the field (functional components, excluding semiconductors and tubes) now pay minimums of $1.

G. D. Reilly, consultant to the Electronic Industries Association, said government business in the field amounts to $59 million annually. Said Reilly: A rise in the minimum for bottom-scale workers will force the companies to raise the rates for other workers to maintain differentials. AFL-CIO economist Seymour Brandwein claimed that if all workers in the industry were raised to the $1.35 minimum proposed by the unions, the total payroll would increase only 1.6 percent.

Tiros Transmits Data With Two 33-Ounce Off-the-Shelf F-M Telemetry Transmitters

Tiros weather satellite developed by RCA uses two 33-ounce f-m telemetry transmitters made by Radiation Incorporated, Melbourne, Fla. The 2-watt "off-the-shelf" units measure about 6 in. by 3¾ in. by 1¼ in.

Frequency modulation is produced at low frequency with wide deviation, where signal to noise ratio is high. This modulation frequency spectrum is then translated to the operating frequency of 235 Mc by mixing twice with a crystal-controlled frequency relatively free of microphonic effects. Signal is applied to a power amplifier stage yielding a minimum of 2 watts. Carrier frequency stability is within ±0.01 percent. Spurious output in the telemetry band is 60 db down from carrier at 25C ambient (50 db over entire temperature range).

Radiation built the antenna at Kaena Point, Hawaii, and recently converted the 60-ft Fort Monmouth antenna to automatic tracking capability. For more on tracking Tiros, see p 57.

New Business Data-Processing System Offers Sophistication at Moderate Price

Aiming at a market of some 6,000 U. S. companies, the Datamatic division of Minneapolis-Honeywell last week introduced its Honeywell 400 data-processing system which it will rent at $8,660 a month or sell for $390,000.

Datamatic says the on-line system handles up to 6,000 additions or subtractions a second, claims it is up to 10 times as fast as available machines in the same price range. Core memory capacity will be 1,024 words of 48 bits each. System is compatible with the big Honeywell 800 introduced 14 months ago, for which Datamatic says it has a $35 million order backlog. The company says data passing through the central processor is checked internally as it is read from or written on the magnetic tape; transfer rate is 64,000 characters or 96,000 decimal digits per second. New system is expected to be available in the summer of 1961.

ELECTRONICS NEWSLETTER

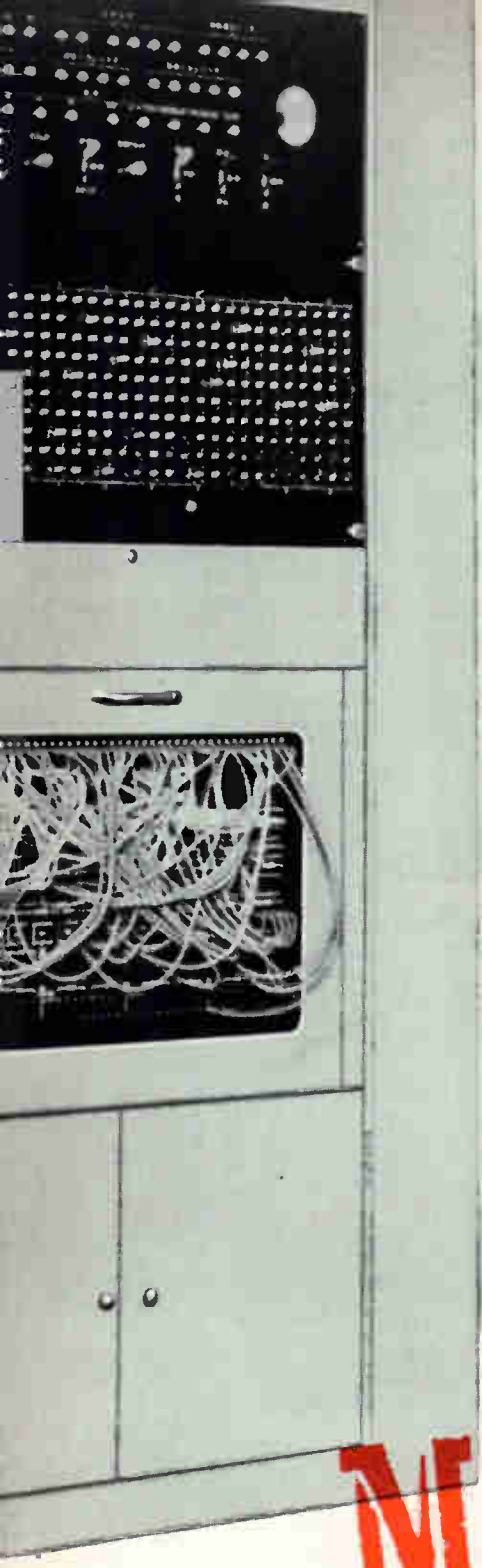
Pay-tv will get a three-year, $10 million test in Hartford, Conn., if a Zenith-Radio—RKO General joint effort wins Federal Communication Commission approval.

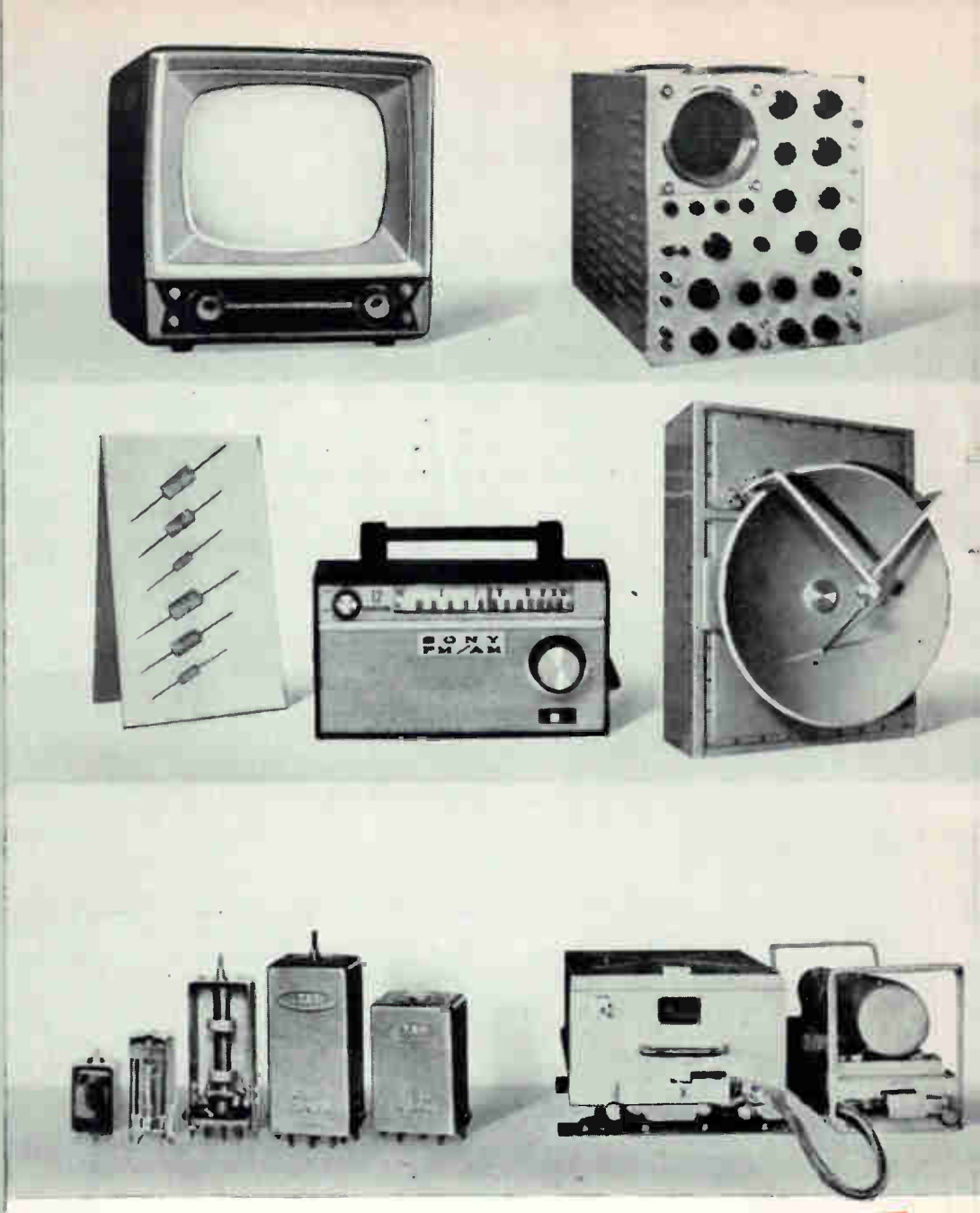
First, the FCC must consider a station application slated to go in today, and then the question of authorizing toll-tv operation. RKO General is negotiating with Capitol Broadcasting Co. for the purchase of WHCT.

The tests, which aim at 360,000 potential homes, would use Zenith's Phonevision decoder. This device, which has a dial mechanism so pay-tv customers can unscramble incoming signals, also makes a record of what was dialed and when.

Hector R. Skifter resigned Monday as Assistant Director of Defense Research and Engineering (Air Defense) to return to the presidency of Airborne Instruments Laboratory, Deer Park, Long Island, N. Y., from which he had taken a leave of absence in February 1959. At the Pentagon Skifter served as chairman of the Ballistic Missile Defense Steering Group, spearheaded the BMEWS installation program, and coordinated the planning for development of the Nike-Zeus and the Defender programs.

Wall Street learned last week it will have to keep its Littons straight. Rumor of a merger between Hermetic Seal Corp. and Litton Industries was denied. But **Litton Engineering Laboratories has been engaged as consulting manager by Hermetic Seal.** This involves integration of the management of the two companies, with Charles V. Litton (who founded and left Litton Industries) as head of the joint management team. Observers regard it as a first step towards a possible merger. Joint management extends to Hermetic Seal's California subsidiary, Connector Seals Corp., and New Jersey subsidiary Thermal Controls.





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THREAT OR OPPORTUNITY?

Top quality Japanese components, radios, electronic computers and many other products have already captured nearly ONE BILLION DOLLARS in U. S. sales... *annually!*

Excellent quality plus low overhead enable Japan to give U. S. design and production men the toughest competition for domestic markets in electronics history! Competition that grows each year.

GET THE FACTS!

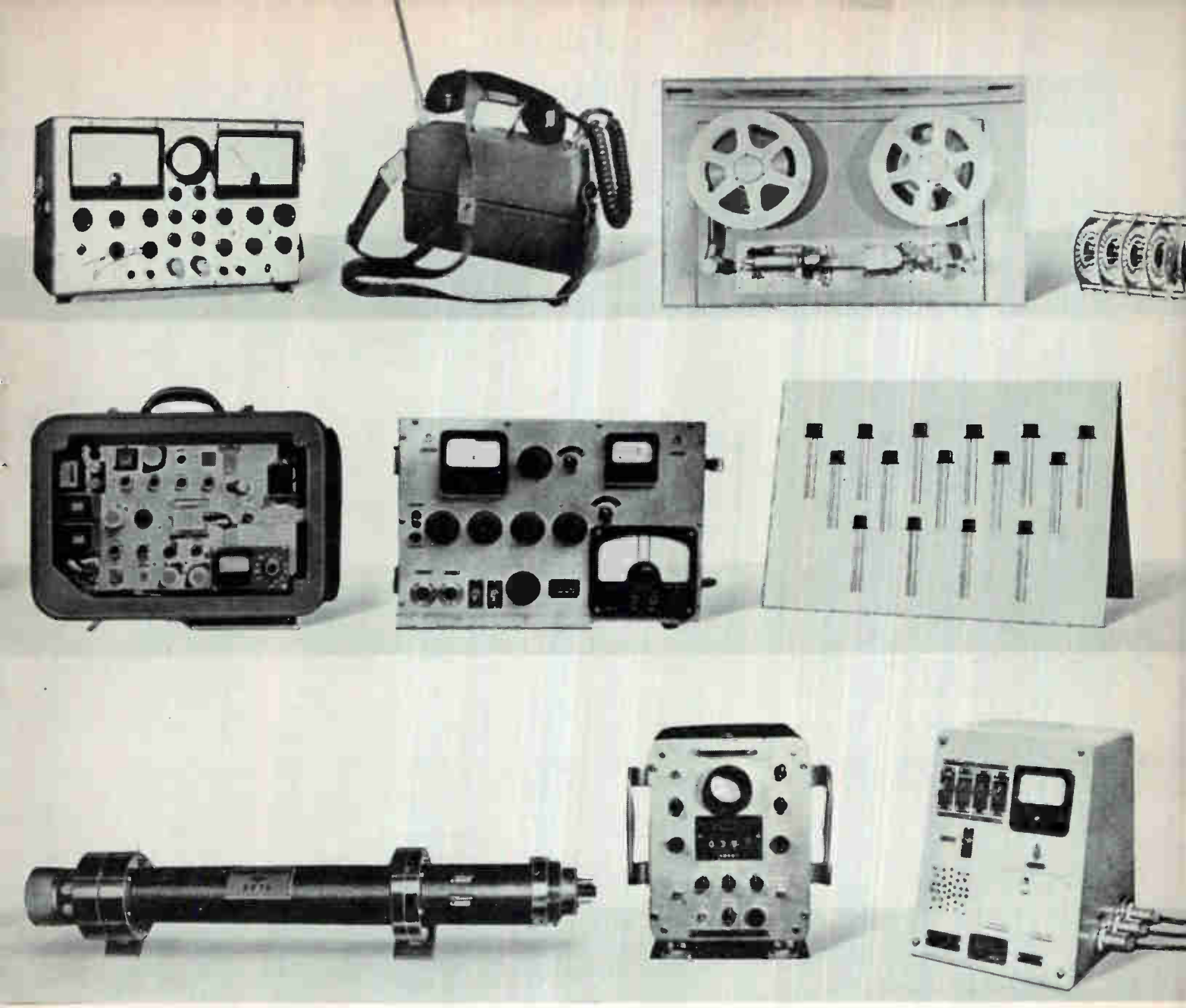
Frank Leary, talented Staff Editor of **electronics**, was sent to Japan for two months to work with the world-wide McGraw-Hill News Bureau in reporting the unvarnished truth about Japan's thriving electronics industry *from the inside* in our May 27 issue.

They tell: Why Japan is concentrating on the U. S. market. Which products. News about Japan's brilliant and original design achievements. The position of Japan's trade officials.

Mature, thoughtful reporting that will help U. S. electronics men to plan *intelligently.*

ELECTRONICS MEN WANT TO KNOW!

Rugged, intelligent competition from Japan can only be successfully met through an objective appraisal of the facts. Only such understanding can lead to constructive



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WASHINGTON OUTLOOK

STILL ANOTHER MISSILE PROJECT IS IN TROUBLE. This time it's the Navy's Corvus radar-busting missile—an air-to-surface weapon which homes in on the beams of an enemy radar installation.

The project is still in the development stage. The Navy wanted to accelerate work during fiscal 1961, starting July 1, so that production might be started in the near future. The Navy's recommendation was supported by the director of Defense Research & Engineering, Dr. Herbert York. But the defense comptroller recommended, instead, that the project be terminated—on grounds that are not very clear.

Defense Secy. Gates has come up with a compromise. The defense budget now under study by Congress does not set aside new funds for Corvus. But Navy has been told it can continue work on the missile by diverting funds from other R&D projects. The Navy now plans to do this.

The Air Force has been under a similar bind this year on the Mace surface-to-surface missile. USAF has been denied new funds but has been allowed to divert money from other projects to buy Mace.

- **The Air Force's proposed budget reshuffling,** centering on a massive Bomarc B-Sage cutback, which was reported in this column last week, earmarks substantial funds to step up electronics procurement.

  Orders for improved surveillance radars to "plug the gaps" in aircraft warning nets in Canada will be boosted $16.7 million. The modernization plan features the addition of frequency-diversity, using multiple frequencies to extend detection range and dimish vulnerability to countermeasures.

  BMEWS procurement will be accelerated by $42.5 million. Objective is to make the Clear, Alaska, site operational several months earlier and the English installation by a year or so.

  An extra $15 million will be awarded to Hughes to rush development of an extremely long-range, pulse-Doppler radar and the associated long-range GAR-9 air-to-air missile. An increase of $135.7 million is planned to modernize electronic systems for the F-106, F-102, and F-101B manned fighters. New time-division multiplex data link equipment will be added, for instance, to allow Sage computers to automatically fly interceptor aircraft to targets.

- **The Air Research & Development Command** is setting up an index of scientists and engineers working on its projects as a means of simplifying the dissemination of technical information among contractors.

  Individual rosters will be prepared for 33 different technical areas. Each of these areas will be broken down into major subgroups. Names, locations and specific specialities of individual Air Force and contractor personnel will then be listed. In all, ARDC expects to list nearly 50,000 scientists and engineers. The index will be widely distributed to contractors.

- **The Air Materiel Command** will reduce the number of its contract management regional offices from eight to three. The three new centers will be at Wright-Patterson AFB, O.; Olmstead AFB, Pa.; and Mira Loma Air Force Station, Calif.

  The offices will be in charge of contract surveillance, production, industrial property control, flight test, quality control, transportation, accounting and finance, and legal and inspection functions connected with Air Force procurement contracts. All air procurement districts, USAF plant representative offices and test site offices will fall under the jurisdiction of one of the three contract management regional offices.

NEW CLOCKS FOR hp DIGITAL RECORDERS

add time-of-day to recorded data
control taking of readings
fit in Digital Recorder cabinet
available for field installation

New hp 570A and 571B Digital Clocks mount in the left-hand side of hp 560A and 561B Digital Recorders, respectively. The clocks may be installed in the field, and fit either in cabinet arrangement, as shown, or into a combined Recorder-Clock rack mount arrangement only 10½" high.

Time appears as a 23 hour, 59 minute, 59 second presentation (12-hour clocks are available on special order). Display is by long-life, in-line indicator tubes. All time digits are available for printing.

Two operating modes provide utmost usefulness. In the first mode, hp or Dymec Digital Counters, Digital Voltmeters or other external equipment control print rate; time being printed simultaneously with other data. In the second mode, for tests where less frequent readings are desired, the Digital Clocks control the timing of readings. A front panel control selects reading rates of 1 per second, 6 per minute, 1 per minute, 6 per hour or 1 per hour.

SPECIFICATIONS

Indication: Six in-line long-life digital display tubes. Indication to 23 hrs., 59 min., 59 sec.

Time Base: Ac line, 1 pps from counter, or external 1 pps.

Accuracy: Time base accuracy + 0, — 1 second.

Print Control: Front panel control selects CLOCK or EXTERNAL control mode. PRINT RATE of 1 sec., 6/min., 1/min., 6/hr., 1/hr. also chosen on front panel control.

Output: Six time digits for time recording. Holdoff signals for hp, Dymec counters.

Power Interruption Alarm: Front panel warning light.

Analog Output: 570A retains analog output of 560A.

Prices: hp 570A (fits hp 560A/AR) $1,050.00; hp 571B (fits hp 561B/BR) $950.00.

Data subject to change without notice.
Prices f.o.b. factory.

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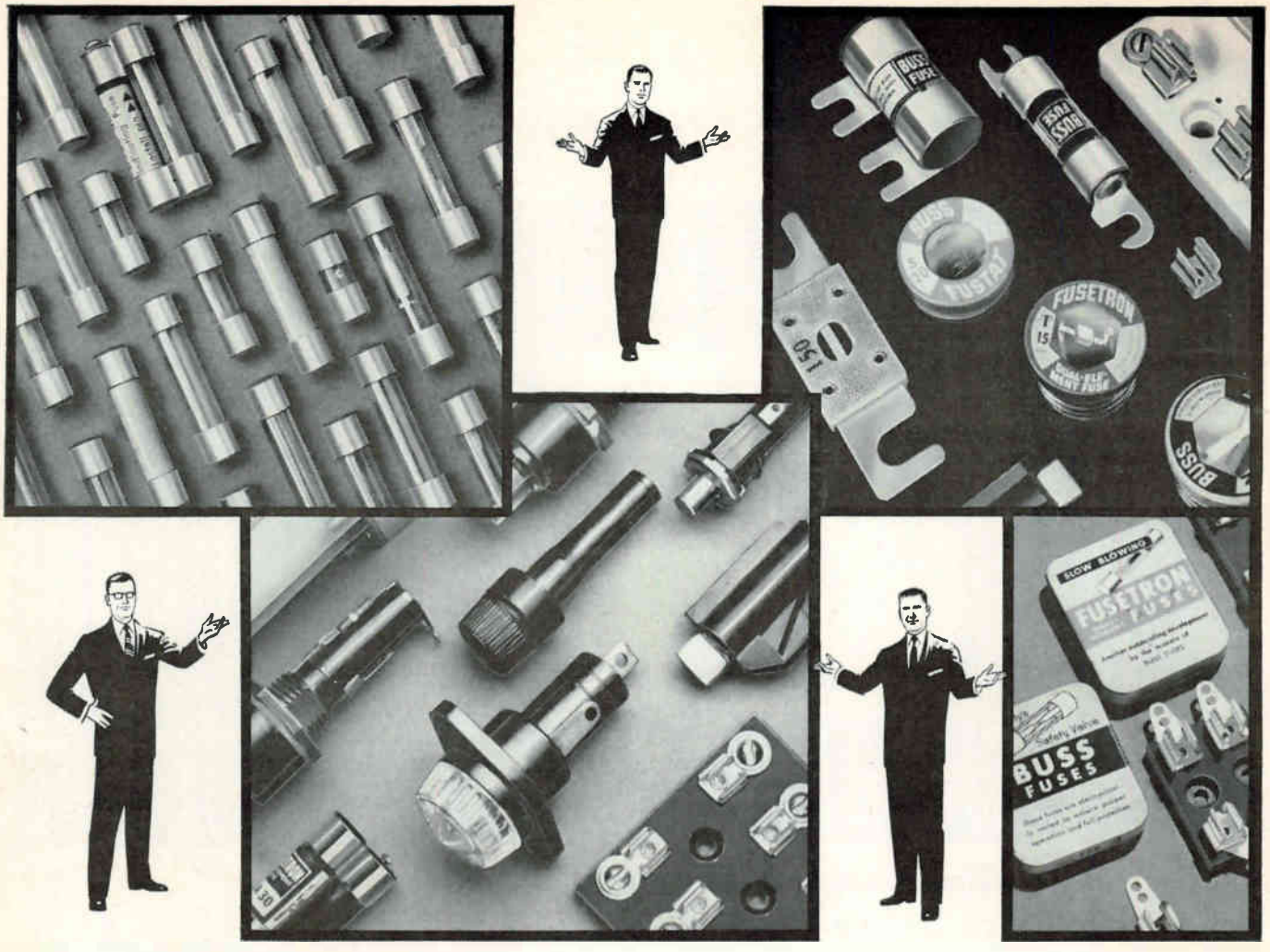

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. . . why it pays to specify and use dependable BUSS FUSES

IT'S A FACT! By specifying BUSS fuses, you obtain the finest electrical protection possible — and you help safeguard the reputation of your product for quality and reliability.

IT'S A FACT! BUSS fuses have provided dependable electrical protection under all service conditions for over 45 years—in the home, in industry and on the farm.

IT'S A FACT! To make sure BUSS fuses will give your equipment maximum protection, every one made is tested in a sensitive electronic device. Any fuse not correctly calibrated, properly constructed and right in all physical dimensions is automatically rejected.

IT'S A FACT! Whatever your fuse requirements, there's a dependable BUSS or FUSETRON fuse to satisfy them. Sizes from 1/500 ampere up and there's a companion line of fuse clips, blocks and fuseholders.

IT'S A FACT! The BUSS fuse engineering staff will work with you to help you find or develop the best-suited to your needs. This places the world's largest fuse research laboratory and its personnel at your command to save you engineering time.

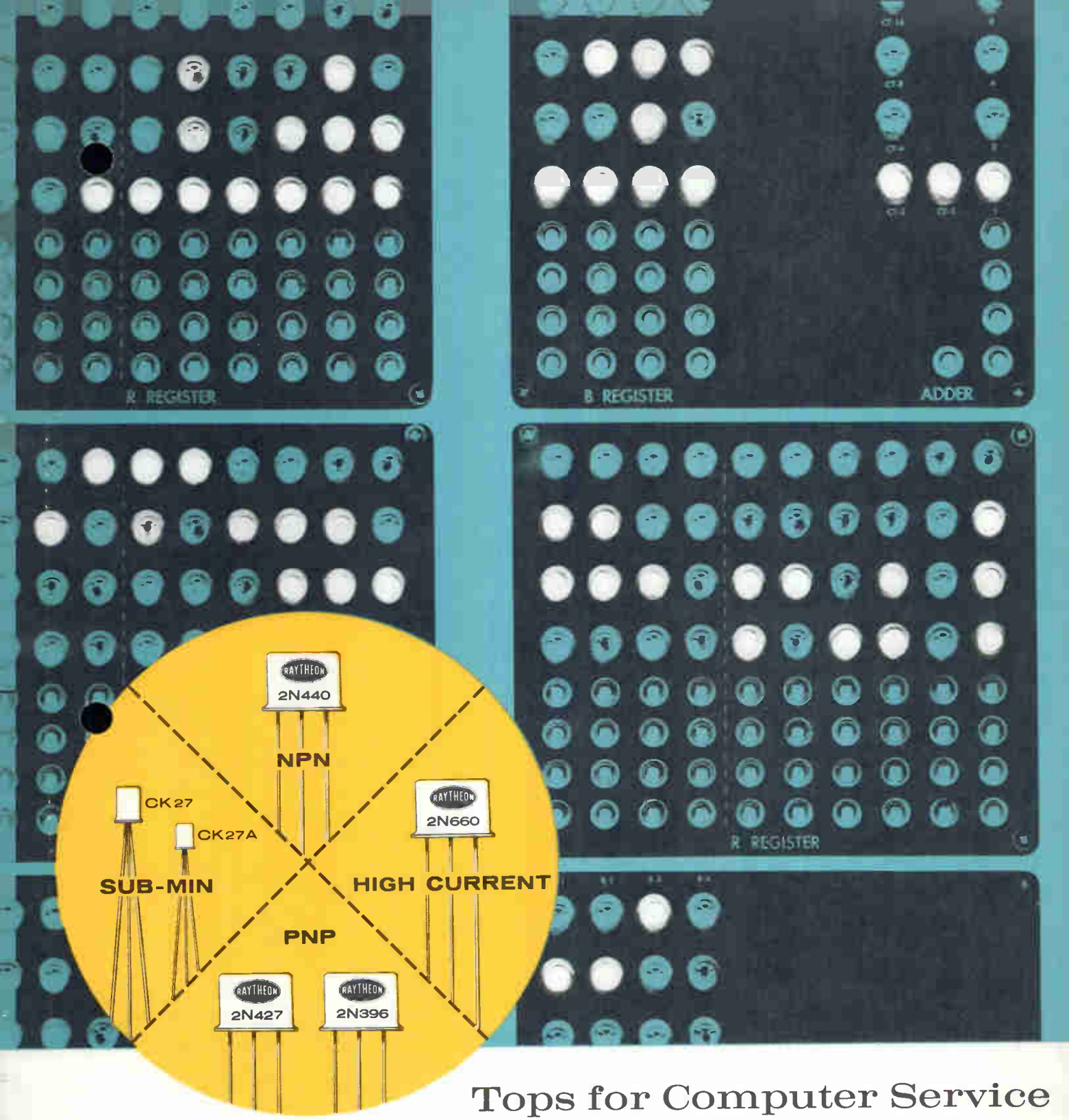
For more information on BUSS and FUSETRON Small Dimension fuses and fuseholders, write today for Bulletin SFB.

BUSSMANN MFG. DIVISION, *McGraw-Edison Co.* University at Jefferson, St. Louis 7, Mo. 480

BUSS fuses are made to protect - not to blow, needlessly.

BUSS makes a complete line of fuses for home, farm, commercial, electronic, electrical, automotive and industrial use.

FUSETRON BUSS TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION McGRAW EDISON



Tops for Computer Service

These Raytheon germanium transistors are top choices of computer engineers for a number of important reasons. They were developed with computer applications specifically in mind — voltage, gain, and response characteristics are optimized for this type of service. In medium frequency computer applications, these Raytheon switching transistors give you the reliability derived from years of production experience. And Raytheon's quality control program assures strict product uniformity and rigid adherence to specifications.

Result of all this is an extensive line of computer transistors that have set highest industry standards for quality and reliability. With the 2N396, which provides an internal base to case connection, Raytheon now gives you an important addition to a broad line of PNP, NPN, subminiature, and high current switching transistors. More details are given on the other side of this page.

Semiconductor Division, Raytheon Company, 215 First Avenue, Needham Heights 94, Massachusetts.

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EVERYTHING YOU NEED FOR YOUR SWITCHING CIRCUITS

AVAILABLE IN QUANTITY... WITH TRADITIONAL RAYTHEON RELIABILITY

RAYTHEON

FOR GENERAL APPLICATION . . . THE 2N396 SERIES PNP germanium strapped base transistors for general switching service. Temperature range −65°C. to +100°C. Immediate availability.

Type	B_{VPT} Max. Volts	$f_{\alpha b}$ mc	H_{FE1}	H_{FE2}	R_{Sat} ohms
2N395	15	4.5	40	12	2.2
2N396	20	8.0	60	20	1.3
2N397	15	12.0	80	35	1.1

A COMPLETE HIGH CURRENT SWITCHING LINE PNP germanium switches for 1 amp, high frequency, high gain service. Temperature range −65°C. to + 85°C. Long a production item — excellent availability in large volume.

Type	B_{VPT} Max. Volts	$f_{\alpha b}$ ave. mc	H_{FE1} ave. I_B=1mA V_{CB}= −0.25V	H_{FE2} ave. I_B=10mA V_{CE}= −0.35V	I_C=150mA ohms
2N658	−16	5	50	40	0.9
2N659	−14	10	70	55	0.6
2N660	−11	15	90	65	0.45
2N661	− 9	20	120	75	0.35
2N662	−11	8	30 min.	50	0.7

IMPROVED DISSIPATION AT LOWER CURRENT VALUES NPN germanium transistors for medium current, high frequency, high gain switching service. Temperature range −65°C. to +85°C. Immediate availability.

Type	B_{VPT} Max. Volts	$f_{\alpha b}$ mc	H_{FE1}	R_{Sat} ohms
2N438	25	2.5	25	3.0
2N439	20	5.0	45	3.0
2N440	15	10.0	70	3.0

HIGH RELIABILITY PNP TRANSISTORS germanium transistors for medium current, high frequency switching service. Temperature range −65°C. to +85°C. Immediate availability.

Type	B_{VPT} Max. Volts	$f_{\alpha b}$ mc	H_{FE1}	H_{FE2}	R_{Sat} ohms
2N425*	−30	4	30	15	2.2
2N426*	−25	6	40	18	2.2
2N427*	−20	11	55	20	1.3
2N428*	−15	17	80	30	1.1
2N404*	−24	12	See Data Sheet		

* Available to MIL Specification

SUB-MINIATURE TRANSISTORS Sub-miniature transistors for medium current, high frequency, high gain switching. Temperature range −65°C. to +85°C. Immediate availability.

TYPE		B_{VPT} Max. Volts	$f_{\alpha b}$ mc	H_{FE1}	H_{FE2}	R_{Sat} ohms
.130" Dia. x .160" High	.100" Dia. x .130" High					
CK 25	CK 25A	−30	4	30	15	2.2
CK 26	CK 26A	−25	6	40	18	2.2
CK 27	CK 27A	−20	11	55	20	1.2
CK 29	CK 28A	−15	17	80	30	1.1

Your local authorized Raytheon Distributors carry in-stock inventories for immediate delivery.

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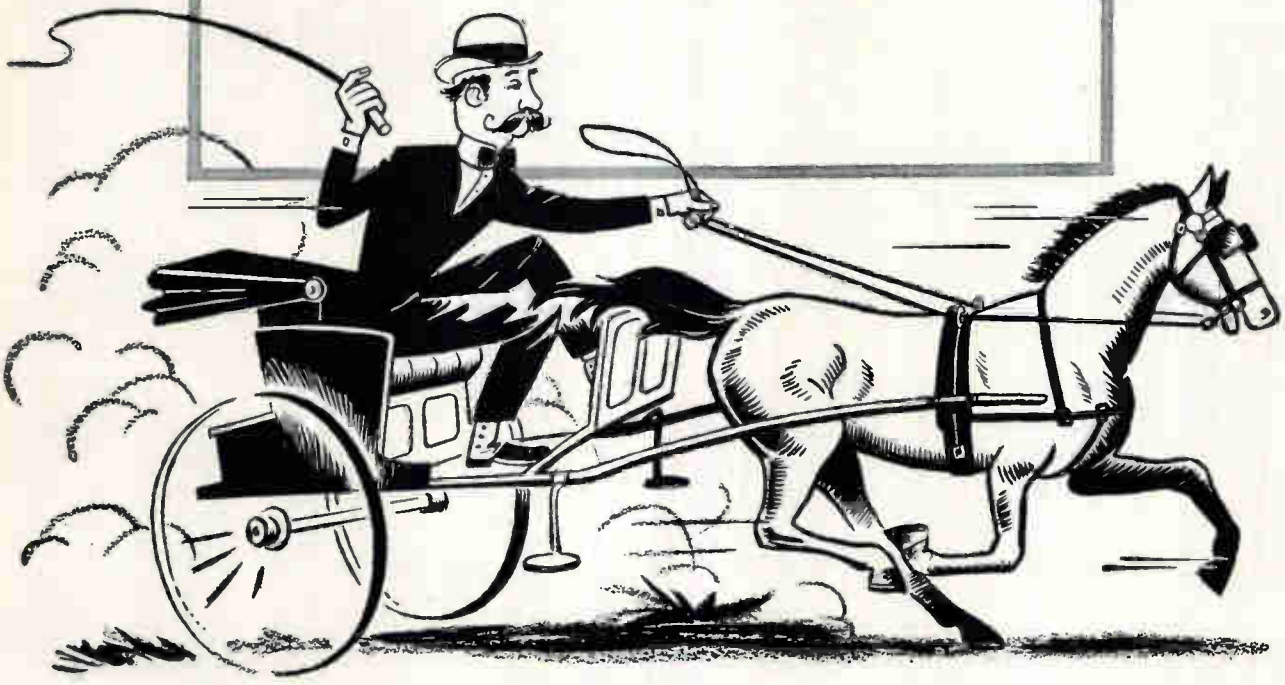
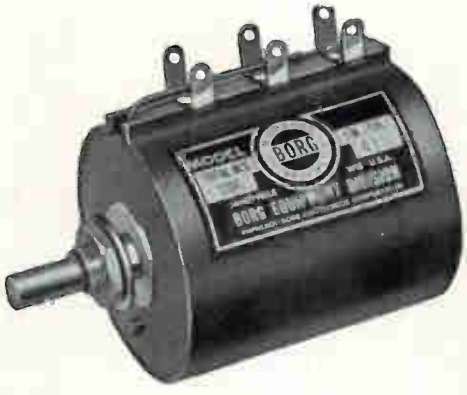


Wherever you are located, there's a Borg "Tech-Rep" or distributor near you with a stockpile of Borg 1100 Series Micropots ready for delivery. 1100 Series Micropots are precision potentiometers economically priced. Units with a total resistance of 50 to 500 ohms inclusive are supplied with a .25% independent linearity. Resistances from 1000 to 100K ohms are delivered with .25% or .1% independent linearity. Call your nearest Borg distributor today.



WRITE FOR DATA SHEET BED-A132

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Amphenol-Borg Electronics Corporation
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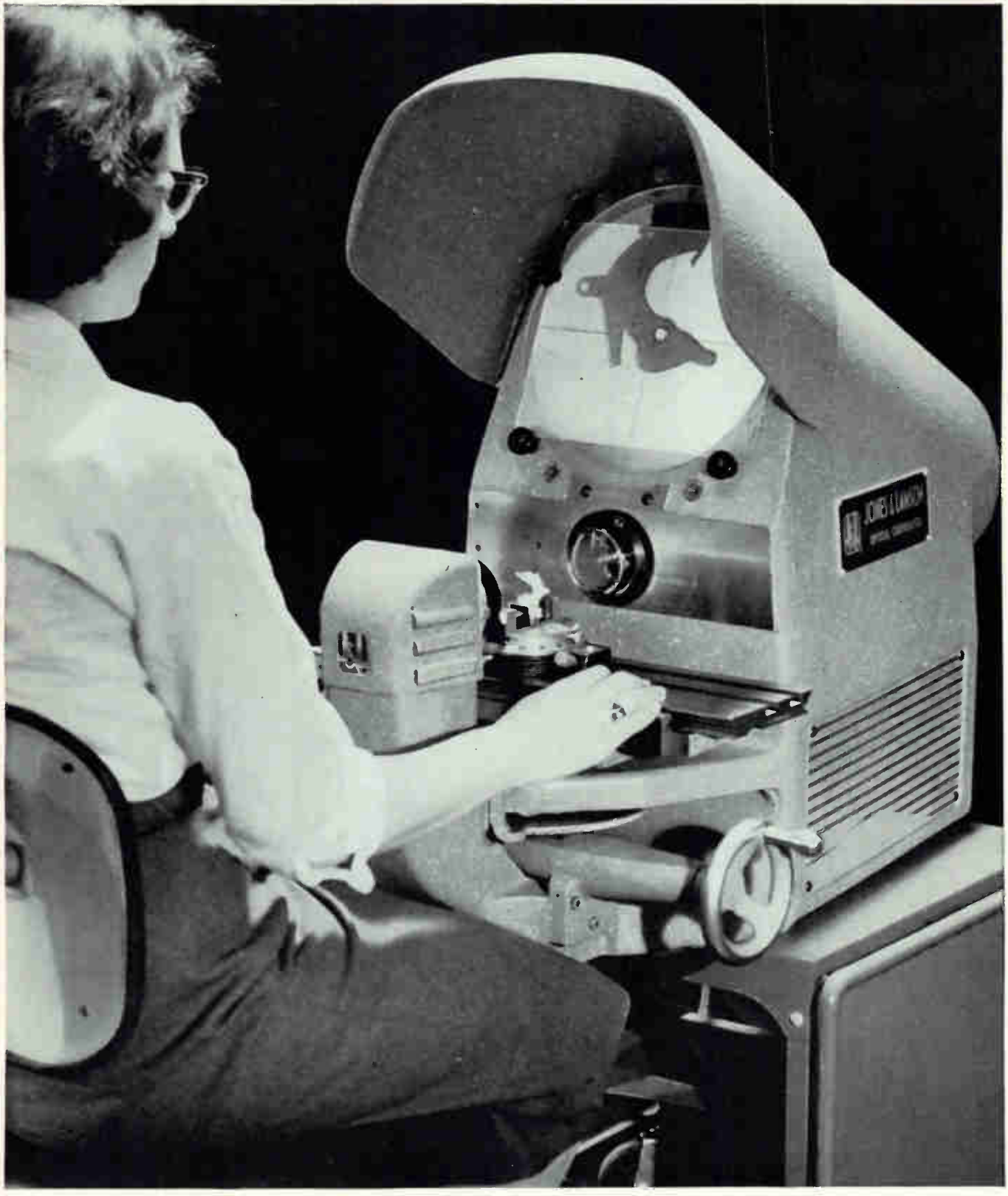


J & L's new 10″ screen model as used in the horizontal position.

OPTICAL COMPARATOR ...the new J&L TC-10

Now, for the first time, the most important features of "big" optical comparators have been combined in a relatively inexpensive machine, the J&L TC-10. As a result, medium and small producers can greatly improve their quality control procedures.

Three different table styles are available, including a fixed table for straight comparison work, a plain table, and a measuring table which gives 3 inches horizontal measurement and 2 inches vertical. All measurements are read directly to .0001", without computation.

The TC-10 handles big 8 x 10" overlay charts and provides precise comparison inspection for a high percentage of most jobs that are normally handled on larger machines. Eccentric chart holders afford rapid alignment of overlay charts in either the horizontal or vertical position.

Other "big machine" features:

ANGLE MEASURING is accomplished with a chart graduated in 90° segments around the full 360° of its periphery, providing direct measurements to 5 minutes of angle.

QUICK-CHANGE LENS MOUNT accommodates all lenses from 5X to 125X, with no lens or mirror adjustments necessary. Lenses are matched, pre-set, pre-focused, and coated for extra light transmission.

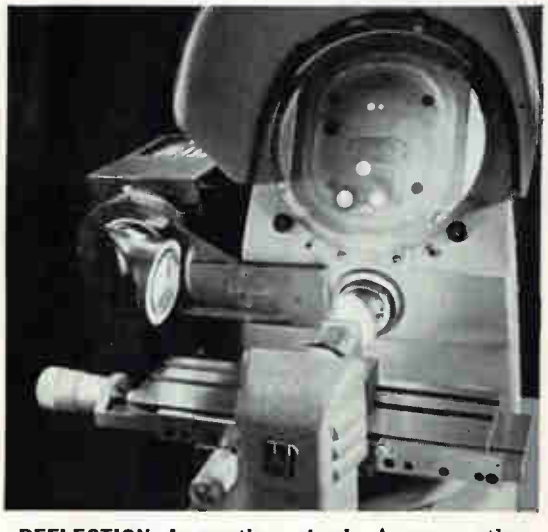
VERTICAL STAGING is done easily. A custom-designed metal stand rigidly supports the machine in the vertical position. Staging facilities include 2 x 3" coordinate measurements, read directly to .0001", and a plain vertical stage with travel in one direction for straight comparison work.

TRACING INSPECTION facilities are readily available. A standard J & L tracing fixture is easily mounted beside the lens.

BONUS! The new 5X, 2" aperture lens, specially designed for the machine, provides comparison inspection capacity and accuracy never before offered on a machine of this size.

See the TC-10 in operation at Booth #1208 ASTE Show, or write for folder #GL-6000.

Here's the TC-10 in the vertical position.



REFLECTION Inspection, too! Among other things, the TC-10 is adaptable for *reflection inspection*. Reflected images are extremely sharp —even at high magnifications.

"the world's oldest and largest maker of optical comparators"

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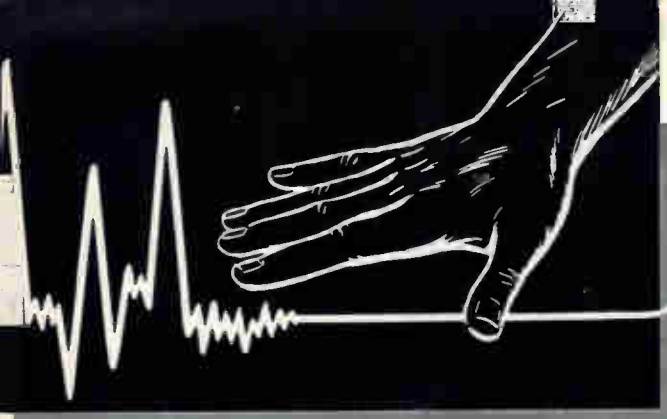
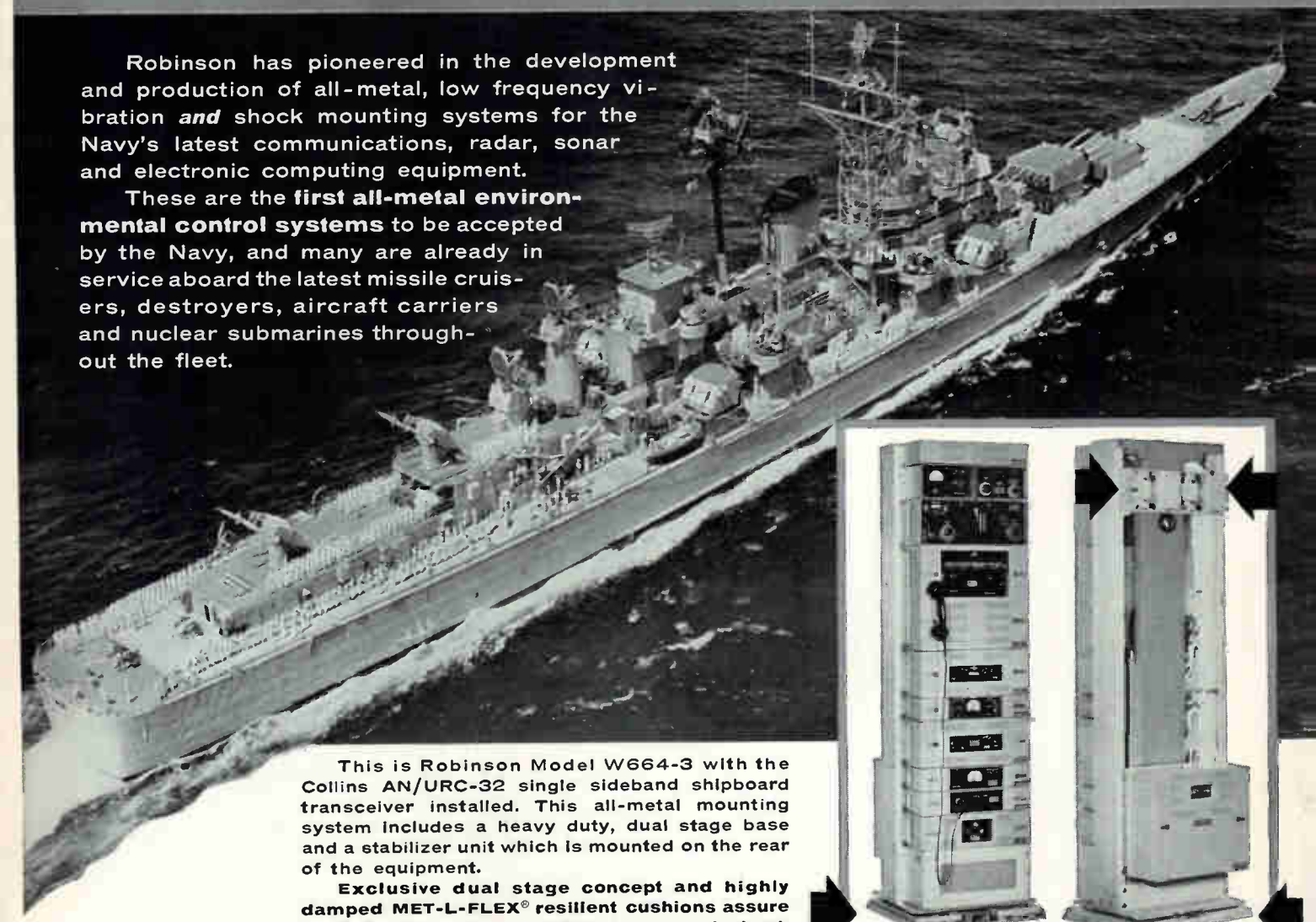


how ROBINSON *Vibration and Shock Control*

PROTECTS PERFORMANCE and assures RELIABILITY in Shipboard Installations . . .

