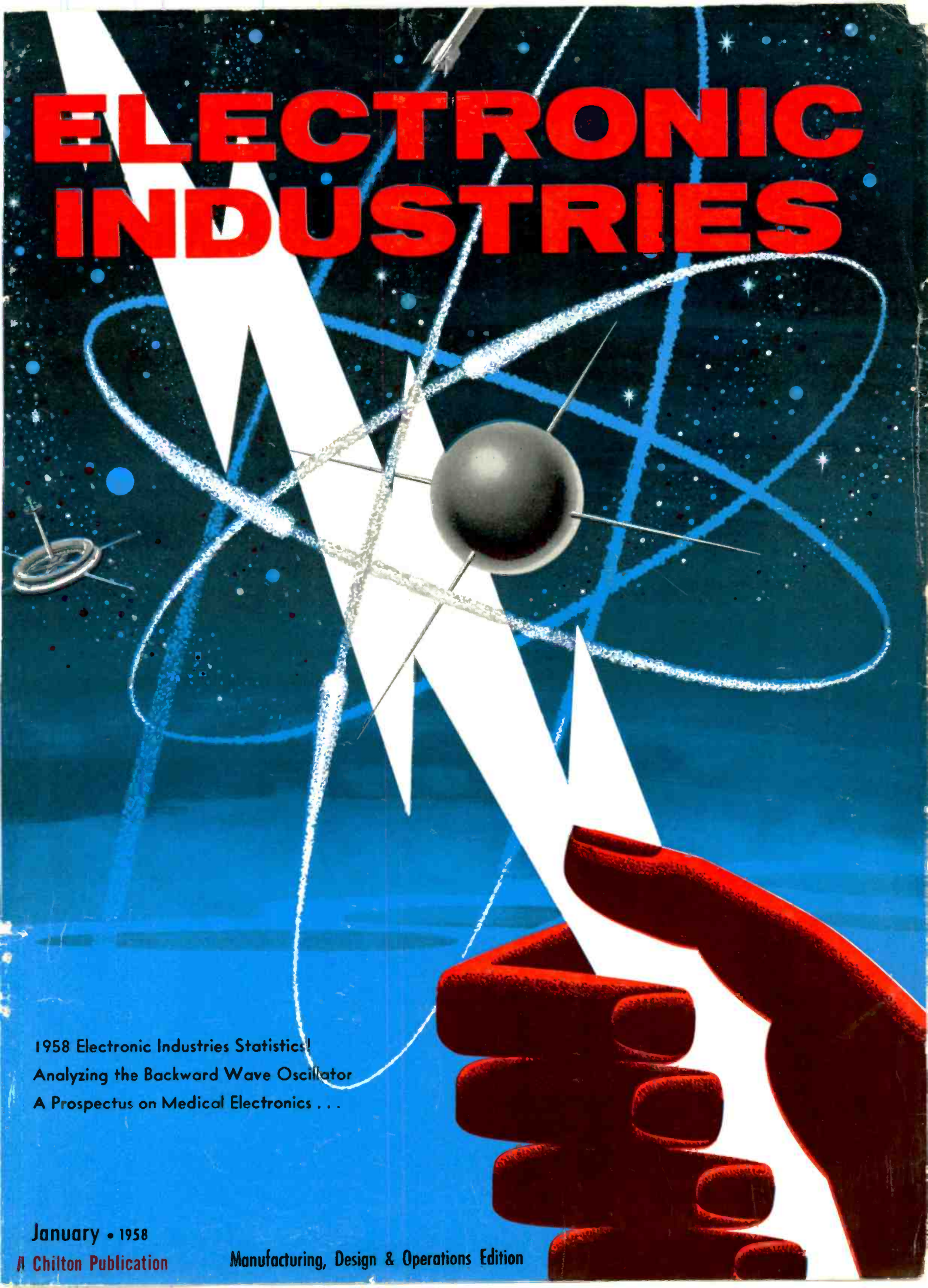
# ELECTRONIC INDUSTRIES



1958 Electronic Industries Statistics!

Analyzing the Backward Wave Oscillator

A Prospectus on Medical Electronics . . .

January • 1958

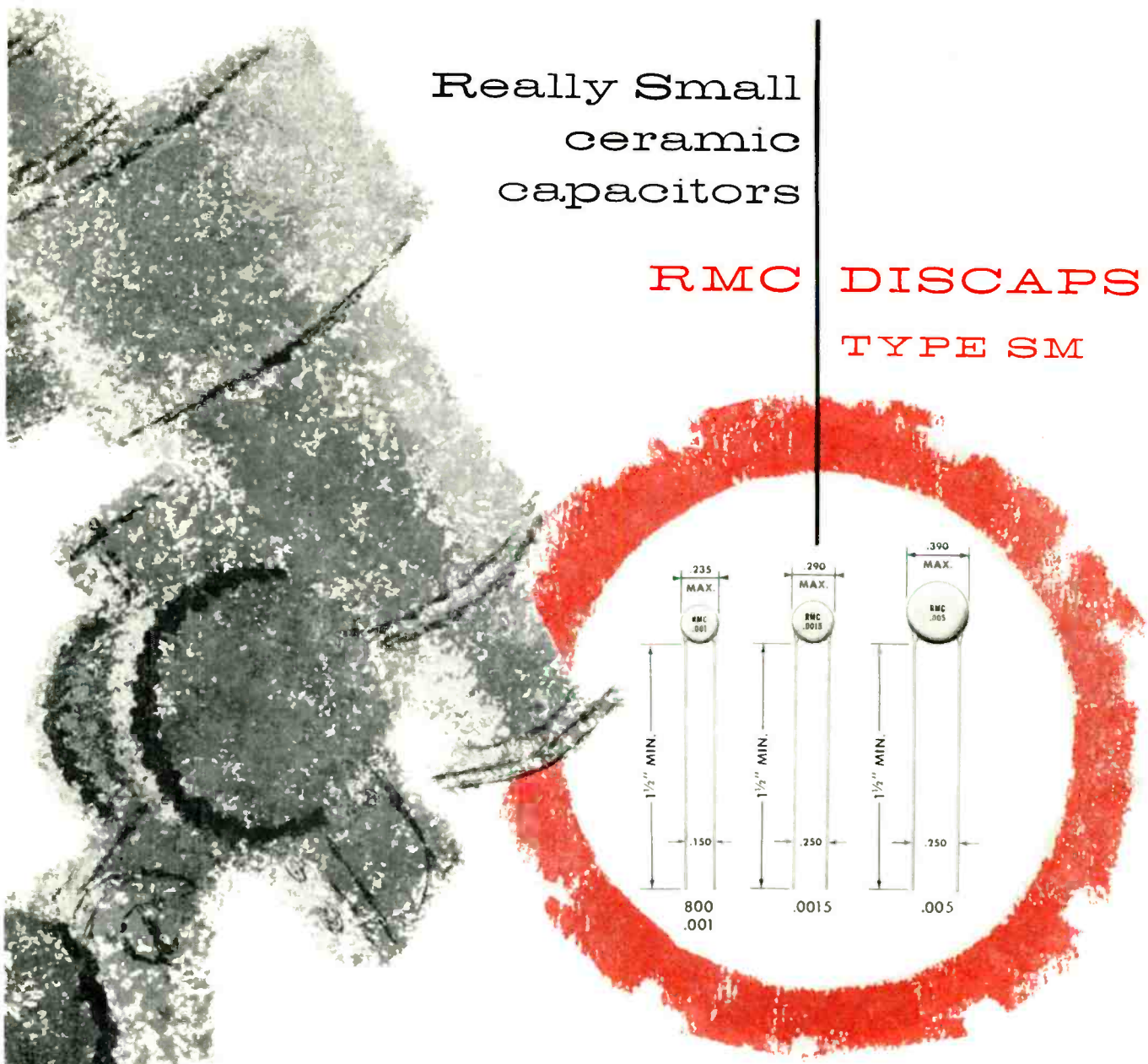
A Chilton Publication

Manufacturing, Design & Operations Edition

# Really Small ceramic capacitors

## RMC DISCAPS

### TYPE SM




## SPECIFICATIONS

**POWER FACTOR:** 1.5% Max. @ 1 KC (initial)

**WORKING VOLTAGE:** 500 V.D.C.

**TEST VOLTAGE:** (FLASH): 1000 V.D.C.

**LEADS:** No. 22 tinned copper (.026 dia.)

**INSULATION:** Durez phenolic ($\frac{1}{8}$" max. on leads)—vacuum waxed

**STAMPING:** RMC—Capacity—Z5U

**INITIAL LEAKAGE RESISTANCE:** Guaranteed higher than 7500 megohms.

**AFTER HUMIDITY LEAKAGE RESISTANCE:** Guaranteed higher than 1000 megohms.

Where space is at a premium, Type SM DISCAPS can be specified with complete assurance of the quality, dependability, and electrical performance built in all RMC DISCAPS.

These new DISCAPS meet the specifications of EIA RS-198 (revision REC-107-A) for Z5U ceramic capacitors and are available in values of 800, .001, .0015 GMV and .005 ±20%. SM DISCAPS show minimum capacity change between +10°C and +65°C.

Take a look (they're small but you really don't need a microscope) at Type SM DISCAPS. Write on your letterhead for samples and performance data.

DISCAP CERAMIC CAPACITORS

RMC

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

Circle 1 on Inquiry Card, page 103

# ELECTRONIC INDUSTRIES

Vol. 17, No. 1 January, 1958

## MONTHLY NEWS ROUND-UP



## NEW PRODUCTS & TECH DATA

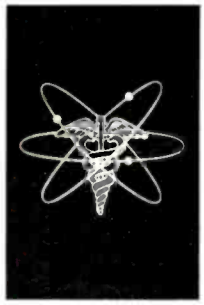


## DEPARTMENTS



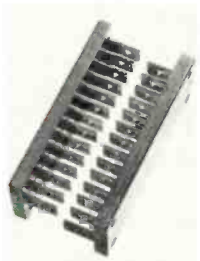
BPA NBP

### Medical Electronics P. 64



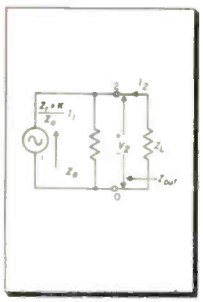
The medical field has need for a wide variety of equipment but manufacturing for the medical profession poses a number of unique problems unfamiliar to the electronics manufacturer.

### Microwave Techniques P. 72



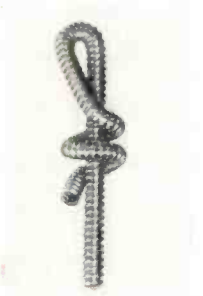
A look at the backward wave oscillator, the principle of operation and a step-by-step analysis of how oscillations are set up and maintained.

### Output Immittance! P. 61



Three basic theorems enable the engineer to analyze the linear networks encountered in transistor circuitry. They are also applicable to tube circuits.