Robinson has pioneered in the development and production of all-metal, low frequency vibration ***and*** shock mounting systems for the Navy's latest communications, radar, sonar and electronic computing equipment.

These are the **first all-metal environmental control systems** to be accepted by the Navy, and many are already in service aboard the latest missile cruisers, destroyers, aircraft carriers and nuclear submarines throughout the fleet.



This is Robinson Model W664-3 with the Collins AN/URC-32 single sideband shipboard transceiver installed. This all-metal mounting system includes a heavy duty, dual stage base and a stabilizer unit which is mounted on the rear of the equipment.

Exclusive dual stage concept and highly damped MET-L-FLEX® resilient cushions assure the full range of vibration isolation and shock attenuation—double protection for extra reliability! ***Send for FREE brochures.***

VIBRATION CONTROL IS RELIABILITY CONTROL

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DESIGNERS AND MANUFACTURERS OF VIBRATION CONTROL SYSTEMS

CIRCLE 22 ON READER SERVICE CARD

Plan $25-Million Complex

MAJOR INTERNATIONAL development program announced by Radio Corp. of America will call for initial investment of $25 million for the creation of an electronics manufacturing complex in southern Italy.

By agreement, termed "unprecedented in scope" by RCA officials, Italy's Istituto per la Ricostruzione Industriale (IRI) has obtained the assistance of RCA International to direct the project, drawing on parent company facilities.

IRI is the Italian counterpart of the now defunct Reconstruction Finance Corp. in the U. S.

Principal purposes of the program will be to expand Italy's electronics business in the Common Market complex, to help industrialize what is now an agricultural region with little industry and much unemployment, and to encourage investment of foreign and domestic capital. Phase one of the program will aim at the manufacture of tubes, semiconductors and other components.

• **Hazeltine Corp.**, Little Neck, N. Y., reports a 21-percent rise in net income for 1959. The 1958 figure was $2,242,226; last year it was $2,724,772. Gross income (including royalties) declined from the 1958 peacetime peak of $62,424,060 to $55,883,841. The firm attributes this to the increased amount of money spent on development in the past year.

• **Dalto Corp.**, manufacturer of electronic flight simulation training equipment, reports stockholder approval of an increase of authorized capital stock from 350,000 to 700,000 shares of common $1 par stocks. The company also announces acquisition of 100 percent of the stock of **Avitronics, Inc.**, Danbury, Conn., another manufacturer of electronic flight-training gear. With the acquisition, Dalto will consolidate manufacturing operations previously carried out in Danbury at a new plant in Norwood, N. J.

• **Lear Inc.**, Santa Monica, Calif., announces a 50-percent rise in net earnings for the year ended Dec. 31, 1959, over the 1958 figure. Net income in 1959 was $2,407,022, compared with $1,607,751 in 1958. Earnings per share in 1959 were 91 cents on 2,643,714 shares outstanding. The comparable figures for 1958 were 68 cents per share on 2,377,081 shares. Shipments in 1959 of $87,002,497 were 37 percent above the 1958 volume of $63,627,475. New business last year set a record of $100,800,000. Year-end backlog was $76 million.

• **Eitel McCullough**, San Carlos, Calif., reports sales of over $29 million for itself and its subsidiaries for 1959. This represents a 60-percent increase in sales, resulting in a net profit in excess of $1.5 million after federal taxes. The 1959 profit figure was 3½ times greater than the 1958 total and was equal to 83 cents a share last year, as compared with 23 cents a share in 1958.

25 MOST ACTIVE STOCKS

WEEK ENDING APRIL 1

	SHARES (IN 100's)	HIGH	LOW	CLOSE
Philco Corp	1,548	37¼	33⅝	37¼
RCA	1,077	70¼	68	69
Ampex	1,006	36⅞	34⅝	35¾
Int'l Tel & Tel	966	39⅝	37⅞	38½
Waltham Precision	868	3½	3	3
Siegler Corp	812	38⅞	35¾	38¼
Litton Ind	794	78⅞	72½	77
Gen Elec	686	92½	88¼	92¼
Collins Radio	627	61	57	59¼
Dumont Labs	611	8¾	7⅞	8⅝
Sperry Rand	595	22¾	21⅞	21⅞
Westinghouse	510	51¼	49⅝	50¼
Gen Tel & Elec	481	79¼	77¼	77⅞
Raytheon Mfg	472	44⅛	39⅝	40½
Texas Inst	467	199	182¾	196½
Burroughs	411	32¾	31½	32
Avco Corp	362	14⅜	13⅜	13⅜
Univ Controls	345	14⅛	12⅞	13¼
Reeves Sndcrft	331	8⅞	8⅛	8½
Gen Inst	326	28	27¼	27¼
Zenith Radio	312	109⅞	102½	108½
Fairchild Camera	284	144¾	132¼	139
Beckman Inst	279	73	68⅝	72½
Gen Dynamics	261	44⅝	42½	42½
Varian Assoc	251	47½	44¾	47½

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., investment bankers.

Your employees' retirement dollars may be your most productive dollars

The dollars you put into a pension or profit sharing plan for your employees are dollars at work for you. Satisfied employees, assured of a secure future, are an asset to any business.

Morale is improved; older employees can be retired; younger employees promoted; good workers attracted; turnover reduced. But, in addition to providing definite retirement benefits for employees, an Ætna Life Pension or Profit Sharing Trust benefits management — and tax advantages are realized by both employer and employee.

As a leader in the field, Ætna Life will tailor-make a retirement plan to fit your company's individual requirements. Advice of our experienced experts is available without charge or obligation through your Ætna Life office.

Ætna Life Pension and Profit Sharing Plans work for you!

- Improve morale
- Provide for orderly retirement
- Give basis for promotions
- Reduce turnover
- Strengthen public relations
- Offer tax advantages

ÆTNA LIFE
INSURANCE COMPANY
Hartford 15, Connecticut

Affiliates: Ætna Casualty and Surety Company
Standard Fire Insurance Company

CIRCLE 25 ON READER SERVICE CARD→

POTTER SETS THE PACE

WITH...THE ONLY PERFORATED STRIP READER IN ITS CLASS

A single speed, unidirectional, photo-electric, perforated strip reader, the Potter 909 is

OBEDIENT...stops *on the stop character* at speeds up to 600 characters per second and it can be stepped one character at a time where synchronous readout is needed.

VERSATILE...output is a timed, shaped pulse for input to a computer, high speed printer, or control system.

...parallel NPN, PNP amplifier output circuit supplies up to 40 ma to loads returned to any bias voltage.

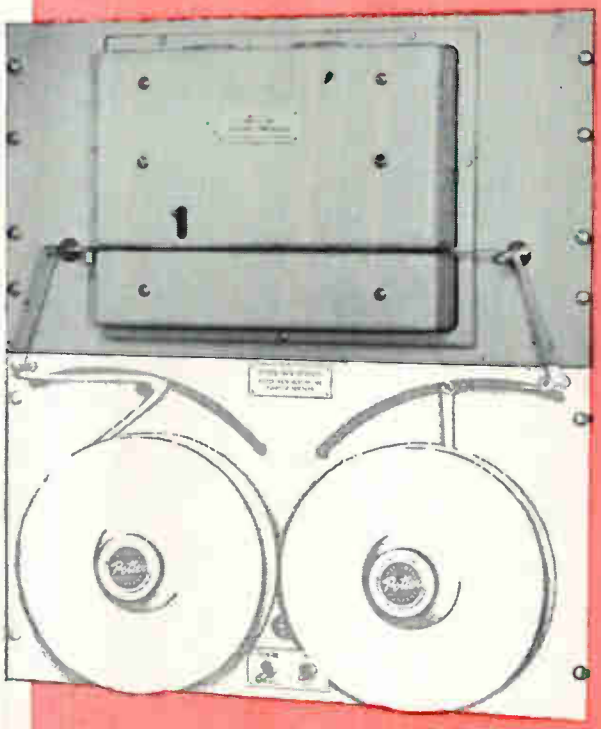
FAST...operates at speeds up to 1000 characters per second with complete dependability.

SENSITIVE...a broad image light source eliminates the effects of filament variations in the lamp.

COMPACT...fits into a 10½ in. case—with its own power supply and amplifiers.

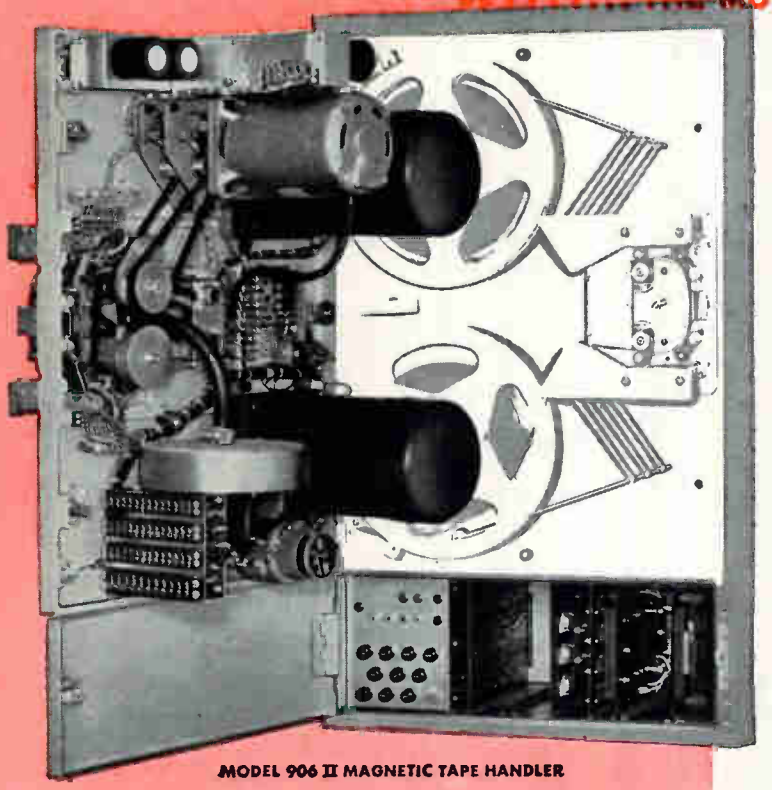
The Potter 909 perforated tape reader includes a tape transport system, tape reading system, power system, and control system. It is designed for panel, rack, or cabinet mounting. Accessories available include tape spoolers and tape bin, cooling fan, mounting adapters and extension frames.

WRITE FOR DETAILED SPECS AND LATEST PRICE AND DELIVERY INFORMATION



MODEL 909 PERFORATED STRIP READER WITH MODEL 3299 SPOOLER

WITH...THE MOST TAPE HANDLER FOR YOUR MONEY



MODEL 906 II MAGNETIC TAPE HANDLER

The Potter 906 II is the high speed digital magnetic tape handler that gives you higher performance, greater reliability, and lower cost than any other tape handler on the market—bar none.

Only with the 906 II do you get such advantages as:

...full forward reverse cycling at 120 ips with 1 inch tape.

...low skew tape guide that permits conventional recording at 400 bpi density.

...1500 bpi recording densities which are made possible by using the 906 II with the Potter Contiguous Double Transition System. 450,000 8-bit characters per second can be recorded on 1 inch tape.

...transistorized control of all functions that simplifies computer design.

...simplified packaging for easy maintenance.

...a price—far below other makes—that proves the economy of superior design.

Compare them any way you like—spec for spec, dollar for dollar, space for space—and you'll agree that the high performance, low cost Potter 906 II is the most tape transport at any price.

WRITE FOR DETAILED SPECS AND LATEST PRICE AND DELIVERY INFORMATION

POTTER INSTRUMENT CO., INC. Potter Sunnyside Boulevard, Plainview, L. I., N.Y.
OVerbrook 1-3200

MARKET RESEARCH

Sees $8-10 Billion Industrial Sales

INDUSTRIAL PRODUCTS are the electronics industry's wave of the future, according to more and more members of the industry who are commenting in this vein.

"We have just begun to scratch the market potential for industrial electronics," said David R. Hull, Electronic Industries Association president, at the IRE show. EIA market planners have forecast a 225-percent sales increase for industrial electronics over the coming decade, with volume rising to $3.4 billion in 1970. Hull indicates this forecast is very conservative and that 1970 volume will be higher than predicted.

"Industrial electronics business will turn up sharply in the middle Sixties and will exceed combined missiles and space spending for electronics by the end of the decade," said Gene Root, group vice president of Lockheed Aircraft's Missile and Electronic division, at the recent EIA Defense Market Planning Seminar. He looks for industrial electronics sales to total eight to ten billion dollars in 1970, with computers accounting for about half of this total.

• **Deliveries** of utility and executive aircraft during 1959 increased 20 percent over 1958 to 7,689 units, with a manufacturers' value of $130 million, reports the Utility Airplane Council of the Aerospace Industries Association. Equipment manufacturers estimate that electronic gear represents about 15 percent of utility and executive aircraft sales.

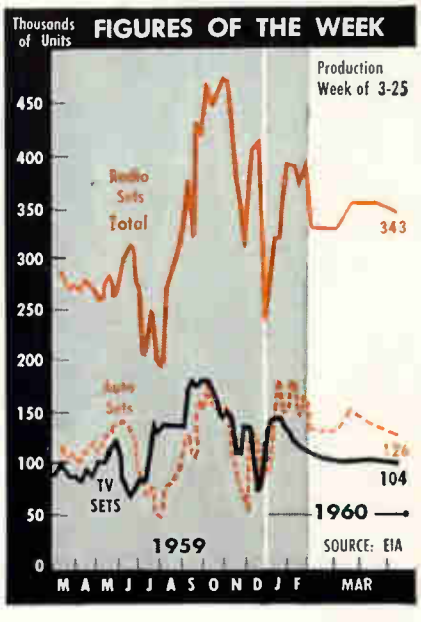
The 1959 record marked the end of a decade of spectacular growth for general aviation (which includes all civil flying except commercial airlines), says Joseph T. Geuting, manager of the airplane council.

Since 1950 unit sales have more than doubled and their value has increased six times. The value increase is substantially greater because of the numerous improvements in the aircraft, which are larger, faster and more completely equipped with various navigation and communication instruments.

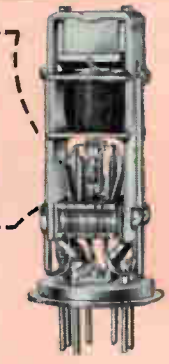
• **Factory** sales of electronic components and accessories produced in Puerto Rico during 1958 was $3.4 million. Sales of radio and tv sets, plus phonograph records and parts, totaled $851,000. Information comes from the island's Economic and Development Administration which recently completed a survey of metal and electrical products manufacturing in Puerto Rico.

• **Evidence of a growing market** for educational tv equipment is coming in from several quarters. Educational publications report growing classroom acceptance and use. Market researchers are stepping up efforts to study the market. General Electric analysts recently predicted the market for educational tv will reach 2,750,000 sets in 1965.

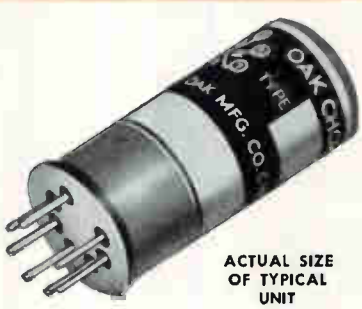
• **Bureau of Census reports** shipments in 1958 of phonograph records and prerecorded tapes had a factory value of $135,098,000, up from $77,446,000 in 1954. Figures for 1958 include 3,121,000 prerecorded tape reels worth $4,286,000, but comparable information for 1954 was not separately reported. Information comes from preliminary reports from the 1958 Census of Manufactures.



Save this Guide to Oak Choppers



MINIATURE SERIES 600—MOST STABLE IN ITS CLASS



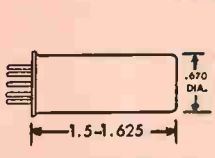
ACTUAL SIZE OF TYPICAL UNIT

MINIATURE SERIES M—SMALLEST, MOST RUGGED IN ITS CLASS

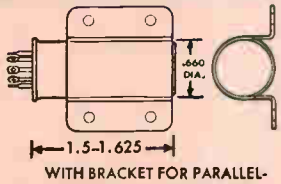
METICULOUS ENGINEERING combined with exhaustive testing provides a line of SPDT choppers which exhibit unusual stability and low noise. While the specifications shown here are necessarily abbreviated, they will help you make a preliminary appraisal. For complete details on any unit, send us the type number and a description of your application with its circuitry.

SERIES 600—MIL C4856, Class B, Type 1. Capacity between switch terminals and ground, 15 uuf average. Contact symmetry, within 10°. Weight, less than 1 oz.
SERIES M—MIL C4856, Class B, Type 1, Grade 2. Capacity between switch terminals and ground, 3-5 uuf. Contact symmetry: 0-500 cps, within 10°; at 1000 cps, within 20°. Weight, less than ¾ oz.

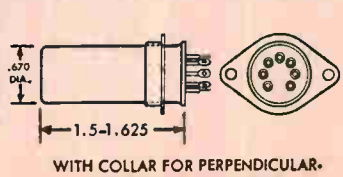
STANDARD MOUNTING AND TERMINAL STYLES—Modifications Available on Special Order



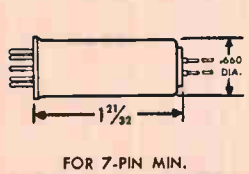
FOR 7-PIN MIN. ELECTRON TUBE SOCKET



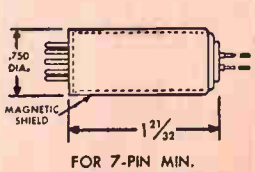
WITH BRACKET FOR PARALLEL-TO-SURFACE MOUNTING



WITH COLLAR FOR PERPENDICULAR-TO-SURFACE MOUNTING



FOR 7-PIN MIN. ELECTRON TUBE SOCKET



FOR 7-PIN MIN. ELECTRON TUBE SOCKET

	SERIES 600						SERIES M For Shock and Vibration Conditions
	Types 607, NC-600, 602, 603	Type 610	Type 604	Type 612	Type 605	Types 608, 609, NC-600A	Types M5-1, M5-2, M5-3
Nominal Drive Freq. and Voltage	400 ±20 cps at 6.3 v	400 ±20 cps at 6.3 v	380-500 cps at 6.3 v	400 ±20 cps at 6.3 v	400 ±20 cps at 6.3 v	60 ±5 cps at 6.3 v Aperiodic from 10-100 cps	4-8 Volts, 10-1000 cps. Aperiodic. Coil Current 60 ma at 400 cps Coil Res. 85 Ohms
Phase Lag at Nominal Drive Freq. and Voltage	65° ±5° at 400 cps (25° C)	65° ±5° at 400 cps (25° C)	75° ±10° at 400 cps (25° C)	90° ±10° at 400 cps (25° C)	180° +10° −0° at 400 cps (25° C)	20° ±5° at 60 cps (25° C)	10 cps: 10° ±5° 60 cps: 15° ±5° 400 cps: 55° ±10° 1000 cps: 110° −0° (25° C)
Contact Dwell Time at Nominal Drive Freq. and Voltage	150° min (25° C)	140° max (25° C)	150° min (25° C)	150° min (25° C)	160° ±10° (25° C)	165° to 170° at 60 cps	160° to 170° (25 °C)
Contact Rating Into Resistive Load (Maximum)	CONTINUOUS: 10 v at 2 ma INTERMITTENT: 15 v at 2 ma	CONTINUOUS: 50 v at 2 ma INTERMITTENT: 100 v at 2 ma	CONTINUOUS: 10 v at 2 ma INTERMITTENT: 15 v at 2 ma	CONTINUOUS: 10 v at 2 ma INTERMITTENT: 15 v at 2 ma	CONTINUOUS: 50 v at 2 ma INTERMITTENT: 100 v at 2 ma	CONTINUOUS: 15 v at 2 ma INTERMITTENT: 50 v at 2 ma	CONTINUOUS: 10 v at 1 ma INTERMITTENT: 12 v at 2 ma
Life Expectancy (Optimum Conditions)	Up to 5000 hours	Up to 1000 hours	Up to 5000 hours	Up to 5000 hours	Up to 5000 hours	Up to 10,000 hours	Up to 10,000 hours
Switching Speed With DC In Coil	Less than 1 Millisecond	Less than 1 Millisecond	Less than 1 Millisecond	Less than 1 Millisecond	Less than 1 Millisecond	Less than 800 Microseconds	Less than 200 Microseconds

OAK MFG. CO.
1260 Clybourn Ave., Dept. G, Chicago 10, Ill.
Phone: MOhawk 4-2222

SWITCHES CHOPPERS VIBRATORS
ROTARY SOLENOIDS TUNERS
PACKAGED CIRCUITRY

Sub-Min.

Widest selection of Pilot Lights –from DIALCO

NEON

T-2

HIGH BRIGHTNESS and REGULAR TYPES

DIALCO's Sub-Miniatures use tiny T-2 Neon Glow Lamps: *NE-2J (High Brightness)* at 105-125 V., A.C.; or *NE-2D* (regular) at 105-125 V., A.C. or D.C.

NEW Series mounts from *FRONT* of panel in 15/32" clearance hole (supplements 17/32" Series). Also—units for mounting from *BACK* of panel in 15/32" clearance hole. Unique lenses in 5 colors; give all-angle visibility. Units are fully insulated; meet applicable Mil. Specs.

Ask for Brochures L-159B and L-162.

(Illust. approx. actual size)

(Front mtg., 15/32")

No. 137–8536–931

(Front mtg., 17/32")

No. 145–5036–991

(Back mtg., 15/32")

No. 138–3836–1431–99

DIALCO®

INCANDESCENT

T–1¾

2-TERMINAL and 1-TERMINAL TYPES

Designed for use with T-1¾ midget flanged incandescent lamps—1.3 V. to 28 V... *NEW* Series mounts from *FRONT* of panel in 15/32" clearance hole—(supplements 17/32" Series). Also—units for mounting from *BACK* of panel in 15/32" clearance hole. Unique lenses in 7 colors. Units are fully insulated; meet applicable Mil. Specs.

Ask for Brochures L-156C thru 159B, and L-162.

(Front mtg., 15/32")

No. 162–8430–931

(Back mtg., 15/32")

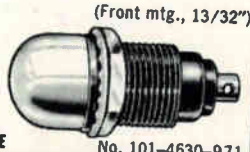
No. 134–3830–375–7

Spring-mounted Lens-with-Message is *rotatable*.

1-Terminal Pilot Lights

For use on *grounded circuits*. Mount in 13/32" or 15/32" clearance hole. Binding screw or soldering terminal.

(Front mtg., 13/32")



No. 101–4630–971

SAMPLES ON REQUEST—AT ONCE—NO CHARGE

Foremost Manufacturer of Pilot Lights

DIALIGHT CORPORATION

58 STEWART AVE., BROOKLYN 37, N. Y. ● HYacinth 7-7600

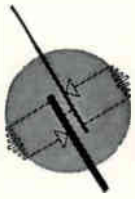
PRICES HAVE DROPPED!

on **low voltage** transistor regulated power supplies

- for critical commercial and military applications
- full five year warranty includes *all* components
- guaranteed to meet published specs.
- short circuit protected
- fit standard 19" rack

Specifications	Model PS4305	Model PS4315	Model PS4330
Voltage Range (VDC)	0-36	0-36	0-36
Current Range (Amps)	0-5	0-15	0-30
Regulation Against 20% Line change 0 to full load	.025% .025%	.025% .025%	.025% .025%
Impedance (Ohms) DC to 100KC	.1	.02	.02
Ripple (RMS) in Millivolts	1	1	1
Panel Height	5¼"	5¼"	8¾"
Price:	$545	$890	$1190

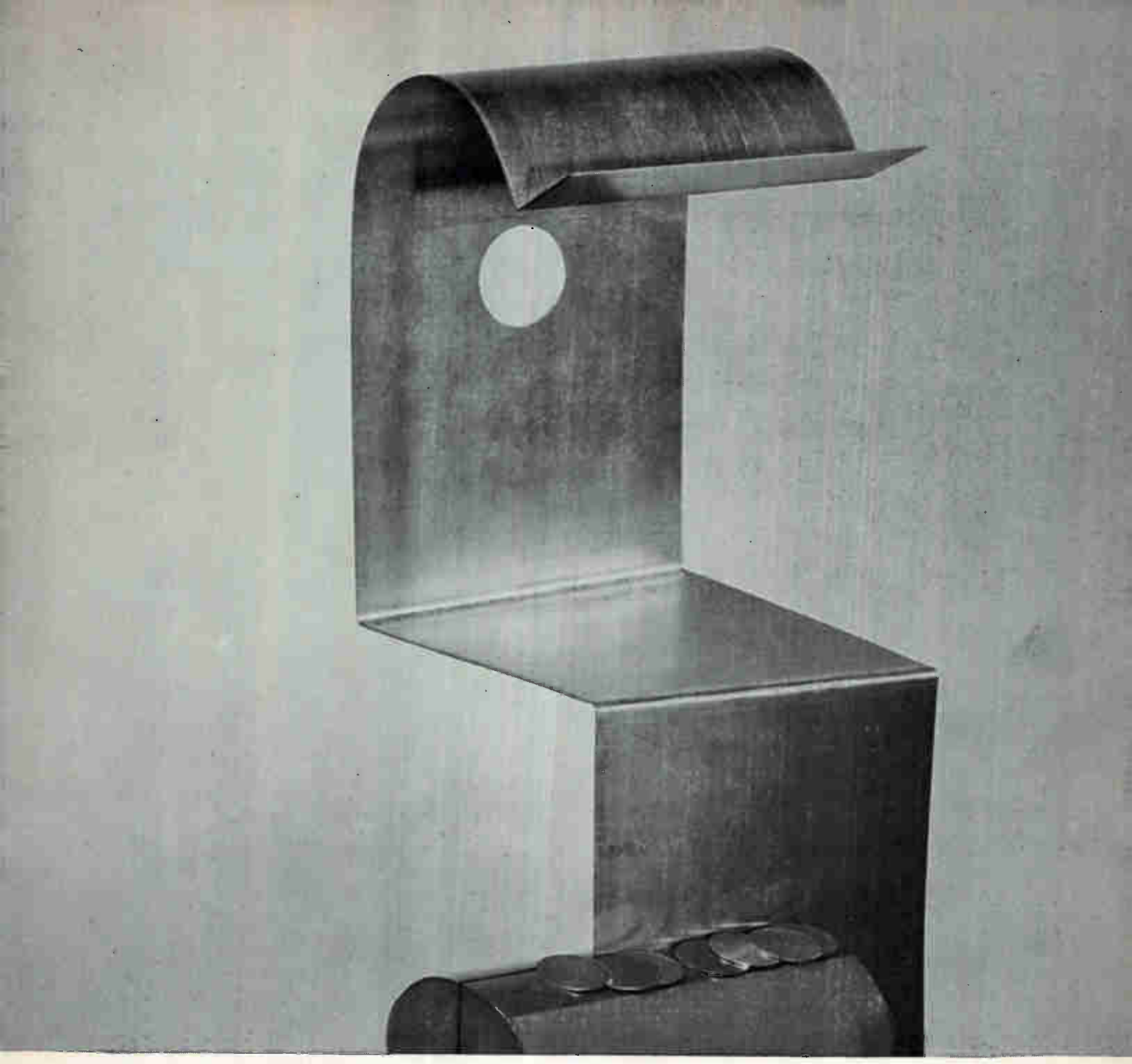
Write for complete specifications



Specify **POWER SOURCES BY**

POWER SOURCES, INC.

Burlington, Massachusetts



PUNCH IT... FORM IT... SHEAR IT... SOLDER IT!

New G-E CLAD-MOLY SHEET won't blister, flake or peel even if you heat it to 950°C

G-E Clad-Moly is molybdenum sheet clad in either nickel or copper, developed by General Electric. It meets the needs of the electronic industry for a molybdenum sheet with good soldering characteristics. What's more, this cladding really sticks! Won't delaminate! Bonds like a single piece of metal!

Base material is General Electric HD Moly Sheet, a new, high ductility sheet of pure molybdenum. The G-E Clad-Moly Sheet retains all the favorable properties of molybdenum—like its coefficient of thermal expansion that's similar to silicon, and its high electrical conductivity.

Order G-E Clad-Moly Sheet in thicknesses of from 0.010 to 0.080 inches—in widths up to 4 inches. Specify copper or nickel cladding on one or both sides. (Cladding will be between 0.0005 and 0.001 inches thick.) Or you can special order the *cladding thickness* up to 10% of *total sheet thickness.*

WIDEST USE AT PRESENT— G-E Clad-Moly is ideal for disks in silicon power rectifiers (see disks in photo above). It gives them excellent soldering properties. But there's no limit to the possible uses of this new material. We'd like to work with you in tailoring just the right G-E Clad-Moly to your specific needs. General Electric Co., Lamp Metals and Components Dept. E-40, 21800 Tungsten Road, Cleveland 17, Ohio.

Progress Is Our Most Important Product

GENERAL ELECTRIC

CIRCLE 29 ON READER SERVICE CARD

Vitramon®

SOLID STATE
CAPACITORS

Unique Construction Offers Superior Electrical And Mechanical Characteristics

The unexcelled reliability of Vitramon® Capacitors is an inherent characteristic of their fundamental design, composition and manufacture — a unique process which chemically combines fine silver electrodes and dielectric into one self-contained homogeneous monolithic unit, requiring no case or hermetic seal.

The low dielectric loss (less than .0006 at 1 kc) and high resistivity of this dielectric are largely due to the fixation of lead ions in its glass matrix. The high fluxing power of lead oxide firmly binds the chemical constituents of the body, keeping dielectric loss from elastic factors to a minimum.

The integral chemical fusion of stubby electrodes, dielectric and terminals assure these units a noise level below the threshold of conventional measurement techniques. The part's physical configuration guarantees a self-resonance point well into the UHF band.

Other performance characteristics deriving from this construction include a mean capacity drift of less than .05% after cycling from −55°C to 125°C when measured at 1 mc per MIL-C-11272A; capacity change at 200°C is less than 4%. Capacitance to 6800 mmf.

NEW!

actual size

Vk*

micro-miniature
CERAMIC CAPACITORS

47 - 10,000 mmf
200 vdc without derating
—55°C to 150°C operation

Square precision molded cases in only two sizes and a single standard 0.2" lead spacing for all values simplify circuit design, guarantee uniformity, facilitate handling, give greater mechanical stability. Package density: 432,000 parts per cubic foot @ 1000 mmf.

®trade mark

Vitramon INCORPORATED
P.O. Box 544 • Bridgeport, Connecticut

CIRCLE 31 ON READER SERVICE CARD

Where Polaris Stands Today

Electronics visits the U.S. Navy's first Fleet Ballistic Missile assembly installation. Polaris program has $2.74 billion so far, may get another $1 billion for next year

By JOHN F. MASON, Associate Editor

CHARLESTON, S. C.—An 880-acre resurrected swampland, seven miles up the sleepy Cooper river from Charleston harbor, is rapidly being changed into one of the most vital installations in our nation's defense.

Here, sleek, nuclear-powered, missile-launching submarines will slip up the river, bordered by oak trees heavy with Spanish moss, to Navy's new Polaris Fleet Ballistic Missile assembly facility. Each sub will be loaded with 16 Polaris missiles before returning to the sea.

$15 Million for Gear

A complex of nine steel and concrete buildings holding $15 million worth of electronic check-out gear, underground communications, roads and railroad tracks down to the river, makes up the new assembly facility. Here at the Naval Weapons Annex, missile subsystems from contractors all over the U. S. will be received for assembly, checkout, storing, and loading into nuclear-powered fleet ballistic missile submarines.

Appropriated funds to date for the Polaris program total $2.74 billion plus. Another $1 billion is expected in fiscal year 1961.

Prime contractor Lockheed, which designed the facility in consultation with Rear Adm. W. F. Raborn's Office of Special Projects, will permanently base about 100 engineers at the Annex to provide technical direction for the work. Actual operation of the facility and assembly of the missile will be done by Navy personnel—19 officers and 200 enlisted men.

General Electric, prime contractor for the missile's all-inertial guidance system and for the ship's fire control system, will station about 15 engineers at the site to conduct guidance system tests and to maintain both test and guidance equipment.

Other contractors include: Westinghouse Electric, for launching and handling equipment; the Atomic Energy Commission, for the thermonuclear warhead; Aerojet-General, for propulsion; and Nortronics div. of Northrop, for the DATICO automatic missile test sets.

Suppliers total more than 3,000 firms.

Key Buildings

Major buildings at the Annex are:

- The inert processing building for storing and repairing guidance, hydraulic and electronic devices.
- Missile assembly building where three assembly lines can operate simultaneously to turn out assembled and thoroughly checked-out missiles.
- Container storage and repair building to store and maintain a wide variety of handling and shipping containers for missile motors, components, and upkeep of support equipment.
- Motor inspection building in which three methods—bore scope, X-ray and ultrasonic—will be used to check rocket motors shipped from the West Coast and those returned from submarines for damage incurred en route.
- Re-entry body building for assembly of this portion of the missile.
- An equipment building.

Polaris inertial guidance system tests will be conducted at the Annex with special computers, test stands, power supplies and test sets designed and produced by the Ordnance Department of General Electric. Test equipment resembles support fire control which is used at guidance system assembly areas, missile assembly areas and the flight test site at Cape Canaveral.

Racks for 135 Systems

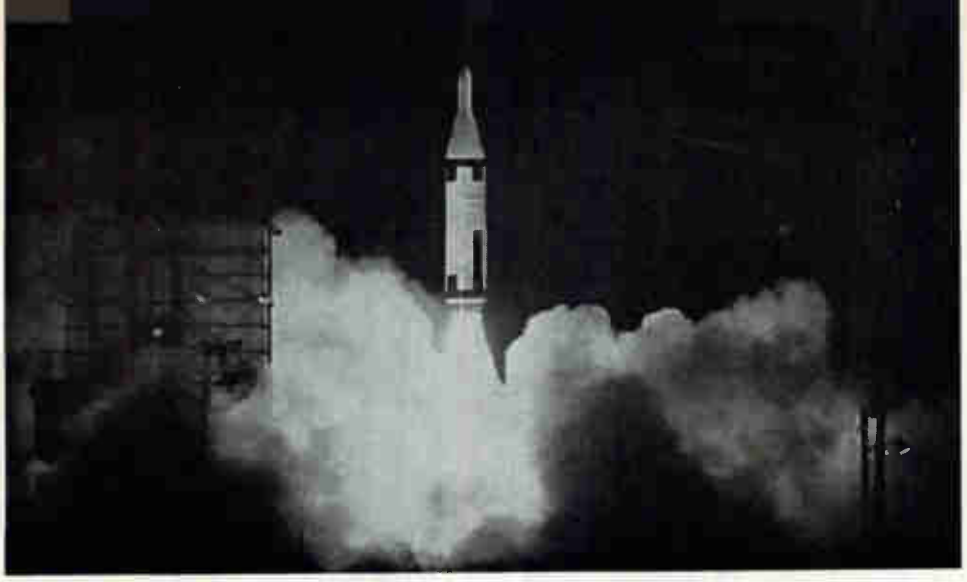
Guidance systems developed by GE's Ordnance Department at Pittsfield, Mass., will be delivered to the Annex for storage. At present there are racks for about 135 guidance systems. New systems will be tested upon receipt, and again when assembled into a missile or delivered to a ship.

Test equipment consists of:

1. Two guidance checkout computers that contain digital and analog circuitry, the power supplies and power switching necessary to exercise the guidance system stable platform and the guidance electronics package.

2. Guidance capsule test stands equipped with special rails and mountings to position and level guidance systems for test with a junction box. Terminated at the junction box are all guidance capsule connectors and cables from the checkout computers and power supplies.

3. Guidance power supplies that furnish the variety of voltages needed for system tests.



Live test schedule for Polaris missile is one-a-week from now on

4. A set for testing individual digital boards, analog electronic modules and servo modules.

Nortronics is supplying five automatic missile test sets (DATICO). These sets slave the guidance checkout computers and can check out the missile in four minutes.

GE's fire control system, installed aboard the Polaris-armed submarines, will continuously provide accurate information to the missile guidance system. It contains a battery of computers, both analog and digital. Information on ship's position, direction and velocities is received from the Ship's Inertial Navigation System (SINS), produced by both Sperry and North American. Target data are fed into the computers and then transmitted to the guidance system of the missile. As the ship moves, prior to launching of the missile, the fire control system makes constant corrections to the guidance information.

High-Speed Performance

The computers used in the fire control system use transistorized plug-in type printed wiring boards which facilitate equipment miniaturization, assembly, maintenance, reliability and improved high-speed performance.

In addition to its primary function of providing the Polaris missile's inertial guidance system with all the information necessary to guide the missile successfully to its target, the fire control system provides information for monitoring and launching.

The first customer for the new facility will be the already-commissioned *USS George Washington*. Each submarine will carry 16 Polaris missiles. Three more subs have been launched but not commissioned. Five more subs are under construction.

Navy would like a total of 45 Polaris-carrying submarines, as well as installation of the ballistic weapons on surface warships. Navy argues that any moving launch site is better than a fixed one. All USAF's intercontinental ballistic missile sites, soft site or hard, Navy says, have a known address. They can be knocked out by an enemy ballistic missile, says the Navy, whereas a submarine or a warship is always on the move and would not be attacked by a huge ICBM.

Navy foresees a new danger in USAF's plan to avoid the "known address" problem by moving Minuteman about the country on railroad tracks. "A ten-year-old boy can sabotage a railroad track with a rock," one Navy official points out.

Another advantage to the submarine-missile combination, Navy says, is that the Polaris missile system has "a recallable first stage"—the first stage being the submarine itself.

Extending Range

Current Polaris test models—such as the one successfully launched from the deck of the *USS Observation Island* on March 29—have a range of about 900 nautical miles. The model scheduled to go on board the *USS George Washington* in September will have a range of 1,200 n. mi. Next model will be a 1,500 n. mi. weapon. And although no money has yet been appropriated, Navy has concrete plans to extend the range of Polaris eventually to 2,500 miles.

The existing inertial guidance system, which now weighs about 250 lbs, will be reduced to about 80 lbs for the 2,500 n. mi. model.

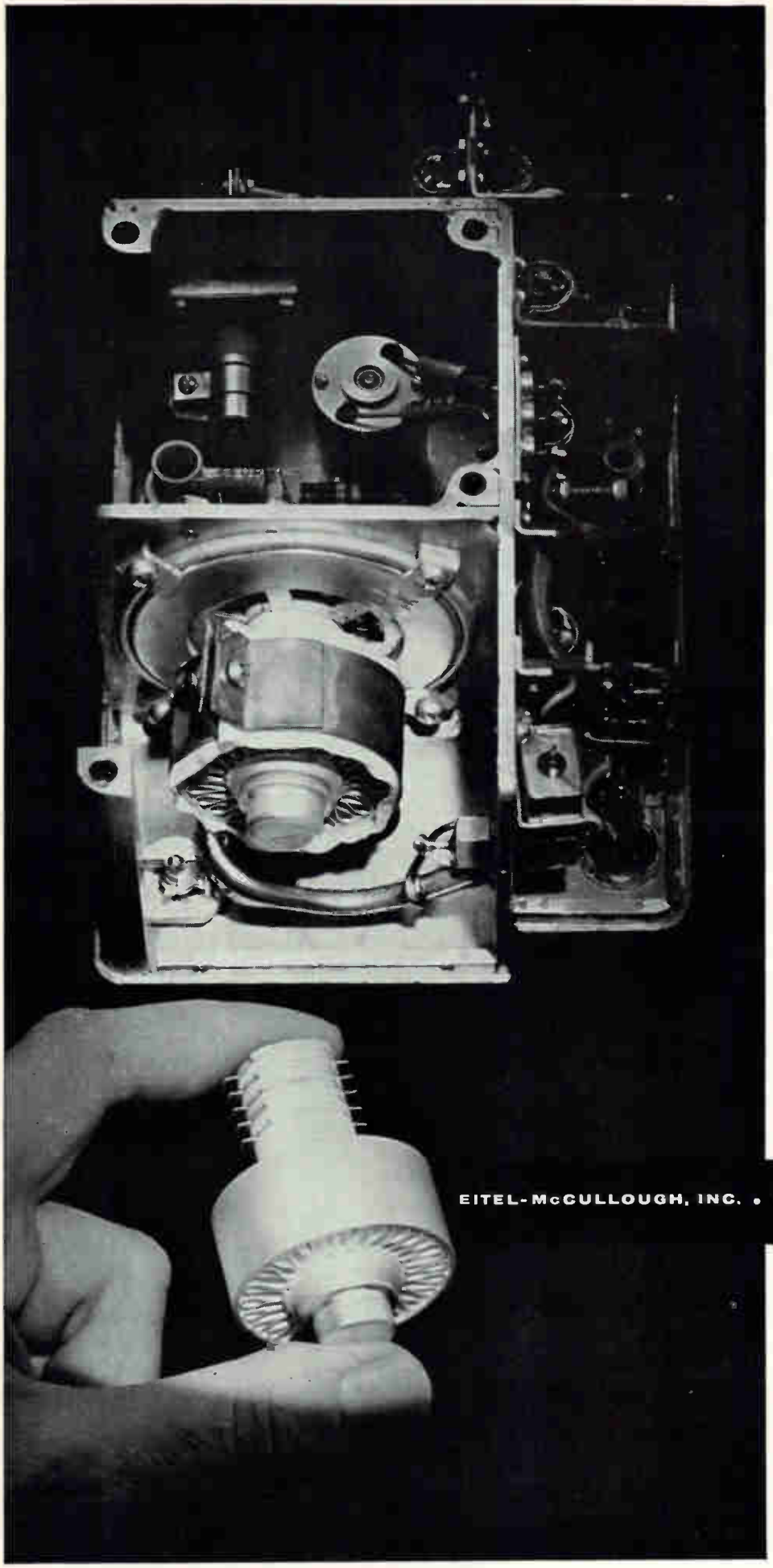
Live testing of the Polaris will continue at the rate of about one a week. Some will be fired from the *Observation Island* surface ship, some from a flat pad at Cape Canaveral, a ship simulator also at Canaveral, and in early summer, the first underwater launching from a submerged submarine, near Cape Canaveral.

Communications

Communications with Polaris submarines, submerged in waters around the globe, is not the big problem many people think, one official Navy source reveals.

"Using brute force, vlf radio will reach any submarine, submerged anywhere in the world," he said. "Hf radio can be received if the submarine surfaces sufficiently to raise an antenna slightly above the surface of the water. And the range we now have with sonar is so good it's hard to believe."

One vlf station in Cutler, Me., is scheduled for operational testing by next January. The complex will consist of 26 towers, all over 800 ft high, using 72 miles of copper wire in "top hat" arrays, with 2,200 miles more of copper wire underground.



SPACE AGE TV WITH EIMAC CERAMIC TUBES

Lockheed's new miniature TV transmitter and camera have special significance for a space-curious world. They may one day help unravel some of the mysteries of the unknown as they soar through the outer reaches of space in a sophisticated satellite.

At the heart of the tiny transmitter is an Eimac ceramic tetrode, the 4CX300A. Eimac ceramic tubes can take tough assignments like this in their stride, with performance "extras" that mean outstanding reliability.

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THRU	LOW NICKEL Squaremu 49 Carpenter 49	THRU
225	GRAIN-ORIENTED SILICON Crystaligned Microsil	.004*

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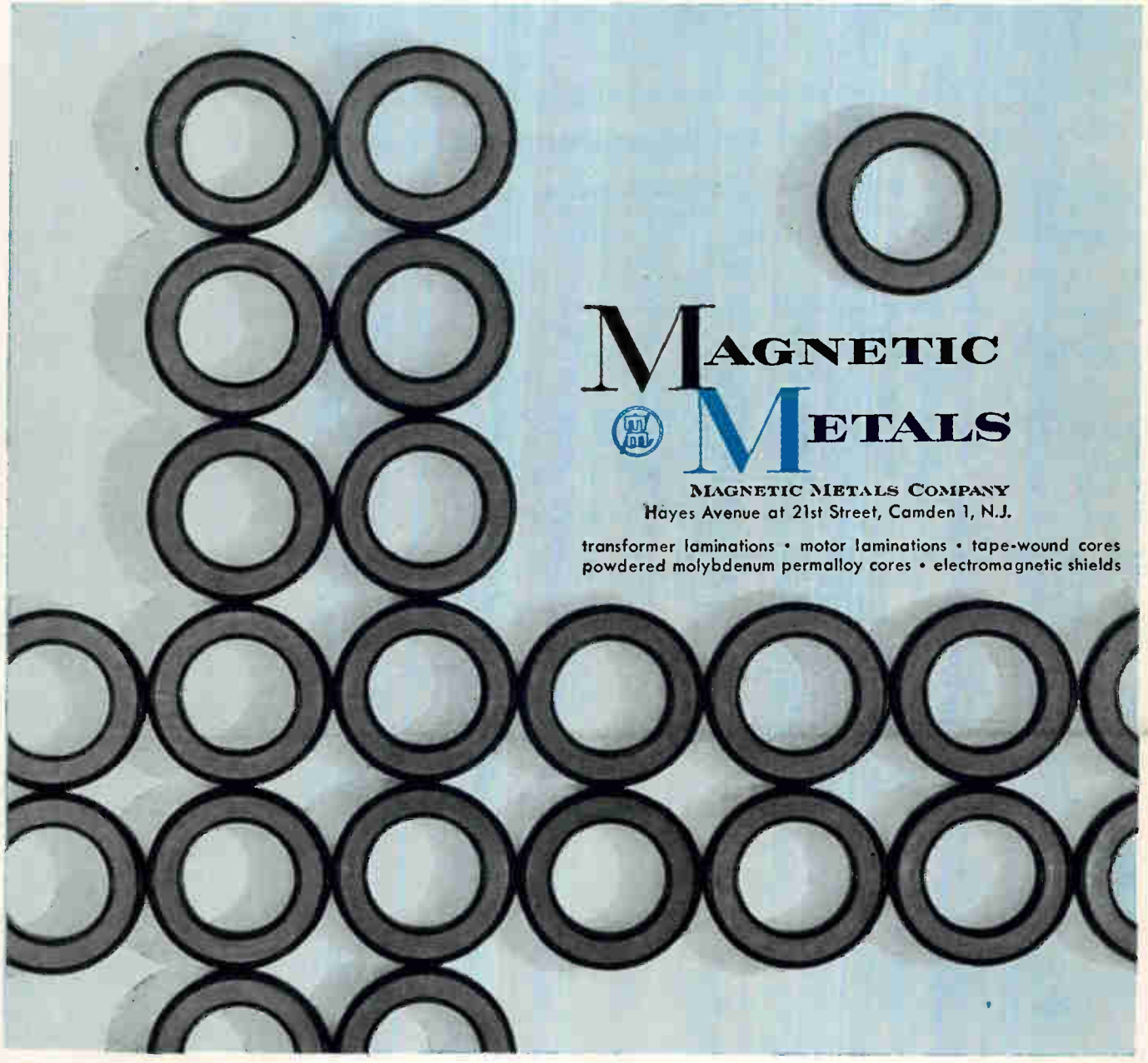


Japan Develops New Computer Logic

Engineers at Nippon Telephone & Telegraph build adder, shifter with speeds independent of number of bits or shifts

By FRANK LEARY, Associate Editor

TOKYO — NEW COMPUTER TECHNIQUES using advanced logic systems have recently been developed by engineers at the Electrical Communications Laboratory of government communications utility Nippon Telephone & Telegraph.