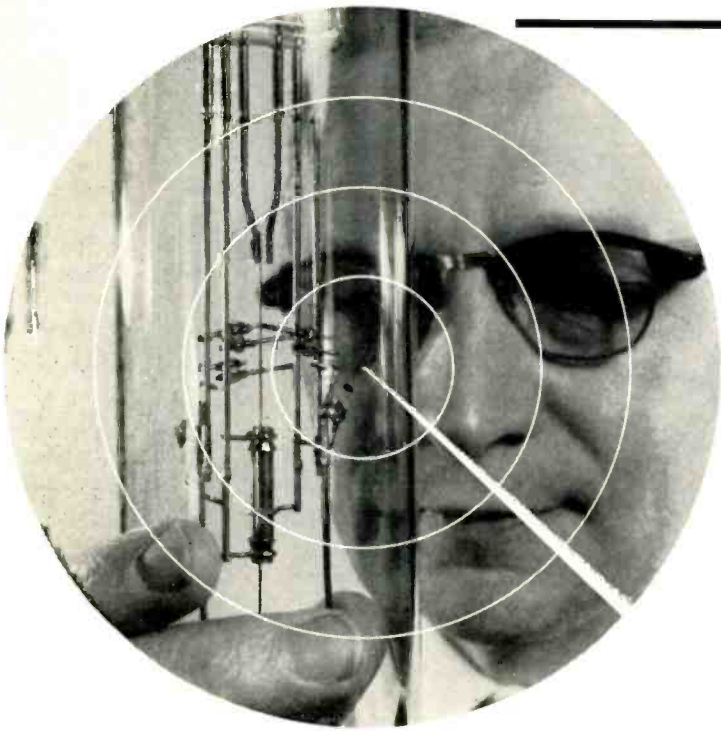
### Hi-Temp Coax Cable P. 81



As the first step in their search for coax cable to operate at 300° to 500°C. the Air Force has completed the most comprehensive study yet made of existing cables.

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

# RADARSCOPE



**HEAT ENERGY CONVERTER**

Dr. Volney C. Wilson inspects one of his experimental thermionic converters at the G. E. Research Lab. The new device has achieved an 8% efficiency in converting heat directly into electricity.

**JAPANESE ATTEMPT** to crack the U. S. transistor portable radio market was thwarted by a sudden drop in U. S. prices and a price war that developed among Nipponese manufacturers. At one point receivers were being imported at well below cost. Late in 1955 imports promised to mushroom but they now have dropped to a trickle.

**MOTION PICTURE STUDIOS** are the main driving force behind efforts to push toll TV, says NARTB president, Harold E. Fellows.

**CANADIAN ENGINEERS** are emigrating to the U. S. in large numbers. Almost one-third of the classes graduating between 1951 and 1956—about 3,000 engineers—have come to the U. S. And in the same period another 800 scientists have also emigrated.

**TECHNICAL INFORMATION** is being ground out in such staggering amounts that unless something is done by a central agency to file and cross-reference papers and articles as they are released we are in grave danger of losing much of the value of our engineering knowledge. One solution proposed last month to the Society of Technical Writers and Editors by Dr. Gilford G. Quarles was the use of computing machine techniques for quick tracing not only of a particular paper but also the pertinent paragraph relating to a subject.

**RUSSIAN ENGINEERS** are offered incentives far beyond their American counterparts. Their respective salaries buy approximately the same amount of goods but the Russian engineer's salary is 10-to-20 times that of the Russian workingman, while the American engineer is only twice as well off as the U. S. laborer. Which is the reason that Russian youngsters are easily persuaded to follow science as a career.

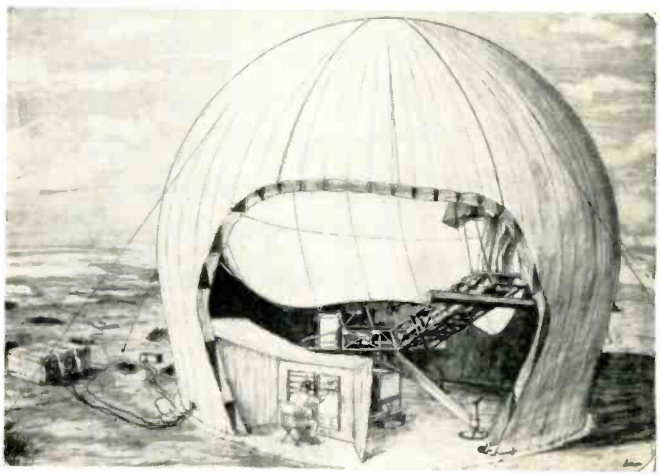
**ENCOURAGING PROGRESS** is reported by GE in their attempts to convert heat directly into electricity. While cautioning against predictions of early commercial use the GE scientists report that their experimental converters have already changed more than 8% of the applied heat energy into electric power. The thermionic converter uses two pieces of metal, heated to different temperatures, and contained in a gas environment. Electrons are boiled out of one of the metals and collected by the other.

**LOOK FOR** pressure to cut down the number of new tubes employing only minor modifications from existing designs. The replacement market now handles 735 different types of tubes, but 80% of total sales are confined to just 95 of these tubes. Sylvania's D. W. Gunn told JETEC last month that the rash of new tubes "has flooded the market and distribution channels with a galaxy of tube duplications representing endless loss of time and money."

**PREREQUISITE** to automation is a wholesale "powering up," increasing the electrical equipment to handle the power loads that will follow automatically with the installation of automatic equipment. In 10 years the power requirements are expected to increase by 40%.

**EARLY WARNING SYSTEM**

New highly portable "TEW" (tactical early warning) system designed for the Marine Corps by Sperry Gyroscope Co. is a combined long-range, search and height finding radar. The inflatable radome is heated or cooled as needed. Only one operator is needed.



**AIRCRAFT INDUSTRY** is looking to numerically controlled machine tools to handle the new hard metals now going into airframes. Stainless steel and titanium require up to seven times the machining time of conventional metals. Standards for these automatic controls are now being drawn up by 30 committees and subcommittees.

**THE FM RADIO COMMITTEE** of the National Association of Radio and TV Broadcasters has called on TV set manufacturers to incorporate FM tuners in their receivers. The group feels that the recent growth in FM stations, set sales and audiences indicates public demand for such a move. Adapters were just recently introduced to the market that enable TV sets to receive the FM broadcast band.

**AIR FORCE MISSILE PROGRAM** involves 22 industries, 17 prime contractors, 200 sub-contractors, 4,000 suppliers, and about 83,000 people.

**BATTLE IS SHAPING UP** between proponents of phonograph stereo discs and stereo tape recorders. Westrex (subsidiary of Western Electric) and London Records have already demonstrated stereo discs, and production has been tentatively promised within two years. In the meantime the tape recorder industry continues to produce stereo playback equipment in substantial quantities. In 1958 80% of the industry production will be in monaural-record stereo playback equipment. More than 90% of recorded tape produced in 1958 will be stereo and every major record label plans to enter the recorded tape business by the end of the year. There are an estimated 2.5 million tape recorders now in use.

## EDUCATION

**PHYSICS GROUPS** have banded together to do something about the quality and quantity of physics teaching in the U. S. A joint effort of the American Institute of Physics, the American Assoc. of Physics Teachers and the American Physical Society, with the support of the Fund for the Advancement of Education and the National Science Foundation, the program has for its aims:

1. To make the study of a basic course in physics a "must" for every secondary school student.
2. To encourage qualified young people to seek careers in physics.
3. To evaluate the feasibility of teaching physics to large numbers of students by the use of television and color motion pictures in spite of the great shortage of science teachers.
4. To assess the increasing need for physicists in a technological society and to strengthen physics instruction in high schools and colleges for non-science majors.

## ENGINEERING MANPOWER

Does an engineering shortage exist, or not? And if it does, why all the hysteria about the need for more engineers and scientists? Whichever side one took it was easy last month to find substantial facts to back up the argument. As far as the government is concerned there is a shortage right now, and it will become increasingly severe with time. Virtually all government installations are understaffed. At the same time a study carried out for the National Science Foundation reports that judging from the salaries paid engineers a shortage cannot be considered to exist. This view is bolstered by statistics from advertising circles that show that "engineer help wanted" advertising has fallen off severely in the last six months.

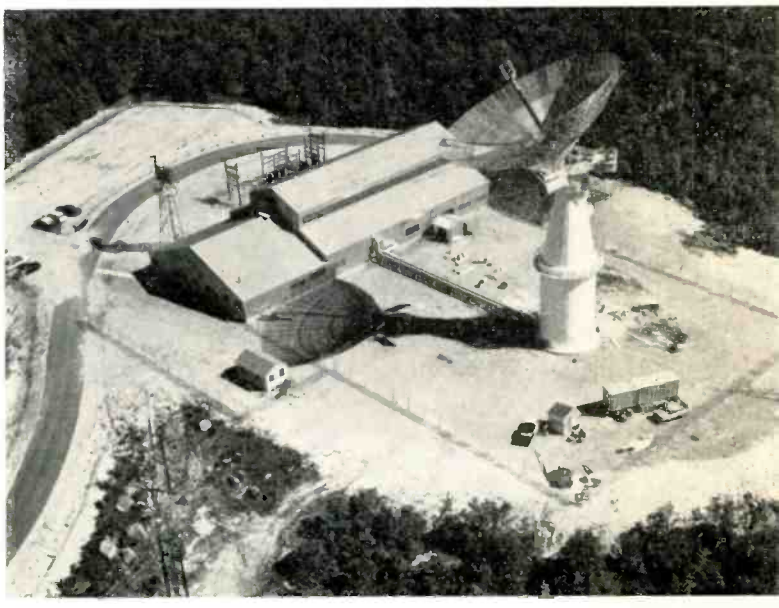
Dr. Guy Suits, GE's Director of Research, discounts reports of a shortage. Doubling or tripling the number of engineering graduates, he says, would be catastrophic; the most that industry can possibly absorb is a 25% increase.

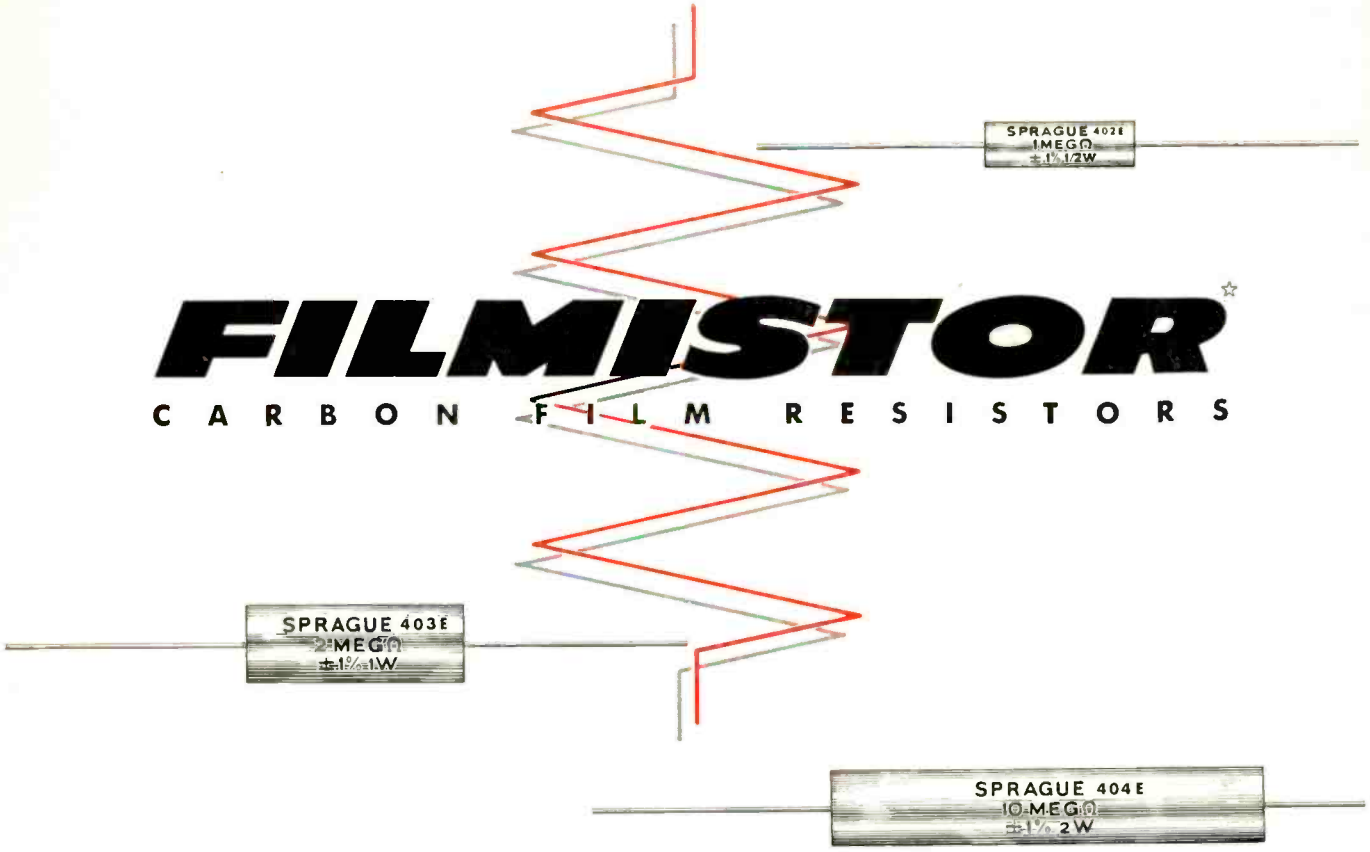
In New York last month 13 unemployed aircraft and missile engineers checked into the joint meeting of the American Soc. of Mechanical Engineers and the American Rocket Society armed with printed resumes and prepared for two days of intense job-hunting. One of the group said, "Let's face it. There's no shortage of engineers."

But at the same time the government was pushing through substantial pay raises for the more than 48,000 government engineers and scientists.

## LONG-RANGE RADAR

Lincoln Lab. of M. I. T. has just unveiled this high-powered long-range radar on Millstone Hill, Westford, Mass. The parabolic reflector is 84 ft. in dia., and is mounted on a concrete and steel tower 90 ft. high. Unit is tracking Sputniks I and II.



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# As We Go To Press...

## First Digital Computer For U. S. Air Force

The first airborne digital computer has gone into production at Hughes Aircraft Co. This miniature device can fly a jet interceptor through all phases of supersonic combat, from take-off to touchdown, leaving the pilot free to make tactical decisions.

"Digitair" is small enough to fit into the cabinet of a 21-inch table model TV set.

Working with coded information flashed to it by powerful ground control stations and the airplane's own radar, the computer simultaneously takes in 61 different types of information while putting out 30 types. In doing so it performs, or monitors, 17 separate navigation and flight control functions during a program cycle of 1.8 seconds, all at least once, some of them several times.

Operations include actuating the control surfaces to correct pitch and roll; commanding the pilot to increase or decrease his speed; maintaining constant check on available fuel and the distance the plane can fly on it under existing conditions; target range, azimuth and elevation information provided to the pilot; proper speed and altitude the pilot should fly in order to accurately intercept the target and, besides, a continuing check of its own accuracy and reliability.

COMPARISON

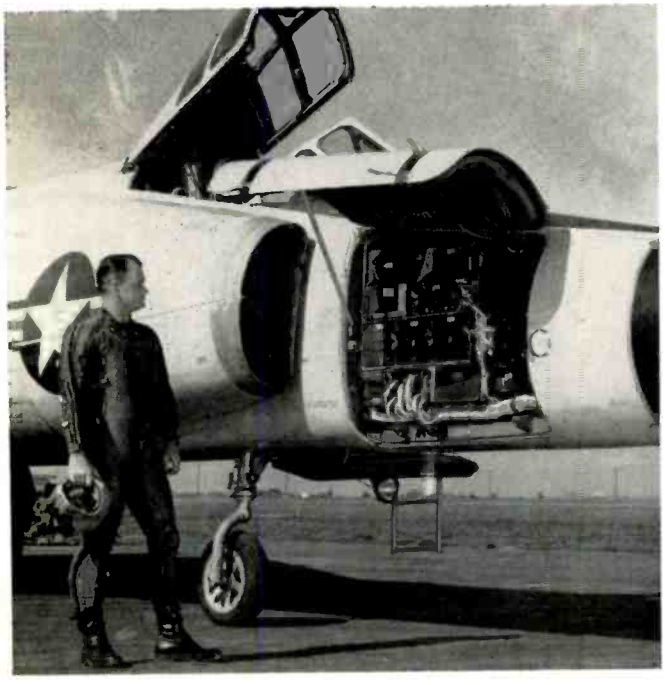
Dr. D. Ishikawa of Japan checks the Japanese standard for measuring microwave power with a similar U. S. instrument at NBS labs.

## High-Speed EDP System For Signal Corps Depots

Four widely separated Army Signal Depots begin operation this month of high speed data processing systems that will reduce Signal Corps record-keeping from days to hours.

The four depots, which will be linked to each other, and to the U. S. Army Signal Supply, Phila., are at Tobyhanna, Pa.; Lexington, Ky.; Decatur, Ill.; and Sacramento, Calif.

The processing systems are capable or handling 170,000 records and some 2,00,000 pertinent facts. Each can be readily expanded in case of an emergency requiring a quick speed up in the Army's electronics logistical effort.



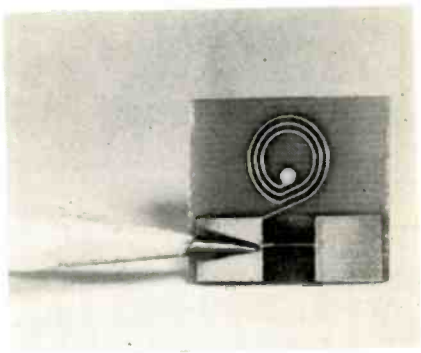
Test pilot inspects prototype test model of "Digitair," first airborne digital computer in actual production. Shown here installed in an F-102A all-weather interceptor, the computer is small enough to fit into a 21-inch table model TV cabinet.

More News On Page 10

## New For Computers, 'Twistor' and 'Persistor'

The computer art last month was introduced to two striking new storage devices, the "Persistor," a miniature bi-metallic printed circuit which operates at temperatures near absolute zero, and the "Twistor," a simple, easily fabricated device of specially processed magnet wire.

The "Persistor," according to its developers, the Ramo-Wooldridge Corp., Los Angeles, improves the computer access time 10 to 100 times over present methods. It consists of a printed circuit loop made of two metals, and maintained in a superconductive state. A critical amount of current will change one of the metals from its superconductive to its normal resistance state. A subcritical amount



"Persistor" consists of bi-metallic loop which is maintained near absolute zero

of current is induced in this loop, the direction of this current representing the information being stored.

The direction of the current is determined by impressing an interrogating a current pulse on the loop.

Developer Dr. Milton U. Clauser said that maintaining the low temperatures is no longer a problem in light of new advances in helium liquefiers.

The "Twistor," developed by Bell Labs, consists of a tiny coil of very fine magnet wire wound on a central conductor. The units are arranged in grids much like the familiar core array.

The name "Twistor" comes from a special torsion process which changes the wire's preferred direction of magnetication from a longi-

(*Continued on page* 13)

*for electronic and avionic devices*

# STEMCO® THERMOSTATS

*give you more of what you want most*

**FEATURES** such as snap or positive-action . . . various terminal arrangements or mounting provisions . . . different temperature ranges—there's a *standard* type Stemco thermostat for your *special* needs. That means you cut down on lead time, research and development costs, tooling and production inventory. Specify Stemco and you get *better thermostats, faster and for less* than you can make them or buy them elsewhere.

**SIZE** and weight are particularly important in avionic and electronic applications. And here Stemco thermostats score, too. Their compactness and lightness give a better product without sacrificing performance.

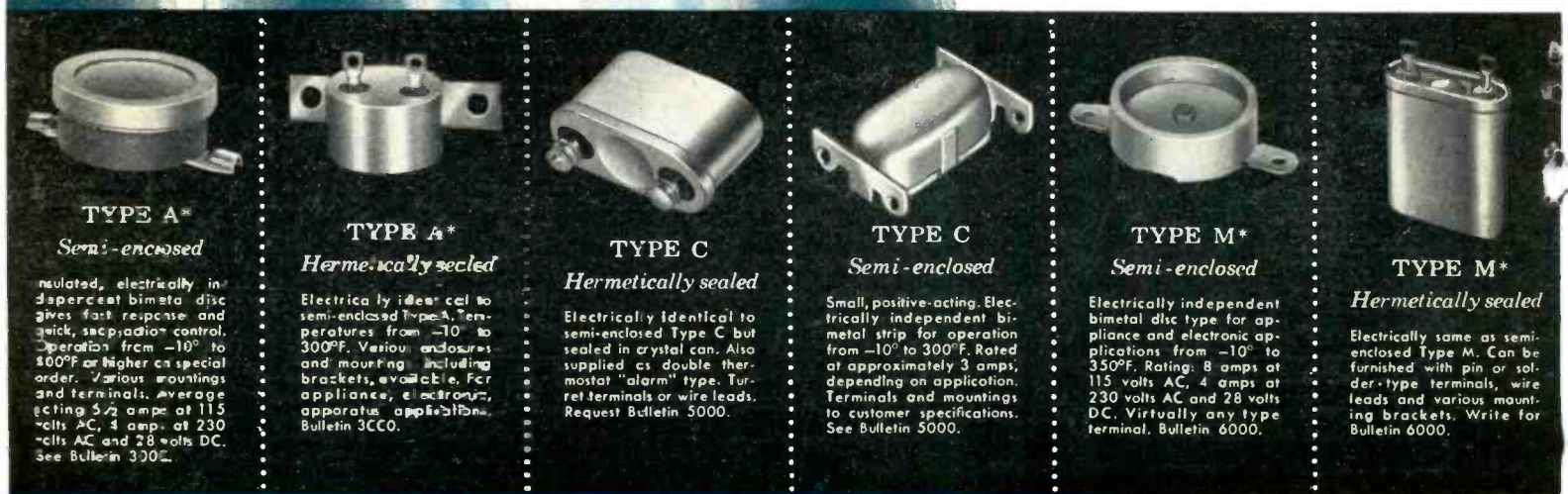
**ECONOMY** of mass production of many standard Stemco types with literally hundreds of terminal arrangements and mounting provisions means your product costs less to make.

**AVAILABILITY** of most types is good. Design is flexible for your special applications, tooling is in existence for short-term delivery. If heat control is your problem, Stemco thermostats can provide the answer.