New circuits use conventional entertainment-type transistors and diodes, require only one new type component—a pulse transformer with as many as 40 secondary windings operating from a single primary. The circuits do not use the Japan-developed parametron phase-locked oscillator, which has become almost the mainstay of the computer technology here.

Circuits were developed by I. Kuroyanagi and T. Sakurai of NTT's communications labs. Like AT&T, the telephone company here develops much computer circuitry as an almost accidental byproduct of its work in switching and network theory. NTT developments of this nature are made available to the entire Japanese electronics industry; lab scientists told ELECTRONICS that several concerns have already evinced interest.

The logical improvements suggested by Kuroyanagi and Sakurai and already incorporated in hardware are a high-speed parallel adder-accumulator and a shifter that can shift n places in a single operation.

Adder Circuit

Adder-accumlator techniques reported by the lab employ a half-adder for each bit in the addend-augend combination (see A in drawing). The two outputs of the half-adder are the sum and carry for that pair of bits. These signals are applied to a detector circuit which is actually a cascade of exclusive-OR circuits.

The detector produces a signal designated V whenever the sum of a pair of bits must be added to a carry from the preceding (next least significant) pair. The V signal and the sum signal are inputs to a quarter-adder.

In the quarter-adder, the presence of V reverses the significance of the sum bit, injecting a ONE into the accumulator register whenever a ZERO is produced in the sum, and vice versa. When the sum and carry combination fail to produce a V signal, the sum for the next most significant bit passes through the quarter-adder as the accumulated bit.

The add time for this cascade of circuits is about 200 nanoseconds plus one bit time. The 200-ns figure is the delay introduced by the circuitry, and is a function only of the response characteristics of the components.

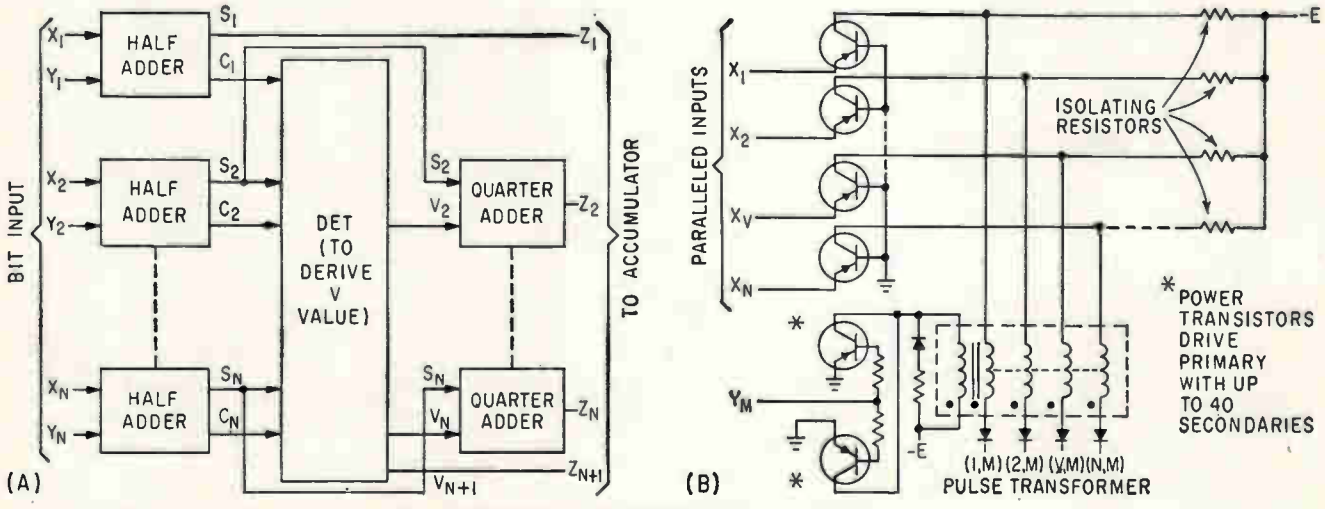
The transistors used in experiments thus far have a frequency limit, when connected in the grounded-base configuration, of about 4 Mc. Operating circuits have been built in the range from 250 Kc to 1 Mc.

Use of high-speed components would not only increase the possible operating frequency, but would also reduce the delay introduced by the adder circuit itself.

N-Place Shifter

The n-place shifter is a sophisticated circuit complex using a multiple-secondary pulse transformer as one input to a matrix selector (see B in drawing). Signals from a bit register come in parallel on the emitters of a series of ground-base transistors.

The collector for each transistor connects to one secondary winding



Adder circuit (A) has 200-ns front-to-back delay time; shifter (B) requires 80 ns for n-place shift

of as many of these multiple-secondary transformers as there are possible shifts in the system (thus there are 10 transformers for a system designed to shift up to 10 places at a time). In each transformer there is one secondary winding for each input bit.

The primary of one of these transformers is keyed by a power transistor output pulse indicating how many places the input word is to be shifted. When the primary is pulsed, diodes on the secondary windings function to gate out the word into the correct positions of an output register. The output register has m-plus-n positions, where m is number of bits in a word, n number of possible shifts.

To save hardware, the outputs from all the pulse transformers are whiffletreed into a single output register. The 4th most significant bit, for example, from this register is the 4th bit from an unshifted word, the 3d from a word shifted one place, the 2d from a word shifted two places and the 1st from a word shifted three places.

Shift time for an n-place shift of an m-bit word is about 80 nanoseconds, independent of either n or m. The shifter circuit as designed in the NTT lab uses entertainment-type transistors and diodes; only the pulse transformer was designed specifically for the circuit.

Other Operations

Sophisticated multiplier techniques use the shifter and adder to best advantage. The multiplier word is scanned for ZEROs and ONEs; the ZEROs are added up, and the position of the ONEs in relation to each other is sensed. An isolated ONEs bit causes the shifter to shift the multiplicant as many times as there were ZEROs, plus one place, and add it to the partial product in the accumulator. Successive ONEs bits cause the same shifting operation and then subtraction, followed by a count of ONEs, shift, and addition.

Average multiplication time is $n/4$ bit times, where n is the number of bits in the multiplier. Division uses many of the same techniques but, as usual, with a reduced efficiency, division being the operation least amenable to digital computer techniques. Average division time is $n/1.6$ bit times, where n is the number of bits in the divisor.

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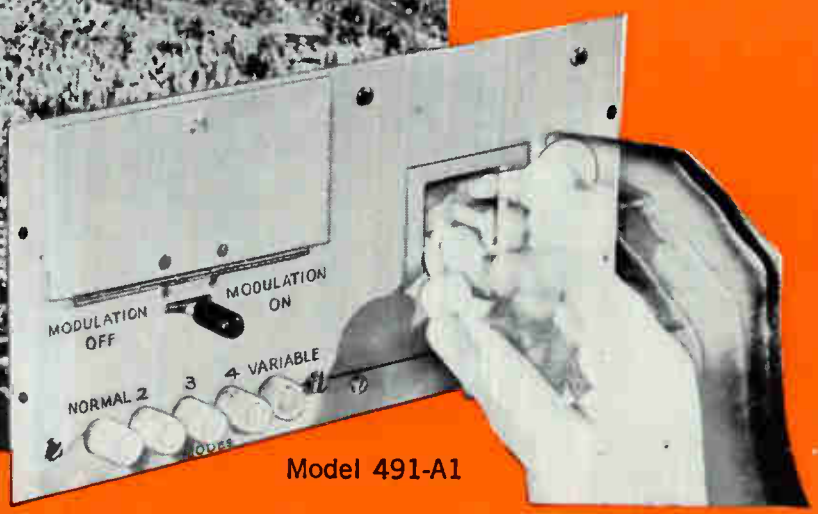

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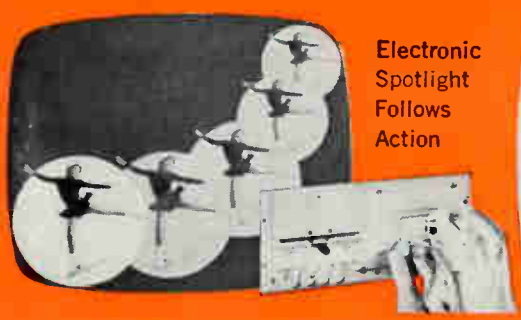

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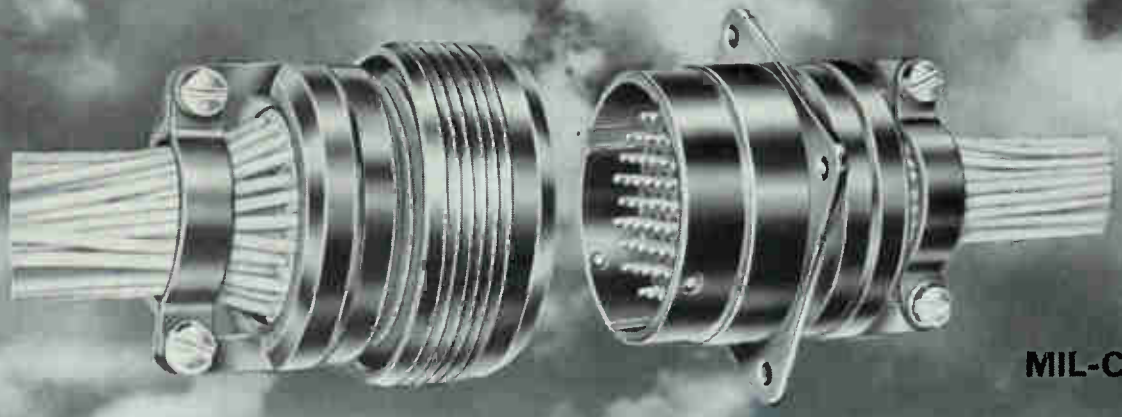
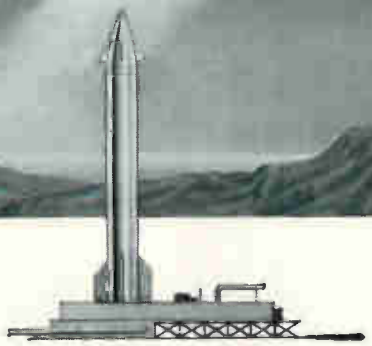


MIL-C-26500



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This is the MIL-C-26500 (USAF) connector—and it is ready today for your use. It is being produced by the AMPHENOL Connector Division of Amphenol-Borg Electronics Corporation.*

**Of importance to manufacturers working to government specifications is the fact that Qualification Approval Listing has been extended to AMPHENOL under MIL-C-26500 (USAF) on the first production connectors in this series.*

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CONNECTORS
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- Supports 1500 volts RMS at high altitudes (sea level to 350,000 feet) fully mated.
- Altitude immersion resistant after 10 contact removal and insertion cycles on all contacts. (Maintains 5000 megohms I.R. after three altitude cycles).
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Amphenol-Borg Electronics Corporation

New Mexico's electronics industry mushrooms around

Missilemen, R&D . . . and Indians

A familiar object over White Sands, N. M., is this Sergeant missile

ALBUQUERQUE—New Mexico's electronics industry, almost nonexistent 10 years ago, is now in the multi-million dollar bracket.

A survey made this week for ELECTRONICS by McGraw-Hill World News shows that in Albuquerque—main electronics center in the state—there are 10 electronics companies employing nearly 400 persons—not counting those having to do with sales or repairs.

From 75 to 90 percent of the companies' production goes to the government.

$700,000 for R&D

In addition, University of New Mexico's electrical engineering department holds nearly $700,000 worth of government contracts for electronics R&D.

The industry here is showing some signs of uneasiness after slipping down from a peak reached in 1959. Some companies blame this decline on a readjustment of the government's missile program.

One interesting development brought to light by survey takers is a project being conducted by the university on submarine communications nearly 1,000 miles from the nearest ocean.

Electronics companies outside of Albuquerque presently number five. But state officials expect this number to grow in the not too distant future. They point out that prior to 1950, the population of electronics companies in the state came to exactly one.

Board Established

Times have certainly changed. Purchases of electronic hardware, units and components by New Mexico electronics companies amounted to $3,297,550 in 1958 and rose to $3,676,250 in 1959.

To support this growth trend, a special electronics advisory board has been established here to furnish practical aid and advice to electronics firms interested in moving into the area. (The state's department of development reports queries from 11 electronics companies in recent months.)

In addition to this encouragement, the state has in effect a municipal bond law (tax free) whereby communities provide financing for companies moving into New Mexico.

The survey also discloses that many large out-of-state firms maintain offices at the Air Force Missile Development Center, White Sands-Almogordo.

Among these are: Aerojet General, Bendix Aviation, Boeing, Convair, Continental Aviation, Curtiss-Wright, Douglas, Firestone, General Electric, Goodyear Aircraft, Martin, Marquardt, McDonnell Aircraft, North American Aviation, Northrop, Remington-Rand, Ryan Aeronautical, Sandia Corp., and Telecomputing Corp.

Indian Silversmiths

Among the local companies, one picturesque example of transition is found in downtown Albuquerque at Maisel's Indian Trading Post. For many years this firm has employed native Indian silversmiths to make costume jewelry for tourists.

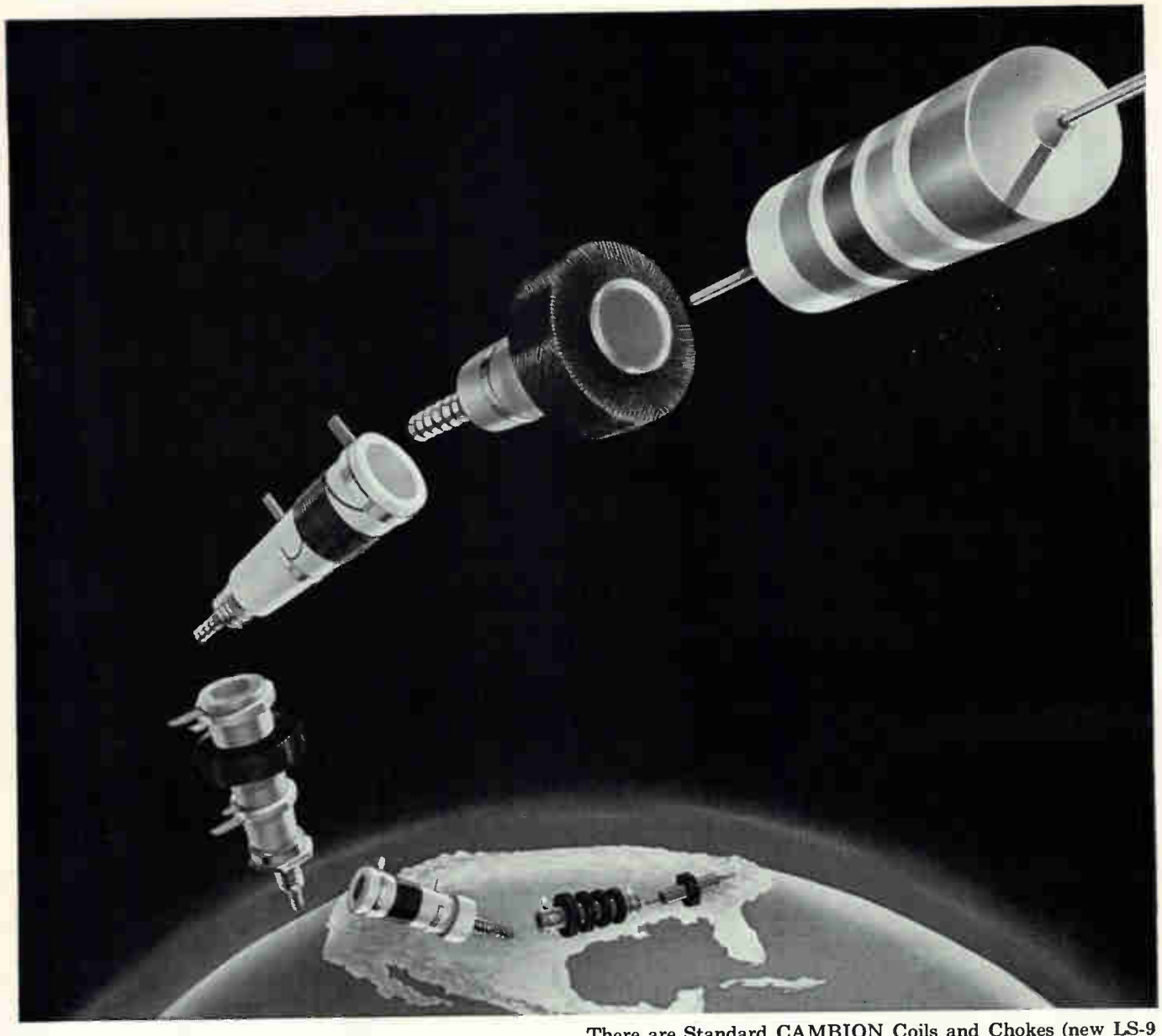
During World War II, Maisel began manufacturing some minor electronic components under government contracts. There are now 30 Indians working with metal on electronic units intended primarily for AEC. These units are mostly mechanical assemblies but they also include single metal stampings, subassemblies and printed circuit devices.

New Mexico electronics companies (with employee totals and key products) include:

A.R.F. Products, Raton, (75) radar gear, test equipment; C. G. Electronics, Albuquerque, (100-150), telemetry and digital equipment; Crown Engineering, Alb., (25-50), r-f equipment, test gear; Curtiss-Wright, Alb., (25-50), solid state relays, transducers; Data Technology, Alb., (5-10), data handling, systems engineering; Eberline Instruments, Santa Fe, (140), radiation detection equipment.

Also: Electronic Components Corp., Socorro, (35), electromechanical subassemblies; Gulton Industries, Alb., (125), digital equipment, antennas; F&M, Alb., (19), transmitters, receivers; Integrated Dynamics division of Globe Industries, Alb., (15), accelerometers, inertial systems; Lytle Corp., Alb., components; Que Enterprises, Alb., (50-100), test gear; Maisel's Electronics Div., Alb., (100), components.

And: Rittenhouse & Revere, Alb., (10-25), electronic products; Rosso Instruments, Cimarron, (3), portable analyzers; Teletube of New Mex., Alb., (10-25), tv picture tubes; Ultradyne Engineering Labs., Alb., (50-100), transducers, indicators.



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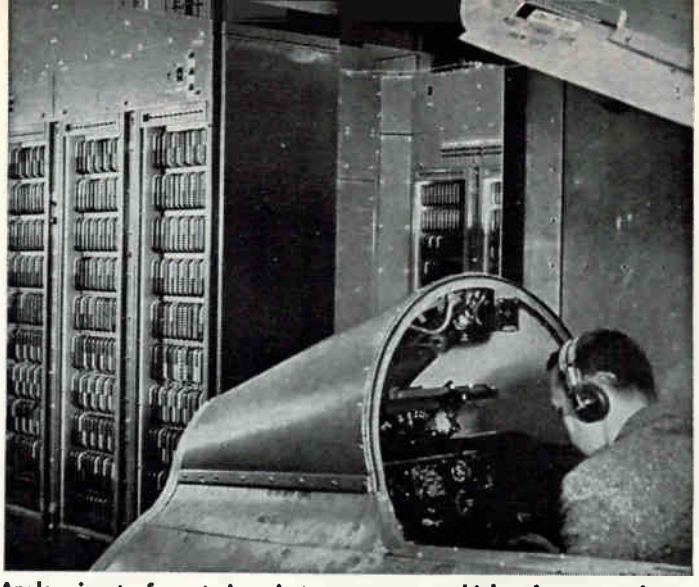

Analog inputs from trainer instruments are multiplexed, converted to binary numbers

Navy Tests Digital

THE NAVY begins tests next month to determine if universal-type digital systems can best simulate extremely complicated jet flight conditions for real-time control of operational flight trainers.

Evaluation of UDOFT (Universal Digital Operational Flight Trainer) will be made at the Garden City, L. I., annex of the Naval Training Device Center, where the system is being reassembled after shipment from Waltham, Mass.

2,000 Logic Cards

UDOFT was built by Sylvania under a $2 million Navy-Air Force contract. The special-purpose computer subsystem is based on original design work by the Moore School of Electrical Engineering at the University of Pennsylvania, with final design and development by Sylvania.

The high-speed digital trainer, using 2,400 vacuum tubes and 2,000 logic cards, is for fixed operation, but studies have already been made on trasistorization of UDOFT and installation in a trailer which could be rotated among flight training centers.

Navy F9F2 and Air Force F100-A cockpits and instructor consoles are tied in to the first UDOFT system, but goal of the project is full exploitation of flexibility, the key advantage which digital techniques can claim over analog computers as operational control elements.

Since the equations of flight can be changed merely by changing the computer program, the digital computer has inherent flexibility in simulating different types of aircraft.

Engine and power system failures, fires, rough air situations and other emergency conditions can be created.

Possible Applications

Among potential applications of UDOFT to be explored are supersonic and hypersonic vehicles, spacecraft, commercial pilot training, and real-time control problems outside the aviation field.

The UDOFT computer is a parallel-sequential, single address, binary, synchronous device. Clock frequency is 1.2 Mc (5 phases), and the circuitry is of the dynamic type, with low-level diode gating (pulses of 5 volts magnitude).

The number memory operates in parallel, but the information is presented to the arithmetic unit sequentially.

UDOFT incorporates two independent, random access magnetic core memories. Use of two memories, one exclusively for instructions and one exclusively for numbers, permits an extremely fast instruction cycle since the instruction memory can be used to decode an instruction at the same time that the number memory presents the operand from the preceding instruction.

Basic order time is 5 microsec-

New system's versatility may show the way to real-time control of industrial processes

Trainer

onds with the result that a complete addition, including memory access times for the instruction and number words, can be accomplished in the 5-microseconds interval. This speed is obtained through use of the two independent time-phased memories of 4,096 words capacity each.

Equations of flight are solved every 50 milliseconds, the basic computation cycle.

The input-output system of UDOFT consists of four basic types of information. There are 24 analog inputs, each of which is obtained from a 10-bit shaft position encoder. There are 64 analog outputs that are generated from 12-bit binary numbers through a digital-to-analog converter and multiplexer system.

64 Discrete Inputs

In order to allow the computer to sense the status of various cockpit and console switches, there is a total of 64 discrete inputs. Each consists of one binary bit. Twenty-four discrete outputs are also provided. They are used to actuate various indicators on the consoles and in the cockpit.

A card reader-punch is used for insertion of program data, and an electric typewriter provides a low-speed printout facility.

With addition of a tape mechanism, memory loading could be accomplished at a rate of a word every 5 microseconds.

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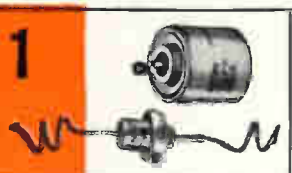
1 

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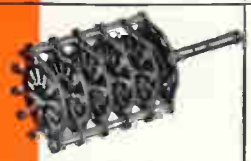
2 

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Zack Radio	1	2	3		5	6	Palo Alto, Calif.
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Melvin Electronics						6	Oak Park, Ill.
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Lafayette Radio	1	2					Boston, Mass.
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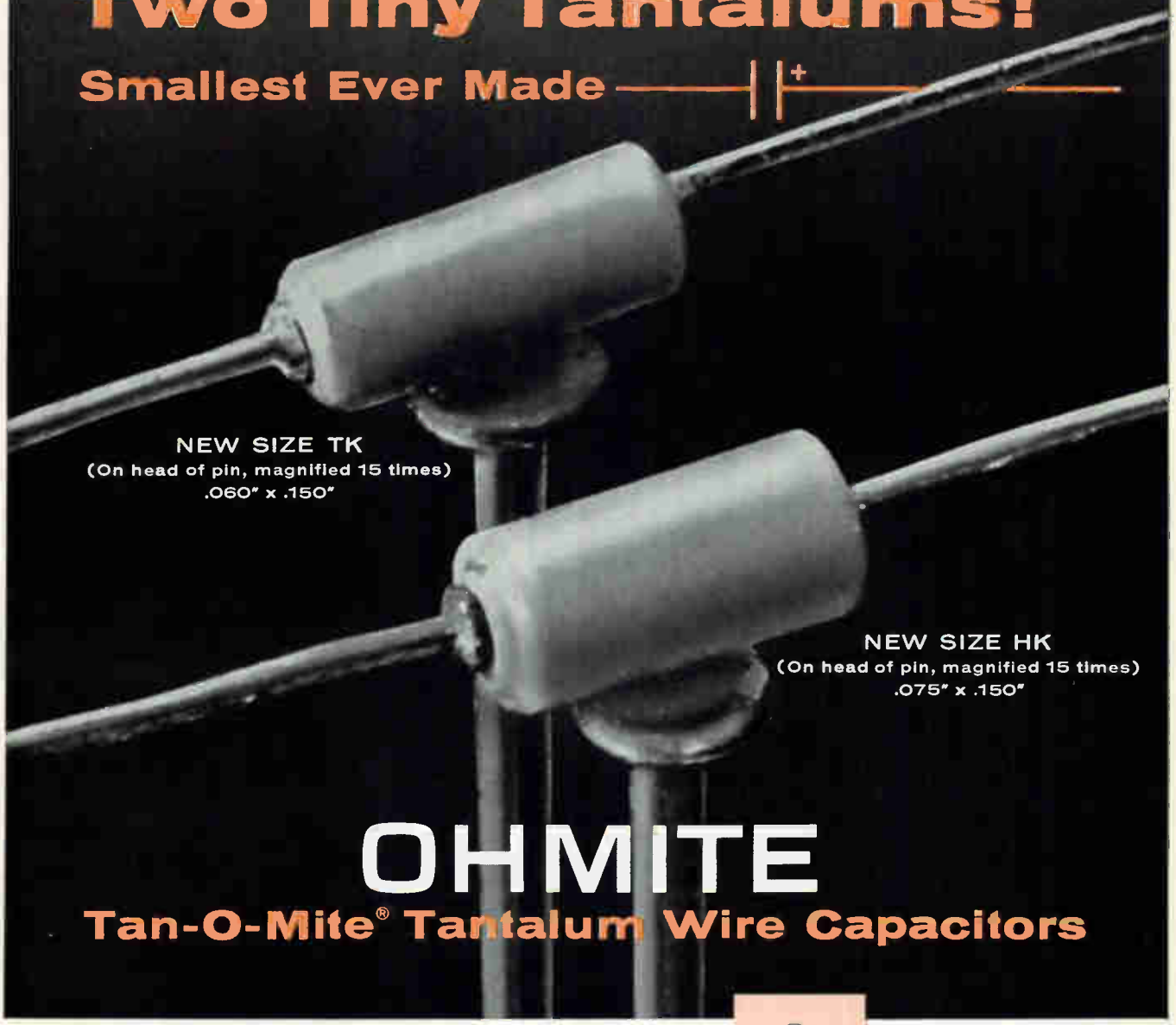

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Now you can scale down your circuits still further. These new Ohmite tantalum wire capacitors are the smallest of their type ever produced. And, like all Ohmite tantalum capacitors, they must pass severe performance tests in Ohmite's laboratory under conditions similar to official ASESA qualifications.

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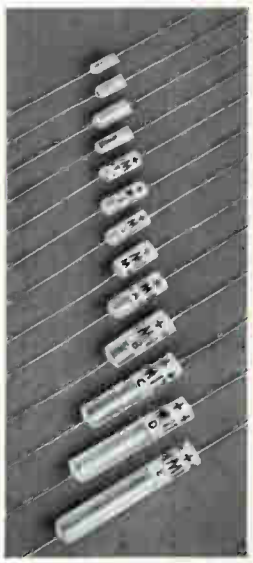

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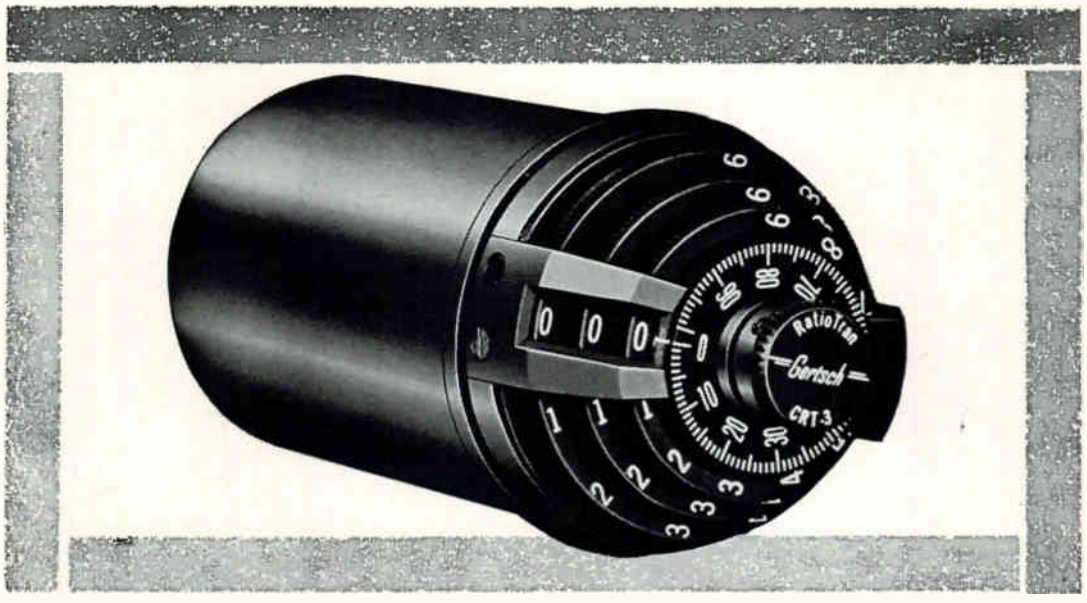

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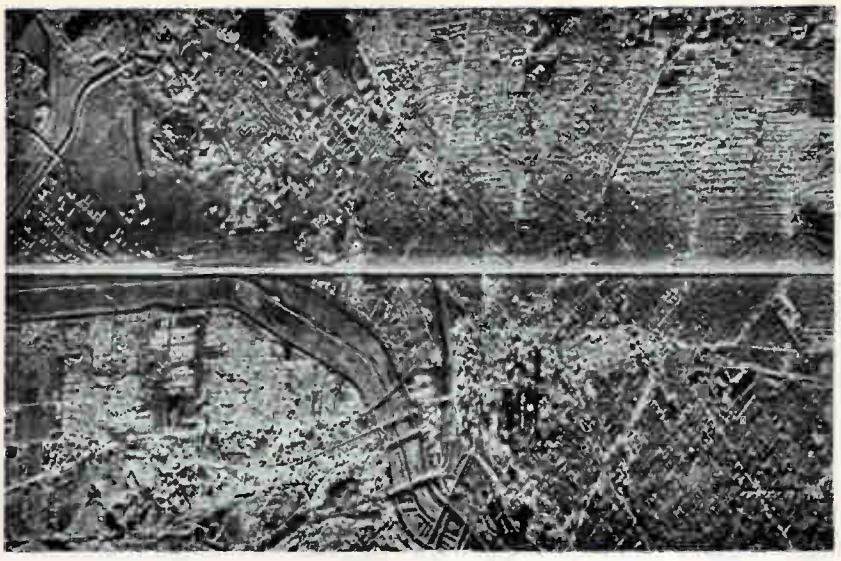

Radar map of Dallas made by recently-declassified surveillance radar. Lower center: downtown Dallas, marked by radar shadows from skyscrapers. Shadows here and from bridges crossing Trinity River help determine height of these objects

Radar Makes All-Weather Air Maps

'Unique switching device' allows single radar to look alternately from either side of plane

DALLAS—Details on a side-looking radar system that produces all-weather aerial mapping from either side of an aircraft have just been released here by Texas Instruments' Apparatus division.

Designated AN/APQ-55, the system consists of a transmitter, receiver and two 8- or 12-ft antennas. What the company describes as a "unique switching device" allows the single radar to look alternately from either side of the aircraft through the side-looking, back-to-back antennas.

The system is designed to record strips of terrain either 3 or 6 miles wide from an aircraft flying between 200 to 800 knots, and at 1,000 to 5,000 ft altitude.

Modifications, the firm reports, will enable the mapping of 10- or 20-mile widths, at ground speeds up to 2,200 knots.

The system was developed and test flown in 16 months starting in 1955. Since then, it has been flown by the Air Force, Signal Corps and Coast Guard, but details have been tied up in security.

The system gives near-photographic, up-to-the-minute information on moving targets, as well as pinpointing stationary targets. It furnishes day or night surveillance, and rain or fog causes "little or no degradation of the final pictures," according to the company.

Radar returns are displayed as a single modulated trace on a cathode ray tube and recorded on film. A film-pulling mechanism carries the film past the trace on the tube face proportional to ground speed and altitude, producing a continuous, high-resolution film strip.

A microwave data link, developed also by TI, can transmit directly from the radar receiver and feed data back to a film recorder and processor at a remote combat post.

Perspective of distance is adjusted electronically so that items at the edge of the photo are of the same scale as those at the center. The system scans a constant ground area independent of altitude and can cover a wide area at a low altitude, recording in fine detail with no perspective distortion.

Shadows of targets establish the heights of buildings, and so forth. A stabilizing system corrects yaw.

The company reports that a "more sophisticated system, with greatly extended range, is now in development and . . . undergoing flight tests."

NEW DELCO 50-AMP. TRANSISTORS

HIGHER CURRENT THAN EVER BEFORE FOR MILITARY AND COMMERCIAL USE

	2N1518	2N1519	2N1520	2N1521	2N1522	2N1523
Maximum Collector Current (Amps.)	25	25	35	35	50	50
Maximum Collector to Base Volts, Emitter Open, Max Ico 4ma	50	80	50	80	50	80
Minimum Open Base Volts (1-Amp. Sweep Method)	40	60	40	60	40	60
Maximum Saturation Volts at Maximum Collector Current	0.7	0.7	0.6	0.6	0.5	0.5
Gain at Ic at 15 Amps.	15-40	15-40	17-35	17-35	22-45	22-45
Minimum Gain at Maximum Collector Current	12	12	12	12	12	12
Thermal Resistance Junction to Mounting Base (°C/Watt)	0.8	0.8	0.8	0.8	0.8	0.8

Characteristics at 25°C Maximum Junction Temperature 95°C

A new family of high current transistors featuring the 50-ampere 2N1522 and 2N1523. Two 25- and two 35-ampere types round out the line. All thoroughly tested and completely reliable. Available in production quantities. Call or write your nearest Delco Radio sales office for full product information and applications assistance.

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IN TOUCH WITH NEW HORIZONS

Another achievement of IBM Applied Scientists: computer program for distillation tower design

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MEETINGS AHEAD

Apr. 18-19: Automatic Techniques, Annual Conf., ASME, IRE, AIEE, Cleveland-Sheraton Hotel, Cleveland.

Apr. 19-21: Active Networks & Feedback Systems, International Symposium, Department of Defense Research Agencies, IRE, Engineering Societies Bldg., N. Y. C.

Apr. 20: Quality Control Clinic, ASQC, Univ. of Rochester, Rochester, N. Y.

Apr. 20-22: Medical Electronics, National Conf., PGME of IRE, Shamrock-Hilton Hotel, Houston, Tex.

Apr. 20-22: Southwestern IRE Conf. & Electronics Show, SWIRECO, Shamrock-Hilton Hotel, Houston, Tex.

Apr. 26-28: Airlines Electronic Maintenance Meeting, Aeronautical Radio, Inc., Hollywood Roosevelt, Los Angeles.

Apr. 30: Sferics and Thunderstorm Electricity, Amer. Geophysical Union, Amer. Meteorological Society & U. S. Nat. Comm. of URSI, National Science Foundation, Wash., D. C.

May 1-5: Electrochemical Society, Annual, LaSalle Hotel, Chicago.

May 2-4: National Aeronautical Electronics Conference, Electronics Probes the Universe, NAECON, IRE, Biltmore and Miami-Pick Hotels, Dayton, O.

May 2-5: National Academy of Sciences, U. S. Nat. Comm. of URSI, IRE, Sheraton-Park Hotel, Wash., D. C.

May 3-5: Western Joint Computer Conf., Jack Tar Hotel, San Francisco, Calif.

May 3-5: Electromagnetic Relays, National Conf., NARM, Student Union Bldg., Oklahoma State Univ., Stillwater, Okla.

Aug. 23-26: Western Electronic Show and Convention, WESCON, Memorial Sports Arena, Los Angeles.

Oct. 10-12: National Electronics Conf., Hotel Sherman, Chicago.

There's more news in ON the MARKET, PLANTS and PEOPLE and other departments beginning on p 92.

WHAT HAS THE **7182 S BAND MAGNETRON** IN COMMON WITH THIS CAT?

A good question! According to legend, a cat has nine lives—something that has yet to be proved. The 7182, on the other hand, has a *proved* life 8 to 10 times greater than any similar S-Band magnetron.

The 7182 retains its remarkable stability and reliability during a life of 10,000 hours, and is one of a series of magnetrons now in production providing peak powers of 5 MW. These magnetrons operate at voltages and current densities usually associated with magnetrons rated at a fraction of the power output.

A parallel development in L-Band ensures that attainments in this field equal the phenomenal successes already achieved with S-Band magnetrons.

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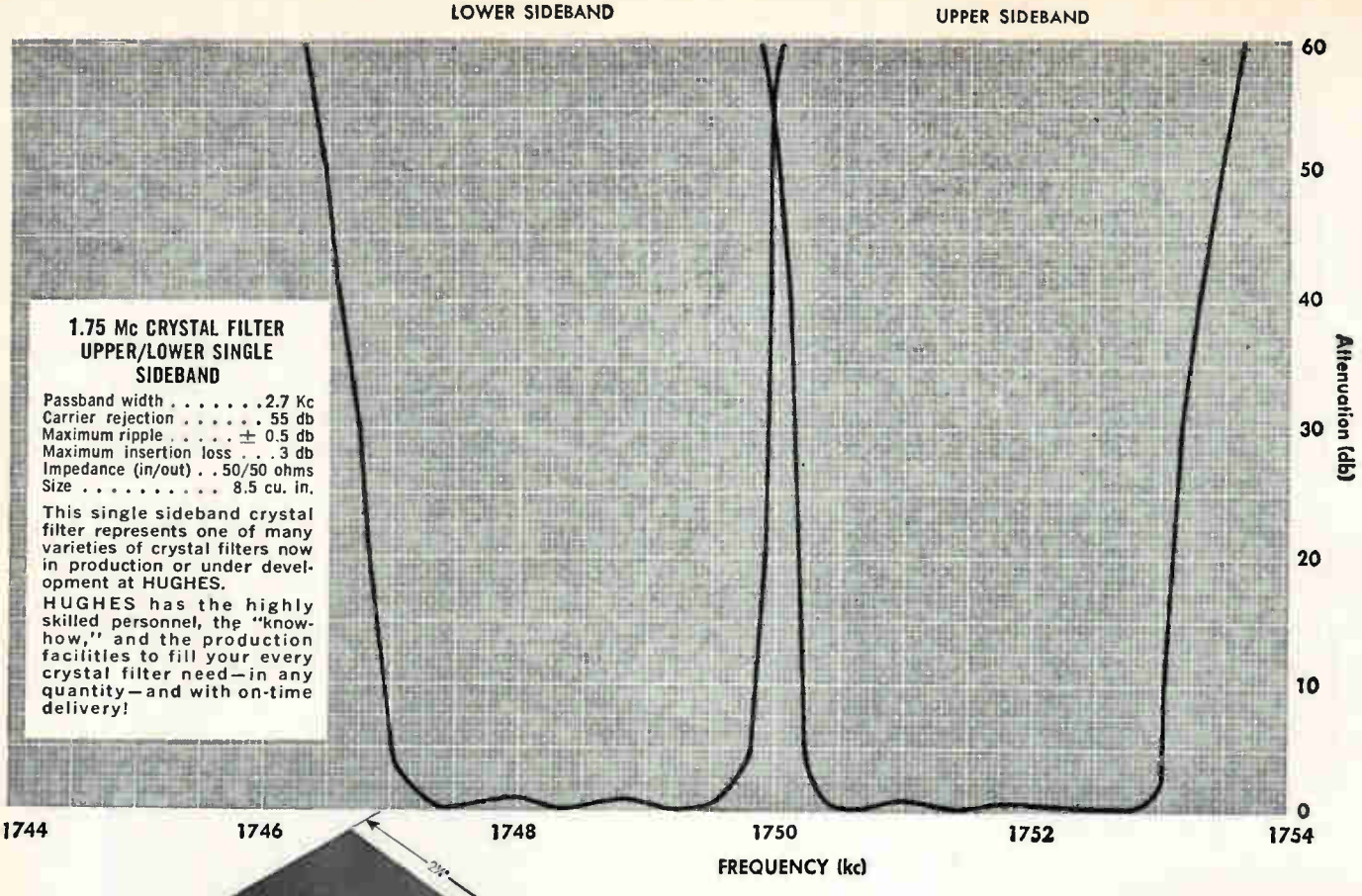
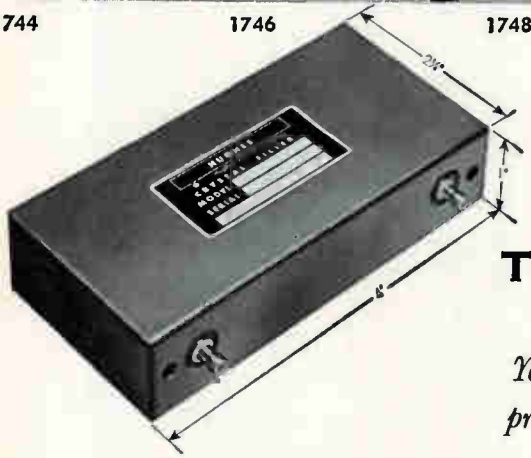


1.75 Mc CRYSTAL FILTER UPPER/LOWER SINGLE SIDEBAND

Passband width . . . . . 2.7 Kc
Carrier rejection . . . . . 55 db
Maximum ripple . . . . . ± 0.5 db
Maximum insertion loss . . . 3 db
Impedance (in/out) . . 50/50 ohms
Size . . . . . 8.5 cu. in.

This single sideband crystal filter represents one of many varieties of crystal filters now in production or under development at HUGHES.

HUGHES has the highly skilled personnel, the "know-how," and the production facilities to fill your every crystal filter need—in any quantity—and with on-time delivery!



TIGHTEN YOUR "SPECS" WITH HUGHES CRYSTAL FILTERS

Your difficult filtering problems solved with high-performance, precision crystal filters custom-designed and produced for you!

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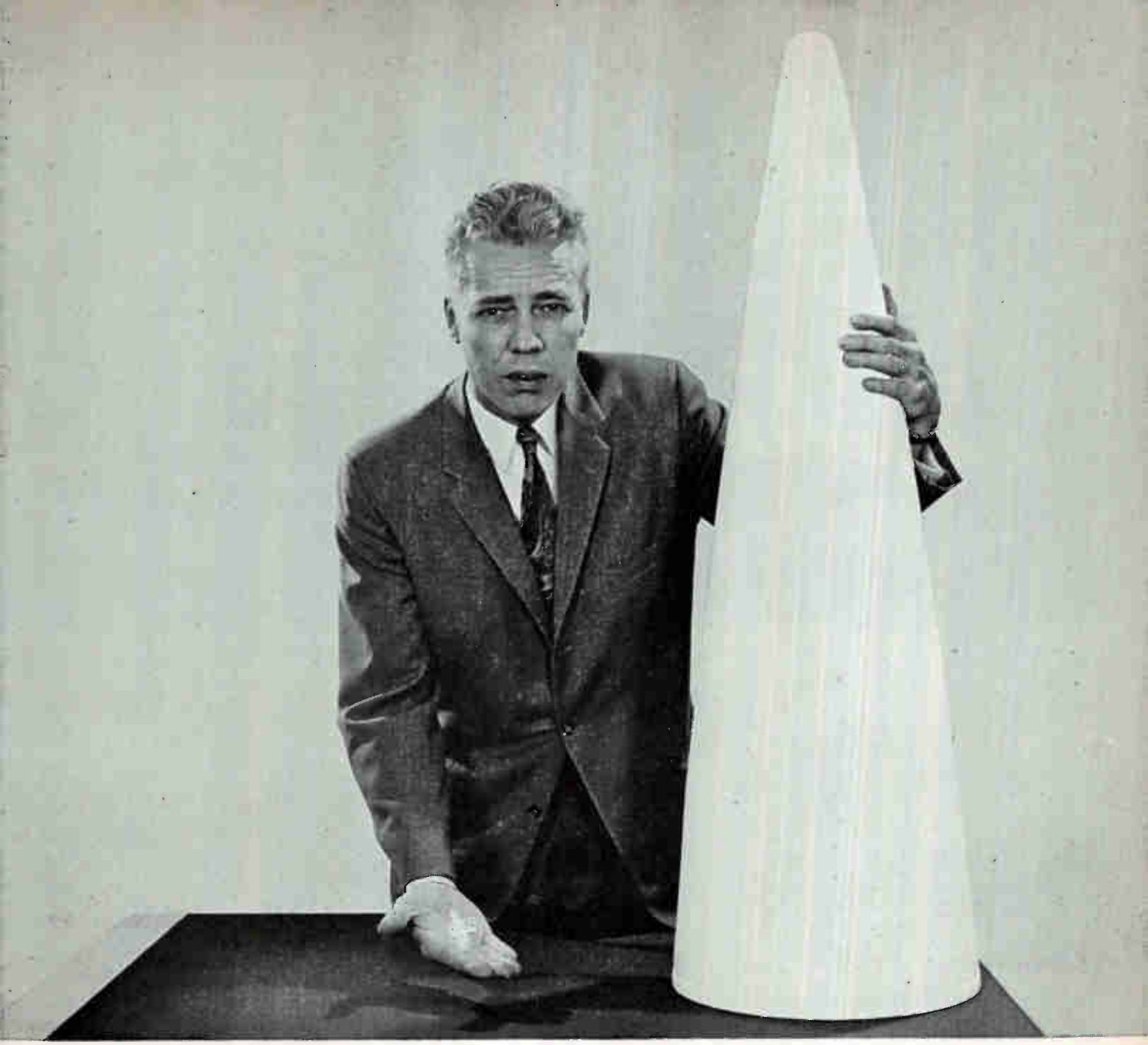

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Coors employs many different ceramic forming techniques — including the unique Isostatic Process, dry pressing, extrusion, casting, jiggering and ram pressing. Thus, depending upon the type of part that must be formed, we select the manufacturing process best suited to make it most economically.