AA-4092

**Refer to Guide 400 EO for U.L. and C.S.A. approved ratings.*

**STEVENS** *manufacturing company, inc.*
*Lexington and Mansfield, Ohio*



### TYPE A*
*Semi-enclosed*

nsulated, electrically in dsperceat bimeta disc gives fast response and quick, snap;adio control. Operation from –10° to 300°F or higher as special order. Various mountings and terminals. Average acting 5½ amps at 115 volts AC, 4 amps at 230 volts AC and 28 volts DC. See Bulletin 3002.

### TYPE A*
*Herme.ica'ly secled*

Electrica ly identical to semi-enclosed Type A. Temperatures from –10° to 300°F. Various enclosures and mounting including brackets, available. For appliance, electronics, apparatus applications. Bulletin 3CC0.

### TYPE C
*Hermetically sealed*

Electrically identical to semi-enclosed Type C but sealed in crystal can. Also supplied as double thermostat "alarm" type. Turret terminals or wire leads. Request Bulletin 5000.

### TYPE C
*Semi-enclosed*

Small, positive-acting. Electrically independent bimetal strip for operation from –10° to 300°F. Rated at approximately 3 amps, depending on application. Terminals and mountings to customer specifications. See Bulletin 5000.

### TYPE M*
*Semi-enclosed*

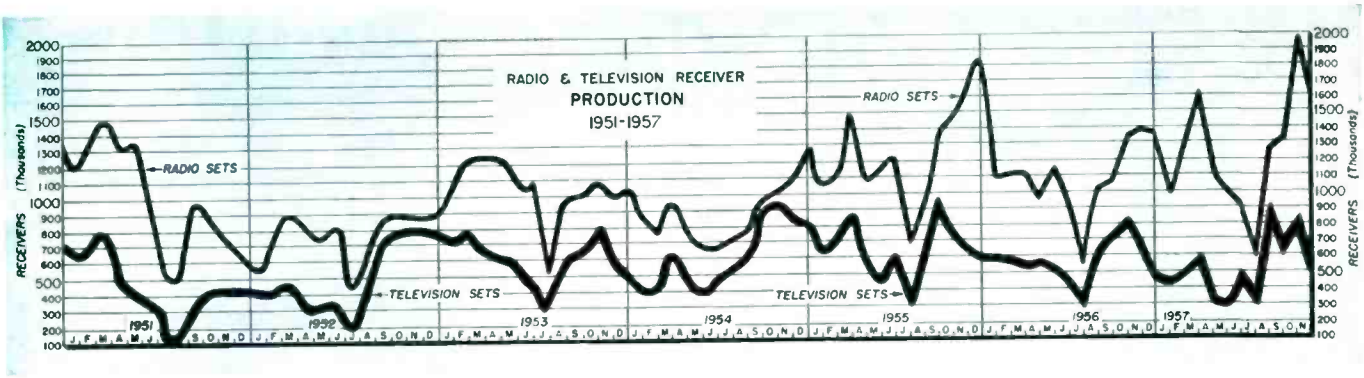
Electrically independent bimetal disc type for appliance and electronic applications from –10° to 350°F. Rating: 8 amps at 115 volts AC, 4 amps at 230 volts AC and 28 volts DC. Virtually any type terminal. Bulletin 6000.

### TYPE M*
*Hermetically sealed*

Electrically same as semi-enclosed Type M. Can be furnished with pin or solder-type terminals, wire leads and various mounting brackets. Write for Bulletin 6000.

**STEMCO® THERMOSTATS**

# TOTALS




## ELECTRIC POWER USAGE

| | 1956 | 1957 |
|---|---|---|
| Total Power Generated (billion kwhr) | 601 | 636 |
| Sales of Electricity (billion kwhr) | 530 | 561 |
| Average annual use per residential customer (kwhr) | 2969 | 3164 |

An additional 85 billion kwhr was generated by industrial and railway plants to bring the total generated in the USA to 721 billion kwhr.

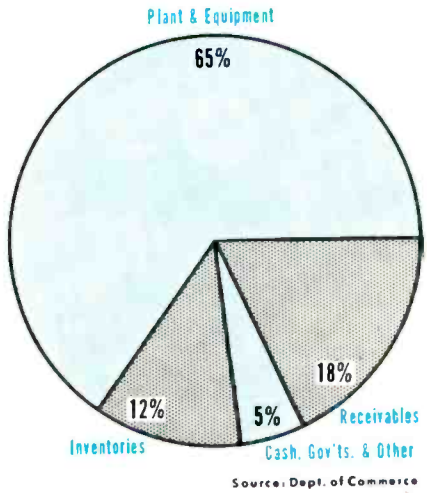
| | 1957 | 1958 |
|---|---|---|
| New construction (million kw) | 8.5 | 16.25 |

The installation of new generating facilities in 1958 will exceed the previous high record of 1955 by almost 4 million kw, and is about equal to the total net installations of the ten years between 1937 and 1947.

SALES OF ELECTRICITY—1956-1957
(billion kwhr)

| | 1956 | 1957 |
|---|---|---|
| Industrial | 277 | 285 |
| Residential | 134 | 147 |
| Commercial | 88 | 95 |
| Others | | 34 |

## USES OF CORPORATE FUNDS
1947-56




Source: Dept. of Commerce

Customers of the electric industry totalled 55,175,000 at the end of 1957, a gain of 1,180,000 over the preceding year. Over 98% of occupied homes, both urban and rural, have been connected for electric service.

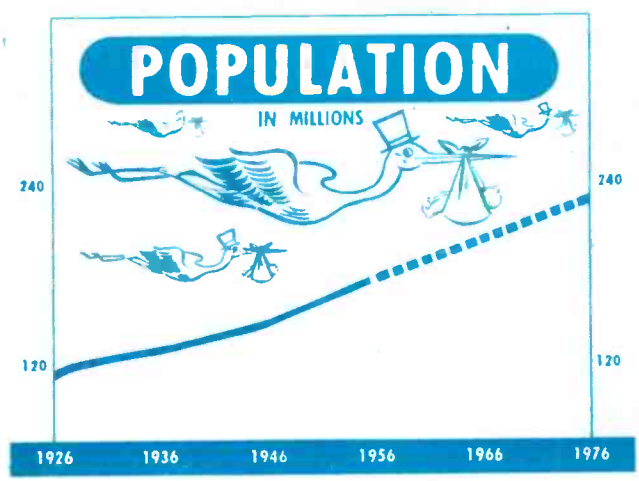
*Source—Edison Electric Institute*

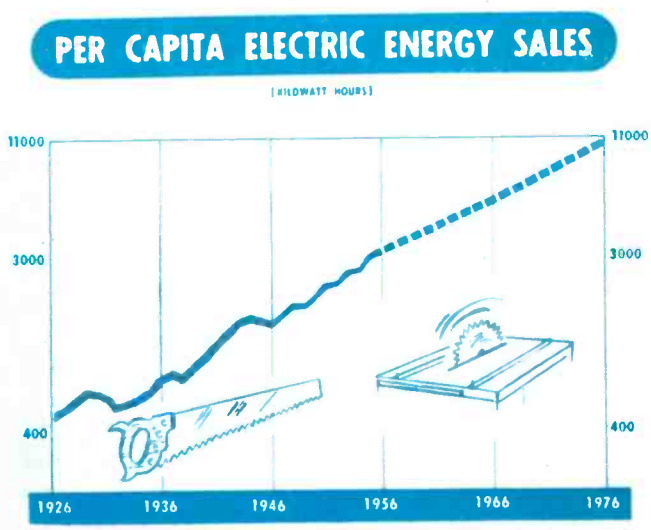
## GOVERNMENT ELECTRONIC CONTRACT AWARDS

*This list classifies and gives the value of electronic equipment selected from contracts awarded by government agencies in November 1957.*

| | |
|---|---|
| Accelerometers | 36,863 |
| Amplifiers | 121,704 |
| Antennas & Accessories | 227,779 |
| Batteries, Dry | 127,759 |
| Batteries, Storage | 336,203 |
| Calibrators | 25,466 |
| Capacitors | 48,561 |
| Computers & Accessories | 433,902 |
| Loudspeakers | 29,852 |
| Meters, Ohm | 33,250 |
| Meters, Volt | 37,701 |
| Oscilloscopes | 98,067 |
| Radar Equipment | 341,995 |
| Radio Receivers | 666,252 |
| Radio Receivers-Transmitters | 122,353 |
| Radio Sets | 100,000 |
| Recorders & Accessories | 26,510 |
| Relays | 167,276 |
| Resistors | 92,000 |
| Switches | 144,900 |
| Tape, Recording | 26,610 |
| Test Sets | 568,238 |
| Tests Sets, Radar | 433,292 |
| Transformers | 70,632 |
| Transistors | 134,000 |
| Tubes, Electron | 941,160 |
| Waveguide & Accessories | 27,790 |
| Wire & Cable | 509,828 |

*—From an address to Edison Electric Inst. on 4/3/57 by E. J. Klock, Marketing Services, G. E. Co.*



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One of the Publications Owned and Published by CHILTON COMPANY

Address all mail to Chestnut & 56th Sts., Phila. 39, Pa. SHerwood 8-2000

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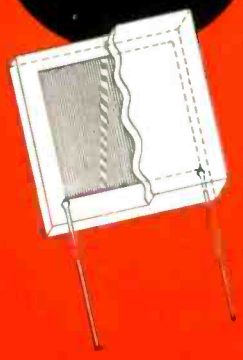

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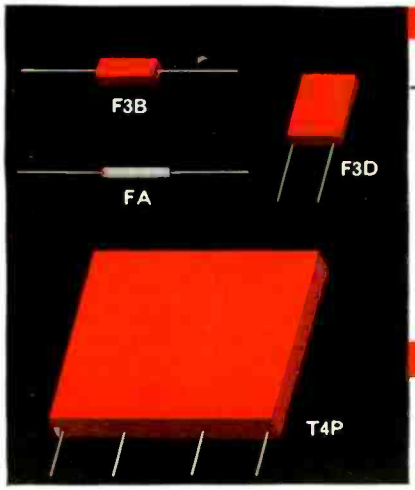
# Bobbinless PRECISION WIRE FIXED Resistors

## *Featuring Unique CTS "Floating" Element*

Another CTS "first". New patented winding process permits resistance elements and contacts to be firmly embedded in epoxy resin, forming a monolithic mass. No bobbin or winding form is used. Wire strain is eliminated.