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Leads and terminals.

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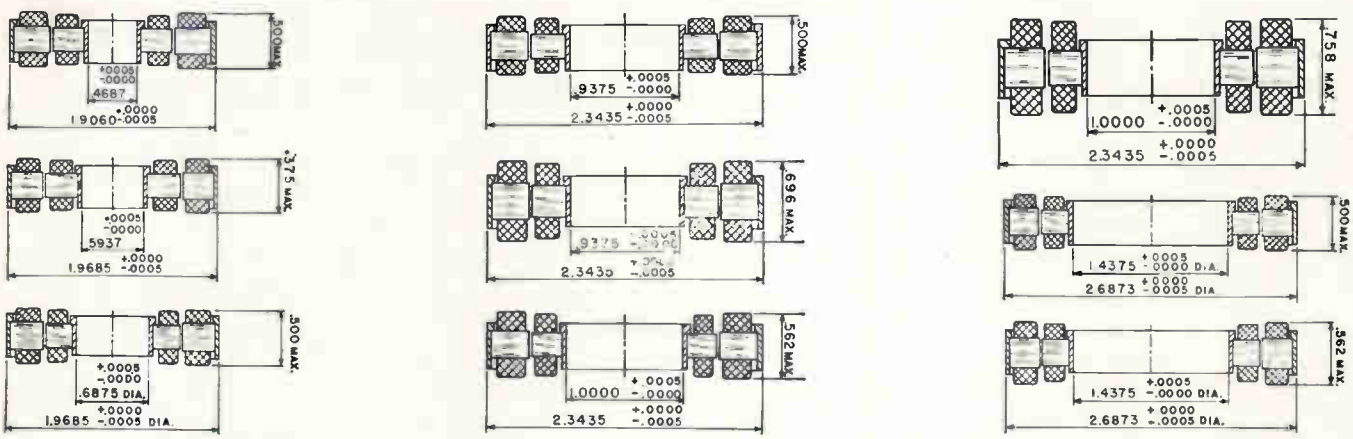

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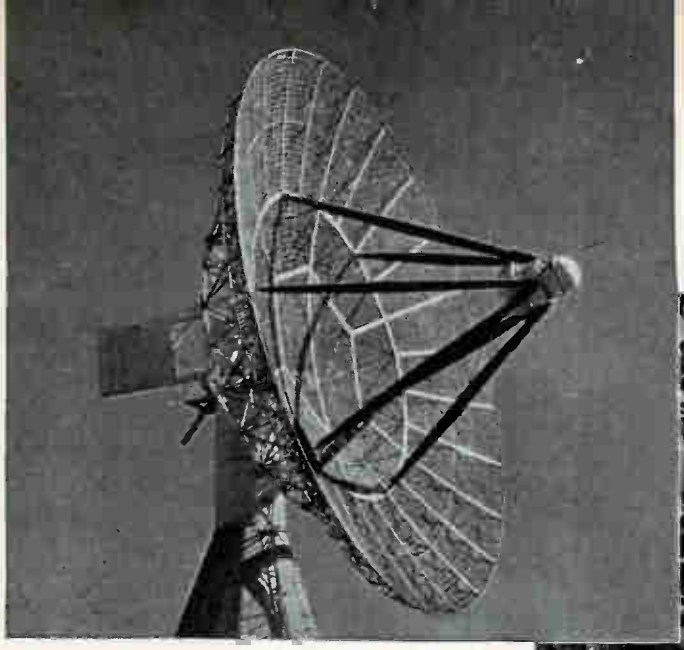
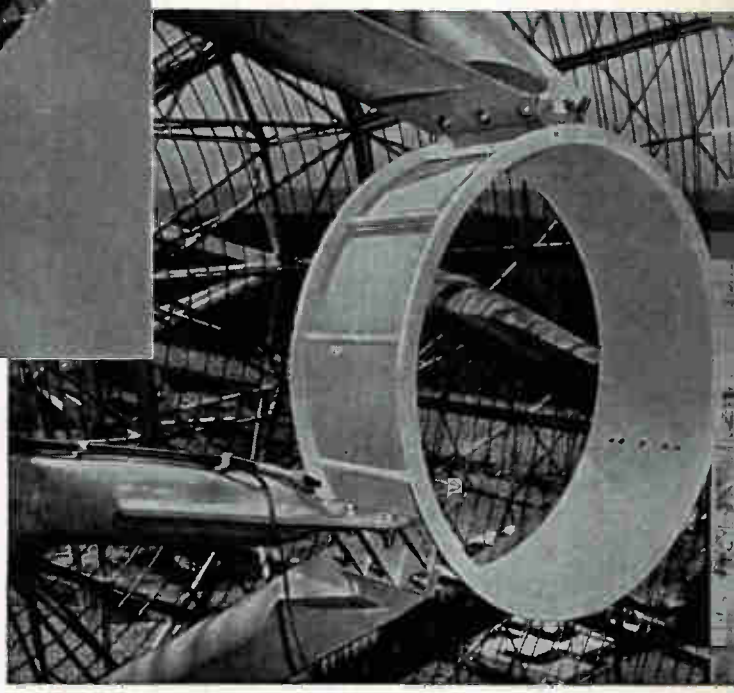


THE FRONT COVER—Sixty-foot antenna with specially-designed feed is being used to track the Tiros meteorological satellite



Feed mounting assembly has six fiber glass spars double-mounted at three points

Tracking Radar for Tiros Weather Satellite

Circularly-polarized, high-gain antenna uses specially designed feed to lock onto satellites. Rotating lens provides conical scanning

By **HAROLD E. O'KELLEY,** Director, RF Division, Radiation, Inc., Melbourne, Florida

AUTOMATIC TRACKING of Tiros meteorological satellites requires a high-speed antenna with gain, acquisition ability and wide bandwidths for handling large quantities of telemetry data over long distances.

On the 5,000-mile Atlantic missile range, polarization characteristics of a missile's carrier signal change rapidly as flight path changes and distance increases. Also, blind spots in telemetry coverage occur at various locations when the missile grazes the horizon. To solve both these problems and still maintain good data recovery over the entire range, an auto-track feed has been developed for the TLM-18 high-gain, circularly polarized antenna.

The new antenna system can lock on its target and track without manual assistance, using the satellite's carrier wave signal. Data readout on the 216- to 260-Mc telemetry band and monitoring at 108 Mc is a primary function of the system. Polarization selection is possible from a remote control console, with polarization diversity combining included. Sixteen data outputs are thereby made available for telemetry.

CIRCULAR POLARIZATION—Even if a missile or satellite is equipped with a so-called circular polarized radiator, signals received by a tracking station may

PROJECT TIROS

The antenna described in this article is one of several systems for tracking meteorological satellites—satellites that are being launched from Cape Canaveral this year under NASA's Project Tiros. Tiros I was put into orbit on April 1. Data is received directly or by readout of recorded tape from the payload, which is 40 inches in diameter and weighs 270 lbs. The payload carries two tv cameras. Tiros II and later satellites will carry two sets of radiation detectors

Data will be transmitted on command as the satellite comes into view of ground stations. Each time the satellite is interrogated, it is preset to take more pictures during the next orbit. If the satellite is taking pictures while in view of the antenna, the pictures may be transmitted directly and the magnetic tape sequence bypassed. Later Tiros satellites are expected to be stabilized so the tv cameras will always look at the earth and its cloud coverage

not be circularly polarized, but may vary from circular right, through linear, to circular left sense. This is often caused by the signal grazing the horizon and being changed by its proximity to the ground. A single terminal circularly polarized antenna will reject circular polarization opposite to that for which it is designed—a right-hand helix will reject a left-hand signal to the extent of 40-50 db.

To prevent polarization modulation to the extent that the antenna output signals are below receiver threshold for too long a period, causing loss of target, polarization diversity was desired. The antenna has output terminals so that either linear or circular polarization is available. These terminals are then utilized for a polarization diversity system, and information is made available for automatic tracking by modulating the target's carrier signal.

The method used to produce circular polarization is to orient two equal linear components at right angles to each other and introduce 90 degrees of phase shift between them. Two orthogonal probes, mounted in the skin of a waveguide, excite the circular waveguide cavity to generate two TE_{11} modes. Horizontal and vertical wave components are separately derived by this arrangement. The basic feed structure is shown in Fig. 1 and the telemetry feed is shown in Fig. 2.

CONICAL SCANNING—A unique method of producing a conically scanning main beam is employed. Conventional methods use eccentric rotation of all or part of the antenna to deflect the beam off center. The auto-track feed employs instead a hemispheric dielectric lens spinning at 600 rpm in front of a section of circular waveguide mounted in an assembly five feet in diameter. It is supported at the parabola's focal point by six fiber glass spars transparent to radio waves of the telemetry frequency.

For the basic TLM-18 antenna conversion, the amount of phase center displacement necessary was 11.4 inches, arrived at by calculating the theoretical pattern of the antenna to produce 1 db of crossover. By overlapping two patterns, in conjunction with beam offset, the peak-to-peak conical scan was 3.3 degrees, same as the necessary phase tilt angle. The secondary phase front had to be properly tilted by moving the phase center of the primary illuminator away from the focal point of the paraboloid.

The mechanical problems created by trying to nutate a heavy 260-Mc feed 11.4 inches about a fixed point led to a method of electrically rotating the phase source. To accomplish this, a phase shift device was developed for the Fresnel zone of the primary illuminator, with the hemispherical tapered dielectric prism designed to serve as the phase shifter. Spinning at 600 rpm, it is dynamically balanced for vibration-free operation. Overall beamwidth is eight degrees and target region is scanned at 10 cps.

PRISM DESIGN—Prism configuration was determined by studies of a 1/12 scale model consisting of concentric dielectric hemispheres of 5, 4½ and 4 inches diameter respectively. Circular metallic loading elements were placed on each side of the three hemispheres except the outer surface. The dielectric constant was tapered across the hemisphere from a value of one on the thin side to six on the thick side. The prism exhibits similar phase shift characteristics for both polarizations to maintain equal conical scan crossover levels. A full scale mockup with 10.5-inch disks on fiber glass hemispheres proved conformance to criteria gathered from the model studies.

The actual lens was constructed with metal disks inserted in Echofoam to delay the wavefront on one side of the lens sufficiently to create a scanning half-cone angle of 1.5 degrees. The dielectric constant of Echofoam provides a converging beam from the lens to increase antenna efficiency. The lens is located at the front of the feed assembly at the waveguide entrance. On the back plate of the waveguide are mounted the prism drive motor, preamplifier, hybrid ring and wiring.

Typical secondary patterns of the telemetry feed made with the 1/12 scale model at 3,120 Mc, which represents 260 Mc on the full scale antenna, are shown in Fig. 3.

AUTOMATIC TRACKING—The system obtains automatic tracking information through position amplitude modulation of the target's carrier signal. This

Table I—Antenna Characteristics

Reflector diameter	60 feet
Frequency	106–110 Mc 216–260 Mc
Gain above isotropic	22 db min (108 Mc) 28 db min (216–260 Mc)
Polarization	Horizontal, vertical, right circular, left circular; available both frequency ranges and remotely selected 216–260 Mc
Circularity-axial ratio	1.26 or less
Scan frequency	10 cps
Beam width, 3 db points	10.5 deg (108 Mc) 4.6 deg (216–260 Mc)
Scanned Cone, 3 db points	12 deg (108 Mc) 6 deg (216–260 Mc)
Side lobes	18 db

provides satellite location and an error signal for giving off-track angles of properly referenced phase to drive the antenna pointing servo motors. These controlling servos obtain this information from the rotating lens which conically scans the antenna pattern's main lobe. Main lobe scanning provides a linearly increasing error signal for increasing angles from the crossover axis. Gain at the crossover point is high, with crossover level of 1 db from main lobe maximum quite adequate for the servo system.

Inside the tracking error zone (one degree on each side of the crossover axis) E- and H-plane beamwidths are kept similar to prevent higher harmonic content in the error signal from getting past the error filter and appearing in the data channel. Studies with the 1/12 scale model indicated that a five-foot diameter horn ring would form a proper ground plane to provide termination of the electrical field around the waveguide mouth. This horn ring produces equal E- and H-plane beamwidths. Proper waveguide dimension in terms of cutoff frequency was found to be 35.6 inches diameter.

The lens, rotating at 600 rpm, supplies a 10-cps error signal whenever the antenna is off target. A comparison is made between the 10-cps signal created by scanning the target, and a pair of signals of the same frequency but in quadrature with each other created by a reference generator attached to the rear of the lens shaft. Magnitude and phase of the target signal are compared to these reference signals in a demodulator to produce two independent d-c voltages, one for azimuth control and one for elevation control. Polarity and magnitude of these voltages are such that the correct torques are developed for returning the antenna to the target.

DATA FLOW—System data flow is indicated in Fig. 4. The signal received by the antenna is divided by the hybrid into two preamplifier channels. The i-f amplifiers in the tracking loops have high agc gain so that amplitude variations due to signal fading do not cause significant variation in the tracking error. This i-f amplifier detected output will not vary more than 3 db when there is a 60-db variation in input signal, when constant modulation index is used. The phase demodulator synchronously detects the azimuth and elevation error signals, using the scan reference voltages for comparison. When the system is in the automatic track mode, secant correction is employed in the azimuth servo control loop, since error signal sensitivity varies directly as the cosine of the elevation angle.

To improve response characteristics of the power drive equipment, an inner loop feedback (shown as tachometer feedback) is used.

Figure 4 shows only a single servo channel. Both servo systems are identical, except for secant correction on the azimuth channel. A type I system, the servo drive-motor has a transfer function representing a single integration.

Torque limiting is provided by a voltage derived from motor armature current, and prevents the sys-

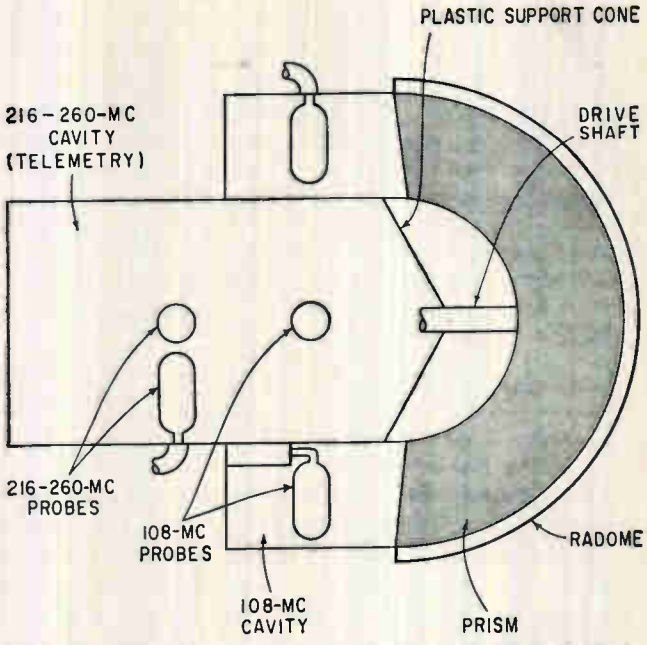


FIG. 1—Cross-section of basic feed structure shows telemetry feed as waveguide cavity excited by two orthogonal probes

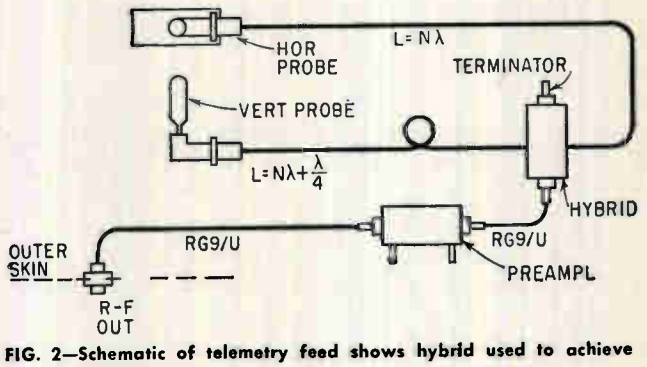


FIG. 2—Schematic of telemetry feed shows hybrid used to achieve circular polarization

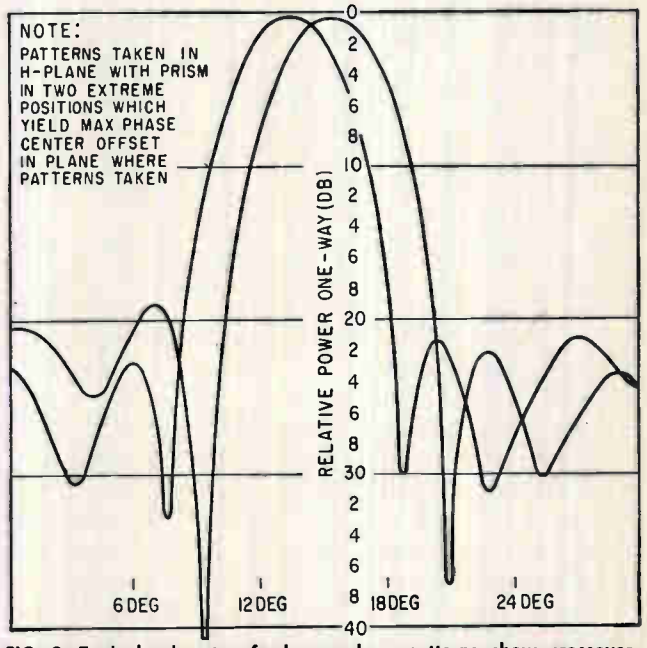


FIG. 3—Typical telemetry feed secondary patterns show crossover depth of 1 db, maximum side lobes approximately 19 db down

tem from requiring excessive motor torques.

TRACKING CAPABILITY—Tests with the Bomarc missile caused the antenna to accelerate at 4 degrees/sec^2 up to maximum velocity of 8 degrees/second. Off-track error of the system is directly proportional to angular velocity of the target, and quite small with slow moving objects. In satellite tracking, it will have an error of no more than 0.03 degree with a satellite subtending an arc of 1 degree/second.

This system is able to track signals well below the level required for suitably recording data, 0.4 microvolt at preamplifier input across 50 ohms or lower. This is possible due to the very small bandwidth required for the tracking portion of antenna. The TLM-18 installation at Hilo, Hawaii, similarly designed for 108-Mc operation, manually followed the Pioneer flight to its limit of 71,000 miles.

ANTENNA STRUCTURE—Basic antenna structure consists of a 60-foot parabolic reflector mounted on a cylindrical tower section so as to permit continuous motion in azimuth over 360 degrees with no stops or resetting required. Motion in elevation is slightly more than 90 degrees with appropriate limit switches, fail-safe brakes, and other safeguards to prevent travel into mechanical stops.

The reflector is driven in azimuth and elevation by 10-horsepower motors, controlled by the servo system which acts on tracking position information from the error signals. Received r-f signals are used to guide the antenna and supply telemetered data.

Manual positioning on both axes is accomplished by two-speed (1:1) and (36:1) synchros. Synchro control transformers connected to position control shafts are driven by follow-up servos when the antenna is moved by slew controls or automatic tracking. This keeps the synchros up with the movement to prevent violent antenna slew when the mode switch is placed on the manual position. When the slew controls are taken out of detented zero position, the follow-up servos start automatically, and the position control knobs are disengaged by instrument-type clutches.

One revolution of the position control knob results in 1 degree of antenna movement. Synchros controlled by these knobs are thus used for fine positioning, whereas slew controls are used for fast manual antenna positioning (up to 6 degrees/sec.)

While in the manual mode, antenna velocity is indicated in degrees on a calibrated dial. When a target comes within the antenna acquisition cone, the angle between target and boresight is indicated in degrees. Thus, for manual track, the operator adjusts the slew controls to keep azimuth and elevation error signals at zero.

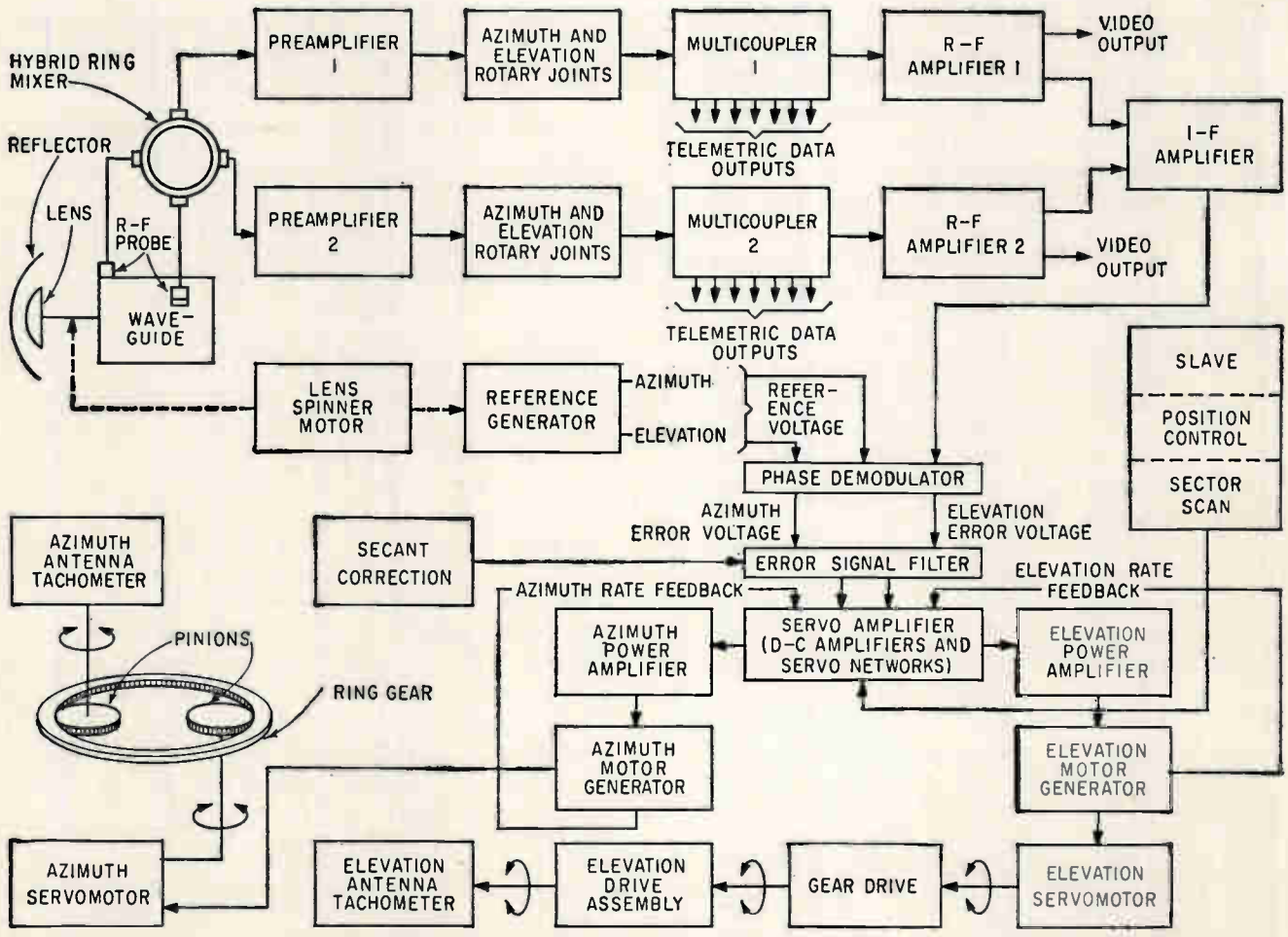


FIG. 4—Antenna system diagram shows how azimuth and elevation error voltages are used to torque antenna back to target position. Telemetry data can be received by two receivers attached to multicoupler outputs

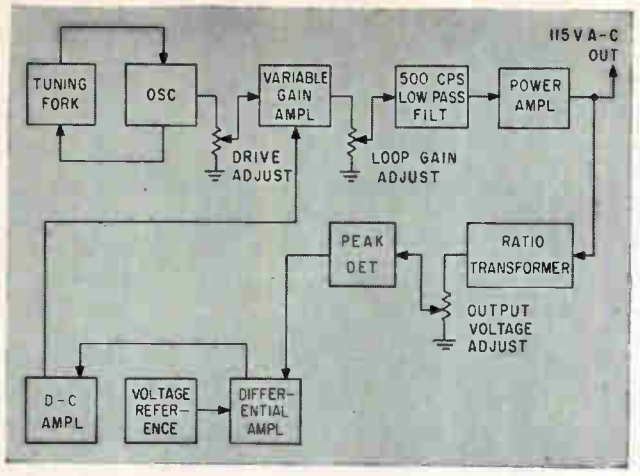


FIG. 1—Error correction mechanism of inverter is shown

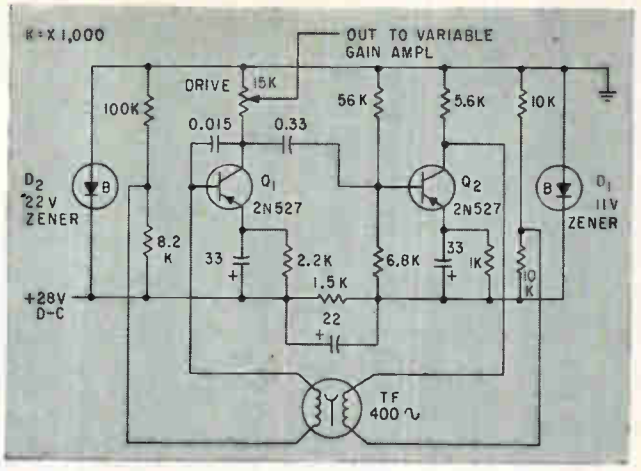


FIG. 2—Accuracy of frequency is dependent upon tuning fork

Linear Circuits Regulate Solid-State Inverter

Transistorized d-c to a-c inverter uses linear circuits to obtain precise voltage regulation of output. Total harmonic distortion of 50-watt unit is 1 percent and 400-cps output is regulated to ±0.2 percent. Tuning fork oscillator gives frequency accurate to 0.01 percent

By **ROGER WILEMAN,** Electronics Engineer, Packard-Bell Electronics Corp., Los Angeles, Calif.

RELATIVELY HIGH conversion efficiencies have been obtained by using transistors as saturating switching elements in d-c and a-c inverters. However, inverters of this type are severely limited with respect to distortion of the output waveform and accurate true rms regulation. If low distortion and precise voltage regulation are to be achieved with a transistor inverter, linear circuit techniques must be used, as the same properties which make a transistor efficient as a switch also contribute to its efficiency as a nonsaturating amplifier.

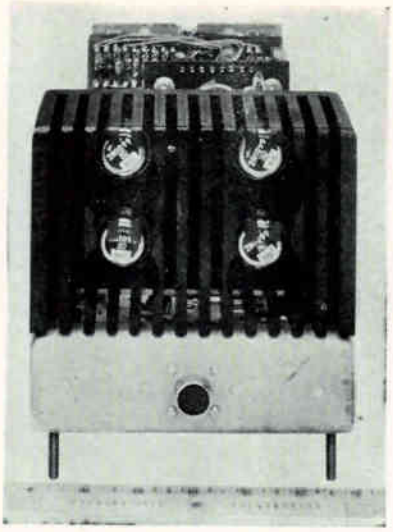
The requirements of low distortion and precise regulation have led to the development of a transistor static inverter using linear circuits having unique capabilities. A 50-watt unit capable of delivering a 115 volt rms 400 cps output regulated ± 0.2 percent is described here. Total harmonic distortion of this inverter is typically 1.0 percent. Output frequency of the inverter can be changed within the limit of 360 and 440 cps by means of plug-in tuning forks. Depending upon the type of tuning fork used, frequency accuracies up to 0.01 percent are obtainable.

Operation

Figure 1 is a block diagram of the inverter. The reference frequency generated in the tuning fork oscillator is coupled to the variable gain amplifier and then to the 500-cps low pass filter for complete removal of harmonics. Output of the filter is amplified to 50 watts and transformed to the output voltage of 115 volts. A precision ratio transformer divides down and isolates the a-c output voltage. The peak voltage from the secondary of the ratio transformer is detected and subsequently compared with a stable d-c voltage reference in a differential amplifier. The differential amplifier feeds an error voltage to a two stage d-c amplifier. Output of the d-c amplifier varies the output of the variable gain amplifier in inverse relationship to output voltage variations.

In this manner, regulation of the output against line and load variations is achieved.

Figure 2 is a schematic of the tuning fork oscillator. Essentially



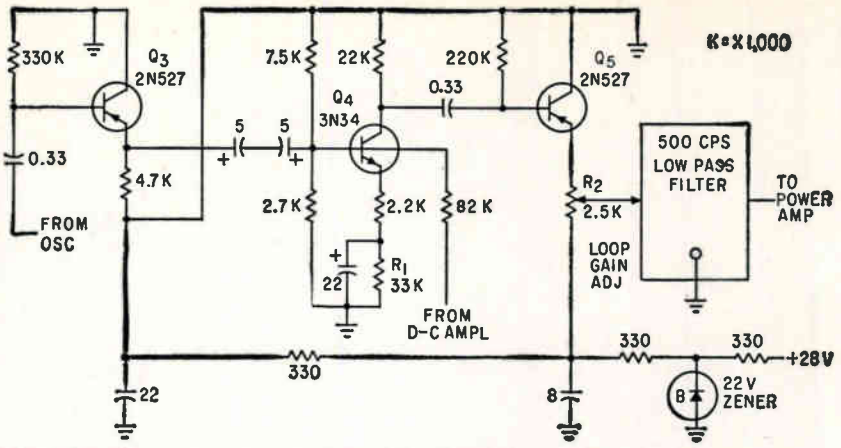


FIG. 3—Tetrode transistor is used as variable gain device

Photo at left shows packaging method employed

it consists of a two stage amplifier, the output of which is regeneratively coupled to the input through the tuning fork. The tuning fork acts as a frequency-selective network having a Q of 10,000 or more. A common problem encountered in the application of such an oscillator is the long build-up time after turn-on. In the circuit shown this problem is circumvented by making the open loop gain of the two stage amplifier high, such that the voltage build-up rate is high, saturating Q_2 soon after turn on. When saturation occurs, further build up ceases, as the fork drive voltage from the collector of Q_2 remains constant at a peak-to-peak value determined largely by Zener diode D_1. The voltage determined by D_1 is purposely made small to further cause early saturation of Q_2. In this manner build-up-to-stabilization times of 3 to 4 seconds have been achieved. As a means of keeping the oscillator output reasonably constant, D_2 is incorporated to regulate the supply voltage. The output taken from the collector of Q_1 is essentially sinusoidal due to the good harmonic rejection of the tuning fork.

Variable Gain Amplifier

The signal from the oscillator is applied to a 3N34 tetrode transistor through emitter follower Q_3 of Fig. 3. The 3N34 and 3N35 tetrode transistors have several unique properties which allow their use as variable gain devices.[1] If cross base current is applied to these transistors, a crosswise drift velocity is imparted to the minority carriers in the base region. The net effect of the crosswise drift is a removal of some of the carriers from the active base region and hence a decrease in base transport efficiency. Consequently, there is a significant reduction in h_{fe}, the common-emitter current gain.

The limits to which the reduction in h_{fe} can be applied are determined by the necessity for maintaining the operating point of transistor Q_4 within a given region. It is for this reason that the emitter resistor of this stage, R_1, is made very large. With the circuit shown in Fig. 3, it is possible to obtain gain variations of up to ten to one, maintaining less than 10 percent harmonic distortion at 1-volt output.

An error current from the d-c amplifier is applied to base two of Q_4 causing the a-c voltage gain of the stage to vary with the magnitude of the error current. The a-c output of Q_4 is then coupled into a 500-cps low-pass filter through emitter follower Q_5. Output of this filter is a sine wave at the reference frequency with less than 0.1-percent distortion. Potentiometer R_2 adjusts loop gain to compensate for variations in the nominal voltage gain and phase shift of the various stages in the inverter. When the loop gain exceeds a given value ringing of the output waveform occurs. By adjusting R_2 it is possible to find a condition which gives a good compromise between response time and overshoot under transient load conditions. Response time for this condition is typically 20 to 30 milliseconds.

The power amplifier used in the inverter is shown in Fig. 4. To provide good output voltage regulation, this amplifier must have characteristics of low internal impedance and low distortion. Low internal impedance keeps the loop error variations small with respect to load variations, thus reducing the regulator loop gain required for a given regulation tolerance. Because a peak detector is used in the inverter, harmonic distortion present in the output waveform affects the true rms regulation of the unit. If accurate regulation is to be achieved harmonic distortion must be minimized.

To achieve the above in a transistorized design, use is made of a compounded common collector output stage.[2] The application of this circuit is not without its problems however. Among the more severe problems are thermal runaway and parasitic oscillation.

Thermal runaway becomes a severe problem in this type of amplifier because of the extremely high effective alpha created by compounding. The problem is aggravated when the d-c resistance of the output transformer primary is reduced to a minimum. Two solutions were tried with a high degree of success. The first is to make the secondary winding resistance of T_2 as small as possible. In the present design it is 25 ohms base-to-base.

The second solution is to incorporate a high degree of d-c current feedback around the output transistors Q_{12}, Q_{13}, Q_{14} and Q_{15}. This was accomplished by incorporating

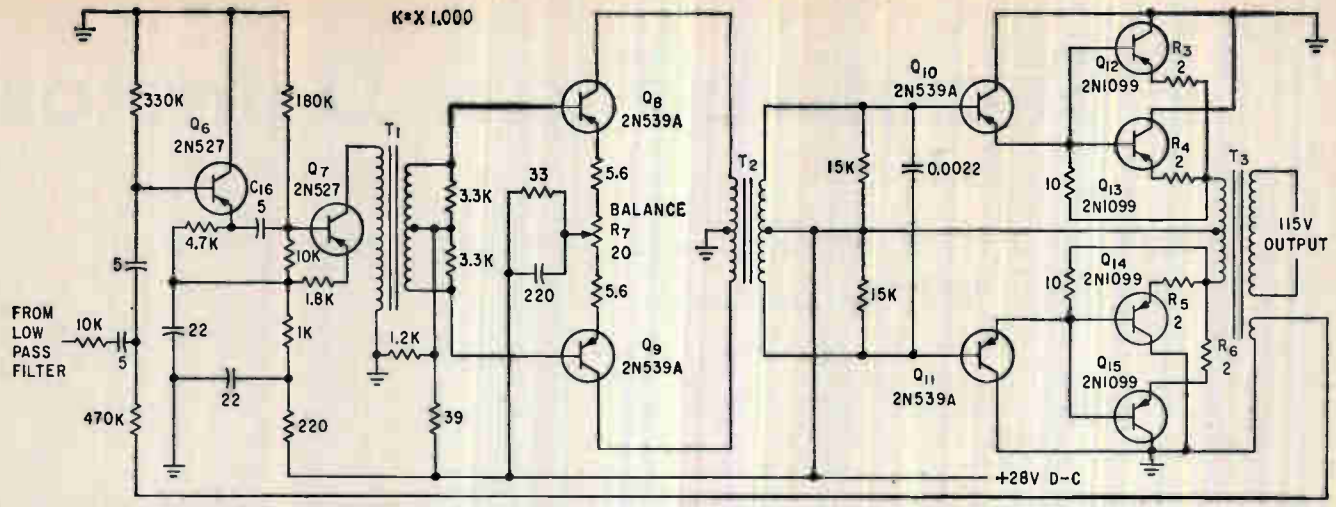


FIG. 4—Power amplifier uses compounded common collector output stage

R_3 to R_6 in series with the emitters of the four output transistors. Although this has a detrimental effect on the amplifier's internal impedance and efficiency, the stability resulting was well worth the compromise. When driven separately from the rest of the amplifier, the output stage delivers 55 watts at 400 cps with only 2.4 percent total harmonic distortion at 70 C ambient. (This corresponded roughly to a junction temperature of 100 C.) When the drive signal was removed, the d-c input current corresponding to leakage at the zero bias condition was less than 100 milliamperes. The unbalanced direct current in the output transformer was less than ten percent of this figure. For this reason an ungapped Silectron toroidal core was used in the output transformer with a consequent reduction in size and weight.

Parasitic oscillations are a problem with this type of amplifier due to the large reactances which exist in the circuit and the multiplicity of in-phase feedback paths. The power gain of the compounded stage can become quite high as in the present case where it was 26 db, and this in turn adds to the problem. The most successful suppression method used was capacitive loading of the secondary of transformer T_2.

The rest of the amplifier is of reasonably straightforward design. It might be mentioned that R_7, the balance control for Q_8 and Q_9 has another not-so-apparent use. This is as a load regulation adjustment and may be explained as follows. In any system which uses a peak detector to sense regulation to true rms the quantity of the harmonic content will cause a deviation from the desired output. Resistor R_7 by controlling to a certain extent the amount of second harmonic distortion in the output can affect the true rms regulation of the inverter. It is generally possible to find a setting of R_7 which gives optimum load regulation with only a slight increase in total harmonic distortion.

Another approach which yields good results is the use of a split load phase inverter as a driver for Q_8 and Q_9. When such a substitution is made performance at low levels is considerably improved.

Reference Element

The most critical area as regards the accuracy and stability of the inverter is in the reference and d-c amplifier circuit which is shown in Fig. 5. Careful attention was given to temperature compensation of the reference element and silicon transistors were used wherever d-c levels were to be handled. The reference element is a 1N2169A Zener reference which employs one reverse biased and two forward biased diode junctions. With a constant current input the voltage variation with temperature is less than 50 microvolts per degree C. A constant input current to this reference is achieved by matching the positive temperature coefficient of R_8 and TR_1 to the negative temperature coefficient of diode D_3.

As in the reference element, use is made of both positive and negative temperature coefficient characteristics of silicon diodes to set up a thermally stable collector voltage source for Q_{16}, Q_{17} and Q_{19}. A compensating control, R_9, is used to couple input voltage variations to the loop in opposition to supply voltage variations.

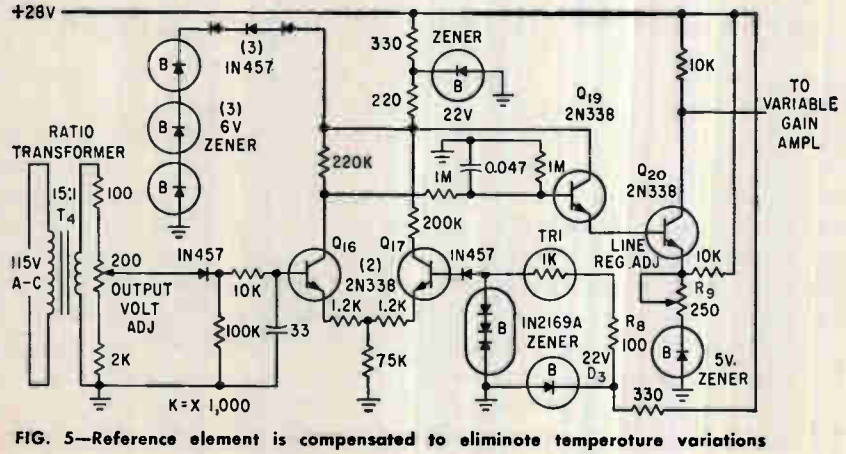


FIG. 5—Reference element is compensated to eliminate temperature variations

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(2) R. F. Shea, "Transistor Circuit Engineering", p 130, John Wiley and Sons, Inc., New York, 1957.

Sensitive Flaw Detector

Electronic system finds defects in paper despite noise amplitudes which are comparable to flow-signal amplitudes

By M. P. MacMARTIN, Electrical Engineering Section, National Research Council, Ottawa, Canada

THE AMOUNT OF LIGHT which is reflected from a flaw in paper is not the same as is reflected from good paper. This characteristic, which applies to almost all defects, is used by the electronic flaw detection system to be described.

The sensing element is a multiplier phototube, which is focussed an a small area on the paper. Multiplier phototube output is proportional to the amount of light reflected into the phototube from the small area of the paper. A change in the amount of reflected light changes the output of the multiplier phototube, indicating a flaw. The main design problem was to distinguish between the signals which indicate a flaw and the signals due to electronic noise in the multiplier phototubes. Another difficulty was that the detector usually has just one look at a flaw.

System Description

A simplified diagram of the detection system and a paper cutter and sorter is shown in Fig. 1. Paper goes into the machine, is cut into sheets of desired length, and then the sheets are piled. The flaw detector inspects the paper while it is in a continuous strip, and if it sees a defect it stores this information in a mechanical memory device. After this inspection the paper is cut, and the cut sheets travel on through the machine to the sorting point. As each sheet arrives at the sorting point, the memory device is automatically checked to see if the sheet contains a flaw.

It is necessary to inspect all the paper—a spot check is not good enough — so the equipment must handle information at the rate required for the widest paper traveling at the maximum speed.

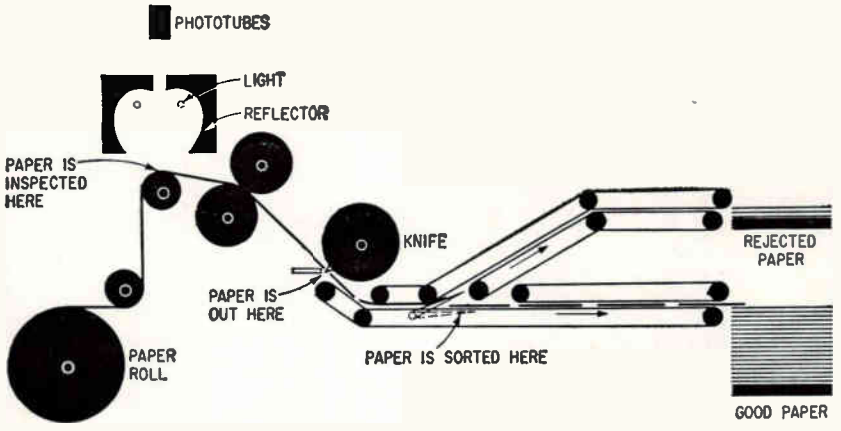


FIG. 1—Paper flaw-finding and sorting system

The detector looks at a small area of paper $\frac{1}{16}$ by $\frac{1}{16}$ in. and this area scans the paper fast enough to inspect the entire surface, even when a sheet 51 in. wide is traveling at 300 ft per min. A spot on the paper is in focus for only 3 by 10^{-6} sec, so the signal produced by a small defect is about 3-μsec wide. To amplify this signal, amplifier bandwidth must be about one mc; thus, the noise produced in the phototubes is amplified also.

Inside the reflector is a drum which rotates at 1,800 rpm. Eight mirrors are mounted on the periphery of the drum. The light beam from the paper to the phototube is reflected off a mirror, and as the drum rotates, the area on the paper seen by the phototube travels across the paper from one edge to the other. At the end of a scan, the area on the paper seen by the phototube drops off the edge of the paper and appears at the other edge ready to scan across the paper again. Width of each scan is $\frac{1}{16}$ in. so with a reasonable allowance for overlap, each scan covers a strip $\frac{1}{4}$-in. wide across the paper. With eight mirrors rotating at 1,800 rpm, there are 240 scans per sec. At 300 ft/min., the maximum speed, the paper moves forward $\frac{1}{4}$ in. during a scan.

Two mercury lamps, 48 in. long, with elliptical trough reflectors, illuminate a strip across the paper. The lamps are supplied with two-phase 60-cps power which gives 240 light peaks per second, one light peak for each scan. Thus, light ripple is not objectionable.

Noise Problems

The output from the phototube contains signals which are due to defects in the paper, to variations which are normal in good paper, and to noise in the multiplier phototube. A conventional pulse-height discriminator circuit passes only those signals whose peak amplitudes are above a preset reference level. This circuit does not remove all the noise.

Suppose the reference level, or sensitivity, were set so that all de-

Solves Noise Problems

fects in the paper could be detected. At this sensitivity setting a signal due to noise in the phototube would pass the discriminator many times each second. This effect is shown in Fig. 2. Five artificial flaws of the same grey color but of different sizes were made up. These flaws were scanned a number of times. The heights of the pulses produced by each flaw and the number of pulses of each height are shown in Fig. 2.

Heights of the highest noise pulses in each 0.5-msec period are shown by the dashed curve; this curve is in the flaw *B* box for convenience. The noise curve shows the probability that any 0.5-msec period will contain at least one noise pulse of a given height.

The highest noise pulse is higher than many of the pulses due to defects. For example, to detect flaw *D* reliably, the sensitivity level must be set to detect all pulses higher than height 6.5. However about 33 percent of the area under the noise curve is above this height, so there should be a noise pulse higher than the sensitivity level in each 1.5-msec period.

Noise pulses are permitted to pass the pulse-height discriminator and then are eliminated. Two identical multiplier phototubes are used, each with identical preamplifiers, amplifiers and pulse height discriminators. One phototube looks at an area of the paper slightly ahead of the other. The output signal from the leading phototube is delayed in a delay line, producing the same effect as if both phototubes looked at the same area at the same time.

Outputs from the two dicriminators go to a coincidence circuit. Pulses which are due to real defects occur at the same time, and pass the coincidence circuit; since pulses due to noise are random in time, the probability of getting two coincident noise pulses is small and practically all the noise is eliminated here. However, noise does cause rejection of some sheets.

The two phototube channels have identical amplifiers and pulse height discriminators (Fig. 3 and 4). The amplifiers have considerable feedback so that the gain depends primarily on passive components. The pass band of the amplifiers is from 100 Kc to one Mc. Discriminators V_2, V_3 and V_6, V_7 are Schmitt circuits[1]. Tube V_3 (V_7) is normally conducting. A signal pulse sufficiently high to drive the grid of V_2 (V_6) positive with respect to the reference level turns on V_2 (V_6) and cuts off V_3 (V_7), generating a pulse of the same width as the signal pulse. All signals below the reference level are ignored. The operator adjusts sensitivity by adjusting the bias level with R_1 (R_2).