Burton Browne Advertising

- Exceptional Stability—Permanent change in resistance less than 0.2% under most environmental conditions.
- Guaranteed Close Tolerance—Resistors guaranteed to be in tolerance under normal conditions of measurement. Tolerances down to ± 0.05% available in standard sizes depending upon resistance value. Closer tolerances or matched multiples available on request.
- Low Inductance and Low Capacitance Characteristics with reproducible uniform frequency response.
- Less than 0.2% resistance change with humidity (MIL-R-93 moisture resistance test).
- Less than 0.2% resistance change with temperature cycling (MIL-R-93).
- Withstands extreme vibration and shock due to unique construction and encapsulation method.
- Extremely Stable—Less than 0.3% resistance change with load life or 100% overload (MIL-R-93).
- Low Temperature Coefficient Wire available.




| Wattage | Dimensions (Inches) | Resistance (Ohms) | CTS Type Number |
|---|---|---|---|
| **RECTANGULAR** | | | |
| 0.25 | 3/4" x 3/16" x 1/4" | 1.0-10,000 | F3B |
| 0.25 | 3/4" x 3/16" x 3/8" | 1.0-100,000 | F3C |
| 0.25 | 3/4" x 3/16" x 1/2" | 0.5-100,000 | F3D |
| 0.25 | 1" x 3/16" x 1/4" | 0.5-100,000 | H3B |
| 0.5 | 1" x 3/16" x 3/8" | 0.1-100,000 | H3C |
| 0.5 | 1" x 3/16" x 1/2" | 0.1-200,000 | H3D |
| 0.75 | 1" x 3/16" x 3/4" | 0.1-300,000 | H3F |
| 1.0 | 1" x 3/16" x 1" | 0.1-400,000 | H3H |
| 1.5 | 1-1/2" x 3/16" x 1" | 0.1-600,000 | L3H |
| 2.0 | 2" x 3/16" x 1" | 0.1-1,000,000 | P3H |
| Special | 2-1/2" x 1/4" x 2" | 0.1-2,500,000 | T4P |
| **TUBULAR** | | | |
| 0.1 | 3/4" x 1/8" | 10-5,000 | FA |
| 0.5 | 1" x 1/4" | 0.5-25,000 | HB |
| 0.5 | 1" x 3/8" | 0.1-250,000 | HC |
| 1.0 | 1-1/4" x 1/2" | 0.1-1,000,000 | JD |

Special dimensions, tolerances, wattage ratings, etc. can be made to your exact specification. Either axial or radial leads available on all rectangular types.

*Write for further details today.*

Founded 1896

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Phone: Penn. 6-8239

Circle 5 on Inquiry Card, page 103

## Portable "TEW" Line For Marines

A new, highly portable, tactical early warning (TEW) system is being developed by Sperry Gyroscope Co. to satisfy the Marines' requirement for helicopter transportable equipment, adaptable to rapidly changing tactical situations in any environment.

The new AN/MPS-21 long-range, search and height finding system—the first of comparable size and weight—can be quickly transported by helicopter, cargo-type aircraft, truck or amphibious vehicle. The system may be brought into operation in a battle area within a two-hour period.

A compact "V-beam" antenna, developed for the system by Sperry's Microwave Electronics Div., using special molding techniques, superimposes both search and height-find radar paraboloidal-shaped "dishes" into a single antenna. The face of each reflector is energized in such a manner to produce a composite, simultaneously transmitted radar beam consisting of a vertical beam for search and slant beam for height finding.

The dome-like radar antenna shelter, designed by Birdair Structures, Inc., resembles in appearance the permanent radomes used on the DEW line. The transportable MPS-21 system, however, uses an inflatable, dual wall, air-mattress-like radome. It is cooled or heated as needed.

## Norris To Govt. Post

Sam Norris, president and chairman of the board of the Nuclear Corp. of America Inc., has been named Assistant Director, Electronics Division, of the Business and Defense Services Administration, U. S. Dept. of Commerce. Mr. Norris will be on loan to the BDSA from his company, and will serve without compensation from the government.

## 'Blast' Parts Into Shape

The Aircraft industry is experimenting with a new method of forming extra-tough metals. They believe that titanium and alloy steels can best be handled by using explosive charges; the metal is punched or formed "before it knows what happens." These metals are so tough that they cannot be handled by conventional presses or rams.

More News on Page 13

# ELECTRONIC SHORTS

**A contract for the production planning of facilities for the U. S. Army Ionizing Radiation Center to be built at Sharpe General Depot, Lathrop, Calif. has been awarded to Irradiated Products, Inc. IPI was formed for the purpose of undertaking the radiation enterprise, the first and most comprehensive pilot-production-size food radiation facility in the world by 4 stockholder-companies representing major areas of the food business: Armour & Co., Continental Can Co., Food Machinery and Chemical Corp., and General Food Corp.**

More than 100 scientists, both American and foreign, attended a recent 4-day workshop held by Varian Associates in the labs and lecture rooms of that company's new instrument building. Purpose: to learn more about the operation and application of nuclear magnetic resonance and electron power magnetic resonance spectrometers. Like conventional spectroscopy, these radio frequency units are used to identify the constituents of a sample but with finer distinctions and without destroying the sample.

**The Electrical Insulating Materials Assoc. has been formed for the purpose of disseminating practical information about the properties and uses of electrical insulating materials. This association will provide a means of establishing better communications in the electrical and electronics industries, specifically on the application of these materials.**

The Radiation Effects Information Center has been established by the USAF at Battelle Memorial Institute. Reason: to gather and disseminate data concerning the effects of nuclear radiation on materials and systems which may be required in aircraft of the future. The Center will compile, evaluate, and summarize all pertinent data and make it available to those designated by the Air Force. Coordinator of the Center is Battelles C. B. Voldrich.

**The Navy has awarded a $548,700 contract for 133 small-boats radars to the Raytheon Mfg. Co. The new equipment, a modification of Raytheon's commercial radar "Mariners Pathfinder," permits the Navy for the first time to economically place radar on small amphibious landing craft. The radars will enable small craft, LCPL (personnel) and LCV (vehicle) to navigate safely through uncharted or dangerous waters by providing needle-sharp, high definition targets on a 10-in radar scope. Navigational hazards also will appear on the scope.**

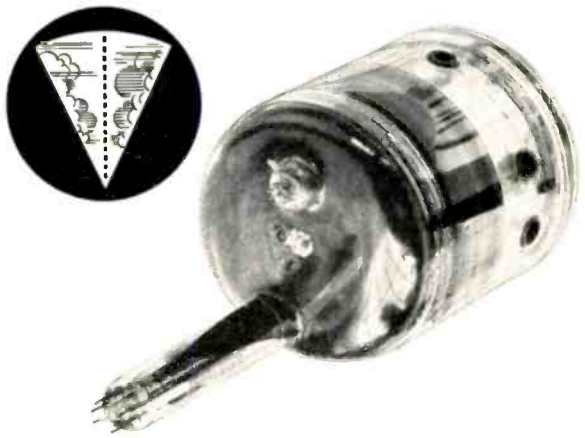
The USAF will begin construction of a missile site at Francis E. Warren AFB, Wyoming during the middle part of calendar year 1958. The construction of facilities required to support the missile program is estimated to cost in excess of $65-million at this one air base.

**The Civil Aeronautics Administration has opened up the continental United States airspace above 24,000 ft. to pilots desiring CAA traffic control service. Up to now, CAA has offered such service only on the 100,000 miles of designated Federal airways and around some major terminals. Over huge areas like the Grand Canyon, pilots had to rely entirely on "see and be seen" as a means of separation. This is a first stage in the CAA program to improve air traffic control system for the civil jet age.**

A tenfold extension in the range of radar has been brought about through a new method of sending and receiving signals. Work was done by a team of Columbia University physicists. The new radar can distinguish echoes more rapidly over much greater distances and with much less power. The system separates weak signals from background electrical "noise," and amplifies them, broadcasting a continuous stream of microwaves, instead of pulses, and analyzes the incoming signal.

**Airlines lack the earning power and financial strength to serve the public adequately and to finance new jet equipment, according to Mr. Donald N. McDonnell, chairman of the Aviation Securities Committee of the Investment Bankers Assn. Mr. McDonnell, quoting from an 8-man committee report to investment bankers who have financed the growth of aviation, charged that the CAB rate regulation restrictions are responsible.**

...applied to weather radar



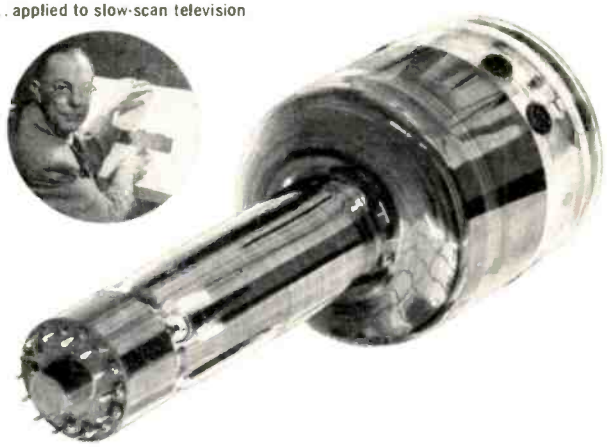
**MAGNETIC DEFLECTION 5" DIAMETER**

Representative applications: plan position indicator information; slow-scan television. (Complies with Aeronautical Radio, Inc. specifications.)

Announcing the...

# HUGHES FAMILY OF TONOTRON* DISPLAY TUBES

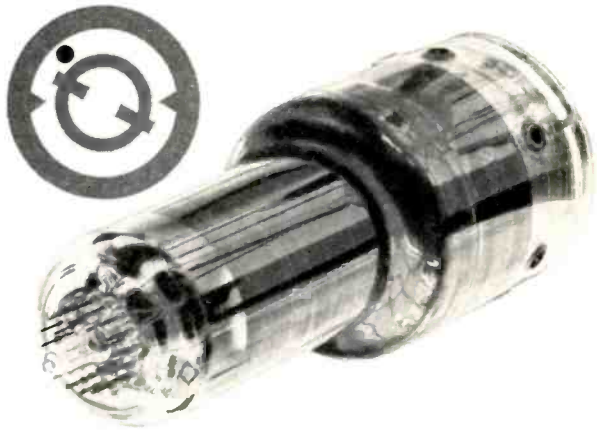
...applied to slow-scan television



**ELECTROSTATIC DEFLECTION 5" DIAMETER**

Representative applications: "B" scan radar, oscillography, armament control radar.

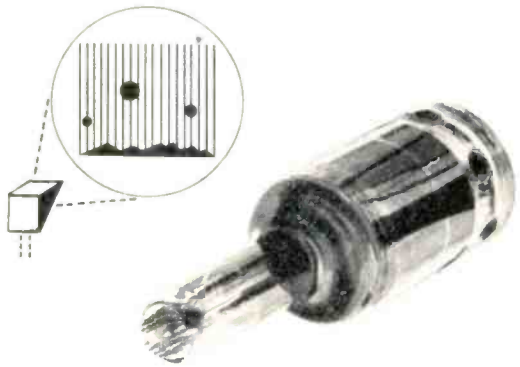
...applied to complex radar systems



**ELECTROSTATIC DEFLECTION 5" DIAMETER**

With two writing guns. Representative applications: multiple "B" scan radar, oscillography, and armament control radar.

...applied to "B" scan projection



**ELECTROSTATIC DEFLECTION 3" DIAMETER**

Representative applications: optical projection systems, miniature radar indicators.

High brightness, multiple halftones, superior storage uniformity, controllable persistence, and compact design are the outstanding characteristics of the Hughes TONOTRON electron tube. All TONOTRON tubes present a complete scale of grey shades for high-fidelity picture reproduction. Hughes offers the only complete line of cathode-ray storage tubes, including the infinite persistence tubes—TYPOTRON® Type 6577 (character-writing storage tube) and the MEMOTRON® Type 6498 (oscillograph storage tube).

Complete technical information—specifications, operating characteristics, suggested circuitry, etc., will be sent you on request. Write: HUGHES PRODUCTS, Electron Tubes, International Airport Station, Los Angeles 45, California.