The signals from both channels are compared for coincidence in V_8. Signals due to noise are eliminated here. However the signals which are produced at the edges of the paper are coincident. Signals which are produced at the leading edge of the paper do not pass the discriminator circuits because they are of negative polarity. However signals produced at the trailing edge of the paper pass the discriminator and the coincidence tube, and must be removed. That is done in gate V_{10}.

A gate signal blocks V_{10} just before the photosensitive area drops off the edge of the paper. The required square wave is generated in the blanking generator, V_{15}, which is a Miller sweep. This circuit is triggered by the pulse which is produced at the leading edge of the paper. The width of the gate signal is set to match the width of paper being handled.

The output circuit includes thyratron V_{21}, which operates a solenoid. Since V_{21} is supplied with 60-cps power, the trigger pulse is stretched so that the solenoid gets at least one full half-cycle of current, which is enough to pull it in. When the solenoid operates, the fact that a flaw has been detected is stored in the mechanical memory device.

Rather than regulate the a-c supply to the lamps, the voltage supply to the multiplier phototubes is continually adjusted to keep the output of the multiplier phototubes constant. A quasi-peak value (with a time constant of about one second) of the output of one multiplier phototube is fed to the high-voltage power supply. Thus the output of the phototubes, rather than the output of the power supply is the regu-

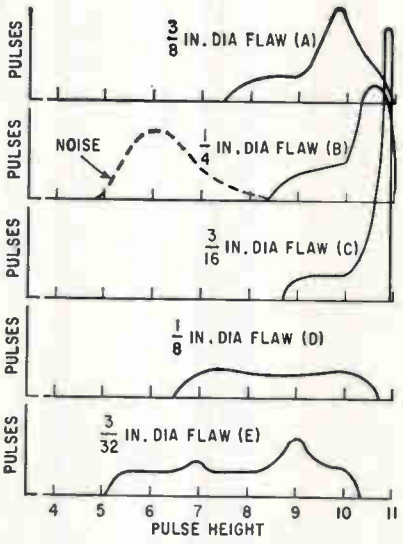


FIG. 2—Ordinates indicate relative number of pulses of various amplitudes

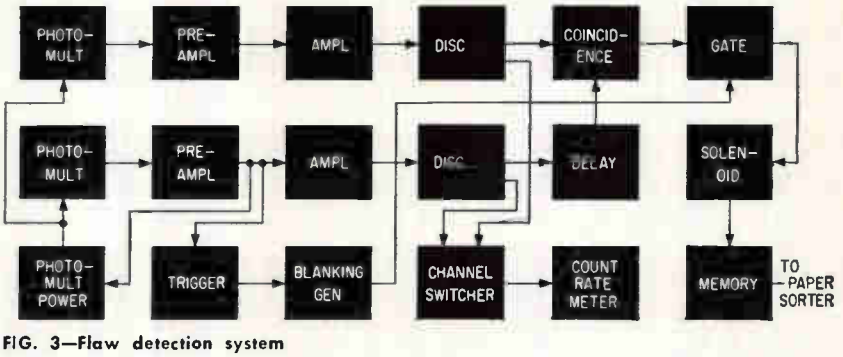


FIG. 3—Flaw detection system

lated quantity. A fixed bias holds phototube outputs near their ON values while they are OFF so that the transient is small when the scan comes to the edge of the paper.

Sensitivity Indication

The number of pulses of noise per unit of time is fairly constant for any given sensitivity setting. That is (Fig. 2), the curves may shift to the right or left, but if the curves shift, the noise curve also shifts, so that all the curves keep the same position relative to each other. The noise curve is used as the reference standard to hold the sensitivity at any desired value. For example, rather than set the sensitivity at height 7, it is set so that 10 percent of the area under the noise curve is to the right of the sensitivity-level setting.

Output pulses from the discriminators, which normally are practically all caused by noise, go to the channel switch (V_{12}). Tube V_{12} is controlled by the channel-switching generator, V_{18}. Bistable multivibrator V_{18} is controlled by S_1, a microswitch on the recording meter. Multivibrator V_{18} flips from one state to the other, passing pulses from V_{12}, one side at a time, to pulse inverter V_{19A}. The average value of the pulse shaper (V_{20}) causes the rate meter to indicate pulses per unit of time, that is, sensitivity.

Selectivity

Another aspect of flaw discrimination is that one cannot set up a standard flaw and say that all flaws greater than this will be rejected and all flaws smaller than this will not be rejected. For example (Fig. 2), to detect flaws *A*, *B*, and *C* reliably, the discrimination level must be set at height 7.5. However, about 75 percent of the *D* flaws and about 60 percent of the *E* flaws will now be detected; these are the amounts of area under the flaw curves to the right of height 7.5. Thus, there will be some unnecessary rejects. For example, in a test run the machine rejected 10 percent of the paper. When the rejects were re-sorted more than half of them were considered acceptable. Sorting 10 percent of the paper is a small job compared to sorting 100 percent.

REFERENCE

(1) O. H. Schmitt, A Thermionic Trigger, *J Sci Inst*, 15, p 24, 1938.

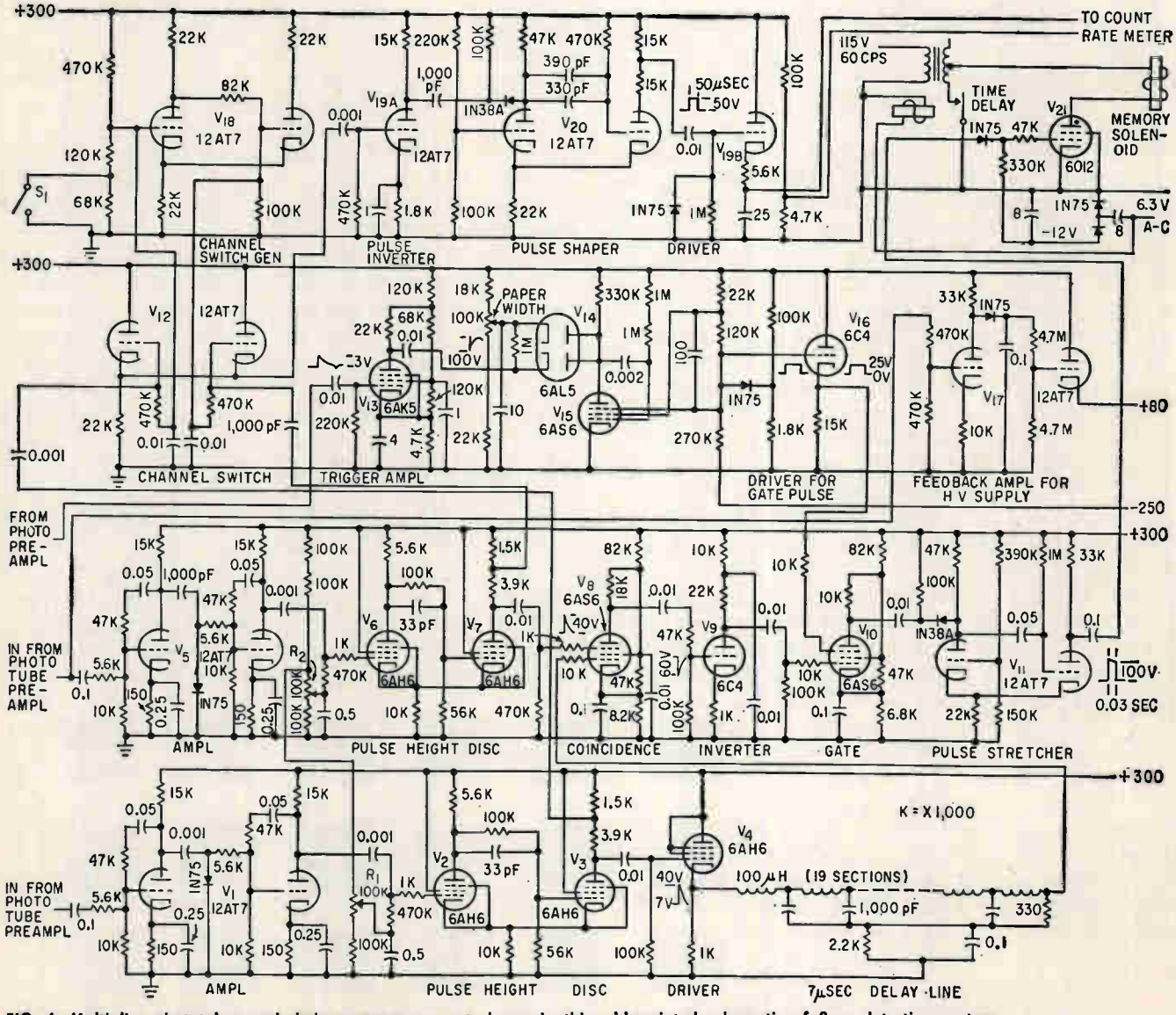


FIG. 4—Multiplier phototubes and their preamps are not shown in this abbreviated schematic of flaw detection system

Calibrating Broadcast Modulation Meters

Method of checking calibration of f-m and television-transmitter percentage-of-modulation monitors uses Bessel function measurements

By D. STANLEY HENRY, Station KNXT, Columbia Broadcasting System, Inc., Mt. Wilson, California

IT is desirable to check periodically the calibration of the percentage-of-modulation meters used as standard monitoring equipment at f-m and tv broadcasting stations. Bessel function measurements are the best means of verifying the monitor calibration. It is well known that at certain discrete ratios of carrier deviation to modulating frequency the carrier component of the f-m signal goes to zero.

If m is the modulation index, ΔF is the carrier deviation, and f is the audio modulating frequency, then $m = \Delta F/f$.

Table I relates the percentage of modulation to the values of m for the first five carrier nulls for f-m and for tv aural service. Modulation test frequencies should be accurate to within 1 percent.

A meter-checking method which requires a minimum of equipment makes use of the multiplier circuit shown in Fig. 1.

This Q multiplier circuit effectively parallels the positive resistance of the coil with the negative resistance of the active circuit, reducing the effective positive resistance of the coil and thereby increasing the Q. The amount of feedback or negative resistance is adjusted by the FEEDBACK control and as long as the positive resistance is slightly greater than the negative resistance, the circuit will work as a very stable, selective amplifier. Too much feedback will cause oscillation.

Figure 2 shows a group of selectivity curves for typical amounts of attenuation of the side band frequencies for various settings of the FEEDBACK control. The fact that the maximum possible amplitude of the first pair of sidebands is less than 60 percent of the unmodulated carrier increases the apparent attenuation by almost 6 db.

Any coil having a Q of 50 to 100 at the i-f frequency may be used. It should be slug tuned to provide a convenient means of tuning the circuit precisely to the i-f of the f-m monitor. The precise i-f will depend on the exact carrier frequency of the transmitter and thus provision is made to allow for normal carrier frequency deviation or for offset operation where the carrier frequency of the transmitter is offset ±10 kc for reduction of interference.

With the aural transmitter on, tune the coil for maximum signal amplitude on the scope and check for oscillation by turning off the aural transmitter. The scope signal should drop to zero. If oscillation is present, increase the FEEDBACK resistance to stop the oscillation and recheck the coil tuning with the transmitter on again. Now apply modulation of the desired audio frequency to the transmitter, gradually increasing the modulation level from zero, observe the carrier nulls and check the reading of the percentage-of-modulation meter at each null point.

The carrier nulls are sharp and unmistakable. There is a residual signal because the side bands are not completely attenuated. It has the form of a suppressed carrier signal when observed with a lower sweep speed on the scope.

REFERENCES

(1) H. E. Harris, Simplified Q Multiplier, ELECTRONICS, p 130, May, 1951.

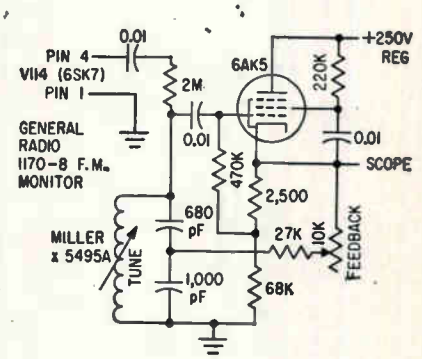


FIG. 1—Q multiplier circuit is used with f-m monitor to make Bessel function measurements

Table I—Test Data for F-M Monitor Calibration

F-M Service: 100 Percent Modulation = ±75 Kc; Modulation Test Frequency = 5 Kc				TV Aural Service: 100 Percent Modulation = ±25 Kc; Modulation Test Frequency = 1,500 cps			
Null #	m	Kc Deviation	Percent Modulation	Null #	m	Kc Deviation	Percent Modulation
1	2.40	12	16%	1	2.40	3.6	14.4%
2	5.52	27.6	36.8%	2	5.52	8.25	33.0%
3	8.65	43.1	57.5%	3	8.65	12.9	51.5%
4	11.79	59.0	78.6%	4	11.79	17.7	70.5%
5	14.93	75.0	100%	5	14.93	22.5	90.0%

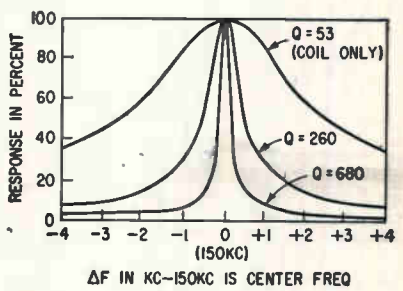


FIG. 2—Normalized selectivity curves as feedback is varied

By HOWARD G. ALLEN,
Director of Research and Development,
Bostitch, Inc., East Greenwich, R. I.

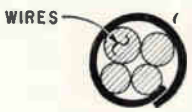
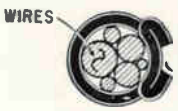
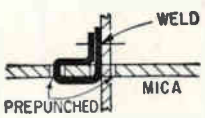
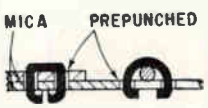
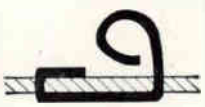
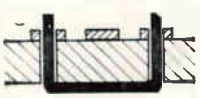
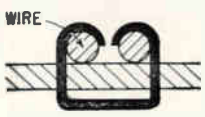
Types of Staples

AUTOMATION in the construction of electronic devices has spurred the use of wire stitching and stapling.

In addition to the speed and accuracy of modern wire stitching and stapling machines, the varied terminal and circuit connections are formed from either standard design staples or from a simple spool of wire. Material cost saving is thus another advantage of the two techniques. Many stapling and wire stitching machines are adaptable to automatic production lines, making it possible to completely automate the forming and fastening of terminals and circuit jumpers.

Most of the terminal and connection designs shown in the table can be formed and fastened by a wire stitcher or manual or motor-driven staplers. The choice of a stitcher or stapler depends upon the pro-

Table I—Characteristics and Uses of Electronic-Production Staples

Staple Shape	Type or Name	Sizes Available (Dimensions in inches)	Use	Wire Size in Inches
	Ring clamp	Up to ½ inside diameter.	Used to clamp from 2 to 10 wires together when forming wiring harnesses, cables, etc.	0.050 x 0.020 to 0.103 x 0.033 or larger galvanized steel.
	Insulated ring clamp	Up to ½ inside diameter.	Same as above except staple ends turned back to prevent any possibility of cutting insulation on wires.	0.050 x 0.025 and 0.074 x 0.037 steel wire, with 0.005 nylon coating.
	Support staples	Crown widths down to approx. 0.100.	Supporting vacuum tube elements, coil assemblies and other component assemblies.	0.010 x 0.030 or larger. Nickel wire, and other suitable wire material.
	Miniature staples	With a crown between legs as little as 0.060	To replace rivets or eyelets in miniature electronic assemblies.	Round wire 0.010 and larger. Flat 0.006 x 0.020 and larger. Material can be brass, nickel, monel, stainless steel, etc.
	Solder terminal	Variable, usually crown about 1/16, point up to ¼ high.	Used largely for connecting terminal on coil forms, or terminal boards.	0.020 x 0.050 copper, brass or steel.
	Special terminals	Crown widths ⅜ to ¾. Loops approximately ⅛ dia. Straight legs from ¼ to ½ long.	Variation of solder terminal above, where application requires terminals in straight, offset, or angular position.	0.020 x 0.100 or larger. Brass or bronze wire.
	Printed circuit jumper	Crown widths ⅜ to 1.	Circuit jumper.	0.030 diameter copper wire and larger.
	Clamp staple	Crown widths ⅜ to 1¼. Maximum opening height not to exceed ⅛.	Useful for clamping components with mounting tabs into position.	Usually 0.050 x 0.019 to 0.103 x 0.023 or heavier.
	Outward clinch staple	Crown ⅜ to 1. Free leg 1/16 to ½.	Connector, jumper, etc.	Round to 0.035 diameter. Flat usually 0.050 wide by 0.020 thick. Any metal.
	Line clamp	Crown any width to suit, up to ¾.	Strain relief to bind wire together. Bunch several lines and attach to flat surface.	Flat 0.050 and wider. May have 0.005 extruded nylon cover for extra protective insulation.

for Electronic Production

duction requirements, characteristics of the particular fastening job and cost of the equipment.

Stapling machines are available in relatively inexpensive motor and foot-operated models. The more expensive wire-stitching machines are all motorized and equipped for continuous operation at high speeds.

Staplers apply preformed wire staples that have been cemented together in the form of sticks or strips, of 50 to 100 staples, as in typical desk type staplers. In contrast, stitchers make their own staples from a spool of wire. In a single operation a wire stitcher draws a preset length of wire from the spool, straightens it, cuts it to proper length, forms the stitch (which is actually an individual staple), drives it into the material to which it is to be fastened and then clinches the legs underneath.

How Applied	For Use With What Material?	Current Capacity	Insulated or Noninsulated	How Connect To Solder, Wire Wrap, etc.
Stitcher or stapler.	Insulated wires as harness assembly.	———	Noninsulated.	———
Stapler; motor or air-driven; portable or fixed.	Insulated wires as harness assembly.	———	Nylon insulation, 0.005 inches thick.	———
Stitcher.	Material to be fastened must have prepunched holes and be accurately registered under stitching head.	———	Noninsulated.	Staple leg lengths can be varied to suit requirements of soldering or spot welding.
Stitcher.	Material to be fastened must have prepunched holes and be accurately registered under stitching head.	———	Noninsulated.	———
Stitcher and stapler.	Fibre or similar nonbrittle material of maximum 0.040 thickness if not prepunched.	Large.	Noninsulated, for soldering.	Wrap and solder.
Stitcher.	Fibre or similar nonbrittle material of maximum 0.040 thickness if not prepunched.	Large.	Noninsulated, for soldering.	Wrap and solder.
Stitcher may be adjusted to bend leg ends to hold jumper in position before soldering.	Printed circuit wiring on insulated board up to $\frac{1}{16}$ thick.	Depends on wire size.	Noninsulated, for soldering.	Solder.
Stitcher or stapler.	Will penetrate paper boards as driven. Harder material requires prepunched holes.	———	Noninsulated.	———
Stapler, or preferably power stitcher.	Requires prepunched holes in fibre and plastic but not in paper boards.	Depends on wire.	Noninsulated, for soldering.	Wrap and solder.
Stapler for standard staple sizes in bare wire. Stitcher if special staple widths and leg lengths.	In paper board, it will punch own holes; otherwise prepunch.	Not for conductor purposes.	Insulated 0.005 nylon coating on steel wire.	———

Operator sets digit switches to identify zones and then determines type of signal

High-Powered Audio Alarm Systems

A series of high-power transistorized amplifiers may be used to replace present mechanical sirens. Characteristic wail of the siren is duplicated by electronic circuits. Voice communications may also be carried by the system

By **W. F. FERGUSON,** Chief Engineer, Electronics and Alarm Div., Fyr-Fyter Co., Newark, N. J.

THERE ARE several basic types of sound generators used for audible signalling by volunteer firemen and Civil Defense authorities. These are: the air horn, mechanical horn, steam whistle and the mechanical siren.

Within the past year, high-power audio systems have made their appearance. While high-power audio amplifiers are not new, their application to the field of audible signalling to entire municipalities is new.

The major advantages claimed for the audio signalling system are improved overall reliability, lower cost per unit area of coverage and the extra advantage of voice transmission over the same system.

Included in the term reliability is the probability of the listener hearing the signal under such varied conditions as wind or ambient noise.

The system to be described consists of a control console that contains the tone generators, coding generators, preamplifiers, microphone and matching circuits. A series of remote stations containing the highpower amplifiers and loudspeakers completes the system. The remote units are linked to the control station by either radio units or leased telephone lines.

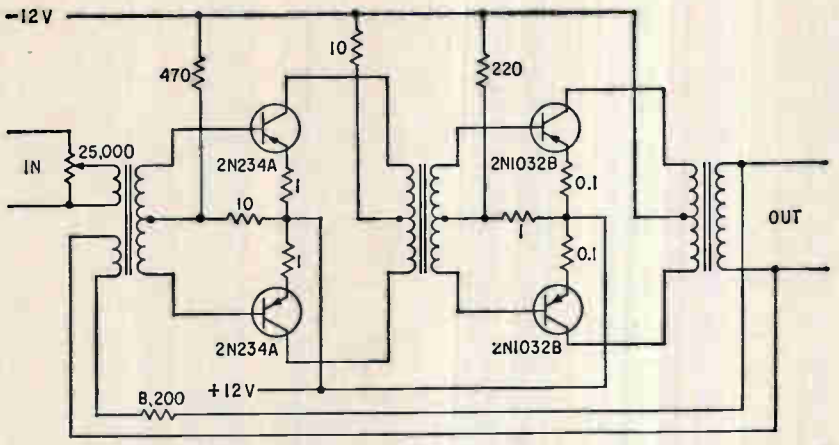


FIG. 1—Class AB audio amplifiers can deliver 200 watts to four loudspeakers arranged in space quadrature for maximum coverage

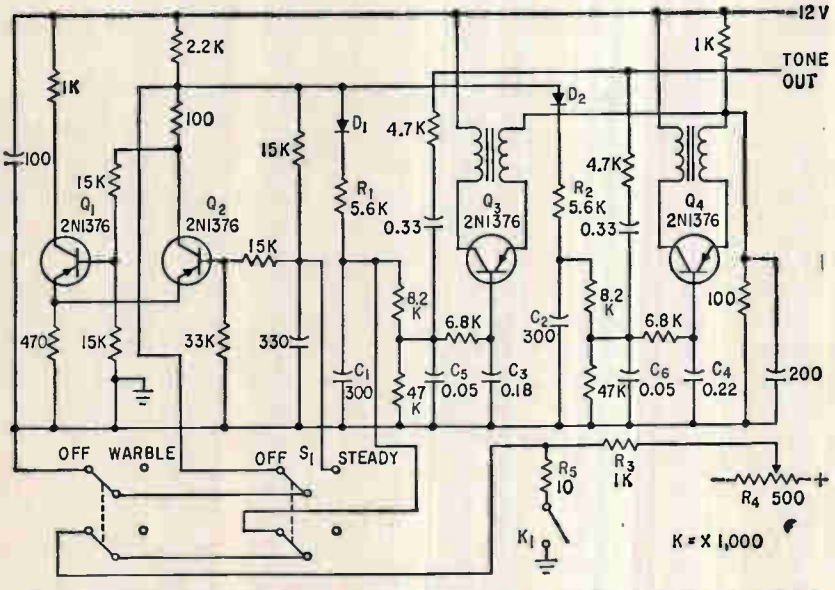


FIG. 2—Warble generator frequency-modulates a pair of oscillators, each at a slightly different frequency, to produce siren-type wail

The remote stations, shown in Fig. 1, are transistorized class-AB audio amplifiers that deliver approximately 200 w to four loudspeakers. The speakers are arranged in space quadrature to achieve 360-degree coverage.

The standby power drain of each amplifier is 12 w. The frequency response of the amplifiers is within 3 db from 100 cps to 5 Kc, with less than 10-percent distortion. The power source for the amplifiers is either a conventional 117-v supply or a conventional 12-v storage battery equipped with an automatic charger.

The remote stations are spaced in such a manner that at least a 10-db signal-to-noise ratio is maintained over the area to be covered. A typical area of coverage could be represented roughly by a circle of $\frac{1}{2}$ to $\frac{3}{4}$ mile in diameter.

Tone Generator

Figure 2 shows the method of generating the single tone and warble signals. Transistors Q_1 and Q_2 form a low-frequency multivibrator. The square wave generated at the collector of Q_2 is integrated and stretched by diode D_1, resistor R_1 and capacitor C_1, and applied directly to the base of tone generator

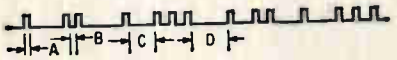


FIG. 5—Typical coding signal to identify zone being called. This code is 1213

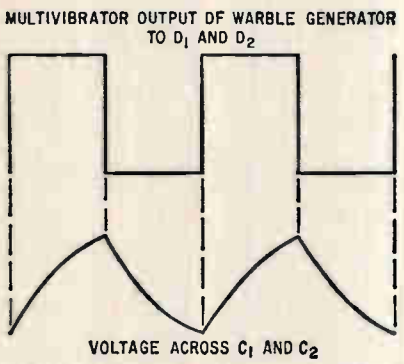


FIG. 3—Multivibrator square-wave output is converted to triangular wave

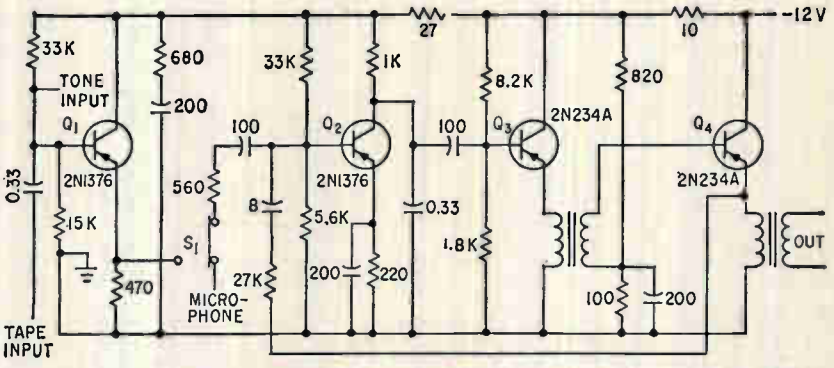


FIG. 4—Preamplifier circuit supplies signals to remote units. Input to the preamplifier can be either the siren signal, tape or microphone audio

Q_3. The network consisting of diode D_3, resistor R_3 and capacitor C_2 applies the multivibrator signal to the base of tone generator Q_4.

Both tone generators (Q_3 and Q_4) are blocking oscillators whose frequency can be varied by applying variable base bias. Since the applied base voltage is approximately triangular in shape, the audio output of the blocking oscillators will be a smoothly varying frequency that will deviate between the limits established by the upper and lower limits of the applied base bias. Figure 3 shows this signal.

Capacitor C_3 establishes the nominal frequency of oscillator Q_3 and capacitor C_4 does the same for oscillator Q_4.

Capacitors C_5 and C_6 eliminate some of the high-frequency components. The audio output is taken from these capacitors.

Tone generators Q_3 and Q_4 have a slight frequency difference in order to produce (after mixing) a distinctive two-tone wail that is characteristic of air raid sirens. The oscillators are nonsynchronous in pitch but are synchronous in warble since they are both frequency modulated by the same warble signal.

A single tone signal is produced by placing S_1 in the steady position, thus disabling oscillator Q_3 by grounding its base circuit.

The system can also generate a siren-type signal in which a single audio tone rises to a maximum frequency and then suddenly terminates. Capacitor C_1 charges through resistor R_8 to the voltage preset by the setting of R_4. The increasing voltage results in an increase of Q_3 frequency. Upon completion of transmission period, the control unit operates relay K_1 to rapidly discharge C_1 through R_6 to ground.

Preamplifier

The circuit of the preamplifier and the line driver is shown in Fig. 4. Conventional circuits are used. The input to the preamplifier can be either the output of the warble or tone generator, the signal from a tape recorder or, if desired, switches can be arranged for a microphone input.

Coding

The area to be covered is divided into zones, each identified by a particular coding sequence. The coding portion of the system generates the predetermined sequence of audio pulses coded to alert personnel in that zone. Once set up, the instrument continues to sound that code for up to four rounds, at which time it will automatically shut off.

The coding consists of gating the audio output on and off. A typical sequence is shown in Fig. 5. Each digit of the four-digit number could be composed of any number between 1 and 9. The number shown in Fig. 5 is 1213. The basic coding circuit is shown in Fig. 6.

Relay K_4, which eventually controls the audio output signal, is normally energized since contacts of relay K_3 are closed disabling the multivibrator Q_3—Q_4. When the contacts of K_3 open, the multivibrator will start to operate with its frequency determined by its RC time constant. Resistor R_3 controls the OFF time of the multivibrator while R_4 controls the ON time.

When transistor Q_5 draws current, it deenergizes relay K_4. This determines time A and B of Fig. 5.

The normally-closed contacts of relay K_5 allow capacitor C_1 to charge. Relay K_5 is energized by operation of the start switch. When K_5 operates, C_1 starts to discharge causing the base current of Q_1 to gradually decrease, resulting in an increase in collector voltage. This causes the base current of Q_2 to increase. The rising collector current of Q_2 causes operation of K_2. The time required for C_1 to discharge is controlled in part by resistors R_1 and R_2. Setting of these resistors produces the delay indicated as C in Fig. 5.

When switch S_6 is opened, the delay time is controlled primarily by R_1. This generates D of Fig. 5.

A system of motor-driven stepping switches (not shown on the schematic) counts the number of operations of relay K_4 and limits them so that they agree with the digits selected by the operator.

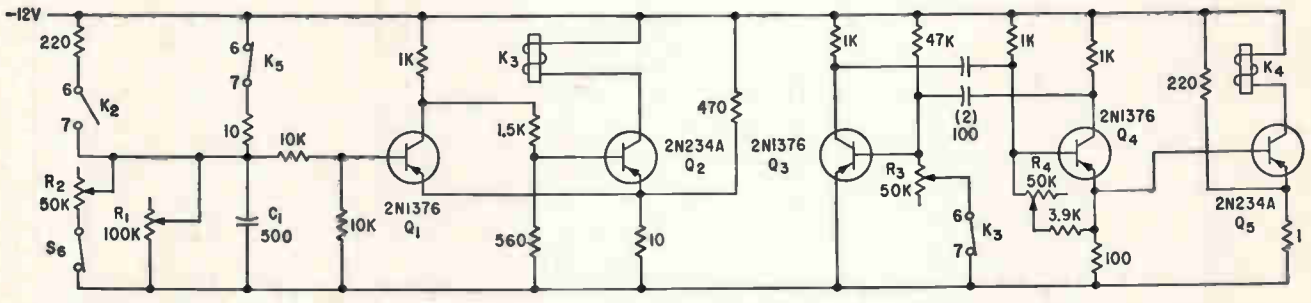


FIG. 6—Basic coding circuit used to generate zone code. Operation of multivibrator Q_3 — Q_4 determines the duration of A and B of Fig. 5, while operation of Q_1 — Q_2 circuit determines time C and D of Fig. 5. System of motor-driven stepping switches (not shown) is operated by relay K_4 and counts the number of K_4 operations to make system operate to predetermined zone coding

Transistor Amplifier Has 100 Megacycle Bandwidth

Shunt feedback networks around each stage reduce overall gain at low frequencies, trading gain for bandwidth. Circuit can be adjusted for use as pulse amplifier

By J. C. de BROEKERT and R. M. SCARLETT,
Stanford Electronics Laboratories, Stanford University, Stanford, California

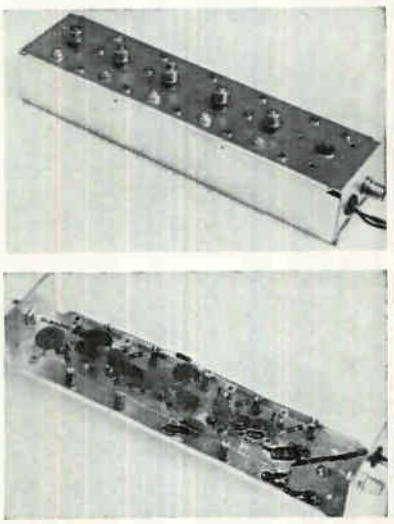
PRESENTLY available drift transistors yield much greater video amplifier bandwidths than those easily attainable with conventional vacuum-tube pentodes, although with less output power. In this amplifier, shunt resistive feedback around each common-emitter stage exchanges gain for bandwidth, with a series inductance to peak the high frequency response. This arrangement results in an amplifier which is particularly simple by comparison with its vacuum-tube counterpart (often a distributed amplifier).

Simple design equations included relate gain and bandwidth per stage to both circuit and transistor parameters. A design example of an amplifier with 50 db gain and over 100 Mc bandwidth is presented. The construction of this amplifier is described, and choice of suitable components discussed in some detail. Performance measurements agreed satisfactorily with the design theory.

Other simple transistor video amplifier configurations have been discussed by Bruun[1] (simple resistive loading), Spilker[2] (emitter degeneration) and Scarlett[3] (common-collector common-emitter pairs). The configuration used here, with $L_f = 0$, has been discussed by F. H. Blecher.[4] He used it to shape loop gain in an amplifier which was gain-stabilized by a large overall feedback.

Design Procedure

A single stage is shown in Fig. 1, where R_L represents either the output load resistance, or the input resistance R_{in} of the next stage. The transistor is represented by the equivalent circuit model of Fig. 2, which is characterized by the five parameters shown. Element $1/\omega_t r_e'$ is made up by the capacitance of the emitter depletion layer and the storage capacitance. The frequency f_t is that frequency at which the common emitter short-circuit current-gain becomes unity. The d-c operating point will ordinarily be chosen to maximize f_t, subject to power dissipation limitations. Collector capacitance C_c should include



Neat surface appearance (A) and straightforward wiring and coupling networks (B)

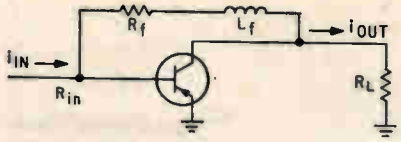


FIG. 1—Shunt feedback is applied to a single amplifier stage

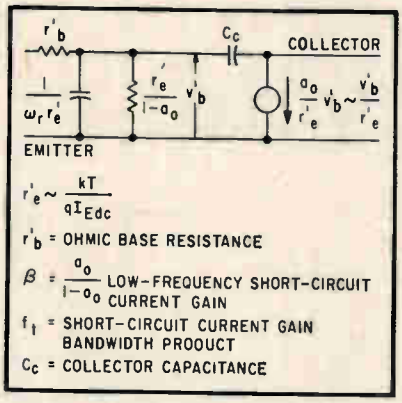


FIG. 2—Equivalent circuit of the transistor is valid over operating range

all direct collector-base capacitance due to the leads and header. In the analysis, the resistance r_e' appears only in combination with r_b'/β; for convenience, this sum is denoted by r_1. Resistor r_1 is actually the common base input-resistance (at low frequencies) h_{ib}, and should be directly measured as such.

Design equations are derived from an exact analysis by the liberal use of simplifying approximations. A useful degree of accuracy is still retained, as the example demonstrates.

Low-frequency current-gain magnitude of one stage (see Fig. 1) is

$$A_i = |i_{out}/i_{in}| = R_f/(R_L + r1) \text{ if } \beta \gg A_i \quad (1)$$

Input resistance is

$$R_{in} = A_i r1 \,(1 + R_L/R_f) \quad (2)$$

In an iterative situation, one has

$$R_{in} = R_L = r1\,(1 + A_i) \text{ if } A_i > 3 \quad (3)$$

If $L_f = 0$, the 3 db bandwidth is, quite closely

$$B_o = \frac{f_t}{A_i} \times \frac{1}{1 + (r_b' + R_L)/R_f + \omega_t R_L C_c\,(1 + r_b'/R_f)} \quad (4)$$

For $L_f = 0$, the selectivity function is of the form $1/(1 + jx)$, and the bandwidth shrinkage as identical stages are cascaded is readily found.[5] The load on a stage other than the last (the input impedance of the stage following) is not in general a constant resistance. However, if R_{in} as given by (3) is within a factor of about 2 of r_b', Z_{in} will be sufficiently constant with frequency. Thus, (4) will give a good estimate of the bandwidth if R_{in} is substituted for R_L.

The peaking inductance L_f extends the bandwidth somewhat, and modifies the response shape to lessen the shrinking of bandwidth which normally occurs when stages are cascaded. If $L_f = R_f/4\pi B_o$, the frequency response is approximately flat (no ripple) with a bandwidth of about $(2)^{\frac{1}{2}}\,(1 + (r_b' + R_L)/R_f)^{\frac{1}{2}}$ times B_o. If $L_f = R_f/2\pi B_o$ some ripple occurs, the gain at B_o is nearly A_i, and the 3 db point is now typically 2 to 2.5 times B_o. If low-overshoot transient response is important, the value of L_f should probably be somewhat less than $R_f/4\pi B_o$.

Consider this example. For a large gain-bandwidth product a transistor with a large f_t and small C_c is required, for example, Western Electric M 2039. It was originally intended to be a high-frequency oscillator transistor; but it is also an excellent amplifier.[6] Five of these transistors were measured. Their average parameters were: $\beta = 30$, $r_b' = 50$ ohms, $r_1 = 10$ ohms, $f_t = 400$ Mc, $C_c = 2$ pf. The d-c operating point was $I_E = 5$ ma, $V_{CB} = 9$ v.

An amplifier of specified gain and bandwidth may readily be designed by trial and error with Eqs. (1-4). Because of the approximate nature of these equations, a precise design based on them is not justified. Some experimental adjustment of R_f and L_f may be necessary.

Suppose an amplifier of at least 50 db gain and at least 100 Mc bandwidth is required, and that some ripple is tolerable in the frequency response. Hence $L_f = R_f/2\pi B_o$ can be used to reduce bandwidth shrinkage, and an assumption of 120 Mc bandwidth for one stage should be safe. This means that B_o is about 60 Mc. Trial and error with Eqs. (1), (3), and (4) shows that A_i is between 3 and 4, or about 10-12 db for the above transistor parameters. Thus 5 stages are probably necessary for at least 50 db gain. From Eq. (3), the input resistance is about 50 ohms, which is also convenient as a load resistance for the last stage. Thus, all stages may be considered identical. Equation (1) gives 220 ohms as a convenient value for R_f. With these values a more exact B_o from Eq. (4) is 75 Mc. Hence $L_f = R_f/2\pi B_o = 0.47\mu h$.

Construction

As with most high frequency amplifiers, careful mechanical layout is necessary to minimize parasitic inductance and capacitance. With the shunt feedback used around each stage, the input and output impedances of each stage are quite low, requiring very short leads to minimize stray inductance. Transistor sockets can be used even at these frequencies because small capacitances are not as important as low lead-inductance.

Bypassing and decoupling networks must be arranged to present an exceptionally low impedance which must be maintained over the entire pass band of the amplifier. The construction necessary to achieve the foregoing requirements is pictured in the photographs showing the underside of the completed five stage amplifier.

Western Electric M 2039 transistors were used. Their short-

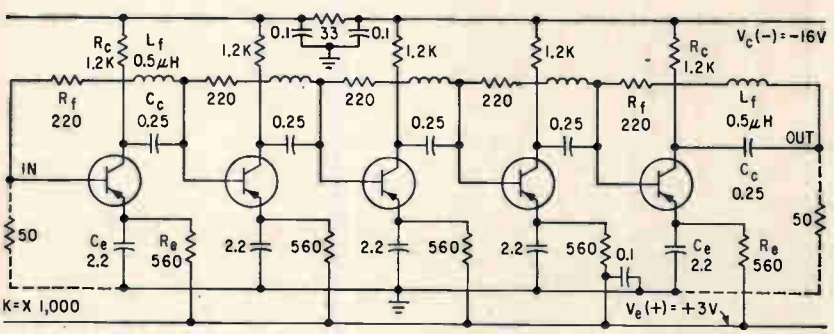


FIG. 3—Five cascaded stages produce overall gain exceeding 50 db ± 2 db over range 8 Kc to 130 Mc

circuit current gain-bandwidth product is 400 Mc at 5 ma emitter current and 9 v collector voltage. Since their gain-bandwidth product increases slightly at higher emitter currents and larger collector voltages, some increase in performance could be achieved by operating the transistors at a higher overall power dissipation. The operating points selected were chosen to keep the input impedance of each stage near 50 ohms.

Emitter Bypassing and Coupling

The emitter bypassing and coupling networks must have extremely low impedance over this exceptionally wide pass band.

The emitter bypass impedance must be small with respect to the 10 ohm impedance seen looking into an emitter terminal. The capacitor used was a disk-ceramic-type, 2.2 μf at 3 v. With the leads trimmed to the minimum, the series inductance—effective at high frequencies—is 9 nanohenrys. Series resonance of the capacitor and its lead inductance, and hence the minimum effective impedance, occurs at about 1 Mc. The magnitude of the impedance across the capacitor terminals is less than 5 ohms from about 10 kc to over 100 Mc.

The impedance requirement for the interstage coupling capacitors C_c is less stringent. This impedance must be small over the pass band as compared to the 50 ohm input impedance of the following stage. Metalized paper coupling capacitors of 0.25 μf, 200 v are satisfactory. An equivalent lead inductance of 10 nh can be obtained by shortening the leads to $\frac{1}{16}$ in. Lead lengths in the constructed amplifier were longer than this.

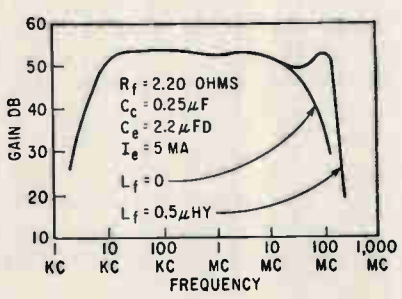


FIG. 4—Performance curve of amplifier shows improved frequency response contributed by inductive feedback

The feedback network around each stage consists of a series resistor R_f and inductor L_f connected from the output of the coupling capacitor back to the input base of each stage. R_f must remain a constant resistance up to the upper cutoff frequency. A low capacitance resistor such as the IRC type HFR is excellent. The feedback inductor L_f must have low distributed capacitance to keep it from resonating in the pass band and disrupting the high frequency response. It should therefore be an air-core single-layer solenoid on a low capacitance form.

Decoupling and Shielding

Decoupling is simple because the shunt feedback around each stage keeps its input and output impedance quite low. Therefore very little signal current flows through collector supply resistors R_c to be coupled back into the collector supply voltage lead. Sufficient decoupling is achieved with the network shown in Fig. 4. Because each emitter is bypassed to ground by C_e, very little signal current flows through emitter bias resistor R_e, and emitter positive supply lead can be decoupled by a single capacitor.

The amplifier is constructed on a conventional i-f strip chassis with all components inside the box formed by the chassis and its cover. The transistors are mounted in sockets through the outside of the box. Since the case of each transistor is internally connected to the collector, signal does appear outside the shielded box on the case of each transistor. This causes no great difficulty although there is some slight tendency toward external signal pick-up and regeneration. A similar transistor may become available with the case connected to the emitter for amplifier applications.

Performance

Measured performance is satisfactorily close to that predicted. In the response curve of Fig. 5, this performance is shown as a function of frequency. These gain measurements were based on the insertion power gain between a 50-ohm source and a 50-ohm load. In this example, where the source, load, and input resistances are all nearly equal, the insertion power gain in db is equal to the current gain i_{out}/i_{in} in db. The gain is plotted as a function of frequency both when $L_f = 0$ and when L_f is adjusted to provide reasonably uniform gain out to past 100 Mc.

Measurements of input impedance as a function of frequency are not conclusive. The input impedance appears to be resistive, and at low frequencies is about 45 ohms. At higher frequencies the impedance rises, until at 100 Mc it is about 100 ohms. The reactive portion of the input impedance is influenced by variations in the inductance of the measuring leads; the reading is therefore unreliable.

The maximum output power level is limited by the current the last stage can deliver into the 50 ohm termination. This stage is biased at 5 ma, and in the sinusoidal steady state can deliver less than 5 ma peak load current. Observable sine wave distortion at the output occurs at about 0.1 v rms across the 50 ohm load. This corresponds to a maximum undistorted output level of about −7 dbm. An increase in the maximum output power could be achieved by both increasing the collector current of the last stage and by operating into a higher value of load resistance.

If a higher gain than 50-db is required, it could be obtained by shielding between cases or collectors of the transistors. Owing to the peaking inductances, the circuit would have a poor response as a pulse amplifier. For good transient response, some compromise arrangement of peaking should be provided.

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Precision Oscillator With Incremental Tuning

Locating sharp resonances in either electrical systems or in mechanical structures requires a precision oscillator. This R-C type provides a high degree of frequency stability

By **J. H. REYNER,** Fursehill Laboratories, Ltd., Watford, England

TO TEST THE behavior of a system when signal frequency is varied over very small limits, a generator with the following characteristics is required: generator frequency must be stable over periods of some hours within a fraction of one percent; and, an incremental control of similar stability must be available whereby the frequency can be varied over a small amount. Moreover, this auxiliary control must not be merely a fine adjustment of the main control; it should provide a constant frequency increment irrespective of the setting of the main dial.

The second requirement can be met by using a beat-frequency oscillator, the incremental control being provided by a small variation in the frequency of the fixed oscillator. However, this class of oscillator does not satisfy the first requirement since its output depends on the difference between two oscillators of relatively high frequency which are not inherently stable and cannot be relied upon to drift in unison.

R-C Oscillator

No such difficulty arises with the R-C type of oscillator which can be produced with a high degree of frequency stability; but hitherto it has not been practicable to design such an oscillator with a truly incremental frequency control. This problem has now been solved by the use of a controlled phase-shift network in the feedback loop[1].

Consider the simple R-C oscillator shown in Fig. 1. The voltages v_g and v_o are in phase at the frequency for which $\omega = 1/R_1 C_1$, so that if the gain of the amplifier at this frequency exceeds v_o/v_g continuous oscillation will result. The angular frequency of this oscillation, however, is only $1/R_1 C_1$ provided that there is no internal phase shift in the amplifier. Otherwise the oscillation frequency is slightly different, being in fact such as to make the overall loop phase-shift zero. It is easy to deduce from this criterion that, provided the reactance of C_3 is negligible, the frequency generated by the circuit of Fig. 1 is given by $\omega = (1/C_1 R_1)(1 + 2 C_1 R_1/C_2 R_2)^{\frac{1}{2}}$. If $C_2 R_2$ is large compared with $2 C_1 R_1$ this expression may be expanded as a binominal series of which the first two terms are $\omega = 1/C_1 R_1 + 1/C_2 R_2$.