Creating a new world with ELECTRONICS

## HUGHES PRODUCTS

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Circle 6 on Inquiry Card, page 103

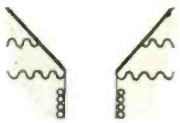
# *Indisputably the Finest!*

# UNIVERSITY'S NEW 315-C 3-WAY 15" DIFFAXIAL


*This speaker protected by U. S. Patent nos. 2,641,329; 2,690,231; 2,751,996 and other patents pending.*

## THESE ARE THE REASONS WHY

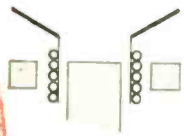
Exclusive self-stabilized woofer cone structure and dual spider construction ensure lifetime centering of moving system, for all extreme excursions.



University-controlled processing of imported cone pulps results in consistently uniform, distortion-free response.

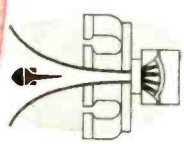
Exclusive, massive flux-contoured 6 pound Gold Dot Alnico 5 magnet provides efficient power drive for deepest low frequencies, free of transient distortion.

Extra-long voice coil ensures purity of maximum low frequency energy conversion during periods of extreme cone excursion.



Exclusive University-formulated long polymer lattice permeates rim suspension for effective acousto-mechanical rim damping.

True through-axial construction permits balanced tweeter, mid-range and woofer acoustic integration without design compromise.

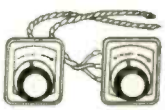


Exclusive hypersonic tweeter incorporating radial phasing equalizer automatically balances all high frequencies for smooth, realistic reproduction.

Exclusive "reciprocating-flare" horn now has wave front equalizer for more uniform wide-angle treble coverage.

Exclusive multi sectional Diffusicone provides controlled diffraction for linear mid-range response and dispersion.

Continuously variable dual control network integrates and blends mid-range and tweeter for concert realism regardless of room acoustics.



**Response:** 25 cps to inaudibility; **Power capacity:** 50 watts, integrated program; **Total magnet wt.:** 6½ lbs. Alnico 5; **Impedance:** 8-16 ohms; **Depth:** 12"; **User net:** $156.00.

UNIVERSITY LOUDSPEAKERS, INC., 80 SO. KENSICO AVENUE, WHITE PLAINS, N. Y.

LISTEN *University® sounds better*

## As We Go To Press . . .

### Computer Elements

(*Continued from page 5*)

tudinal to a helical path. Information is inserted into the wire by using the coincidence of the circular field and the longitudinal magnetic field of the central conductor. The magnetic wire itself is used as the sensing means.

A. H. Bobeck tests the memory characteristics of the "Twistor" at Bell Labs

The speed of operation and output of the "Twistor" are comparable to ferrite memory systems. But the manufacturing of memory devices reportedly becomes much more economical using "Twistors."

### Fink New IRE President

Donald G. Fink, Director of Research of the Philco Corp., has been elected president of the Institute of Radio Engineers for 1958, succeeding John T. Henderson of the National Research Council, Ottawa, Can.

Carl-Eric Granqvist, Director of Svenska Aktiebologet Gasaccumulator, Stockholm-Lidingo, Sweden, becomes IRE vice-president.

**ARMY "HUT"**

An easily assembled lifting device simplifies the Army's task of raising this Craig Helicop-Hut to level of truck bed. Shelters are designed to house complete radar, microwave or other installations

### Electronic Scanning For "Fastest Printer"

Electronic scanning and the light sensitivity of selenium have been combined into the world's fastest printer, Stromberg-Carlson's SC-5000, demonstrated last month.

The new printer will print the output of electronic computers at 4,680 lines (about 65 ft) per min, five to ten times faster than the speed of present electro-mechanical printers.

The system is designed around two unique devices, an electronic display tube which forms and projects the figures to be printed and a new selenium coated printing drum which is the heart of the high-speed xerographic printing method used in the system. The Haloid Co. was primarily responsible for the design of the printing equipment.

The figures to be eventually printed are first formed in S-C's Charactron tube by an electron beam passing through an aperture shaped in the form desired. Once the beam has been "extruded" to shape it is deflected to the proper position on the display tube.

From the display tube the figures are focussed on to a revolving drum coated with light sensitive selenium, leaving a pattern of charges corresponding to the material to be printed. The surface is then dusted with a charged powder and the excess quickly removed. Powder clings to the charged areas, duplicating the figures to be printed. The pattern is transferred to paper through a magnetic attraction.

### FTC Says Tube Firm Sells 'Rejects' As New

The Federal Trade Commission charged last month that Rad-Tel Tube Co., 604 Market St., Newark, N. J. is misrepresenting "rejects" as first quality radio tubes.

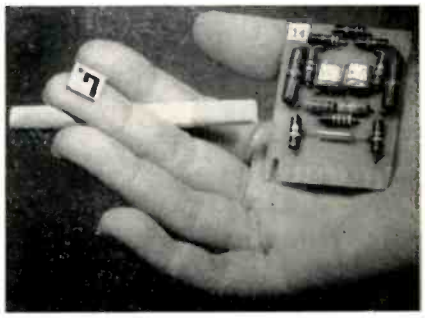
Though the firm's advertisements specify that their tubes are brand new, the FTC complaint says that the tubes are not first quality but are seconds which tube manufacturers have rejected. Neither the cartons in which the tubes are packed nor the firm's invoices disclose the true nature of the tubes, says the commission.

A hearing is scheduled Feb 4, 1958 in N.Y.C.

### "Printed" Transistors For Army Equipment

Army electronic equipment may be reduced to 1/10th the present size through a new method of printing transistors developed at Diamond Ordnance Fuze Laboratories.

The transistors produced by the new method are 1/20th in. wide and 1/100th in. high. When printed on a board together with printed components, a highly shock



Transistor is tiny dot on printed circuit

resistant circuit is produced which lends itself well to automatic production.

Technically the new method of producing transistors starts with a tiny wafer of germanium. Photosensitive film provides precise positioning masks on a ceramic plate for the pin-point electrodes of the transistor. The electrodes are formed by vapor deposit.

The process was invented by Dr. J. W. Lathrop and James R. Nall of Diamond Ordnance Fuze Laboratories.

**LONG-LIFE LAMP**

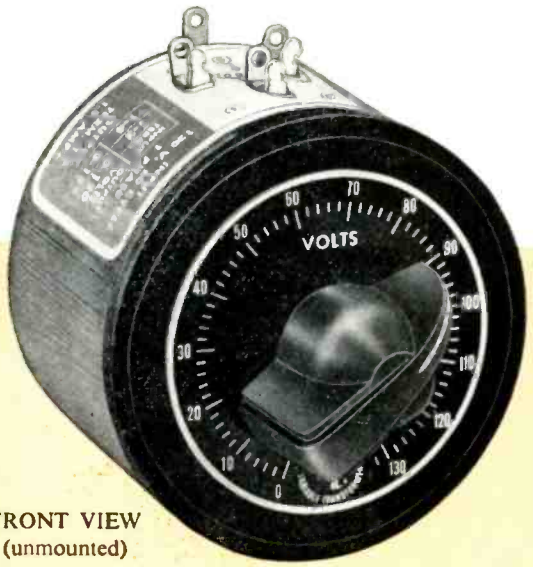
GE president Ralph J. Cordiner lights replica of Edison's first practical incandescent lamp at GE Lab, Schenectady, N. Y. Special memorial lamp will burn for over a century. Observers are Dr. W. D. Coolidge (1) and Dr. Guy Suits, GE director of research.

More News on Page 15

# INDUSTRY'S MOST ADVANCED DESIGN!

*(Patent No. 2,790,882)*

**OHMITE®**
**V.T.**
**VARIABLE Transformer**




FRONT VIEW
(unmounted)

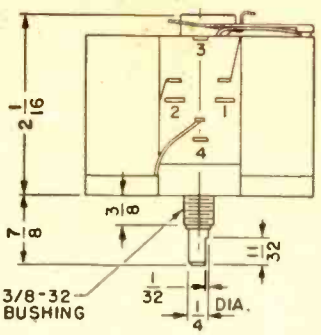
## MORE CAPACITY FOR EQUAL SIZE

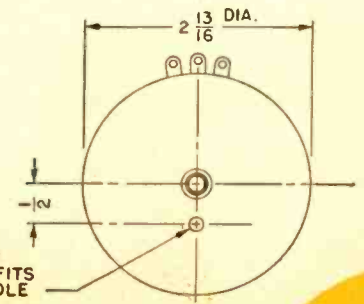
MODEL VT1R5—1.5 AMPERES. The rating of 1.5 amperes represents a continuous current rating at any brush setting even at full overvoltage! This "bonus" in current capacity is the result of a unique core design by Ohmite. This new component from Ohmite is made to the same high standards as the famous Ohmite resistors, rheostats, and other components. Other models in larger sizes will be announced soon.


Direct reading dial is calibrated to 120 on one side—132 on the other, for line or overvoltage connections respectively.

In addition to its greater capacity for equal size, the new Ohmite VARIABLE TRANSFORMER, representing industry's most advanced design, features the following quality features:

- *Heavily Plated Rhodium Brush Track* . . . Generous, nonoxidizing plating assures unsurpassed life under demanding conditions.
- *Positive Current Transfer* . . . The contact arm carries no current in this unit! A pigtail shunts the current from the brush, directly to a large copper-graphite slip ring which contacts a large area of the terminal. The spring-like contact arm provides its own completely independent pressure.
- *Rugged INTERNAL Stop* eliminates possibility of damage to contact arm and brush due to application of torque at rotation limits.
- *Ceramic Hub* . . . Mounts and aligns the contact arm, provides 3000 volts ac insulation between parts at line potential and shaft.




AVAILABLE FROM STOCK:
SPECIFICATIONS—MODEL VT1R5
INPUT VOLTAGE—120V, 60 CYCLE.
MAX. OUTPUT AT ANY BRUSH SETTING—1.5 AMPS. OUTPUT VOLTAGE—0-132—0-120.
ANGLE OF ROTATION—320°.
Includes knob, reversible dial plate, washer and nut.
Tandem assemblies available soon.

BACK VIEW

WRITE FOR BULLETIN 151

OHMITE V.T. VARIABLE TRANSFORMER

**OHMITE®** QUALITY Components

RHEOSTATS • RESISTORS • RELAYS •
TAP SWITCHES • TANTALUM CAPACITORS •
VARIABLE TRANSFORMERS

**OHMITE MANUFACTURING COMPANY**
3662 Howard Street, Skokie, Illinois

## Signal Corps Tests New Radio Terminal

An air-transportable radio communications terminal with an antenna that inflates like a balloon is being evaluated at the U. S. Army Electronic Proving Ground, Ft. Huachuca, Ariz. The unit will provide beyond the horizon communications for fast-moving tactical groups.

The equipment can be completely packed in two metal "huts" that serve as shelters when the station is erected. They would be carried in transport aircraft, or by motor vehicles.

The "Transhorizon" method provides extremely reliable UHF radio communication for ranges of 50-150 miles without relays. Up to 12 voice or 96 teletypewriter messages can be transmitted or received simultaneously at the single station.

Two 15 ft. dish antennas are used. The inflatable portion of the antenna consists of two pieces of plastic fabric clamped together at a hoop-shaped girder to form an enclosed envelope. The rear piece of fabric is coated with aluminum to reflect the radio energy.

A motor-driven blower inflates the antenna in about 12 minutes and then maintains the pressure.

## New TV Is 10 In. Deep

Sylvania introduced a new ultra-slim 21 in. TV console last month, the "Sylouette," that is housed in a cabinet only 10 in. deep.