Precision oscillator being used for alignment of filters with sharp resonance curves

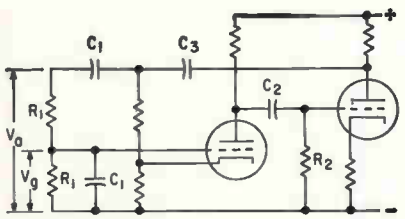

FIG. 1—Basic circuit of R-C oscillator

Thus the frequency is determined by the two products $C_1 R_1$ and $C_2 R_2$ independently, so that the phase-shifting network $C_2 R_2$ may be used to provide an incremental control. By making C_2 or R_2 variable a change of frequency can be produced which is constant irrespective of the actual frequency.

This is only true, however, for small increments of the order of a few percent. In a practical oscillator the product $C_1 R_1$ is variable over a range of ten to one so that as the frequency is reduced, the ratio $C_2 R_2/C_1 R_1$ falls and the higher terms in the series are no longer negligible. If we include the next

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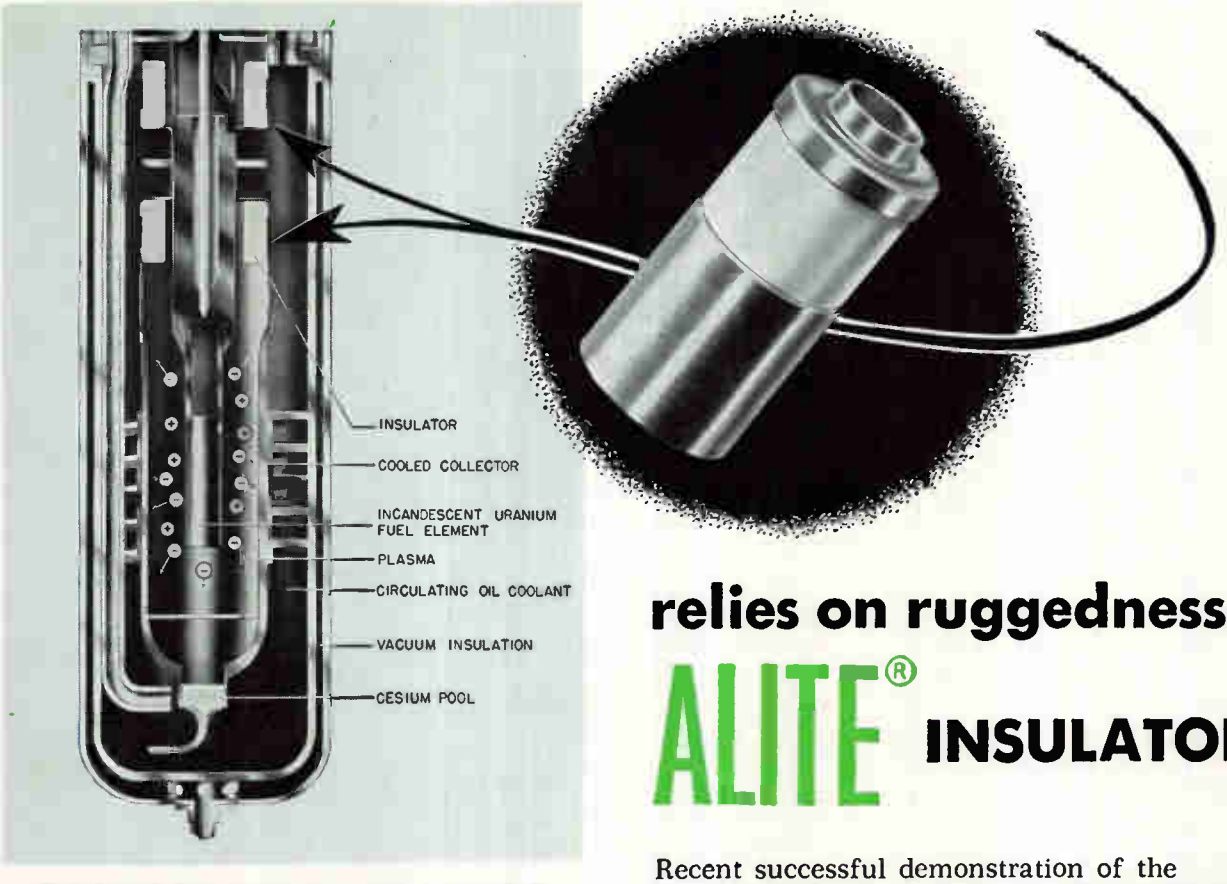

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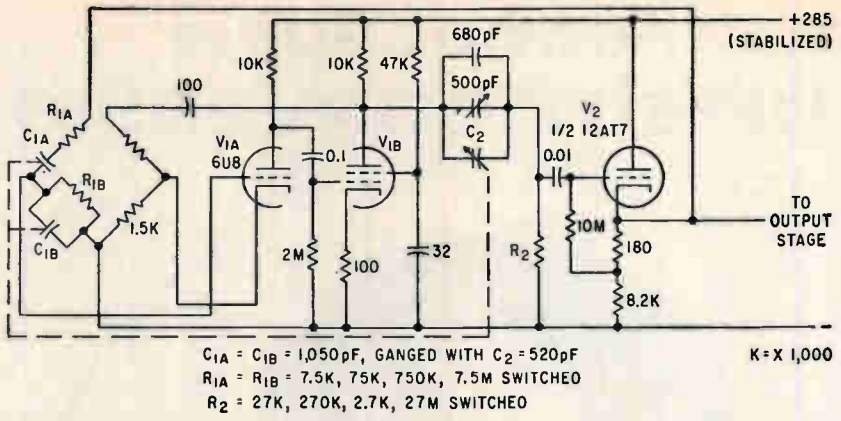

FIG. 2—In the oscillator, control of frequency is obtained by variable capacitors

term, the expression becomes

$$\omega = 1/C_1R_1 + (1/C_2R_2)\,(1 - C_1R_1/2\,C_2R_2)$$

from which it will be clear that as C_1 R_1 increases, the frequency increment produced by a given setting of C_2 R_2 becomes less. However, if C_2 or R_2 could be arranged to decrease proportionately to the increase in C_1 R_1, it should be possible to compensate for this error, and in fact this has been found to be practicable[2].

This is the technique used in the Furzehill G.432 oscillator (see Fig. 2). The basic arrangement is similar to that of Fig. 1 but a cathode follower tube, V_2, is included in the feedback loop to reduce the loading on the bridge network. Control of frequency is obtained by variable capacitors because even the highest grade of variable resistor can only progress by discrete (though very small) jumps. A two-gang capacitor is therefore used in the main frequency-determining network, while a single capacitor is employed to provide the required incremental

Table I—Ranges of Oscillator

Main Dial	Incremental Dial (cps)
25–250 cps	0–5 additive
250–2,500 cps	0–50 additive
2.5–25 Kc	0–500 additive
25–250 Kc	0–5,000 additive

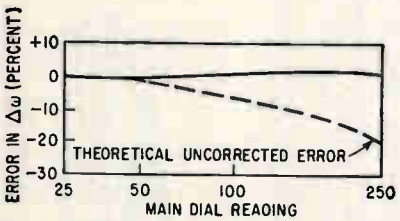

FIG. 3—Correction of error in incremental dial reading

control. In parallel with this is a second variable capacitor which is ganged with the main control and is so arranged that its capacitance decreases as the main capacitance increases, to an extent which provides the compensation previously mentioned.

The compensation is not exact, because of the effect of the higher terms in the series, but with the values used in the G.432 the error is less than 2 percent of the increment (less than 0.1 percent of the mid frequency on the main dial). A typical measured error curve is shown in Fig. 3.

The resistors in the various frequency-determining networks are switched in decade steps, while the main dial also covers a 10:1 range, giving a total coverage from 25 cps to 250 Kc. The incremental control is also switched on each range, to give an increment of 2 percent of the maximum frequency. The ranges are shown in Table I.

As mentioned earlier, the incremental facility can only be fully utilized provided that the oscillator as a whole possesses a high degree of stability. This requirement has received special attention in the G.432 as a result of which the frequency stability is better than 0.1 percent over long periods.

It is practicable therefore to set the frequency against a reference standard when conditions of high accuracy are involved; the instrument incorporates an (optional) tuning-fork standard providing pulses of 1 and 10 Kc. This enables the main dial to be set to multiples or sub-multiples of these frequencies to an accuracy of 0.01 percent.

Output

Output arrangements are shown in Fig. 4. The signal from the oscillator is fed through a phase-splitter V_2 to two cathode-follower tubes, V_3 and V_4, in push-pull. This arrangement permits a symmetrical output to be obtained when required, the circuit being switched to feed either a 600 ohm unbalanced load or two 300-ohm outputs balanced with respect to ground. The maximum output is 10 mw in either case, monitored by a panel meter.

Alternatively, the signal may be fed through bistable multivibrator V_1 which delivers to the output stage a square wave having unity mark-space ratio with a rise time of less than 0.1 microsec (independent of the input frequency).

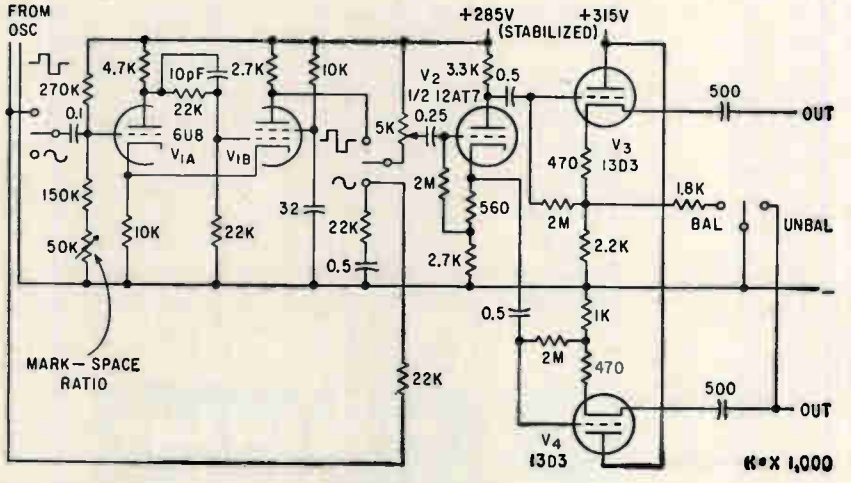

FIG. 4—Output stage of the precision oscillator

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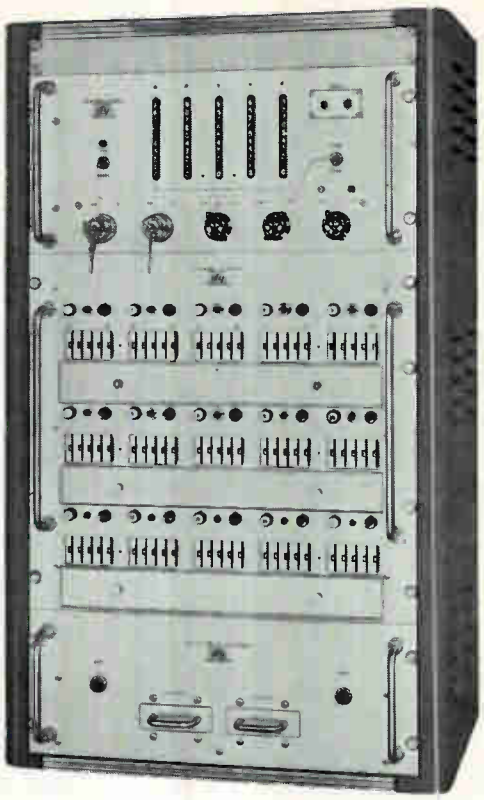

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Measuring Cathode Temperatures

By J. H. AFFLECK, Power Tube Dept, General Electric Co., Schenectady, N. Y.

EFFICIENT operation and long life of a vacuum tube is dependent on cathode temperature. With too low temperature, cathode emission may be limited; higher temperatures cause evaporation, reduce coating and therefore shorten tube life.

Cathode temperatures of commercial tubes can be determined by the retarding potential method, which does not require modification of tube structure or additional leads. Tube envelopes may contain glass, metal or ceramic members, and tube operation is not changed.

Measuring Temperature

The retarding potential method has been used for experimental tubes. W. B. Nottingham reported a technique for applying it to commercial tubes using a magnetic field parallel to the retarding field. An investigation was made to evaluate this technique.

Retarding potential is based on a relation derived by Schottky. Assuming a Maxwellian distribution of electron velocities, for plane parallel geometry retarding current is $I_r = I_s \exp(-eV_r/kT)$, where I_r is current reaching collector, I_s is zero field emission, V_r is true retarding potential between cathode and collector in volts and T is cathode temperature in deg K.

Plotting log I_r versus V_r as in Fig. 1 gives a straight line with slope $-e/kT$ in the retarding region. Applied voltage differs from V_r by contact potential difference between cathode and collector. As voltage becomes less negative, saturation is reached, producing a straight line of different slope. The intersection of the two straight lines establishes zero field emission I_s. Also V_s equals contact potential difference when I_r equals I_s. Two points in the retarding region are selected and temperature is $T = 5040\,(V_1 - V_2)/\log\,(I_2/I_1)$ in deg K.

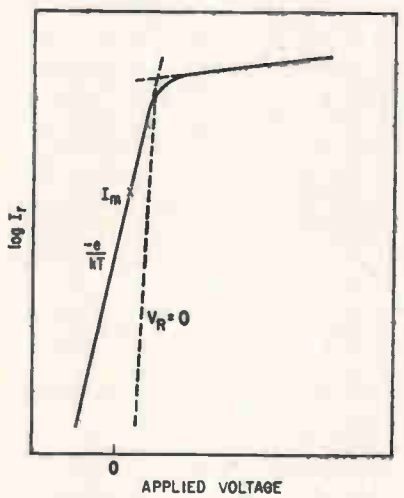

FIG. 1—Plot of log I_r versus applied voltage permits determination of temperature by retarding potential method

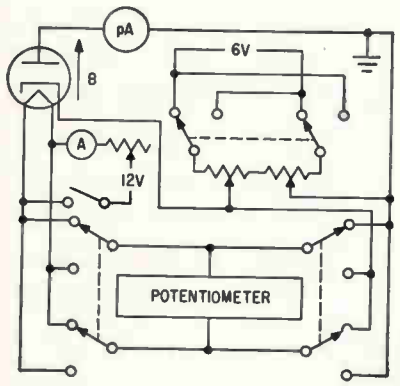

FIG. 2—Circuit used to determine retarding field potential

A portion of the retarding region is chosen in which electrons are not inhibited by a space charge. This region is obtained at currents less than that required for a zero field at the collector. Maximum current density for zero field at the anode is $I_m = 7.72 \times 10^{-16}\,(T^{3/2}/x^2)$ in amp/cm^2.

Magnetic Field

For commercial tubes a magnetic field parallel to the electric field collects electrons leaving the cathode with velocity components in directions other than the parallel electric and magnetic fields. Because it is necessary to measure electron energy distribution, all electrons with an energy component normal to the emitter surface must be collected.

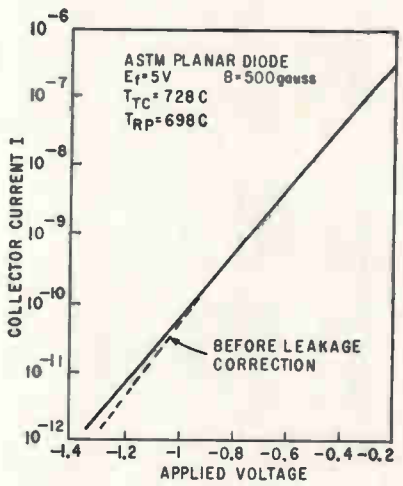

FIG. 3—Plot of retarding potential characteristics

The potentiometer in Fig. 2 measures retarding voltage as well as filament and grid voltages. It has a range from 0.000001 to 16 v. The meter has current ranges from 10^{-8} to 10^{-14} amp. Negative feedback causes voltage drop across the input to be less the 0.005 v. All voltages are provided by storage batteries.

The data in Fig. 3 were obtained by measuring collector current as a function of applied voltage. Voltage is increased negatively. Temperature is determined by selecting points on the straight line portion of the curve in the retarding range. At very low currents some deviation from leakage and photoelectric currents may occur. Corrections can be made for total leakage by making a plot as in Fig. 4. Slope in the region between −2 and −3 v is V/I, which gives leakage resistance. Extending this curve back to zero volts gives photocurrent.

Total leakage current can be found by selecting a specific voltage. Leakage current is added to indicated collector current to find true collector current. The correction in Fig. 4 is for currents from 10^{-11} to 10^{-12} amp. The corrected points fit the retarding field curve very well.

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SC-32-5	0-32	0-5	
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SC-32-15A	0-32	0-15	
SC-60-2	0-60	0-2	
SC-60-5	0-60	0-5	
2SC-100-0.2 Dual Output	0-100	0-0.2	
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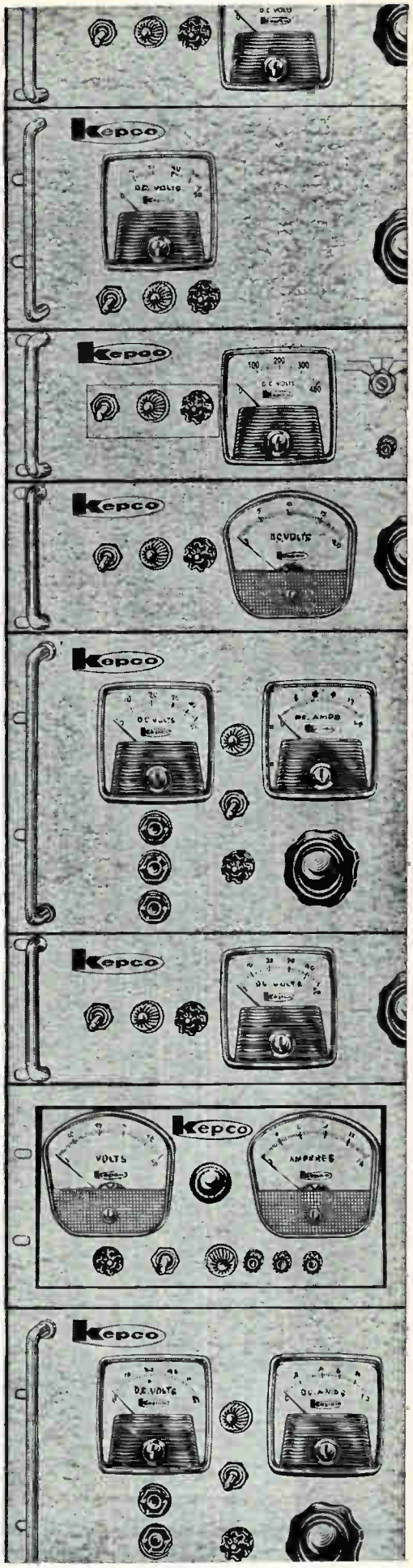
SC-300-1	0-300	0-1	
SC-18-0.5	0-18	0-0.5	0.1%
SC-18-1	0-18	0-1	
SC-18-2	0-18	0-2	
SC-18-4	0-18	0-4	
SC-36-0.5	0-36	0-0.5	
SC-36-1	0-36	0-1	
SC-36-2	0-36	0-2	
SC-3672-0.5	36-72	0-0.5	
SC-3672-1	36-72	0-1	
PSC- 5-2	0-7.5	0-2	0.02%
PSC-10-2	7.5-12.5	0-2	
PSC-15-2	12.5-17.5	0-2	
PSC-20-2	17.5-22.5	0-2	
PSC-28-1	22.5-32.5	0-1	
PSC-38-1	32.5-42.5	0-1	
HB-2	0-325	0-200 ma.	0.1%
HB-4	0-325	0-400 ma.	
HB-6	0-325	0-600 ma.	
SR12-50	5-13	0-50	0.1%
SR28-50	24-32	0-50	
SR48-30	44-52	0-30	



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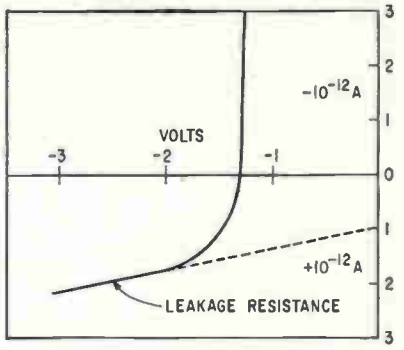


FIG. 4—Plot permits determination of leakage resistance

the retarded field method were compared with thermocouple indications. Reasonably good agreement was found in tubes with plane parallel geometry. For an electron gun assembly temperature was 200 to 300 degrees higher than the thermocouple indicated. With a magnetic field, deviation was −1 percent.

Cathode temperature in the electron gun assembly was measured for various values of magnetic field with filament voltage held constant. At zero magnetic field, temperature measured by the retarding field method was high. As B increased, measured temperature dropped to true value. A plot should be made for each tube type to ensure that B is sufficiently high.

Microwave Transistor Uses Coaxial Mounting

GERMANIUM mesa transistor operates in the low microwave region. A very wide band amplifier using it has been developed at Bell Telephone Laboratories.

The diffused-base, alloyed-emitter, *pnp* mesa transistor functions as an oscillator at 3 Gc or as an amplifier at 1 Gc and below. It is 1.8 mils long and 1.5 mils wide. Three metal stripes, each $\frac{1}{10}$ mil wide by $1\frac{1}{2}$ mils long, are evaporated onto the surface of this small plateau and alloyed into the semiconductor. Gold wires 2/10 mil in diameter are used for connections. The diffused base is 1/50 mil thick.

It is mounted in a coaxial shell that electrically matches a 50-ohm coaxial line. (The germanium wafer is gold bonded to the inner conductor of the output section; the emitter stripe is connected to an in-

ternal shield integral with the encapsulation shell; the base stripes are connected to the center conductor of the input line.)

Amplifiers

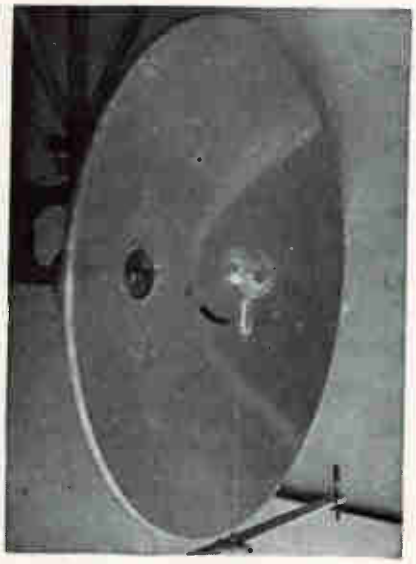
Wide-band and narrow-band feedback amplifier circuits using the new transistor were constructed. The three-stage amplifiers used transmission-line principles, with a channel-type line for easy access to the center conductor. The amplifier has a gain of 18 db, flat within 1 db from below 1 Mc to over 750 Mc. Higher gain, with correspondingly lower band width, can also be achieved.

The emitter (header) is grounded to maintain outer-conductor continuity, and the transistor biases are stabilized with local d-c feedback. A low-frequency transistor is inserted in each biasing circuit to increase d-c feedback without sacrificing high-frequency gain.

The amplifiers are very stable, and the noise figure at 200 Mc is 5.5 db with the feedback loops open.

The work was partly supported by the U. S. Army Signal Research and Development Laboratories.

Radar Field Discharges In Low-Pressure Gas



Radar field at parabolic focus causes continuous discharge in bulb with gas at reduced pressure. Drs. Hans Kleinwachter and Jens Geerk, Ernst-Mach Institut, Freiburg, W. Germany, are experimenting with electrodeless bulb in conjunction with ionized gases, chemical and nuclear reactions

Materials Progress Not Accidental

ACCELERATED EFFORTS in the fields of physics, chemistry and mathematics, supplemented by cross fertilization of scientific and engineering fields, are required to bring new knowledge about the fundamental properties of matter to bear on solving materials problems.

In the few days since our short report on materials push by the National Academy of Sciences (ELECTRONICS, p 85, Apr. 8) we have received several letters of concordance with the National Research Council's proposal for more effective organization and administration of materials research and development. And we are continuously on the alert to report materials progress since we recognize this underlying need for the electronics industry.

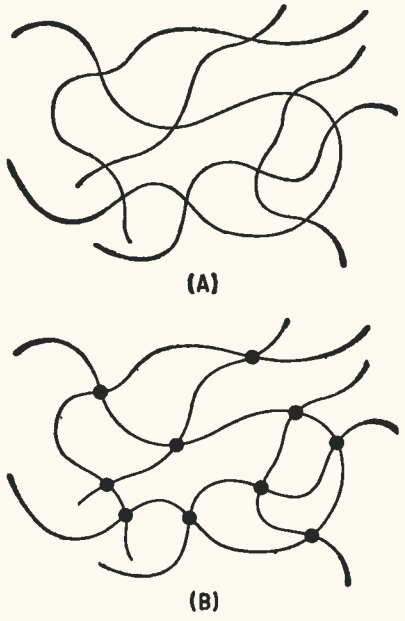
Transistor Potting

Last week, Dow Corning Corporation announced a new high purity silicone dielectric for potting transistors. This special grade material, SYLGARD 81, protects the transistor from welding splatter during assembly, then cushions mechanical shock and vibration for greater reliability in service.

Nonmelting and greaselike, the transistor compound is serviceable from −70 to 200 C. As a potting material, it aids in conducting heat away from the wafer and to the outer case of the transistor. The compound is easy to apply by dispensing manually or with automatic metering devices.

An easy-to-use encapsulant that remains serviceable despite continuous exposure to temperatures from below −60 C to 250 C, SYLGARD 191 is applied to electronic parts with the fill-in-place technique —it retains its physical and electrical properties indefinitely at temperatures up to 250 C, and much higher for short periods.

The fill-in-place application process eliminates laborious preparation of high viscosity mixtures. An organic filler, one of the two components of the SYLGARD 191 system, is poured into the form. Then the other component, a solventless silicone resin, is vacuum impregnated through the filler to complete the encapsulation. This compound combines the economy and improved thermal stability of highly filled encapsulants with the inherent properties of silicone resins. The compound, as supplied, consists of precatalyzed solventless silicone resin, and the necessary quantity of inorganic filler.



Unlinked polyethylene (A) softens and flows, unlike the cross-linked chains (B) that retain strength at high temperatures

Strong Polyethylene

An improved polyethylene which exhibits excellent tensile strength, particularly at high temperatures may find applications in hot-strength films and tapes, molded industrial parts and wire and cable insulation.

Nonexclusive licenses under General Electric's U. S. patent No. 2,888,424 directed to the manufacture of this material will be made available on reasonable terms, according to S. L. Brous, Marketing Manager of the Company's Chemical Materials Department at Pittsfield, Mass.

Figure 1A shows polymer chains of polyethylene. Because the chains are not linked together, polyethylene is a thermoplastic material: that is, it softens and flows at moderate temperatures. In the improved polyethylene, Fig. 1B, the chains are linked together with actual chemical bonds, and this cross-linked polyethylene is a thermoset material: that is, it retains its strength even at high temperatures.

Chemically cross-linked polyethylene has been used in VULKENE cables for over a year. Meanwhile much developmental work is in progress at GE looking to early introduction of 600-v power and control cables during 1960 with higher voltage cable insulations some time after that. Cross-linkage is also possible by irradiation, but in the past this has been more difficult to obtain even irradiation with parts that were not flat. With chemical cross-linkage, peroxides and reinforcing fillers, are added to the powder to give the required results.

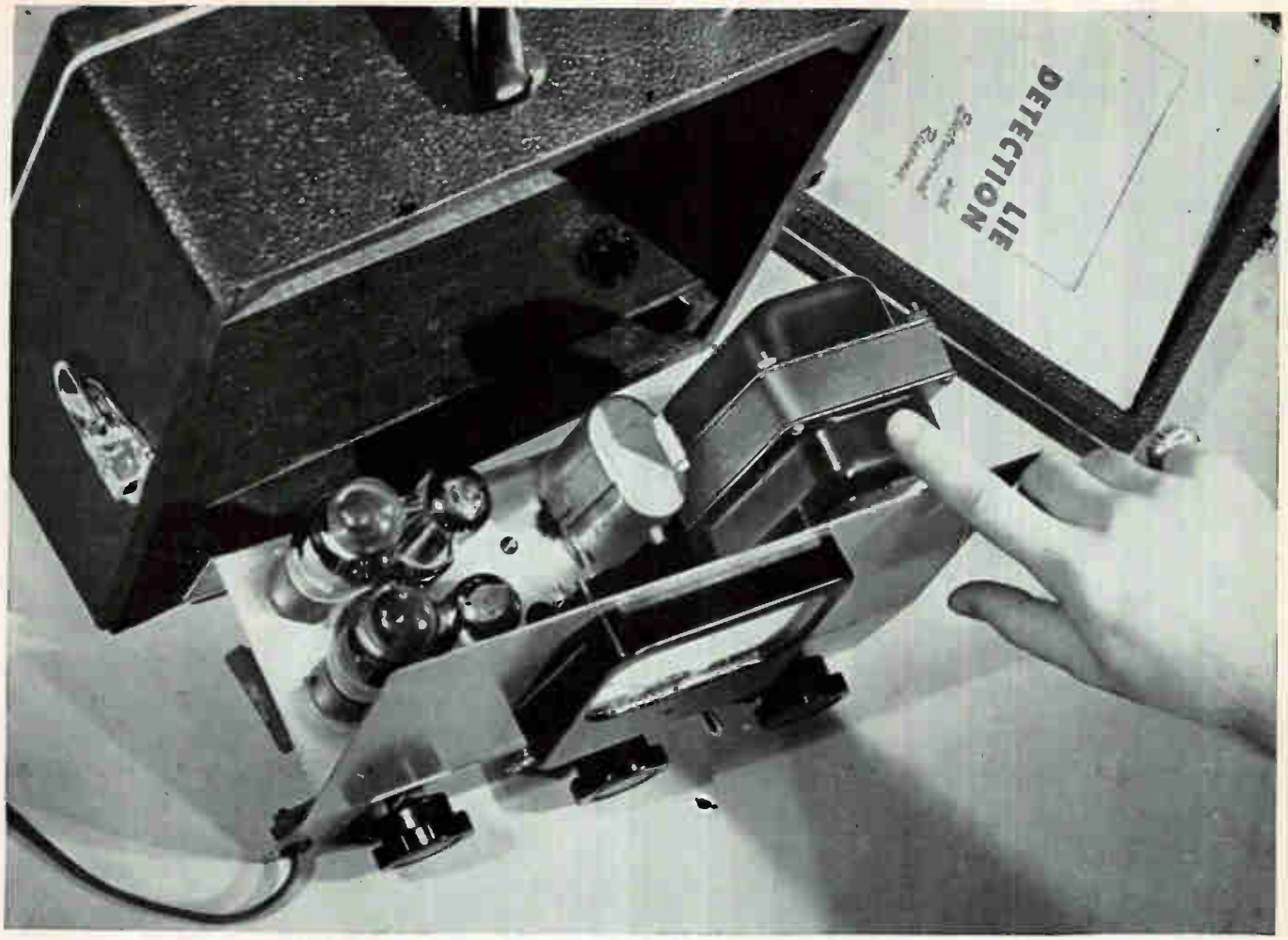
Plastics for Missiles

Laminates developed for missile applications should produce materials with substantially superior ablation resistance and other desirable properties, according to C. M. Thacker, Technical Director, Taylor Fibre Co., Norristown, Pa.

Although several laminates now available have been successfully applied in missile parts, their suitability has been more or less an accident. The grades now in use were developed primarily for electrical applications where a premium is placed on such properties as electrical resistivity and resistance to absorption. In missile application, on the other hand, resistance to high temperature erosion and high thermal insulation are prime.

Nylon-web, phenolic-resin laminates and glass-epoxy laminates are proving useful in missile applications. Taylor is preparing to test a variety of web and resin combinations. Web materials include paper, asbestos, Nylon, Dacron, Refrasil, graphite cloth and Teflon.

Selection of web-resin combinations will be guided by the prevailing knowledge that when laminates



B & W Associates built in a Sola regulated plate-filament power transformer as an integral component in their portable lie-detection apparatus.

Portable lie detector operates accurately with Sola-regulated plate and filament voltages

This sensitive polygraph operates by picking up and immensely amplifying tiny electrodermal responses. It's small wonder that line voltage variations encountered in field operation must be corrected if the responses of the witness are to be measured accurately.

The lie detector's built-in power supply transformer is a Sola Constant Voltage Plate-Filament Transformer which performs this dual function: (1) it supplies plate and filament voltages just as an ordinary power supply transformer would do; (2) it regulates these supply voltages within ±3% even when the line voltage varies over a 100 to 130-volt range.

Besides providing regulation which assures accurate polygraph operation, the Sola transformer protects tubes and components from cold inrush current and from fault currents.

This simple, reliable component costs little more than ordinary, non-regulating transformers. And compared to other types of regulating circuitry used with conventional power transformers, it is considerably cheaper.

The plate-filament regulator is only one of the complete family of Sola Constant Voltage Transformers including such special types as filament and adjustable-output units. More than 40 models are available from stock, and Sola manufactures custom-designed units in production quantities to meet special needs.

For additional information write for Bulletin 7D-CVE

SOLA

B P C

A DIVISION OF BASIC PRODUCTS CORPORATION

SOLA ELECTRIC CO., 4633 W. 16th St., Chicago 50, Ill., Bishop 2-1414 • In Canada, Sola Electric (Canada) Ltd., 377 Evans Ave., Toronto 18, Ont.

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are used in missiles, particularly where resistance to ablation is desirable, the following properties strongly influence results: low-heat conductivity; a steady but slow evolution of low molecular weight gases on decomposition of the material; high heat absorption resulting from physical transitions, decomposition and, finally, dissociation of the gases into monatomic forms; and high structural strength before and after surface charring.

The first step in Taylor's program is to calculate the physical characteristics of the experimental laminates. Thermodynamic and other physical data are available on many web-resin combinations whereby quantitative values may be given. Where data is not available, conventional approximation methods, particularly for heat of dissociation, are used. The experiments are designed to cover a wide range of gas evolution per unit of weight, as well as a wide range of capacities for heat absorption.

Improved Capacitors

CAPACITORS in which the electrodes are formed of plastic with a sputtered metal conducting layer are claimed to show advantage at high temperatures over standard types.

By making the electrode from the same material as the insulant, cracking due to differential thermal expansion is avoided and operating limits are raised.

Rights for these capacitors are held by the United Kingdom Atomic Energy Authority.

Tiny Light Bulbs

PIN-SIZED, or mite-sized incandescent lamps are available from two manufacturers. The PINLITE is an incandescent lamp that measures 0.015 in. dia and 0.062 in. length. And the MITE-T-LITE is cylindrical with a nominal diameter of 0.040 in. and length of 0.125 in. Uses: medicine and medical electronics; computer read out, meter pointer visual aid; high frequency indicator to 3,000 Mc; low-voltage, low-current circuit performance; indicators for transistorized circuits. PINLIGHT is available through Kay

Electric Co., Pinebrook, New Jersey. MITE-T-LITE is available from Sylvania Electric Inc., Salem, Mass. Light output of the latter is given as 100 millilumens at 1.5-v input. The efficiency of the lamp is approximately 1.5 lumens per watt.

Portable Tv Battery

DEVELOPMENT OF a lighter, smaller silver-cadmium portable tv battery capable of more than 2,000 hours of operation (500 charge-discharge cycles) has been announced by Yardney Electric Corp., N.Y.C., manufacturer of the compact, powful Silvercel and Silcad batteries.

The 8-cell power pack, called the 8xYS5, weighs only 2.6 pounds; is 3.16 in. wide, 3.24 in. long and 3.92 in. high; offers 22.4 watt-hours per pound and 1.5 watt-hours per cubic inch. It is rated at 5 ampere hours; has a nominal operating voltage of 8.7 volts; and can be operated at temperatures ranging from −20 F to 140 F and stored at temperatures ranging from −40 F to 165 F. In typical application, it produces 8.7 watts for 6.7 hours.

Cheaper than any comparable unit, this extremely rugged Silcad battery, now in mass production, costs less than 1½ cents per hour of operation. It is a lighter and smaller model of a previous silver-cadmium battery developed by the company for portable television.

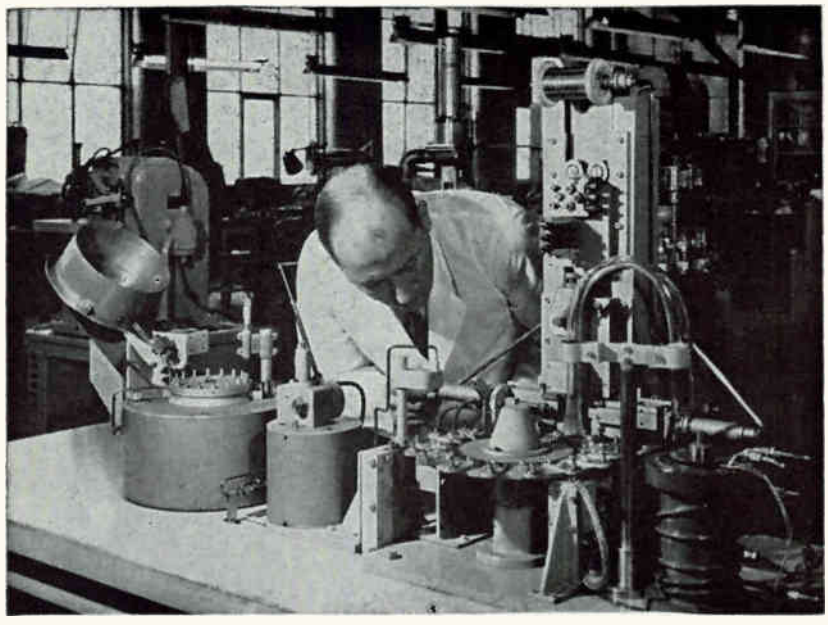
The new Silcad system combines the high power output of silver with the long life of cadmium. Silcad batteries have a capacity two and a half times greater than that of heavier batteries of other types. They have found wide application in portable commercial and military equipment, and wherever else miniaturization and high power output over a long cycle life are crucial.

Welded Studs Hold Chassis to Panels

END-WELDED STUDS are used at Sola Electric Co., Chicago, to mount d-c power supply chassis to rack mounting panels. The studs do not require drilling and countersinking the panel for bolts and leave the panel exterior unmarred by screw heads.

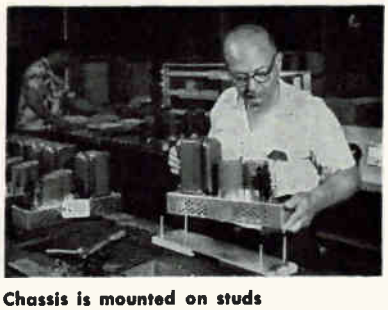
Studs 3 or 5 inches long are welded to the inside of the panel. For standard panels, a stud-welding gun is mounted on an air cylinder and the panel is located in a jig.

Production rate with the semi-automatic setup is 3 studs a minute. A hand gun can be operated off the same welding control box for small runs or odd-shaped panels which do not fit the jig. Guns and studs used are from Nelson Stud-Welding Division, Lorain, Ohio.



Lead welder is part of line capable of producing 43,000 diodes weekly

Fixture which locates panels under welder slides in track on table



Chassis is mounted on studs

Nuts are run down on prethreaded studs

Machine Welds Leads to Headers

VACUUM, AIR JET and mechanical transfer methods are combined in a machine developed by Ferranti Ltd. to weld leads to diode headers. The machine is part of a line of automatic equipment producing a new series of miniature silicon diodes at the firm's plant in Oldham, Lancs., England.

Headers are loaded into a hopper, where they are kept in motion by an oscillatory stirring bar. As they leave the feed chute through an escapement, they are influenced by an air jet into the cups of the first rotary index table. They are horizontally indexed a half turn.

Since the headers are larger at the base, to which the lead is welded, than at the top, they are upside down at this point. They are inverted by a vacuum pickup arm which rotates 180 degrees vertically in the transfer to the second rotary table. Nimonic alloy jigs then carry the headers to the welding station.

Wire, fed from a spool, is welded to the bases with an oxy-coal gas flame. The wire is measured to length and cropped with transverse guillotine knives. The headers are moved under the U-shaped tube and blown through the tube into a small hydrogen furnace. After oxide created by the weld is removed, the headers are taken from the furnace and copper and gold plated. The machine is controlled from a common camshaft, enabling the indexing time (nominally eight seconds) to be varied at will.

Solder discs and silicon dice are fused to the headers in a jig passed through a hydrogen furnace. Etching, cleaning, drying and varnishing, and sealing are carried out on 2 more automatic machines. Before sealing, solder rings are placed on the headers and the cams, with glass-sealed leads, are positioned over the headers. After the assemblies are heated in a series of eddy current heaters in a vacuum chamber, the cams are dropped onto the headers by a trip mechanism, sealed and cooled.

Magnetic Electrodes Hold Parts for Weld

MAGNETIC SPOT-WELDING electrodes simplify the problem of positioning small parts which are to be welded to sheet or strip material. Small bar magnets are placed inside the

Model QM6.3-.32. Miniature Transistorized Regulated D-C Supply features regulation to ±0.05% for combined line and load variations. This is one of more than 180 miniature component-type power packs offered by Sorensen. They include, in addition to highly regulated d-c supplies, dc-to-ac inverters and dc-to-dc converters.

Model Q12-15A. One of the 15 Sorensen Q Series high-precision transistorized low-voltage supplies, features voltage regulation to ±0.05% for combined line or load variations. Models for 6, 12, 28 vdc out, with power capacities up to approximately 240 watts. Similar QR Series features precision regulation with wide output voltage adjustment range. Two models: 0-75vdc at 2 amps max and 0-36vdc at 4 amps max.

Model 2150-5 (Control Section). This is just one of a tremendous variety of Sorensen high-voltage d-c supplies, high-voltage a-c and a-c/d-c testers, and electrostatic -generators. Models completely cover the voltage range from 1000 to 600,000 volts. Power outputs range up to 60 kilowatts.

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electrodes. Polarity is arranged so that one electrode tip forms a north pole and the other tip forms a south pole.

The small parts are placed on the tips and the magnetic attraction holds them in place until the weld is made, as in Fig. 1. Magnetized rods can also be used instead of tweezers to pick up the parts and place them on the electrodes. Coating the pickup rods with nonmagnetic material will lessen their magnetic pull and make the transfer easier.

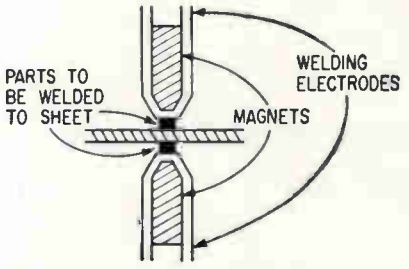


FIG. 1—Rod magnets placed in hollowed electrodes hold small parts during spot welding

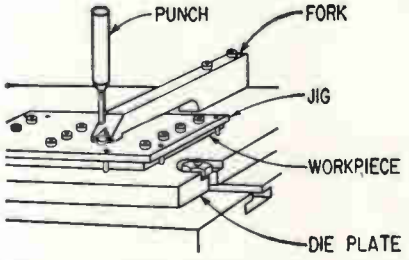


FIG. 2—Type of jig used for drilling can also be used for punching

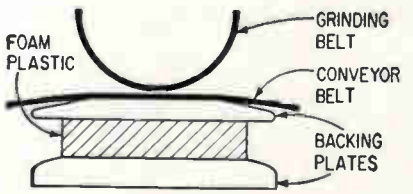


FIG. 3—Foam plastic between backing plates enables abrasive belt to be used as belt grinder conveyor belt

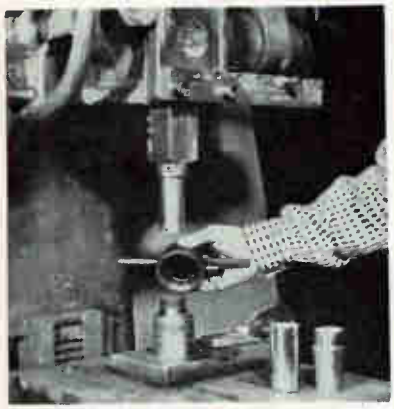
Another Swedish shop trick, also reported (in European Technical Digest 3280) by the European Productivity Agency, Paris, France, is illustrated in Fig. 2. A drill press type of jig is used to position workpieces in a punch press. The jig is fitted with guide bushings at hole locations. Pins on the edges of the jig hold the workpiece in position under the jig. The die is in the die plate, under the punch. The operator slides the jig and workpiece

over the die plate, placing each guide bushing in the V-groove in the end of the fork.

The setup shown in Fig. 3 enabled a Swedish firm to avoid degreasing small flat stampings before grinding them on a semiautomatic belt grinder. With a rubber conveyor belt, parts not degreased were thrown out of the machine when the belt got greasy. Changes in the shape of the rubber belt resulted in uneven grinding.

Substituting a grinding belt for the rubber belt permitted the greasy parts to be ground. The foam plastic between the original backing plate and a second backing plate restored resiliency. Leaving lubrication on the stampings was also found to increase belt life and reduce the risk of clean stampings corroding.

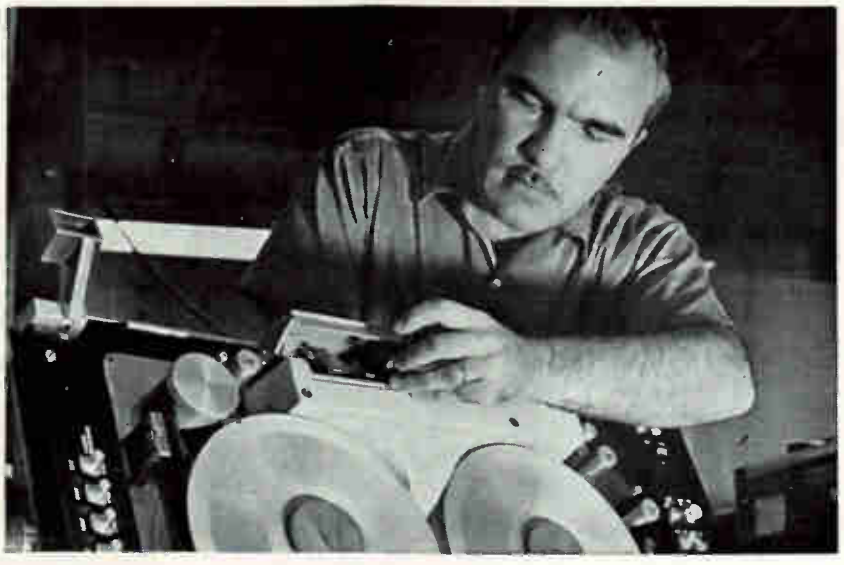
Neoprene Plug in Die Forms Odd-Shaped Can



Fram left, laaded die, brass blank and finished flaat

ODD-SHAPED cans can be made of easily-formed metal by filling a simple die with a Neoprene plug. The method is sometimes used in metal shops when production demands do not warrant investment in compound dies. The photo illustrates how switch floats are made on a compound mandrel press at Newark Controls Co., Bloomfield, N. J. The die is in 2 parts, a base machined to form the taper and a screw-down cap which accepts the press plunger. The plug is placed in the brass float blank in the die. As the plug is compressed, plug and float take the shape of the die.

On The Market



Wideband Video Recorder
records from 10 cps to 4 Mc

MILITARY and scientific applications are planned for a new wideband recording system developed by Ampex Corp., 934 Charter St., Redwood City, Calif.

The unit is available in both airborne and ground-based models. The airborne unit is capable only of recording and is designated the AR-300. The ground unit is capable of recording and reproducing. It is known as the FR-700.

Both units can record two channels of wideband information over the frequency spectrum from 10 cps to 4 Mc. Amplitude response is flat to within 3 db over this range.

Solid-state components and etched circuits are used throughout the system. The airborne AR-300 recording system displaces only 3.5 cu ft and weighs less than 150 lb including tape. The FR-700 recorder-reproducer is mounted in a standard 19-in. electronics rack and uses four feet of rack space for tape transport and electronics.

In addition to being able to record two channels of wideband information from 10 cps to 4 Mc simultaneously, the system also records two auxiliary information channels with a frequency response from 200 cps to 15 Kc. Tape used is 2-in. wide 1-mil Mylar base. Each auxiliary track takes 0.24 in. on the tape. The control track requires 0.034 in. and the wideband data for two-channel recording uses 1.803 in. Tape reels, 10½ in. in diameter carry 3,800 ft of tape.

Both machines use a rotating magnetic head that records wideband data in a transverse fashion. This method provides a head-to-tape speed of 1,300 in. per second even though the tape moves past the head assembly at the rate of only 12½ or 25 in. per second. The two speeds are part of the option of recording one wideband channel for one hour at 12½ in. per second or two wideband channels simultaneously for one-half hour at 25 in. per second.

CIRCLE 301 ON READER SERVICE CARD

Radio-Frequency Converter-Amplifier
for missile telemetering test purposes

THE DAVEN CO., Livingston, N. J. New r-f converter-amplifier for use in closed circuit tests of missile telemetering and data transmission systems. Unit consists of an r-f amplifier and converter section, a crystal-controlled oscillator and multiplier section, and a high gain, high output i-f amplifier. Using a ceramic triode in a grounded grid circuit, the r-f amplifier accepts any one of four pre-set frequencies in the 200 Mc and is amplified to the final output level of 5 v at an impedance of 200 ohms. Maximum overall voltage gain is 500,000 from the 50 ohm input to the 200 ohm output, and the bandwidth is 200 Kc at the −1 db points. A manual gain control provides for gain adjustment over a 40 db range.

CIRCLE 302 ON READER SERVICE CARD

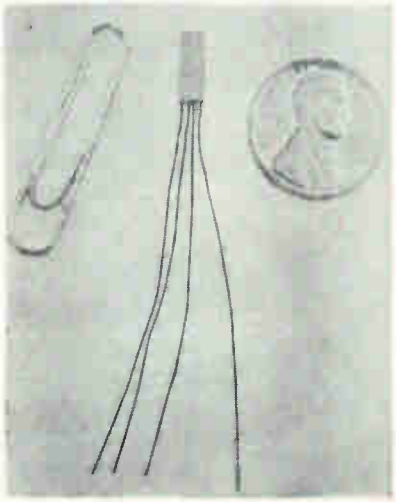
Trimmer Capacitors
coaxial type

MARSTAN ELECTRONICS CORP., 204 Babylon Turnpike, Roosevelt, L. I., N. Y. The ME series coax trimmer capacitors with insulating washers were developed to meet the need for 3,000 wvdc low cost units with extremely low capacitance, excellent linearity and very low DQ for chassis grounded, chassis isolated and isolated chassis feed through applications. Units can be precalibrated to any value within their range to ± ½ percent and operate over − 55 C to + 125 C. The capacitor lends itself to any standard coax capacitor ranges as well as two-gang units. Unit is of bonded one-piece construction, has position locking features and can withstand shock and vibration requirements.

CIRCLE 303 ON READER SERVICE CARD

Hall-Effect Device
miniature size

SUITABLE for use as a gaussmeter probe is a new indium arsenide Halltron or Hall-effect device announced by Ohio Semiconductors, Inc., 1035 W 3rd Ave., Columbus, O.



The unit features miniature size,

low ohmic residual error and low temperature coefficient. Designated the HP-310, the unit measures 0.375 in. long by 0.125 in. wide by 0.019 in. thick.

The device is capable of operation from −35 C to 85 C and has a temperature coefficient of approximately −0.1 percent per deg C. With a control current of 100 ma and a flux density of 10 kilogauss, the nominal open-circuit Hall-effect output voltage is 100 mv.

Linearities (Hall voltages verses magnetic intensity) of one percent or better can be achieved when the input of output circuit is properly loaded. Rugged construction is achieved by mounting the device on a rigid substrate and molding it in high-strength epoxy resin.

Sample quantities (one to four units) are priced at $37.50 each. Savings are available on larger quantities.

CIRCLE 304 ON READER SERVICE CARD

Modular Sideband Receiver offers flexibility in use

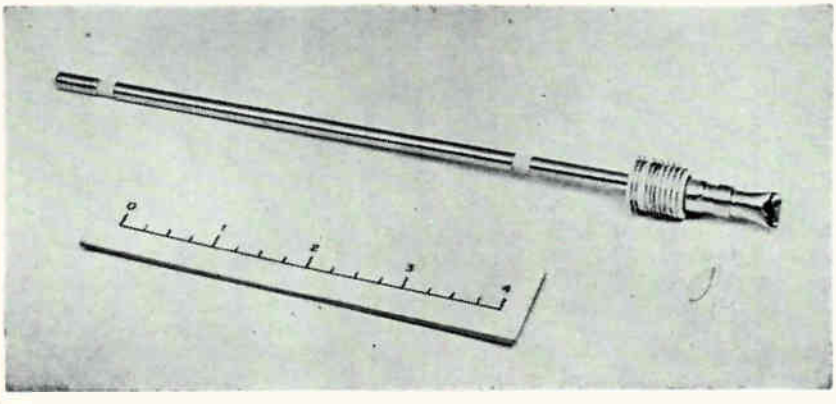
A NEW high-frequency single-sideband strip receiver made by Wilcox Electric Co., 14th and Chestnut, Kansas City, Mo. permits unusual flexibility of use.

Designated the model 605, it is made up of two module sections. These sections are separate r-f and i-f/audio strips. Photo shows i-f/audio section.

The i-f/audio chassis can be used with one or more of the r-f fixed-frequency strips or with a tunable high-frequency receiver. The fixed-frequency strips afford a frequency stability of one-half cycle. The tunable receiver permits monitoring several frequencies. The i-f/audio unit converts a high-frequency tunable receiver to single sideband use. In the r-f chasses, six bands each covering about one octave are used to cover the 2 to 32-Mc range.

Reception modes include: upper sideband, lower sideband, simultaneous upper and lower sideband, a-m, modulated c-w and frequency-shift keying. The units are designed for military and commercial applications.

CIRCLE 305 ON READER SERVICE CARD



Traveling-Wave Amplifier ruggedized for 8,000 to 12,000 Mc use

A RUGGEDIZED broadband traveling-wave amplifier for the 8,000 to 12,000 Mc band has been introduced by the General Electric Power Tube Dept., Schenectady, N. Y.

The new tube, designated Z-5259 is designed for input service to radar receivers but is said to have use also in radio astronomy, radiometry, electronic countermeasures and microwave radio-relay service. The tube can be used as a limiter, automatic gain control tube, microwave mixer and frequency divider as well as an amplifier.

The tube is said to have the advantages of low noise figure, high gain, rugged construction, broad bandwidth and freedom from mechanical tuning.

CIRCLE 306 ON READER SERVICE CARD

Burglar Alarm fully transistorized

SAFES, filing cabinets and other metal objects that can be insulated from ground can be guarded by a new capacitance burglar alarm introduced by Kidde Ultrasonic & Detection Alarms, Inc., Clifton, N. J. The unit is called the Prox-O-larm and is approved by Underwriters' Laboratories.

The alarm circuit is fully transistorized and will compensate automatically for changes in temperature or humidity while retaining required sensitivity. The cabinet measures 11 by 8 by 7 in.

The system can be used to protect up to 40 standard filing cabinets and can be adjusted to trigger when an intruder approaches within a few inches or to trigger on actual contact only.

Power for 2,000 hours operation is provided by self-contained dry cells or the unit can be powered by a 12-v bell-ringing transformer, the dry cells provide standby power.

CIRCLE 307 ON READER SERVICE CARD

Amplifier Mesa 30-Mc unit

MOTOROLA INC., Semiconductor Products Division, 5005 E. McDowell Rd., Phoenix, Ariz., announces the 2N741 30 Mc amplifier mesa transistor. Designed for a wide range of h-f applications including tv video amplifiers, its low collector cutoff current of 0.2 μa make it usable for critical d-c direct-coupled amplifier service. It can also be used in transmitters as a low power output or driver/mul-

NEW

AEROGLAZE® CONFORMAL COATING ON Hi-Q® Carbofilm® RESISTORS

Exceed Painted Resistor Performance at NO Increase in Price!

Now... deposited carbon resistors with exclusive Aeroglaze conformal coating offer superior performance and greater mechanical protection over conventional painted units at NO increase in price.

Aeroglaze coating applied as a 100% solid eliminates weakened coatings through use of solvents and provides uniform sizes and appearance. Aeroglaze coating will meet all moisture requirements of MIL-R-10509B. Mechanical protection is superior to any other method and special tubes, sleeves and jackets are eliminated.

Aeroglaze resistors are available for immediate delivery in production quantities in the following ratings and sizes:

CPM CARBOMOLD RESISTORS

Encapsulated resistors in a strong reinforced moisture and heat resistant plastic for stability, precision and reliability. Available in ⅛, ¼, ½, 1 and 2 watt sizes in MIL designations RN60B, RN65B, RN70B, RN75B and RN80B.

CPC CERAMIC-CASED CARBOFILM RESISTORS

Extra-rugged construction to meet all requirements of critical circuitry. Especially suitable for applications demanding maximum protection against exposure and extreme environmental conditions. Available in ⅛, ¼, 1 and 2 watt sizes.

TYPE CPX—AEROGLAZE CARBOFILM RESISTORS

Type	A±1/16	B Max.	Watts	Res. Range	Mil Designations	Max. Volts
CPX ¼	13/32	.125	¼	5 ohms to 1 meg.	RN10	300
CPEX ⅓	½	.203	½	10 ohms to 2 meg.		350
CPSX ⅓	5/8	.203	½	10 ohms to 2.5 meg.	RN20	350
CPX ½	23/32	.250	½	10 ohms to 5 meg.		350
CPLX ½	1	.250	½	5 meg. to 7.5 meg.		500
CPX 1	1 3/16	.328	1	10 ohms to 15 meg.	RN25	500
CPX 2	2 1/16	.328	2	15 ohms to 50 meg.	RN30	1000

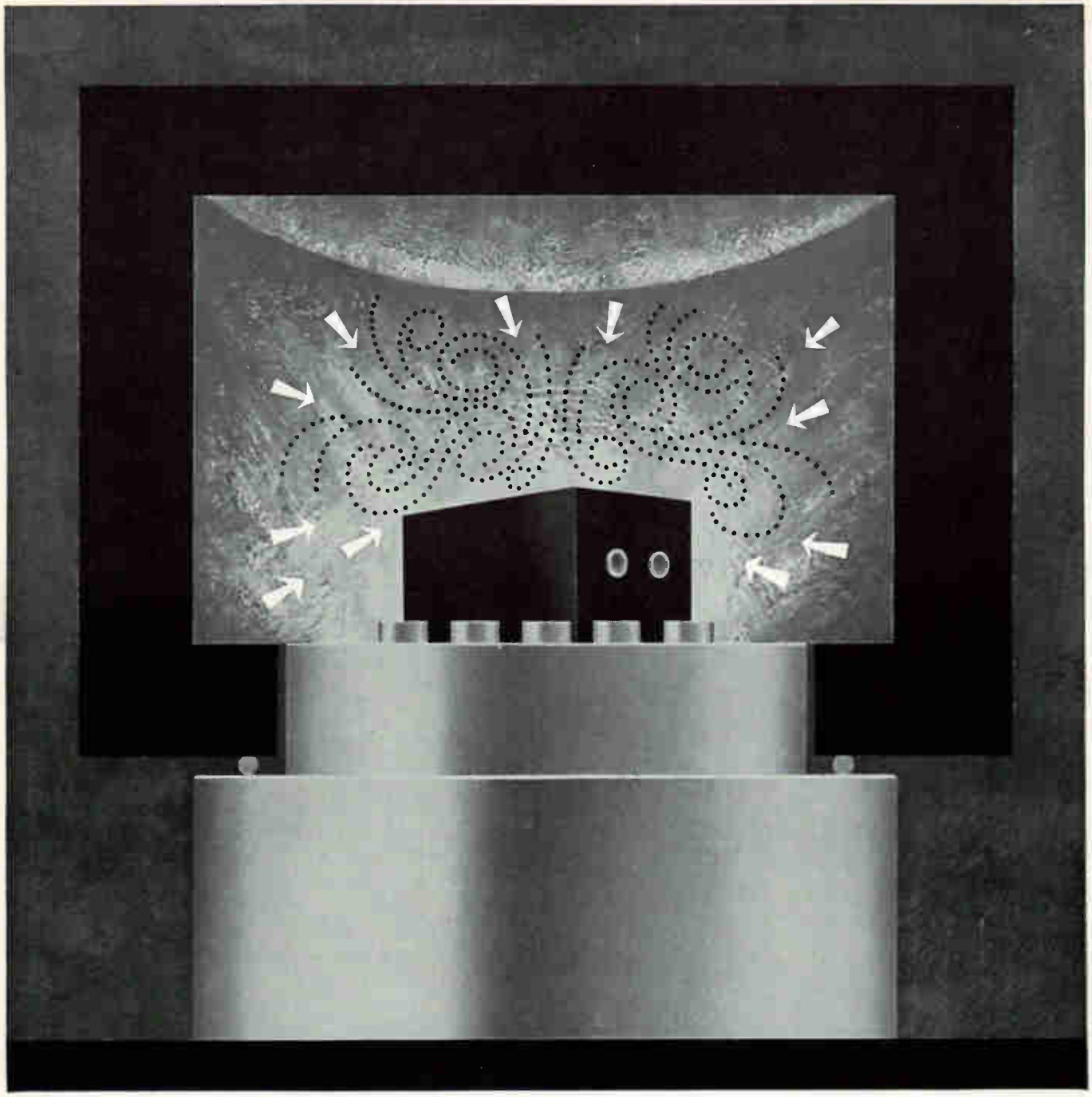
Write for new descriptive literature to...

Hi-Q® DIVISION

AEROVOX CORPORATION

OLEAN, NEW YORK

CIRCLE 95 ON READER SERVICE CARD



LING'S LIGHT-ARMATURE SHAKER LETS YOU TEST UNDER PRESSURE

Altitude, temperature, humidity! To help you conduct vibration tests under such extremes, Ling brings you the new liquid-cooled Shaker A246 of revolutionary design. In this 7500 force-pound shaker, Ling shaves the weight of the armature to a new low of only 68 pounds—the lightest armature by far for this force-rating. Structural resonance, first major, develops at 2570 cps, bare table. Shaker efficiency is at a new high; the A246 delivers full output at reduced amplifier power, cutting costs on associated electronics equipment. In a chamber, it functions at extremes well above ordinary shakers—from −100°F to +300°F, and up to 125,000 ft. Further, it simplifies chamber testing even more when used with the piggy-back chamber shown above. With Ling seals and baffles, the shaker body acts as one wall of the chamber, and only the table rides into the chamber. This is just one more advance from Ling research; for electronics that always help you out of prototype into production, *fast*—look to Ling. For details, write Dept. EL-1, at either address below.

LING ELECTRONICS

A DIVISION OF LING-ALTEC ELECTRONICS, INC. • 1515 SOUTH MANCHESTER, ANAHEIM, CALIFORNIA • 120 CROSS STREET, WINCHESTER, MASSACHUSETTS

tiplier intermediate stage. The 2N741 is a germanium *pnp* diffused junction transistor in a TO-18 (3-lead, 0.100 in. pin circle) package with collector connected to case. A vacuum bake-out at 200 C and a stabilization bake for a minimum of one week at temperatures in excess of 100 C help assure stability.

CIRCLE 308 ON READER SERVICE CARD

Indicator Lamp
5,000-hr life

A LIFETIME rating of 3,000 to 5,000 hours is among the advantages of a low-cost indicator lamp introduced by Sylvania Electric Products Inc., a subsidiary of General Telephone & Electronics Corp., 730 3rd Ave., New York, New York.

The new-product package includes a redesigned short-base indicator lamp, plastic color lamp caps, multisocket strips for panel mounting and single sockets.

The lamps are useful as indicator lamps for computers and other data-processing equipment. They may also be used in photocell activation, scanning devices, lighted pushbuttons, panel switches and aircraft instrumentation. A flat-top end construction of the lamp permits relocating the filament thus providing up to 60 percent more light.

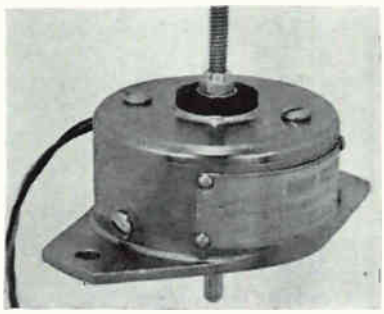
The multisocket strips are available in 6 and 12 socket lengths with sockets mounted on ½ or ¾-in. centers. One ground connection takes care of an entire strip. The strips fit standard mounting accessories.

Color caps can be supplied in red, green, yellow or white molded

nylon, can be snapped over the lamp or cemented to it.

Lamps are available in standard 4, 6, 10, 12, 16, 24 and 28-volt sizes. Other voltages can be made to order. Current ratings are 35 to 45 ma with lower current ratings available. End foot-candle illumination ranges from 200 for the 4-volt lamp to 1,285 for the 28-volt lamp.

CIRCLE 309 ON READER SERVICE CARD



Precision Pot for short travel

SPECIAL testing, such as measuring distortion or expansion of missile parts due to heating is the major use seen for a new precision potentiometer for measuring extremely short mechanical travel or deflection. The unit is now in production at Humphrey, Inc., 2805 Canon St., San Diego, Calif.

The spring-loaded, rectilinear potentiometer can provide travel as small as 0.05 in. with resolution as fine as 1 part in 200 or ½ percent. The component provides directly useful output without additional equipment such as amplifiers.

The short-travel pot is of all-metal construction. It will withstand temperatures from −65 F to 275 F and 500 F for short periods. It can also withstand 95 percent humidity, 50 g acceleration on all axes and shock of 100 g for 3 milliseconds. Service life is in excess of 500,000 cycles.

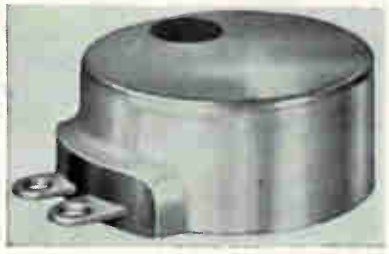
CIRCLE 310 ON READER SERVICE CARD

Magnetron voltage-tunable

GENERAL ELECTRIC CO., Schenectady 5, N. Y. The Z-5405 voltage-tunable magnetron is an electronically tunable oscillator used in L-band frequencies. It is designed

for use as driver or output tube in a number of applications including telemetry, radar, and electronic countermeasures.

CIRCLE 311 ON READER SERVICE CARD



Thermostat
low-differential

A LOW-DIFFERENTIAL precision thermostat that opens or closes on temperature rise is designed for use as a control or warning device in guided missile, aircraft control, computer, crystal oven or other applications. Manufactured by Texas Instruments Incorporated, Metals & Controls Division, Attleboro, Mass., the unit is designated the Klixon 4286.

The control features a thermal coupling between the thermostat case and the temperature-sensitive element that allows exceptionally fast response. The snap-acting bimetallic disk is electrically insulated and attached to the cup.

Continuous temperature exposure limits are −65 F to 270 F. Momentary overrides to 325 F can be handled by types designed to open on temperature rise. Momentary overrides to 320 F can be handled by types designed to close on temperature rise. The temperature setting range is 0 F to 250 F.

Models are rated from 6 amperes, 30 v a-c/d-c to 1 ampere, 250 v, a-c. Life expectancy is 250,000 cycles. Switch action is single-pole, double-throw. All models resist 60 g shock. The wider differential types, 5 to 9 F, are resistant to 10 g vibration. Weight is 3.5 grams.

CIRCLE 312 ON READER SERVICE CARD

Time Delay Relays
solid state

MARSTAN ELECTRONICS CORP., 204 Babylon Turnpike, Roosevelt, L. I., N. Y. Solid state Economy series

time delay relays are low cost units of fixed or adjustable versions having nominal accuracies of ± 1 percent and ± 5 percent in the time period of 0.5 to 110 sec over the temperature of − 20 C to + 85 C. Current ratings of 2 and 5 amperes are available with voltage inputs of 6-250 v a-c or d-c. The timing accuracy is maintained when unit is subjected through a voltage variation up to 30 percent of nominal value.

CIRCLE 313 ON READER SERVICE CARD

Tiny Networks
solid circuit

TEXAS INSTRUMENTS INC., Semiconductor-Components Division, P. O. Box 312, Dallas, Texas. Type 502 solid circuit network is a binary multivibrator capable of operation at a 200 Kc repetition rate. Device measures 0.250 in. by 0.125 in. by 0.031 in. and contains the equivalent of 16 conventional components—a 100 to 1 reduction in size when compared to an equivalent transistorized p-c device. The solid circuit design integrates the component equivalents into a single piece of high-purity semiconductor material, eliminating the majority of reliability-decreasing interconnections.

CIRCLE 314 ON READER SERVICE CARD

Capacitor
Mylar dielectric

GOOD-ALL ELECTRIC MFG. Co., 112 W. 1st St., Ogallala, Neb. Type 623 "civilian" capacitor is designed specifically for use under conditions of high humidity. The combination of Mylar dielectric encapsulated in epoxy assures dependable performance under the most adverse conditions. The 623 is available in ca-

pacities from 0.001 to 1.0 μf and in 100, 200, 400 and 600 v a-c ratings. This design may be used at full rated voltage to 85 C and to 125 C with derating.

CIRCLE 315 ON READER SERVICE CARD

Vacuum Furnace
small size

MRC MFG. CORP., 47 Buena Vista Ave., Yonkers, N. Y. The VF-92 vacuum furnace measures 2 ft by 3 ft. It can be used for all kinds of heat treating operations, brazing, sintering, bright annealing, and single crystal growing in high vacuum or inert atmospheres. Vacuum chamber is 20 in. long, 11 in. in diameter. The furnace is a standard 8 in. long, 6 in. in diameter. A quick release mechanism on the vacuum chamber facilitates recharging. For specimen surveillance throughout the run, there is a sight window in the stainless steel top plate. A specially designed liquid nitrogen vapor trap is used to filter out gaseous impurities.

CIRCLE 316 ON READER SERVICE CARD

Pulsed TWT
high-gain

WATKINS-JOHNSON CO., 3333 Hillview Ave., Stanford Industrial Park, Palo Alto, Calif., has announced a small, lightweight, high-gain periodically focused X band 10 Kw pulsed twt. The WJ-206 provides a minimum of 10 Kw over the 8,400 to 9,400 Mc range with an output power of less than 500 mw. The magnetic focusing and r-f

Through the looking glass...

You'll find new opportunity new reward in the new look at Link

It's even more exciting — and certainly more real — than looking-glass land and nearer to now than the closest mirror.

Right now, things are really humming at the Link Division of General Precision, Inc. Link is one company which has accepted the challenge of the years ahead with eager enthusiasm. In fact, projects now under way at Link are among the most advanced in the nation.

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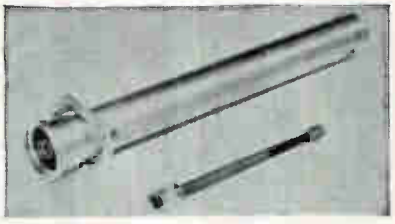
slow-wave structure are integral, i.e. the walls of the r-f cavities serve as flux guides for the focusing system. This feature permits a high current density beam to be focused with magnets weighing only 2.5 lb. This construction (utilizing all metal and ceramic vacuum joints) withstands severe shock and vibration.

CIRCLE 317 ON READER SERVICE CARD

Test Instrument transistor-diode

TRANSISTOR ELECTRONICS CORP., 3357 Republic Ave., Minneapolis 26, Minn. Model TDT-200A is designed for quick and convenient checking of the d-c parameters of transistors and diodes. It will check reverse and leakage currents of silicon as well as germanium transistors and diodes. The reverse current metered range has been extended downward by means of external shunts and microammeters. The unit checks voltage, reverse and forward current and current gain (transistors). Price is $325.

CIRCLE 318 ON READER SERVICE CARD



Coax Terminations ruggedized

RADAR DESIGN CORP., Pickard Drive, Syracuse 11, N. Y. Pictured are the smallest and largest of a complete line of broadband coaxial terminations covering the 500 Mc to 12,500 Mc range. Ruggedness is achieved by mechanically joining

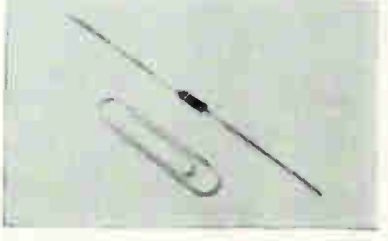
the inner and outer conductors through a metal plug at the rear of the unit. Instead of breakable resistors, the dissipative element consists of a long, gentle taper of heat- and moisture-resistant lossy plastic. Models are available with type N, TNC, BNC, HN, LC, LT, ⅜ in. and 1⅝ in. connectors.

CIRCLE 319 ON READER SERVICE CARD

Buffer Amplifier
dual channel

KEARFOTT DIVISION of General Precision Inc., 1150 McBride Ave., Little Falls, N. J. The S3105-01 transistorized dual channel buffer amplifier is lightweight and hermetically sealed. It is designed to drive any resolver with a tuned primary impedance of greater than 2,000 ohms and a primary resistance of less than 1,000 ohms. The amplifier-resolver combination has stable gain and phase shift characteristic through an ambient temperature range of − 55 C to + 75 C. Weight is 5 oz maximum.

CIRCLE 320 ON READER SERVICE CARD



Diode/Rectifiers
high temperature

GENERAL INSTRUMENT CORP., Semiconductor Division, 65 Gouverneur St., Newark 4, N. J. Designed to operate at temperatures up to 200 C, new subminiature silicon diode/rectifiers in hermetically-sealed glass case (MP100 through

MP600), have been developed. Of fused junction construction, with pigtail leads, the units are built to meet military specifications, cover the range from 100 to 600 v peak inverse, and operate at ambient temperatures from −65 C to +200 C. At 200 C and 225 piv, maximum average rectified current is 50 ma. Because of their size (0.300 in. long and 0.105 in. in diameter) the units are particularly suited for applications in miniaturized, as well as standard equipment.

CIRCLE 321 ON READER SERVICE CARD

Pressure Switch
subminature

THE BRISTOL CO., Waterbury 20, Conn., announces an adjustable pressure switch especially suited to applications in which performance with minimum size, weight, and cost is important. It weighs slightly more than 1 oz, and its volume is less than 1 cu in. An all-stainless-steel housing contains a Ni-Span C pressure capsule and a snap-action switch. Pressure-setting adjustment is simple and positive; and performance up to 200 psi under vibration, shock and acceleration test conditions exceeds the requirements of MIL-E-005272B.

CIRCLE 322 ON READER SERVICE CARD

Delay Line
compact unit

ESC CORP., 534 Bergen Blvd., Palisades Park, N. J., announces the compact continuously variable delay line, model 72-17, for printed board mounting. Terminals and holding tabs are provided. Delay

is 0.5 μsec; impedance, 1,000 ohms; rise time, 0.1 μsec; attenuation, 10 percent maximum; maximum voltage, 500 v peak; resolution, less than 0.001 μsec.

CIRCLE 323 ON READER SERVICE CARD

UHF Preamplifier
low noise

COMMUNITY ENGINEERING CORP., P.O. Box 824, State College, Pa. Designed for use in the 500 to 900 Mc range, model 1003 has a noise figure of better than 5 db at 500 Mc and 6 db at 900 Mc, with a nominal gain of 20 db. Unit is fixed tuned to required frequency with a bandwidth of up to 15 Mc. Incorporating two GE planar triodes, the 1003 is a two stage grounded grid cavity amplifier. Tubes are mounted as integral parts of the silver plated coaxial resonators. This increases efficiency, reduces losses, and permits more compact packaging.

CIRCLE 324 ON READER SERVICE CARD

Resistor Networks
many applications

KELVIN ELECTRIC CO., 5509 Noble Ave., Van Nuys, Calif., has available resistor networks in virtually any arrangement of values and physical configuration. Resistor ratio matching accuracies to 0.005 percent with absolute tolerances of 0.01 percent are featured. Standard temperature coefficient is 10 ppm; lower t-c can be supplied. Distributed capacitance as low as 0.5 $\mu\mu$f

and rise time as low as 0.1 μsec can be supplied depending upon network circuit configuration. Frequency range to 250 Kc available. Resistors are noninductively wound. Can be provided in hermetically sealed cases, mounted on boards or encapsulated in high temperature epoxide resin.

CIRCLE 325 ON READER SERVICE CARD

Two-Pen Recorder transistorized

ELECTRO INSTRUMENTS, INC., 3540 Aero Court, San Diego 11, Calif. Model 480 X-YY′ recorder features plug-in input modules for general purpose, computer, low-level, differential time base, curve following and other specialized functions. Paper size is 11 by 17 in. with recording size 10 by 15 in. Slewing speed on all axes is 30 ips. The rack mounted model 481 measures 19 in. wide by 22¾ in. high by 11¾ in. deep.

CIRCLE 326 ON READER SERVICE CARD

Digital Multimeter for laboratory use

FRANKLIN ELECTRONICS INC., Bridgeport, Pa. Model 500A is a digital multimeter for measuring a-c, d-c and ohms. Top scale is 1,200 v for a-c and d-c. Accuracy is ±0.1 percent on d-c ranges and ±0.5 percent on a-c ranges. Ohms range extends to 1 megohm at an accuracy

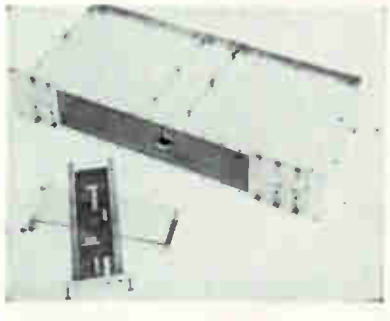
of ±0.2 percent. Instrument features automatic polarity switching and indication. Input resistance on the 1,200 v d-c range is 20 megohms. On all other d-c ranges the input resistance approaches infinity. An output is provided for direct operation of digital printers so that the instrument can be used in data processing systems.

CIRCLE 327 ON READER SERVICE CARD

Solder & Flux Kit for R&D use

ALPHA METALS, INC., 56 Water St., Jersey City 4, N. J. New solder & flux R&D kit solves soldering problems, cuts experimental work to a minimum, speeds research and development, saves time. Included are 16 varieties of soldering chemicals —fluxes, solder paste, flux remover and the like—11 kinds of solid wire and special, flux-filled solders in handy dispenser tubes and 3 different foil solders for making preforms, and built-in guide charts. Price is $24.

CIRCLE 328 ON READER SERVICE CARD



Amplifiers transistorized

BURR-BROWN RESEARCH CORP., Box 6444, Tucson, Ariz. Series 1600 instrumentation amplifiers feature completely solid-state circuitry in a modular package designed for rack mounting. Operational amplifiers and fixed gain units are available. Some units employ chopper stabilization for minimum drift while others utilize differential circuitry for added compactness. Typical open loop gains are 10,000,000 for chopper stabilized combinations and 10,000 for differential units, outputs of ±10 v at 2-20 ma. Sixteen modules fit into a 3½ in. by 19 in.

rack space. Several hundred amplifiers may be powered from a single power supply. Prices range from $140 to $190 per module.

CIRCLE 329 ON READER SERVICE CARD

Ultrasonic Cleaner transistorized

THE NARDA ULTRASONICS CORP., 625 Main St., Westbury, L. I., N. Y. The UniBlast 66 is a fully transistorized ultrasonic cleaner featuring unitized construction, replaceable cleaning chamber, and Powerbloc ceramic transducer. It measures 9 in. wide, 10 in. long, sloping from 4 to 7 in. in height. Weight is 12 lb; output frequency, 60 Kc (nominal); power requirements, 60 w at 117 v, 60 cycles; operating controls, indicating pushbutton and activity adjustment. Price is $97.50.

CIRCLE 330 ON READER SERVICE CARD

Measuring System telegraph-distortion

RADIATION INC., Melbourne, Fla. The TDMS (Telegraph Distortion Measuring System) not only allows on-line evaluations of operating communications links without interrupting service, but also provides a maintenance capability for relays, operates as a signal generator for clear and distorted signals and permits wave shape evaluation. It actually replaces most test equipments now required for teletype terminal maintenance and monitoring, resulting in reduced test equipment costs, increased efficiency, and reduced circuit outage. The equipment provides continuous monitoring of telegraph and data circuits,

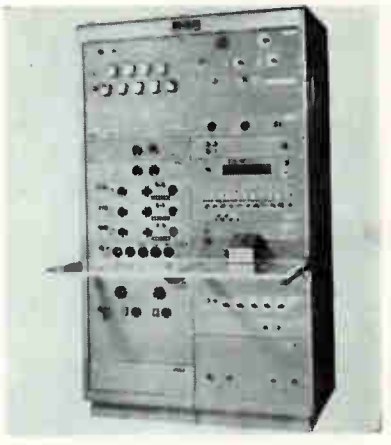
pinpoints the type and source of trouble as it occurs, and thereby reduces down-time of circuits and improves quality of service.

CIRCLE 331 ON READER SERVICE CARD

T-W Tube
1-watt unit

HUGGINS LABORATORIES, 999 E. Arques Ave., Sunnyvale, Calif. An electrostatic focused 1-w twt, the HA58 operates on a frequency range of 500 to 1,000 Mc, with a small signal gain of 30 db minimum, and a saturation gain of 28 db minimum. Unit measures 1¼ in. diameter and 18 in. long. No magnetic structure either solenoid or permanent magnet is needed. Operating temperature range, vibration and shock performance meet military specifications.

CIRCLE 332 ON READER SERVICE CARD

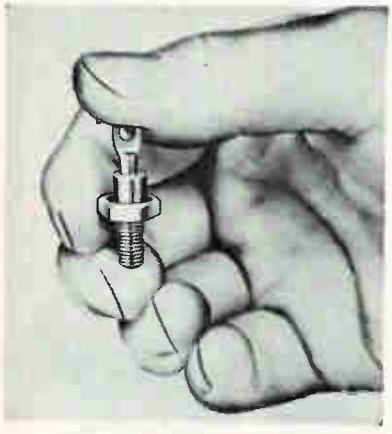


Transistor Tester
and classifier

INDUSTRO TRANSISTOR CORP., 35-10 36th Ave., Long Island City 6, N. Y. The ITVAC (Industro Transistor Value Automatic Computer) is available in several models, and can test 750 transistors per hr, classify them according to programmed specifications and record the test data of each unit in one or more of several recording methods. Accuracy of the machine is on the order of ¼ of 1 percent, and is maintained by a series of self-checks that ITVAC undergoes before every transistor test. A battery of standard cells built into the machine is used as a reference by the machine before testing. Programming is

done by a direct reading dial system which sets the test conditions, as well as the results looked for and the test limits. The entire programming operation may be done in 2-5 minutes by unskilled operators after a short training period.

CIRCLE 333 ON READER SERVICE CARD



Silicon Rectifier
double diffused

SYNTRON Co., 241 Lexington Ave., Homer City, Pa., has developed a double diffused silicon power rectifier. Style 21 is rated at 13 amperes average at 25 C ambient on a 3 in. by 3 in. by ⅛ in. copper heat sink. Standard and reverse polarity are achieved through the double diffusion. Typical forward dynamic resistance is 0.009 ohm.

CIRCLE 334 ON READER SERVICE CARD

Sweeping Oscillator
wide range

KAY ELECTRIC Co., 14 Maple Ave., Pine Brook, N. J. The Ligna-Sweep SKV is designed for audio, video and vhf coverage of frequency ranges from 200 cps to 230 Mc and sweep repetition rates from 0.2 to 60 cps. It provides linear and logarithmic sweeps over three highly stable video bands—1 Kc to 12 Mc (variable or in single sweep); eight narrow fixed frequency bands, 20

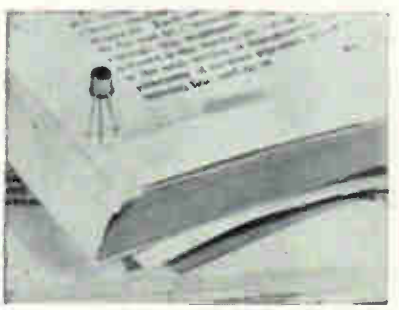
Kc to 12 Mc (customer selected) are provided for special production test; nine fundamental frequency, vhf bands—10 Mc to 12 Mc; one audio sweep—200 cps to 20 Kc. The high output is held constant over the entire range by a fast acting agc circuit to within ±0.5 over widest sweep. Unit is ideal for testing and aligning of instruments such as audio amplifiers and filters, communication receivers, radar i-f channels, and tv receivers and transmitters.

CIRCLE 335 ON READER SERVICE CARD

Tiny Battery
silver-cadmium

YARDNEY ELECTRIC CORP., 40-50 Leonard St., N. Y. C. The 8YS01 Silcad battery powers a portable voice page system. The 9-v battery is made up of eight cells of 0.1 ampere-hr nominal capacity; it will supply power for continuous operation for 12 to 15 hr before recharging is necessary. Unit weighs 1.44 oz and has a total volume of 1.36 cu in.

CIRCLE 336 ON READER SERVICE CARD



Tunnel Diodes
gallium arsenide

GENERAL ELECTRIC Co., Syracuse, N. Y. New gallium arsenide tunnel diodes are immediately available in two peak current ratings—10 ma and 22 ma. Capacitance for both devices is typically 1.5 pf per ma. Typical peak to valley current of

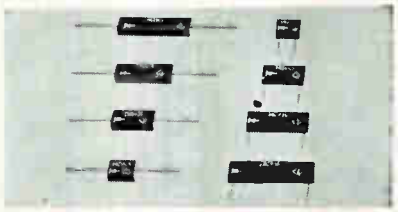
both is 15 to 1. Typical voltage swing is 1.0 v. Typical peak point current variation is less than a total of 2 percent over the temperature range from −55 C to +150 C. The new tunnel diodes are housed in the TO-18 standard transistor package. The high frequency capabilities of devices in this package are limited to approximately 1,000 Mc.

CIRCLE 337 ON READER SERVICE CARD

Tv Camera transistorized

BLONDER-TONGUE LABORATORIES, INC., 9 Alling St., Newark 2, N. J. Model TTVC transistorized tv camera operates equally well on 12 or 24 v a-c/d-c, or 117 v a-c (50 to 400 cycles). It provides 600-line resolution for maximum picture detail. It also features a crystal controlled r-f modulator—channels 2 to 6; maximum output: 50 mv, plus a video output of 1.4 v peak to peak. Camera weighs only 14½ lb.

CIRCLE 338 ON READER SERVICE CARD

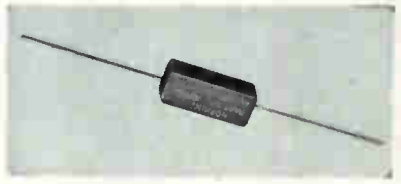


H-V Diode Stacks for power supplies

TEXAS INSTRUMENTS INC., Semiconductor-Components Division, P. O. Box 312, Dallas, Texas. Encapsulated silicon diode stacks 1N2878 through 1N2925 provide from 700 v to 6,500 v for immediate use in h-v power supplies for radar and communications applications. Company has provided 4 miniature case sizes with either single ended or axial lead construction with 24 standard piv ratings. Smallest unit (0.075 cu in. weighing 2.0 grams) contains two diodes in series to provide 700 v; largest standard unit (0.225 cu in. weighing 6.0 grams) contains 13 silicon diodes in series to provide 6,500 v. At all 24 piv ratings, the units provide 250 ma average rectified forward current at 25 C, 0.5 μa

reverse current at piv, 30 μa leakage at piv at 100 C and an extremely low forward voltage drop.

CIRCLE 339 ON READER SERVICE CARD



Tiny Capacitor
metallized paper

HOPKINS ENGINEERING CO., 12900 Foothill Blvd., San Fernando, Calif. New 50-v microminiature metallized paper capacitors are especially designed for applications requiring low voltage and small physical size. A 4.0 μf unit measures only $\frac{55}{64}$ in. thick by $\frac{9}{16}$ in. wide by $1\frac{1}{8}$ in. long. Standard units can be supplied from 0.10 to 20μf in phenolic coated or hermetically sealed construction. Higher capacities are available. Units are impregnated in a specially compounded high K thermosetting resin, and are produced with a new rectangular shape to permit additional savings in size.

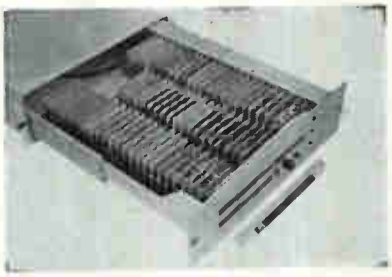
CIRCLE 340 ON READER SERVICE CARD

Digital Recorder
portable unit

PRECISION INSTRUMENT CO., 1011 Commercial St., San Carlos, Calif., announces a 16-track digital magnetic tape instrumentation recorder/reproducer weighing only 100 lb. The PS216-D measures $16\frac{1}{2}$ in. wide by $25\frac{1}{2}$ in. high by 14 in. deep. It features modular construction and p-c boards which provide "NRZ" digital read and write amplifiers in compact solid-state plug-

in form. Standard unit is furnished with 1-in. wide tape and the new pcm telemetry tape configuration of 16 tracks per in. Standard tape speeds from 1⅞ to 60 ips are available. Units are also available with different tape widths and head configurations.

CIRCLE 341 ON READER SERVICE CARD



Core Memory Tester
solid-state

PACKARD BELL COMPUTER CORP., 1905 Armacost Ave., Los Angeles 25, Calif. Solid-state magnetic core memory tester verifies the operational status of a 19-bit, 4,096 address core memory. Unit measures 5¼ in. high by 19 in. wide by 20 in. deep. Price is $10,500. The core memory test may be made on selected addresses and bits or in sequence on all addresses with every combination of the 19-bits. During the test it is possible to start, stop, or restart from any address with any word pattern. Register indicators on the front panel show each 19-bit word written in or read out and the relevant memory address. When an error is detected in the memory, the tester stops immediately and the indicators show the error source.

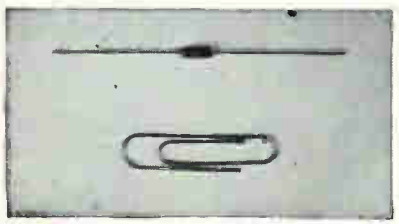
CIRCLE 342 ON READER SERVICE CARD

Computer
mixture ratio

REDCOR DEVELOPMENT CORP., 14750 Arminta St., Van Nuys, Calif. Mix-

ture ratio computer uses digital and analog techniques to simplify flow rate control problems. Digital counters determine the periods of two input frequencies from flow meters. Digital to analog conversion provides two outputs: one voltage proportional to flow rate error and another proportional to mixture ratio err. References are selected by digital registers. Accuracy of both outputs at null is 0.1 percent. System utilizes solid state components throughout.

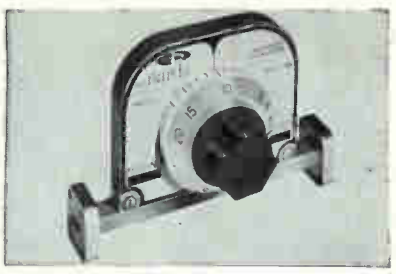
CIRCLE 343 ON READER SERVICE CARD



Computer Diodes
fast switching

RHEEM SEMICONDUCTOR CORP., P. O. Box 1327, Mountain View, Calif. Fast switching silicon computer diodes with U. S. Army Signal Corps Single Service specification approval are now available in production quantities. They feature recovery times down to 0.3 μsec with reverse voltages ranging up to 200 v. They are listed under type numbers 1N643 (MIL-E-1/1171), 1N658 (MIL-E-1/1160), 1N662 (MIL-E-1/1139) and 1N663 (MIL-E-1/1140). Diodes are sealed in the standard glass package.

CIRCLE 344 ON READER SERVICE CARD



Variable Attenuator
direct-reading

NARDA MICROWAVE CORP., Mineola, L. I., N. Y. Semiprecision direct-reading variable attenuator, utilizing a variably inserted Narda-Iron

cam provides minimum frequency sensitivity and low vswr over the entire frequency and attenuation range. Direct-reading dial is accurately calibrated to within 1 db up to 10 db and 1.5 db up to 20 db over the entire waveguide frequency range. Maximum attenuation exceeds 25 db and minimum insertion loss is under 0.5 db. A multiturn knob permits smooth movement without backlash. Models for K and V bands are priced at $150 and $180 respectively; for Q, M and E bands at $200 each.