The slimness is achieved by a "floating picture" design that projects the 110° picture tube out four inches from the cabinet.

### NUCLEAR REACTOR

R. Marcott and E. Lodi demonstrate American Machine & Fdry. Co.'s nuclear reactor control console at the recent Nuclear Show at New York's Coliseum. AMF is a leading mfr. of educational reactors.

# Coming Events

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

**Jan. 6-8: 4th National Symp. on Reliability & Quality Control, IRE; at Hotel Statler, Washington, D. C.**

**Jan. 7: Annual Business Mtg., Veteran Wireless Operators Ass'n; New York, N. Y.**

**Jan. 13-15: Annual Conv., NARDA; Conrad Hilton Hotel & Merchandise Mkt., Chicago, Ill.**

**Jan. 14-15: Yankee Instrument Fair & Symp. ISA; Hotel Bradford, Boston, Mass.**

**Jan. 22-24: Conf. on Automation, by EIA; at Arizona State College, Tempe, Ariz.**

**Jan 27-28: Scintillation Counter Symp., IRE, AIEE, AEC & NBS; Shoreham Hotel, Washington, D. C.**

**Jan. 27-30: 11th Annual Symp. on Modern Methods of Analytical Chemistry; at Louisiana State Univ., Baton Rouge, La.**

**Jan. 27-30: Plant Maintenance & Engineering Show; International Amphitheater & Palmer House, Chicago.**

**Jan. 27-31: 26th Annual Mtg., IAS; Hotel Sheraton-Astor, New York, N. Y.**

**Feb. 10-14: Committee Week, by American Soc. for Testing Materials; at Hotel Statler, St. Louis, Mo.**

**Feb. 20-21: Conf. on Transistor & Solid State Circuits, by IRE; at Univ. of Pennsylvania, Philadelphia, Pa.**

**Feb. 20-21: 14th Annual National Wiring Promotion Conf.; Statler Hotel, Detroit, Mich.**

**Feb. 20-24: Industrial Relations Conf., by EIA; at Town & Country Hotel, San Diego, Calif.**

**Mar. 11-13: 8th Annual Conf. on Instrumentation for the Iron & Steel Industry; at Roosevelt Hotel, Pittsburgh, Pa.**

**Mar. 16-21: Nuclear Engineering & Science Conf., IRE, ASME, EJC & ANS; Chicago, Ill.**

**Mar. 24-27: IRE National Convention; at Waldorf-Astoria Hotel & Coliseum, New York, N. Y.**

**Mar. 25-28: Packaging Machinery & Materials Expos.; at Convention Hall, Atlantic City, N. J.**

**Mar. 26-28: American Power Conf.** Illinois Inst. of Tech.; Hotel Sherman, Chicago, Ill.

**Mar. 27-29: Electrical Industry Show;** Shrine Exposition Hall, Los Angeles, Cal.

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

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

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

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

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

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

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

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

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

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

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

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

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

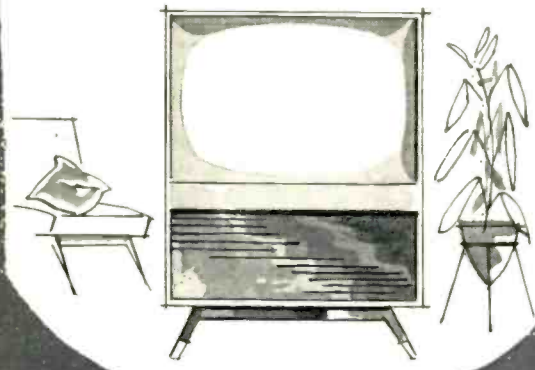
**May 12-14: National Aero & Navigational Electronic Conf., IRE; at** Dayton, O.

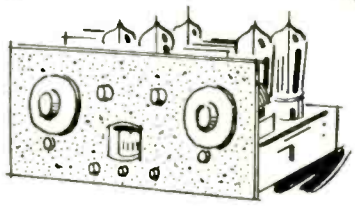
**May 19-21: 1958 Electronic Parts Distributors Show;** Conrad Hilton Hotel, Chicago 3, Ill.

Abbreviations:

**ACM**: Association for Computing Machinery
**AIChe**: American Institute of Chemical Engineers
**AIEE**: American Inst. of Electrical Engrs.
**ANS**: American Nuclear Society
**ASME**: American Society of Mechanical Engineers.
**EJC**: Engineers Joint Council
**EIA**: Electronic Industries Assoc.
**IAS**: Inst. of Aeronautical Sciences
**IRE**: Institute of Radio Engineers
**ISA**: Instrument Society of America
**PACE**: Producers of Associated Components for Electronics
**WCEMA**: West Coast Electronic Manufacturers Association

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

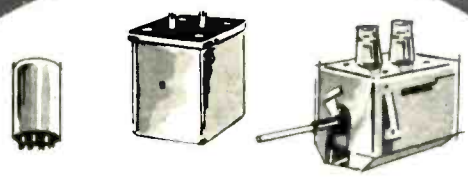




FROM PRIMITIVE "TRF'S" TO THE HIGHEST OF THE "FI" . . . the earphone era to the most modern of radios.

# KESTER SOLDER

COMPANY • 4210 WRIGHTWOOD AVENUE • CHICAGO 39, ILLINOIS
NEWARK 5, NEW JERSEY • BRANTFORD, CANADA



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

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

POLARAD *IN ACTION*

PROVEN RELIABILITY

# MICROWAVE SIGNAL GENERATION

## Complete Coverage 650 to 11,500 mc.

Each Polarad Microwave Signal Generator is equipped with the unusually simple UNI-DIAL control that tracks reflector voltages automatically while tuning continuously. Frequency, accurate to ±1%, is read directly on the single frequency dial. These rugged instruments include internal modulation, pulse and FM; internal square wave modulation; synchronization outputs, delayed and undelayed; provision for multi-pulse modulation input; provision for external modulation and synchronization; variable attenuator calibrated directly in dbm; engineered ventilation to insure specification performance over long operating periods.

SIGNAL GENERATORS

650 mc

11,500 mc

L BAND

S BAND

C BAND

X BAND

650

1,000

2,000

3,000

4,000

5,000

6,000

7,000

8,000

9,000

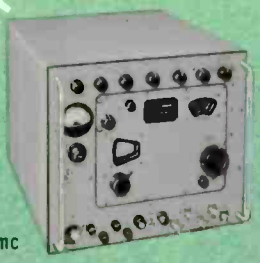
10,000

11,000

11,500

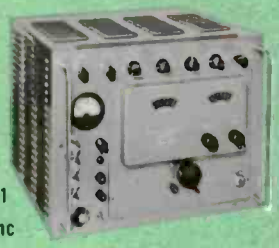
Model MSG-4A
6,950-11,500 mc

Model MSG-34
4,200-11,000 mc



Model MSG-3
4,450-8,000 mc

Model MSG-2
2,150-4,600 mc



Model MSG-1
950-2,400 mc

Model SSX-A*
7,850-10,750 mc

Model SSM-A
4,450-8,000 mc

Model SSS
2,140-4,600 mc

Model SSL
1,050-2,250 mc

Model SSR
650-1,300 mc

SIGNAL SOURCES

These Polarad Microwave Signal Sources are direct reading and continuously tuned with Polarad's UNI-DIAL control that automatically tracks the reflector voltage as the klystron cavity is being tuned. Maximum power output is assured throughout the entire range of each instrument by means of a power set control.

For improved stability, a klystron tube is in an external precision cavity. All Polarad Signal Sources can be externally modulated with either square wave or FM signals.

*(Model SSX-E 7,850-11,500 available on special order)

# MICROWAVE SIGNAL GENERATION

## Complete Coverage

## 12,400 to 50,000 mc

### EHF Microwave Signal Generators

- A completely integrated self-contained signal generator covers 12,400 to 17,500.
- 7 plug-in r-f tuning units and a basic unit cover the frequency range from 18,000 to 39,700 mc.
- Direct-reading calibrated output attenuator, accuracy ± 2 db.
- Frequency calibration accomplished by a ± 0.1% direct-reading wavemeter.
- Internal 1000 cps square-wave modulation.
- Capable of external modulation, both pulse and FM.
- Equipped with integral electronically-regulated power supplies.

SIGNAL GENERATORS

50,000 mc

12,400 mc

50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
12,400
12,000

K BAND

KU BAND

Plug-In Tuning Unit
Model G3540-1
35,100-39,700 mc

Plug-In Tuning Unit
Model G3336-1
33,520-36,250 mc

Plug-In Tuning Unit
Model G3033-1
29,700-33,520 mc

Basic Unit
Model HU-2 and
Plug-In Tuning Unit
Model G2730-1
27,270-30,000 mc

Plug-In Tuning Unit
Model G2427-1
24,500-27,500 mc

Plug-In Tuning Unit
Model G2225-1
22,000-25,000 mc

Plug-In Tuning Unit
Model G1822-1
18,000-22,000 mc

Model SG-1218
Signal Generator
12,400 to 17,500 mc

Plug-In Tuning Unit
Model S4150-1
41,700-50,000 mc

Plug-In Tuning Unit
Model S3742-1
37,100-42,600 mc

Plug-In Tuning Unit
Model S3540-1
35,100-39,700 mc

Plug-In Tuning Unit
Model S3336-1
33,520-36,250 mc

Basic Unit
Model HU-1 and
Plug-In Tuning Unit
Model S3033-1
29,700-33,520 mc

Plug-In Tuning Unit
Model S2730-1
27,270-30,000 mc

Plug-In Tuning Unit
Model S2427-1
24,500-27,500 mc

Plug-In Tuning Unit
Model S2225-1
22,000-25,000 mc

Plug-In Tuning Unit
Model S1822-1
18,000-22,000 mc

Model SS-1218
Signal Source
12,400-17,500 mc

SIGNAL SOURCES

### EHF Microwave Signal Sources

- A completely integrated self-contained signal source covers 12,400 to 17,500 mc.
- 9 plug-in r-f tuning units and a basic unit cover the frequency range from 18,000 to 50,000 mc.
- Internal 1000 cps square-wave modulation.
- Capable of external modulation, both pulse and FM.
- Equipped with integral electronically-regulated power supplies.
- Frequency calibration accomplished by a ± 0.1% direct-reading wavemeter.