CIRCLE 345 ON READER SERVICE CARD

A-C/D-C Recorder six-channel unit

BELOCK INSTRUMENT CORP., 112-03 14th Ave., College Point, N. Y. High stability and virtual drift free operation is obtained by positioning the recording styli by means of servomechanisms rather than the conventional galvanometers. The styli are thermal writing and produce rectilinear traces. In addition to recording signals with a bandwidth of from 0 to 30 cps, each channel is capable of accepting modulated signals on both 60 cps and 400 cps carriers and provides a phase sensitive recording with no additional equipment required. Maximum sensitivity of each channel is approximately 2.5 mv per mm of stylus deflection. Maximum sensitivity permits recording signals of up to 30 v peak to peak. Each recording channel is 5 cm wide. Initial application of the unit is for recording error signals from fire control computers used with shipboard guided missile systems.

CIRCLE 346 ON READER SERVICE CARD

Literature of

DIGITAL LOGIC MODULE. Tele-Dynamics, Division of American Bosch Arma Corp., 5000 Parkside Ave., Philadelphia 31, Pa. Bulletin TTS-A-6000A describes a new solid-state switching-circuit module capable of reliable operation at input pulse repetition rates of 5 Mc.

CIRCLE 380 ON READER SERVICE CARD

SILICON RECTIFIER CONVERSION. General Electric Co., Schenectady 5, N. Y. GEA-7060, four page bulletin describes new oil-filled silicon rectifier conversion units for electrostatic precipitator and other types of h-v power supplies.

CIRCLE 381 ON READER SERVICE CARD

TRAVELING-WAVE TUBE. Watkins-Johnson Co., 3333 Hillview Ave., Stanford Industrial Park, Palo Alto, Calif. Technical Bulletin Vol. 2, No. 1, illustrates and completely describes the WJ-206, a 10-Kw pulsed amplifier at X-band, weighing 12 lb including permanent magnets.

CIRCLE 382 ON READER SERVICE CARD

DELAY LINE. ESC Corp., Palisades Park, N.J. A recent mailing piece describes a lumped-constant delay line with 170 to 1 delay time/rise time ratio.

CIRCLE 383 ON READER SERVICE CARD

PIPE LOCATOR. Gardiner Electronics Co., 2545 E. Indian School, Phoenix, Ariz., has published a bulletin describing the model 174 transistorized pipe, valve and cable locator.

CIRCLE 384 ON READER SERVICE CARD

FACILITIES AND CAPABILITIES. Datex Corp., 1307 S. Myrtle Ave., Monrovia, Calif. An 8-page brochure illustrates and describes facilities and capabilities in the application of digital techniques to the solution of recording and control problems.

CIRCLE 385 ON READER SERVICE CARD

F-M MONITOR RECEIVER. Acton Laboratories, Inc., 533 Main St., Acton, Mass., has available literature describing its new f-m

the Week

monitor receiver that monitors calls in either the emergency or industrial frequencies 30-50 Mc or 148-172 Mc.

CIRCLE 386 ON READER SERVICE CARD

VOLTAGE REFERENCE SOURCE. Epsco, Inc., 275 Massachusetts Ave., Cambridge, Mass. A six-page technical data and applications brochure describes three new secondary standard precision voltage reference sources.

CIRCLE 387 ON READER SERVICE CARD

SEALED RELAYS. Filtors Inc., Port Washington, N.Y. A new 24 page catalog covers a line of sub and micro-miniature hermetically sealed relays.

CIRCLE 388 ON READER SERVICE CARD

WIRE AND CABLE. Standard Wire and Cable Co., 3440 Overland Ave., Los Angeles 34, Calif., has published a pocket sized (4 by 6) glossary of wire and cable terms. It is available at no cost on letterhead request.

TRANSIENT VOLTAGE PROBLEM. Sola Electric Co., 4633 W. 16th St., Chicago 50, Ill. A 16-page booklet contains an article on the static-magnetic regulator as a solution to the transient voltage problem. The paper was written by the company's chief product engineer.

CIRCLE 389 ON READER SERVICE CARD

SEISMOGRAPH SYSTEM. Southwestern Industrial Electronics Co., 10201 Westheimer Road, Houston 27, Texas. Described and illustrated in a bulletin is the G-33 full spectrum seismograph system, a combination reflection, refraction, high-frequency recording system combining three seismic systems in one unit.

CIRCLE 390 ON READER SERVICE CARD

FERRITES. Ferroxcube Corp. of America, Saugerties, N. Y. Volume 1 No. 3 of *The Ferroxcube Engineer* contains articles of current interest to the ferrite engineer.

CIRCLE 391 ON READER SERVICE CARD

NEW BOOKS

Telemetering Systems

By P. A. Barden and W. J. Mayo-Wells.

Reinhold Publishing Corporation, New York, 349 *p*, $8.50.

THIS book is primarily written for practicing systems engineers and all those who must gain an over-all view of the field. Most of the material presented in the book has never before been assembled in an organized fashion, such as the chapters on telemetering pickups, telemetering links and channels, and coordinating, totalizing, computing, and integrating. Actual systems and components are described and abundantly illustrated, supplementing general discussions which serve to introduce the various phases of telemetering. The authors have given due consideration to mobile telemetering systems which form the heart of all missile research efforts today.

The chapter on selection and application of telemetering systems will be of particular value to the neophyte systems engineer and proposal writer, because it presents an introduction to the state of the art of telemetering.

References are provided with each topic, and they cover such sources as universities and government research institutions, besides the standard engineering journals.
—IVO HERZER, *Electronics Research Laboratory, Columbia University, New York, N. Y.*

Modern Network Analysis

By F. M. Reza and S. Seely

McGraw-Hill Book Co., Inc., New York, 373 *p*, $10.00.

THIS book should find wide acceptance as a standard text on network analysis fundamentals. Treatment of the subject matter is both logical and clear and is reasonably successful in giving physical insight into the mathematical relationships involved.

Main virtue of this book lies in the liberal use of well chosen examples. These examples are used most effectively in illustrating each newly introduced concept. Another useful device employed is the con-

venient summarizations of step-by-step procedures.

The chapters on linear algebra and the Laplace transform are comparable to those contained in numerous other texts, but merit inclusion for the sake of completeness. Early introduction and the fresh treatment of the S-plane concept is both encouraging and useful. Examples of both distributed and lumped networks are treated in a good and consistent manner. A convenient summary of general network considerations is given at the end of the text.

In summary, this book is a well presented one-volume text on fundamental network analysis. It should fulfill its stated purpose of bridging the gap between introductory level texts and the professional literature.—MAURICE C. NEWSTEIN, *Technical Research Group Inc., Syosett, N. Y.*

Elements of Solid State Theory

By G. H. WANNIER.

Cambridge University Press, New York, 270 *p*, $6.50.

SOLID STATE theory is an application of many basic disciplines of physics and frequently becomes mathematically involved. A student desiring a thorough understanding should, therefore, not embark on it before he has mastered classical mechanics, thermodynamics, electromagnetic theory and quantum mechanics, as well as all important mathematical tools (including, for example, group theory) to the point where he is not only able to follow a derivation but is also able to accept statements without derivation.

Professor Wannier has no patience with a mediocre background. Unlike many other textbooks, his does not give an introduction to various basic disciplines before applying them to the subject on hand. This is the reason for the book's brevity—it covers the vast field in 260 pages. Introductory references at the end of each chapter may help the less qualified reader to follow the author.

The book consists of eight chapters covering the geometry of crystal structures, diffraction of

radiation in crystals as a tool to experimentally explore this geometry, lattice vibrations, cooperative phenomena such as paramagnetism and ferromagnetism, three chapters on carrier motion in metals and semiconductors, and solid cohesion and chemical bonding. Even with the omission of any basic physics background, the treatment is extremely terse, and when first read from cover to cover the concise presentation may not immediately reveal the author's entire message.

The list of topics barely mentioned or altogether absent is long. It includes, for example, carrier diffusion, recombination, photoconductivity, impurity scattering and superconductivity. The author obviously attempted to give only the basic formulations, critically inspected, and a short summary of the major results. As such, the book constitutes the most recent and most radical attempt to reduce the mushrooming field of solid state physics to its bare essentials. Professor Wannier has gone a long way in this most difficult and very urgent task. The book is, therefore, highly recommended to any solid state physicist who is heavily specialized in a particular area, such as, for instance, carrier transport in semiconductors since its summarizes the foundations of his own subject and their relation to other aspects of solid state physics.

The reader will also find the text full of stimulating statements, not necessarily in explicit mathematical terms. To the highly qualified student, it gives a very good introduction to the basic concepts of solid state theory which will enable him to make an educated choice of his area of specialization.—W. W. GAERTNER, *Chief Scientist, Solid State Devices Div., Electronic Components Research Dept., U. S. Army Signal Research and Development Lab., Fort Monmouth, N. J.*

THUMBNAIL REVIEWS

How to Troubleshoot TV Sync Circuits. By I. Remer, John F. Rider Publisher, Inc., New York, 1960, 119 p, $2.90. This book is designed to help both experienced technicians and beginners to readily recognize, locate and repair troubles in sync circuits in both black-and-white and color tv sets. Illustrations complement the text well.

Fundamentals of Nuclear Energy and Power Reactors. By Henry Jacobowitz, John Rider Publisher, Inc., New York, 118 p, $2.95. This book is aimed at both the general public and readers within the atomics industry. About one third of the book deals with fundamentals and uses many descriptive pictures to tell its story. The balance concerns semi-practical details of putting the fundamentals to work in the shape of past present and projected nuclear reactors. For the general reader, a higher proportion of pages might perhaps have been allotted to fundamentals.

Electric Impedance Plethysmography. By J. Nyboer, Charles C. Thomas, Publisher, Springfield, Ill., 243 p, $7.50. Written by the recognized leader in the field, this monograph is a welcome addition to the literature pertaining to electrical techniques in medicine and biology. The author presents much material relating to electrical properties of tissues, describes a number of electrical methods that have been employed to study vascular phenomena and discusses the use of the impedance plethysmograph in the study of specific vascular phenomena. Electronics men seriously involved with this work will find much food for thought here.

Strange World of the Moon. By V. A. Firsoff, Basic Books, Inc., New York, 226 p, $6.00. The author, a well-known British astronomer, has placed between two covers most of what is known about the moon. Unfortunately, the Russian photographs of the unviewed side of the moon were taken after this book was published. Main purpose of the book is to describe the present condition of the moon with special reference to atmosphere, surface and subsurface structure, as well as possibility of life. Since popular distribution was planned, a good deal of background material is presented. Necessary mathematical arguments are presented in appendix form (34 pages), thus complicated equations and relationships are entirely excluded from the text.

Air Traffic Control. By C. D. Colchester, Marconi's Wireless Telegraph Co., Ltd., Chelmsford, Essex, England, 1960, 100 p, $2.50. This is the book-form of what was originally a study report on future electronic requirements for air traffic control. Author has compiled the contributions of a group of engineers concerned with research, development and production of all types of air radio equipment. Discussed are: development and present state; communications; navigation; ground information; and storage, display and reproduction of information. Objectives of clarifying thought and aiding progress in a difficult technical area are well realized.

Raytheon Opens New Facility

ANNOUNCEMENT comes from Waltham, Mass., that Raytheon Company's Special Microwave Devices Operations has completed its move into a new 30,000-sq-ft facility. This is the electronics firm's sixth building on Route 128, the "Electronics Highway."

A single-story structure, the new facility integrates design, development and production of microwave ferrite devices, as well as marketing and management activities.

A unit of the Microwave and Power Tube division, Special Microwave Devices Operations is managed by Howard Scharfman.

Formed in 1956, the operations became engaged in development of miniature rotational isolators, reciprocal switches, broad-band modulators, high power isolators and circulators for uhf, L, and S-bands. The group also developed miniature circulators for 400 to 17,000 Mc maser and parametric amplifier applications.

The parametric amplifier is finding increasing use in highly sophisticated radars for tracking missiles and space vehicles. This device makes a relatively weak signal from missiles and space probes thousands of miles away more discernible for use by researchers in this field.

Geared for research and development of ferrite devices and their applications to new fields, the Raytheon facility has test and production equipment for devices ranging from ultra-high frequencies to the 35,000 Mc (K-band) area. The building also includes a specially equipped laboratory for research and development of ferrite materials, the "heart" of microwave devices.

An initial group of management, marketing, engineering production and support units comprising more than 100 men and women will staff the new building.

Provision has been made to readily expand the building from its present 30,000-sq-ft area to 50,000 sq ft.

TIC Sets Up Space Division

TECHNOLOGY INSTRUMENT CORPORATION announces formation of a new Space Instrumentation Division at Acton Laboratories, Inc., a subsidiary in Acton, Mass. This division will engage in research, development and fabrication of packaged rocket and satellite precision instrumentation.

Acton Laboratories will offer a complete service from: a conception of a basic idea—plan of measurement procedure—selection of a vehicle—designing, engineering and fabrication of a package, complete with necessary telemetry and fully tested to withstand severe environments—supervision of flight with required block-house controls for check-out and telemetry. Recoverable packages or data for evaluation by the project contractor will be provided. If preferred, evaluations and reports of collected data will be made by Acton Laboratories.

Herbert A. Cohen will be manager of the Space Instrumentation Division. He was formerly branch chief of meteor physics and airglow branch of the Geophysics Directorate of the Air Force Cambridge Research Center.

Associated with Cohen will be Joseph R. Frissora, formerly with Geo-Science Inc. assigned as an instrumentation engineer at the Geophysics Research Directorate of AFCRC. Both men were co-inventors of the Membrane Meteorite Detector for which patent application is pending.

James L. King, designer and builder of instrumentation for space vehicles including high altitude balloon flights, has been for the past 9 years with the engineering section of Geophysics Research Directorate at the AFCRC prior to joining the new TIC division.

A staff of over 35 engineers and 15 designers at the Acton plants of TIC have been coordinated to provide a comprehensive service in space instrumentation. Model shop, machine shop and production equipment of all the nationwide TIC subsidiaries provide support to this new division.

Hoffman Division Advances Golden

NORMAN J. GOLDEN has been promoted to vice president-research and development of the Semiconductor Division of Hoffman Electronics Corp., Los Angeles, Calif. He succeeds Morton B. Prince, who recently was named vice president and general manager of the division.

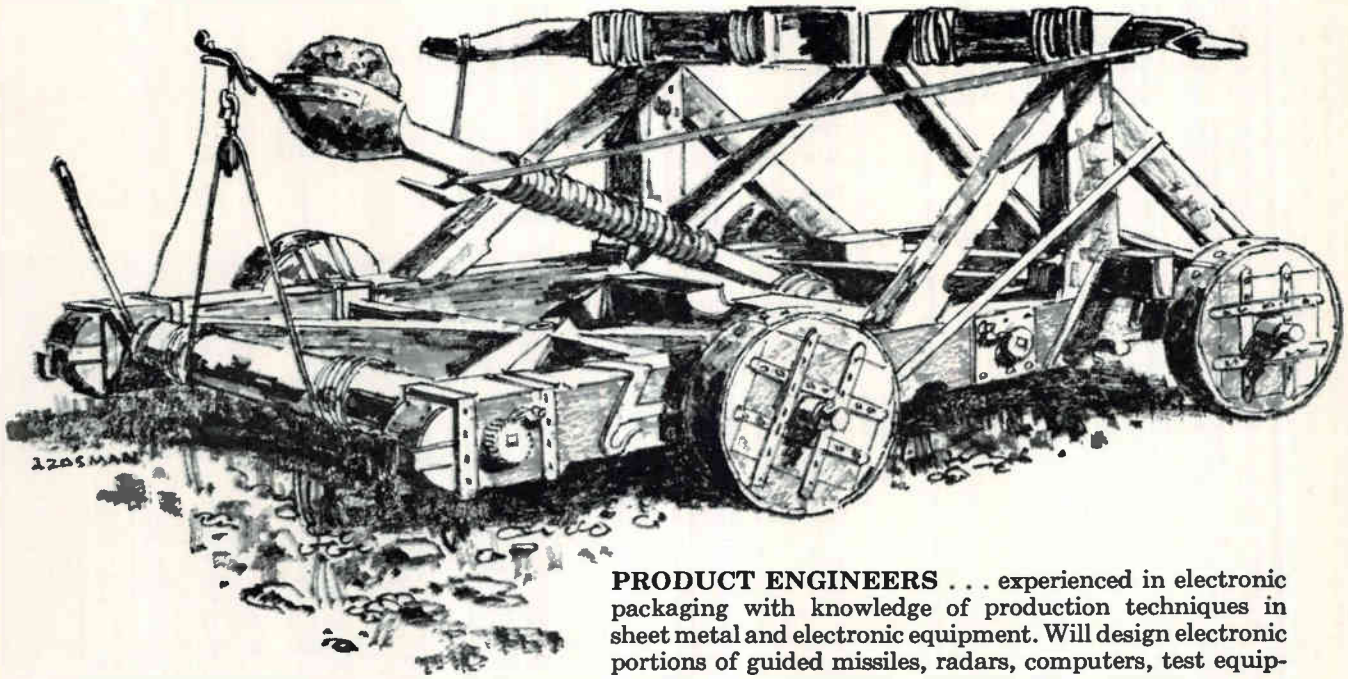
Golden has been manager of the transistor section the past year. He has nine years experience in semiconductor research and development and is the holder of 25 patents in the field. Before joining Hoffman he was in charge of semiconductor

Catapults like this hurled darts and iron ball missiles from castle strongholds. Medieval knights considered these the most formidable defense weapons in their arsenal.

Missiles have become greatly more sophisticated since these crude catapults guarded kingdoms. As a vital part of one of the world's largest purely electronics companies, Raytheon Missile Systems Division is making great advances in this field. The exciting new Pin Cushion Project for the selective missile identification and the continually being improved Navy's air-to-air SPARROW III and Army's HAWK are examples of their outstanding creative work.

We are now seeking talented, qualified people to maintain Raytheon's leadership in this constantly advancing field. Raytheon's Missile Systems Division creates a climate for much talent — perhaps your talent.

MISSILE LAUNCHER 14th CENTURY



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Please send detailed resumés or letters to: Mr. Robert T. Hodges, Employment Manager, Missile Systems Division, Raytheon Company, Andover Plant, Andover, Mass.

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RAYTHEON MISSILE SYSTEMS DIVISION

...creates a climate for talent.

operations and product development at Sylvania-Thorn, Ltd., London.

Dunn to Direct New Division

DONALD A. DUNN has been named director of the newly formed Research Division of Eitel-McCullough, Inc., San Carlos, Calif.

Conducting new and advanced technological research in present and new areas of company interest, the division will contribute new technical knowledge to the product development programs of Eimac and its subsidiaries, according to executive vice president Gould Hunter.

Dunn, a senior research associate and lecturer in the electrical engineering department of Stanford U., joined Eimac in 1959 as manager of the Supporting Research Group.

H-P Building Another Plant

CONSTRUCTION was recently begun on a $1 million electronics manufacturing plant in Loveland, Colo., for Hewlett-Packard Co. of Palo Alto, Calif. The firm produces some 300 varieties of electronic testing devices.

Completion of the first unit on an 83-acre site is scheduled by June 1 when production will begin. The entire plant is scheduled for completion by January 1, 1961. It will

have 130,000 sq ft of floor space.

David Packard, president, said the firm's gross sales last year exceeded $30 million.

Rutherford Hires R.J. Ohlsen

RUTHERFORD ELECTRONICS CO., Culver City, Calif., announces the appointment of Richard J. Ohlsen as its production manager. His responsibilities include production, scheduling, manufacturing and quality control.

Prior to joining Rutherford, Ohlsen was production manager of Networks Electronics Corp., Van Nuys, Calif. Previously he served three years with Coleman Engineering and eight years with Universal Engineering Co. as production manager.

Lafferty Takes New Post

BOONTON ELECTRONICS CORP., Morris Plains, N. J., has named Raymond E. Lafferty chief engineer. He will be concerned with the design and development of new test equipment and with application engineering.

Lafferty has had over 20 years of engineering experience in broadcasting and component and instrument design, and has most recently been with the Daven Co. as assistant chief engineer.

BACKTALK

SAC Control System

I just received your 25 March issue of ELECTRONICS which contains your story on the SAC Control System 465-L. I have shown it to our communications people and they were amazed that, what they called an average writer, could grasp a program and express it as well as you did in your story. Needless to say, I assured them that John Mason was not an average writer and could probably teach us a lot of things about electronics.

EDWIN C. DERRYBERRY
CAPTAIN, HEADQUARTERS STRATEGIC AIR COMMAND
OFFUTT AIR FORCE BASE, NEB.

Retrieval System

In your October 16, 1959, issue, there appeared on page 88 under Research and Development an article entitled "Practical Retrieval System Development". Your article was very interesting, and appears to have application in our company.

Would you please establish contact for me with the proper company which may be involved in developing this system.

Thank you very much.

THOMAS P. LUCK

Electronics based the article on information received from the National Bureau of Standards, Office of Technical Information, Washington 25, D. C.

Slow-Scan Tv

In your Feb. 12, 1960, issue, you carried a story entitled "Hams Seek Facsimile Gear." In this article, mention was made of our interest in transmitting slow-scan images over a single-sideband transmitter.

Since this article appeared, it was read by Mr. Copthorne MacDonald, WA2BCW, an applications engineer of the Westinghouse Tube Division, Elmira, N. Y.

Using a 25-watt transmitter, Mr. MacDonald successfully transmitted slow-scan images to England where they were recorded on conventional audio tape.

Through Mr. MacDonald and the kind cooperation of George Grammer, technical director of the American Radio Relay League, we are now in the process of making experimental transmissions on the first Army MARS technical net using subcarrier frequency-shift and amplitude modulation with the hopes of arriving at some standards and hardware for sending slow-scan images by radio.

If other readers of ELECTRONICS have had any experience in transmitting slow-scan images, and are interested in participating in the program, I would appreciate hearing from them.

S. EDWIN PILLER
DIRECTOR, FIRST ARMY MARS SSB TECHNICAL NET
GOVERNORS ISLAND, N. Y. 4, N. Y.

Report from Japan

It was a pleasant surprise to read, "Japanese Production Workers: A Close-Up," in your April 1 issue. I found this article to be a well-written human interest story of the type rarely found in technical magazines. Mr. Leary's article gave me for the first time an insight into the "cheap labor" phrase which occurs in the frequent trade references to foreign imports. Let's have more of this category of article in the future.

MORTON NORMAN
SYLVANIA ELECTRIC PRODUCTS
WALTHAM, MASS.

Credit Line

Unfortunately, and completely inadvertently, we omitted the name of the co-author of "Measuring Dielectric Absorption" which appeared in your R&D Department, in the March 18th issue. He is Leonard W. Huband, Project Engineer.

We would appreciate it if you will make appropriate note of this in your magazine.

KURT GREENE
UNITED STATES TESTING CO.
HOBOKEN, N. J.

ENGINEERS • SCIENTISTS

BRIDGING THE GAP

from components, equipments, and subsystems to fully integrated, large-scale systems

Air defense missiles, unmanned interceptors, manned interceptors, early warning aircraft, long-range radar, gap filler radar, Texas towers, vast communication nets, high-speed computers and advanced information display devices are a few of the integral parts in an air defense system. Each of these has its individual operational characteristics and it is the responsibility of The MITRE Corporation to provide the basic system engineering and design necessary to integrate these many diverse and complex parts into a mutually compatible, fully-integrated air defense system.

Formed under sponsorship of the Massachusetts Institute of Technology, MITRE employs the skills of engineers, mathematicians, physicists and psychologists on large-scale system projects ranging from design through prototype engineering and subsystem development to test and evaluation of the total on-line system. The growing scope of MITRE's technological effort affords the opportunity to establish a rewarding professional career in one of these areas of long-term importance:

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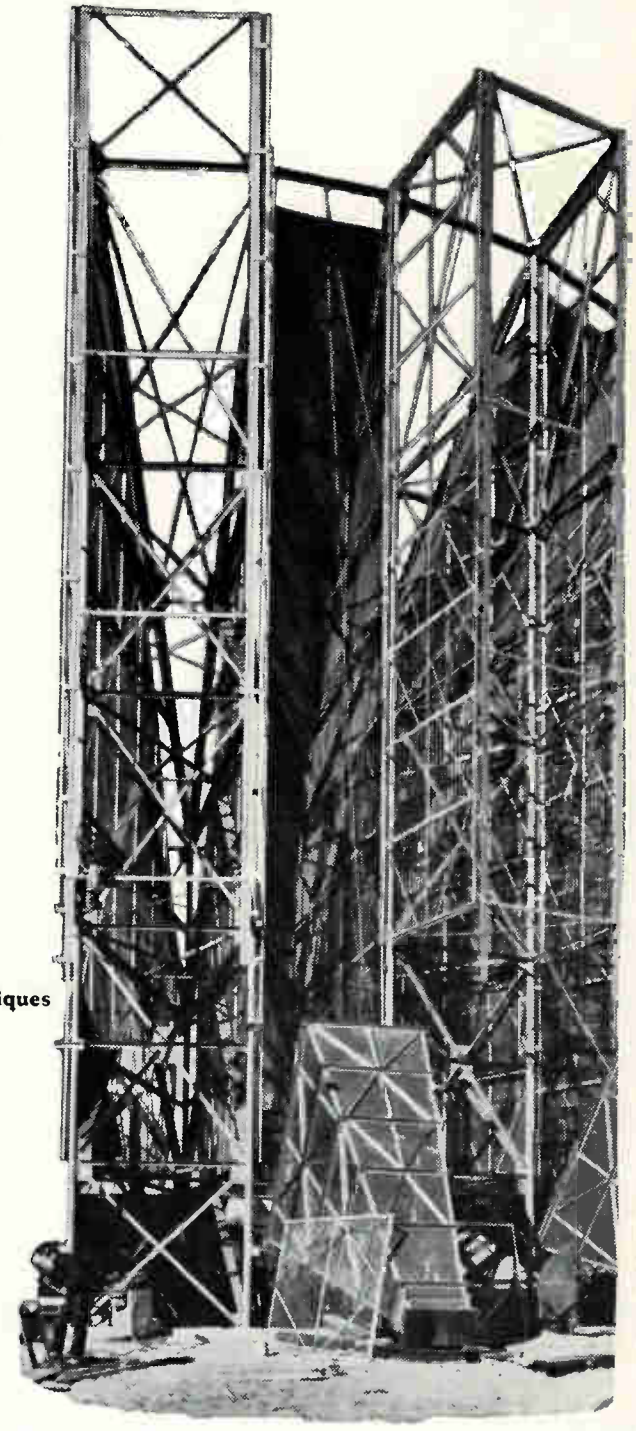
- **Advanced System Design**
- **Communications**
- **Radar Systems and Techniques**
- **Computer Programming**
- **Air Traffic Control Systems**



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Dana N. Burdette, Personnel Director

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A brochure more fully describing MITRE and its activities is available upon request.

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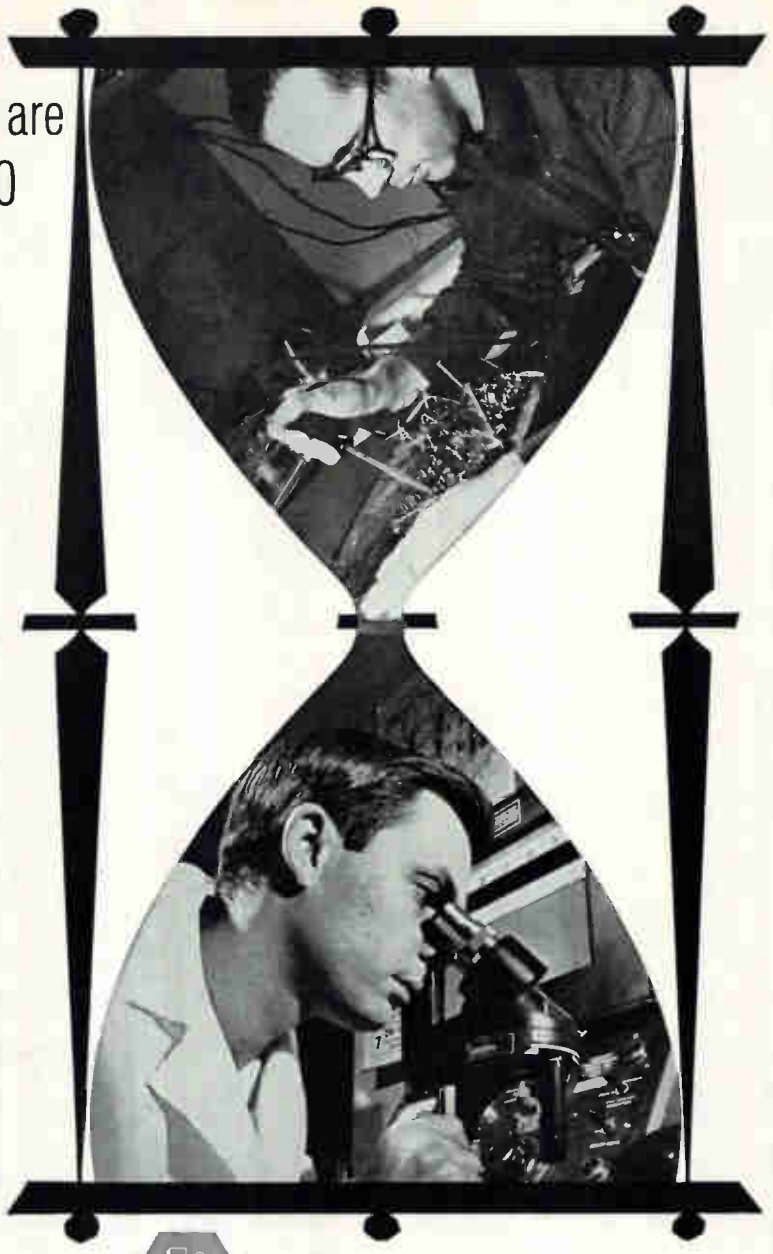

DEVICE DEVELOPMENT ENGINEER. *Mission:* Probing the unknown to evolve a variety of new advanced semiconductor-component devices.

CIRCUIT DEVELOPMENT ENGINEER. *Mission:* Discovering through experience and educated imagination, new uses for transistors and specialized semiconductor devices by exploring new frontiers in thought.

Device and Circuit Development Engineers we seek, want liberal freedom of thought and action and advanced physical facilities to permit maximum creative productivity. They desire broad and rapid expansion of their professional horizons with solid financial security and recognition matching personal achievements.

Our Device Development Engineer would be equally intrigued with studies in solid-state diffusion and nuclear radiation experimentation on semiconductor materials and devices. Our Circuit Development Engineer would be productively stimulated by participation in transistorization projects ranging from AM, FM and TV receivers to computer system logic.

You qualify as our Device Development Engineer if you hold a degree in Electrical Engineering, Chemistry or Physics and experience in semiconductor or related development areas. An Electrical Engineering degree and knowledge of transistor circuitry are required for Circuit Development Engineers.

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Interested scientists and engineers are invited to address inquiries to: Mr. E. E. Landefeld, Personnel Director.

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* * *

ELECTRONICS ENGINEER

with degree for product development and design. Two or more years experience required in microwave field, preferably with coaxial devices.

JUNIOR ENGINEER

with EE degree. RF connector experience and inclination for sales. Application engineering plus market forecasting, statistical sales data. Limited traveling.

You will be working in a clean, modern plant and be part of a growing team enjoying a liberal fringe benefit program.

Salaries open.
Submit detailed resume to F. C. Knudsen, Industrial Relations Mgr.

ipc DK

INDUSTRIAL PRODUCTS DANBURY KNUDSEN
A Div. of Amphenol Borg Elect. Corp.
DANBURY, CONNECTICUT

COMPUTING ENGINEER

$12,000

BSEE 6 years of computer experience and 6 years of general engineering experience. Desirable to have had courses in Digital Logic and Digital Circuits. Provide technical guidance and support on digital computers. Aggressive expanding strong concern in the east. Fees and expenses paid.

MONARCH PERSONNEL
28 E. Jackson Blvd., Chicago, Ill. Wa 2-9400

PROJECT ENGINEER

SALARY $14,000 PER YEAR

Will supervise infrared group. Physics degree preferred, and should be familiar with the state of the art on systems, components, techniques, etc. Any experience in noise analysis helpful. Company client will assume all employment expense.

ESQUIRE PERSONNEL, INC.
202 South State St., Chicago 4, Ill.

POSITION WANTED

Ton propulsion specialist with several years experience in research and development wants to change to leading company. PW-4134, Electronics, 520 N. Michigan Ave., Chicago 11, Ill.

MANUFACTURERS' REPRESENTATIVES

IN THE ELECTRONIC INDUSTRY

LINES WANTED
Territory Middle Atlantic States

NORMAN PORRECA
Serving The Industry 35 Years.
Barclay Building Bala-Cynwyd, Pa.

SEARCHLIGHT SECTION

(Classified Advertising)

BUSINESS OPPORTUNITIES

EQUIPMENT - USED or RESALE

DISPLAYED RATE
The advertising rate is $24.75 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request. An ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page. EQUIPMENT WANTED or FOR SALE ADVERTISEMENTS acceptable only in Displayed Style.

UNDISPLAYED RATE
$2.40 a line, minimum 3 lines. To figure advance payment count 5 average words as a line. BOX NUMBERS count as one line additional in undisplayed ads.

lab grade TEST EQUIPMENT for sale

standard brands—military surplus
(new or professionally reconditioned)
experienced problem solvers and budget-cutters

ENGINEERING ASSOCIATES
434 Patterson Road Dayton 19, Ohio

CIRCLE 460 ON READER SERVICE CARD

PLATING SPECIALISTS

for the
ELECTRONICS INDUSTRY
Gold, Silver, Nickel, Tin, Cadmium PLATING to any thickness.

PALUMBO BROS., INC.
347 Ferry St. Newark 5, N. J.
MArket 2-5060 • Est. 1915

CIRCLE 461 ON READER SERVICE CARD

LOOKING FOR

USED/SURPLUS ELECTRONIC EQUIPMENT/COMPONENTS?

For an up-to-date listing of such equipment see Searchlight Section of April 8th

Engineering Sales Manager

ABOUT THE POSITION:

Work with top echelon, blue-chip corporation executives and engineers on some of the most advanced electronic and electrical projects of our time. Complete responsibility for sales programming, execution and evaluation.

ABOUT THE COMPANY:

World's largest manufacturer of specialized high temperature insulation moterials. World's first producer of a vital synthetic mineral. Leoder in high reliability, mechonical switches. Located in metropolitan New York areo.

ABOUT YOU:

EE degree or strong electronics engineering background. Familiarity with insulation materials and telemetering experience desiroble.

If you can fill the challenging requirements of this executive position, please write immediately giving full details and salary desired

P-4047, Electronics
Class. Adv. Div.,
P. O. Box 12, N. Y. 36, N. Y.

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the specialty: ELECTRONICS

the field: HELICOPTERS

the openings: AVIONICS INSTRUCTORS
FIELD SERVICE REPRESENTATIVES

World's foremost designer and builder of helicopters now has openings for two types of specialists in the field of electronics.

AVIONICS INSTRUCTORS—Good opportunity for advancement available to men with a minimum of four years' experience in electronics and aircraft maintenance. Teaching background or a sincere desire to teach is essential.

Positions entail instruction of commercial and military customers in helicopter stabilization systems, Doppler radar, sonar, servomechanisms and electrical systems. Of paramount importance is a thorough understanding of flight controls, hydraulics, mechanics and electronics.

Occasional travel is required of men in these positions.

ELECTRONIC FIELD SERVICE REPRESENTATIVES—Unusually interesting career here for men with advanced electronics training and experience.

Previous helicopter experience desired but not essential.

Assignments require the ability to maintain and trouble-shoot all weather flight instrumentation and related systems. Maintenance requirements necessitate the ability to repair electronic discrepancies to the smallest repairable item and use of all types of electronic test equipment.

If you feel you qualify fully for either type of position outlined above, please send your resume to Mr. James L. Purfield.

SIKORSKY AIRCRAFT

One of the Divisions of United Aircraft Corporation

Stratford, Connecticut

SCIENTISTS / ENGINEERS

Which area of progress in Electronics interests you most?

With the outlook for the electronics industry in 1960 brighter than ever, a significant fact for career-conscious engineers is the breadth of opportunities at Electronics Park. Here General Electric research, development, design and manufacturing groups are actively engaged in almost every area of electronics—whether in the industrial, military, or entertainment fields.

A cross fertilization of products and talents characteristic of Electronics Park will help you advance along with the major advances in the electronics art.

Some of the many areas of research, development, and production at Electronics Park are listed to the right. Check your particular interest and mail the coupon to us today. Requirements for our current openings include a Bachelor's or Advanced Degree in Electronics, Physics, Mathematics, or Mechanical Engineering, and/or experience in electronics. All communications will be held in strict confidence.

GENERAL ELECTRIC

To: **GENERAL ELECTRIC COMPANY**
Electronics Park Div. 69-WO
Syracuse, New York
Att.: Technical Personnel Dept.

I am interested in

- ☐ Advanced Development
- ☐ Design
- ☐ Field Service
- ☐ Technical Writing
- ☐ Research

in the field of

- ☐ Military Radio & Radar
- ☐ Multiplex Microwave
- ☐ Semiconductors
- ☐ Electronic Components
- ☐ Computers
- ☐ Missile Guidance
- ☐ Television Receivers
- ☐ Industrial Television
- ☐ Antennae
- ☐ Defense Systems
- ☐ Underwater Warfare
- ☐ Broadcast Equipment
- ☐ Technical Products

NAME_____

ADDRESS_____

_____

DEGREE_____

INDEX TO ADVERTISERS

• See advertisement in the June, 1959 Mid-Month ELECTRONICS BUYERS GUIDE for complete line of products or services.

CLASSIFIED ADVERTISING
F. J. Eberle, Business Mgr.

ADVERTISERS INDEX

• See advertisement in the June, 1959 Mid-Month ELECTRONICS BUYERS GUIDE for complete line of products or services.

Advertising is Informative Too

Now and then an issue of an industrial magazine is made special to its readers as much by the advertisers as by the editors. It seems to us the March 11th issue of ELECTRONICS, heralding the IRE show of 1960, served up a fascinating diet to the subscriber on both counts.

We are proud of the editorial content of that particular issue. We are, in fact, pretty proud of our editorial record for the past several years. Here it is, in number of editorial pages published: 1956: 1,886, 1957: 2,633, 1958: 2,857 and 1959: 3,029. We'll publish even more in 1960.

Yet in a field as dynamic as ours advertising also plays a major role. The 226 pages of advertising in the March 11th issue contained thousands of pieces of information, thousands of statistics about thousands of new components, systems, instruments, materials and services.

These pages were bought by many advertisers, bought with the conviction that the contents were of value to YOU. The issue was a preview of what you might expect to see at the IRE show, and much more. If you didn't attend, they became your show in print — quite literally.

We hope sincerely you'll go back and look at the March 11th issue again. The information it contains can be useful and even vital to you.

Use the reader service card to acquire more information, or more specific data.

James Lindwood

PUBLISHER

For unmatched reliability . . . BOMAC BEACON MAGNETRONS

Life — up to 500 hours guaranteed — over 3000 hours reported
Frequency stability — less than 2 Mc drift per 100 hours (C band)
Power stability — drop of less than 1 db for constant voltage input
Duty cycle stability — less than 3 Mc frequency shift for a change in duty cycle of 0.00005 to 0.002 (C band)
Vibration — less than 2.5 Mc frequency shift from 55 to 2000 cps
Shock — withstands 100 g's of 6 millisecond duration
Lightweight — 7 to 10 oz.
Miniaturized
Tunable over a broad band

Band	Tube Type	Fixed Freq. or Tunable	Frequency Range Mc	Min. Peak Power Watts	Outptut Mates With
C	BL-212	Tunable	5400-5900	100	UG699/U
C	BL-243	Tunable	5400-5900	200	UG699/U
C	BL-242	Tunable	5400-5900	400	N
C	BLM-022	Tunable	5400-5900	500	TNC
C	BLM-026	Tunable	5400-4900	500	TNC
C	BLM-020	Tunable	5400-5900	700	TNC
C	BL-245	Tunable	5400-5900	900	TNC
C	BL-250	Tunable	5400-5900	150	TNC
X	BLM-003	Tunable	9000-9500	150	TNC
X	BLM-014	Tunable	8500-9000	150	TNC
X	BLM-012	Tunable	8900-9400	1000	TNC
X	BLM-021	Tunable	8900-9400	1000	UG40A/U
X	BLM-024	Tunable	9300-9500	150	TNC

New short form catalog available. Send for your copy today,

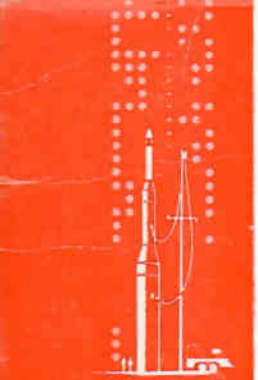
BOMAC laboratories, inc.

SALEM ROAD • BEVERLY, MASSACHUSETTS

Offices in major cities — A subsidiary of Varian Associates.

Leaders in the design, development and manufacture of TR, ATR, Pre-TR tubes; shutters; reference cavities; crystal protectors; silicon diodes; magnetrons; klystrons; duplexers; pressurizing windows; noise source tubes; high frequency triode oscillators; surge protectors.

VISIT US AT THE IRE SHOW — BOOTH #2710-2712



MISSILE GUIDANCE

EARLY WARNING SYSTEMS

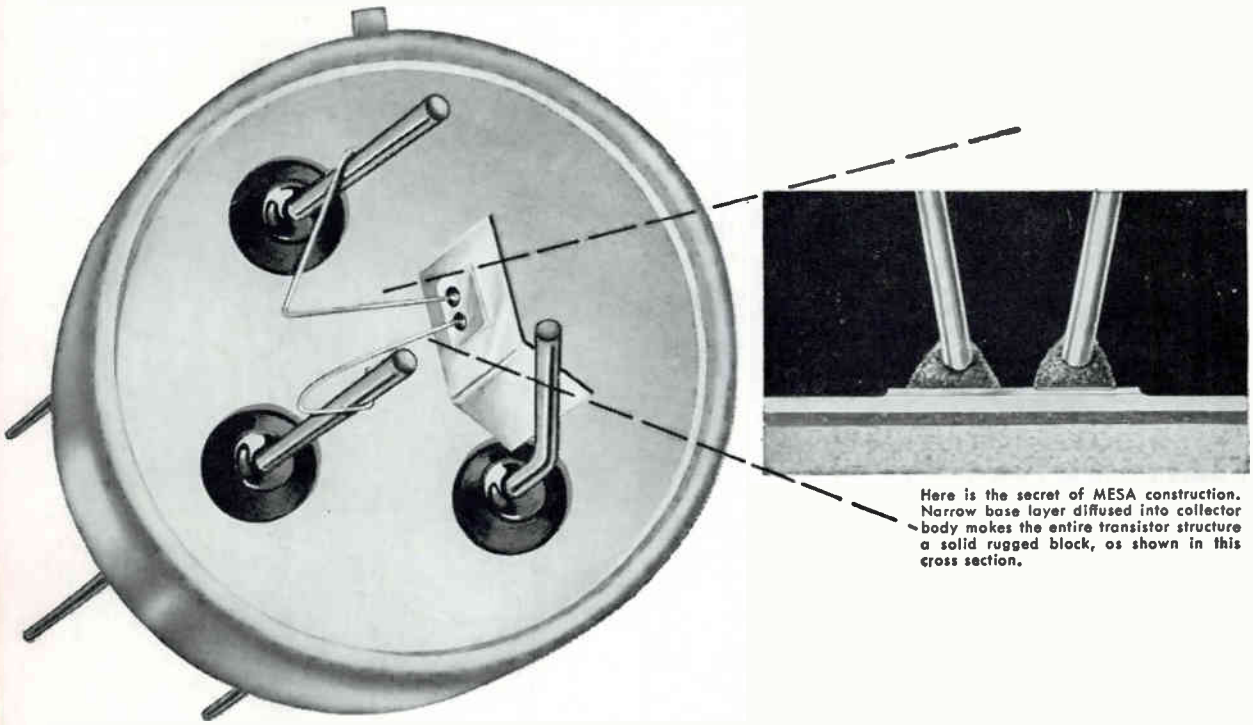
COMMERCIAL DATA SYSTEMS

FIRE CONTROL

MULTIPLEX SYSTEMS

SPACE EXPLORATION

Rugged all the way...inside and out



Here is the secret of MESA construction. Narrow base layer diffused into collector body makes the entire transistor structure a solid rugged block, as shown in this cross section.

RCA-2N1300 and 2N1301 MESA COMPUTER TRANSISTORS

Now you can see why RCA-2N1300 and 2N1301 germanium P-N-P diffused-junction Mesa computer transistors achieve and maintain top performance at high frequencies. From base to case, reliability is built in for today's high-speed switching applications.

Ruggedness and reliability are inherent in the RCA-2N1300 and 2N1301 Mesa Computer Transistors. They are specifically designed, constructed, and tested to assure extra dependability.

Through rugged Mesa construction RCA achieves the extremely narrow base-width necessary for switching speeds up to 10 Mc without sacrificing mechanical strength. Mesa construction provides high dissipation capabilities and assures long and dependable performance under the most severe *field* conditions.

RCA's diffused-junction process provides a flat, precise junction assuring exceptional uniformity of electrical characteristics from unit to unit. This diffused-junction process in combination with RCA's mesa-construction technique makes possible the high collector-breakdown-voltage and punch-through-voltage rating of these devices.

As a result of these features plus built-in ruggedness, the RCA-2N1300 and 2N1301 can meet the stringent mechanical and environmental requirements of the basic military specification MIL-T-19500A.

Call your RCA representative today and get the complete story on these low-cost extra reliable types. For further technical information, write RCA Commercial Engineering, Section D-19-NN-3, Somerville, New Jersey.

RADIO CORPORATION OF AMERICA
SEMICONDUCTOR AND MATERIALS DIVISION — SOMERVILLE, N. J.

ANOTHER WAY RCA SERVES YOU THROUGH ELECTRONICS

East: 744 Broad St., Newark, N. J., HUmboldt 5-3900 • Northeast: 64 "A" St., Needham Heights 94, Mass., Hillcrest 4-7200 • East Central: 714 New Center Bldg., Detroit 2, Mich., TRinity 5-5600 • Central: Suite 1154, Merchandise Mart Plaza, Chicago, Ill., WHitehall 4-2900 • West: 6355 East Washington Blvd., Los Angeles, Calif., RAymond 3-8361 • Southwest: 7905 Empire Freeway, Dallas 7, Texas, FLeetwood 7-8167 • Gov't: 224 N. Wilkinson Street, Dayton, Ohio, BAldwin 6-2366; 1625 "K" Street, N.W., Washington, D.C., District 7-1260

AVAILABLE THROUGH YOUR RCA DISTRIBUTOR