**POLARAD ELECTRONICS CORPORATION**

**43-20 34th St., Long Island City 1, N. Y.**

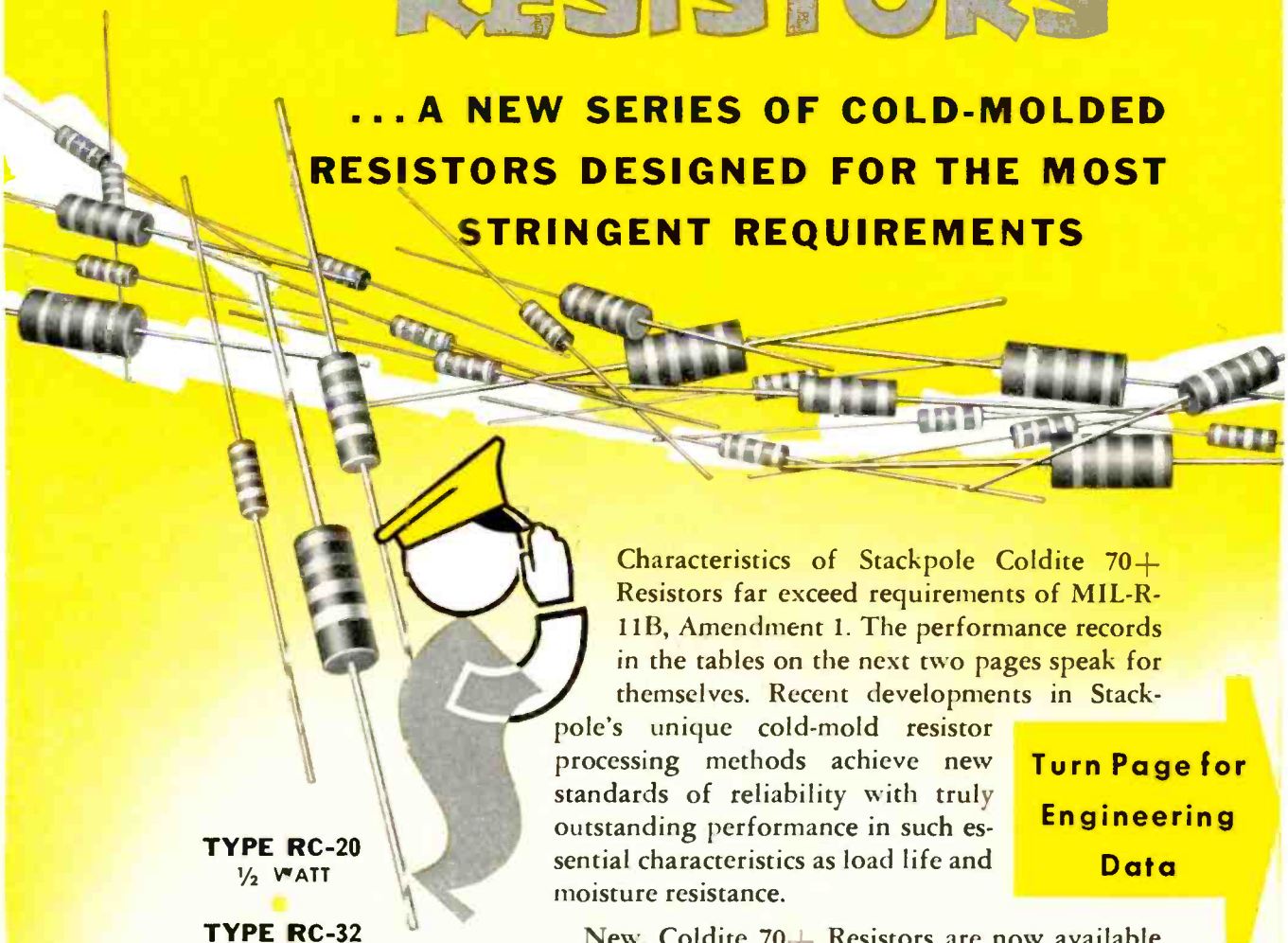
REPRESENTATIVES: Abington, Albany, Atlanta, Baltimore, Boeing Field, Chicago, Cleveland, Dayton, Denver, Detroit, Englewood, Fort Worth, Kansas City, Los Angeles, Portland, Rochester, St. Louis, Stamford, Sunnyvale, Syracuse, Washington, D. C., Westbury, Westwood, Wichita, Winston-Salem, Canada: Arnprior, Ontario. Resident Representatives in Principal Foreign Cities.

# Announcing...

# STACKPOLE Coldite 70+®

## FIXED COMPOSITION RESISTORS

**...A NEW SERIES OF COLD-MOLDED RESISTORS DESIGNED FOR THE MOST STRINGENT REQUIREMENTS**



**TYPE RC-20**
½ WATT

**TYPE RC-32**
1 WATT

**TYPE RC-42**
2 WATTS

Characteristics of Stackpole Coldite 70+ Resistors far exceed requirements of MIL-R-11B, Amendment 1. The performance records in the tables on the next two pages speak for themselves. Recent developments in Stackpole's unique cold-mold resistor processing methods achieve new standards of reliability with truly outstanding performance in such essential characteristics as load life and moisture resistance.

**Turn Page for Engineering Data**

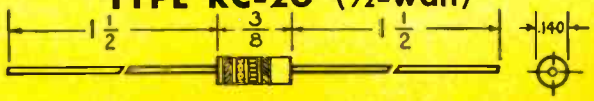
New, Coldite 70+ Resistors are now available in MIL-R-11B Styles RC-20 (½-watt) RC-32 (short 1-watt), and RC-42 (2 watts) . . . in all standard resistance values . . . and at regular resistor prices.



Circle 11 on Inquiry Card, page 103

# STACKPOLE Coldite 70+

## TYPE RC-20 (½-watt)




### Average Percent Resistance Change

| 10 ohms | | 270,000 ohms | | 22 megohms | | Compare THESE SPECS! |
|---|---|---|---|---|---|---|
| COLDITE 70+ | MIL-R-11B | COLDITE 70+ | MIL-R-11B | COLDITE 70+ | MIL-R-11B | |
| 1.6 | 3.25 | 2.1 | 7.5 | 5.6 | 12.5 | RESISTANCE-TEMPERATURE CHARACTERISTICS @ −15°C |
| 3.8 | 6.5 | 7.1 | 15.0 | 16.2 | 25.0 | @ −55°C |
| 1.4 | 2.5 | 0.1 | 5.0 | 3.7 | 7.5 | @ +65°C |
| 2.0 | 5.0 | 3.2 | 10.0 | 3.5 | 15.0 | @ +105°C |
| not applicable | | 0.0164 | 0.0350 | 0.0277 | 0.0350 | VOLTAGE COEFFICIENT per volt |
| 0.2 | 2.0 | 0.2 | 2.0 | 1.5 | 2.0 | LOW-TEMPERATURE STORAGE |
| 0.05 | 3.0 | 0.1 | 3.0 | 0.2 | 3.0 | LOW-TEMPERATURE OPERATION |
| 0.1 | 4.0 | 0.1 | 4.0 | 0.4 | 4.0 | TEMPERATURE CYCLING |
| 3.5 | 10.0 | 4.7 | 10.0 | 4.4 | 10.0 | MOISTURE RESISTANCE |
| 0.3 | 2.5 | 0.4 | 2.5 | 0.3 | 2.5 | SHORT TIME OVERLOAD |
| 0.3 | 6.0 | 1.6 | 6.0 | 0.2 | 6.0 | LOAD LIFE at 70°C after 50 hours |
| 0.5 | 6.0 | 0.9 | 6.0 | 0.7 | 6.0 | after 250 hours |
| 0.2 | 6.0 | 0.6 | 6.0 | 1.2 | 6.0 | after 500 hours |
| 0.3 | 6.0 | 0.5 | 6.0 | 1.0 | 6.0 | after 1000 hours |
| 0.02 | 1.0 | 0.1 | 1.0 | 0.5 | 1.0 | LEAD TWIST TEST |
| 0.4 | 3.0 | 0.5 | 3.0 | 0.5 | 3.0 | EFFECT OF SOLDERING |

**New!**

All Stackpole Type RC-20 Coldite 70+ Resistors withstand standard tests of 700 volts r.m.s. at atmospheric pressure for 5 seconds as well as 450 volts r.m.s. at 3.4 inches of mercury for 5 seconds without damage, arcing, or breakdown. — DIELECTRIC STRENGTH

All Stackpole Coldite 70+ Resistors withstand the standard 5-pound pull test. — SECURITY OF TERMINALS

## ... A Major Resistor Development for Major

# STACKPOLE

### TOPS IN SOLDERING TOO!

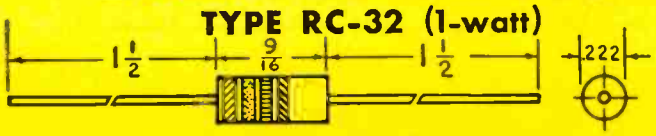
Thanks to an extra solder coating—applied as the final step in manufacture after the usual tin-lead coating—Stackpole Coldite 70+ Resistors solder perfectly by any method . . . dip or iron.

Moreover, the effects of normal soldering heat on Coldite 70+ Resistors causes average resistance variations far below today's critical requirements.

### PACKAGED for AUTOMATION

For fast, convenient assembly . . . manual or automatic . . . Stackpole Coldite 70+ Resistors are supplied either in Reels, or Strip-pack as required.

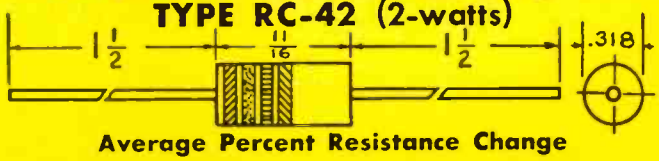
## STACKPOLE Coldite 70+ TYPE RC-32 (1-watt)




**Average Percent Resistance Change**

| 10 ohms | | 270,000 ohms | | 22 megohms | |
|---|---|---|---|---|---|
| COLDITE 70+ | MIL-R-11B | COLDITE 70+ | MIL-R-11B | COLDITE 70+ | MIL-R-11B |
| 1.5 | 3.25 | 2.2 | 7.5 | 6.7 | 12.5 |
| 3.7 | 6.5 | 6.2 | 15.0 | 15.7 | 25.0 |
| 1.6 | 2.5 | 1.1 | 5.0 | 4.0 | 7.5 |
| 2.1 | 5.0 | 5.7 | 10.0 | 3.7 | 15.0 |
| not applicable | | 0.0068 | 0.0200 | 0.0160 | 0.0200 |
| 0.1 | 2.0 | 0.1 | 2.0 | 1.0 | 2.0 |
| 0.1 | 3.0 | 0.2 | 3.0 | 0.5 | 3.0 |
| 0.1 | 4.0 | 1.1 | 4.0 | 0.2 | 4.0 |
| 3.7 | 10.0 | 7.4 | 10.0 | 3.2 | 10.0 |
| 0.2 | 2.5 | 0.13 | 2.5 | 0.2 | 2.5 |
| 0.2 | 6.0 | 3.0 | 6.0 | 0.25 | 6.0 |
| 0.4 | 6.0 | 1.9 | 6.0 | 0.9 | 6.0 |
| 0.5 | 6.0 | 1.9 | 6.0 | 1.9 | 6.0 |
| 0.5 | 6.0 | 1.5 | 6.0 | 2.3 | 6.0 |
| 0.04 | 1.0 | 0.0 | 1.0 | 0.1 | 1.0 |
| 0.2 | 3.0 | 0.6 | 3.0 | 0.4 | 3.0 |

## STACKPOLE Coldite 70+ TYPE RC-42 (2-watts)




**Average Percent Resistance Change**

| 10 ohms | | 120,000 ohms | | 22 megohms | |
|---|---|---|---|---|---|
| COLDITE 70+ | MIL-R-11B | COLDITE 70+ | MIL-R-11B | COLDITE 70+ | MIL-R-11B |
| 1.5 | 3.25 | 2.1 | 7.5 | 9.8 | 12.5 |
| 3.7 | 6.5 | 5.9 | 15.0 | 22.7 | 25.0 |
| 1.6 | 2.5 | 1.2 | 5.0 | 7.2 | 7.5 |
| 2.1 | 5.0 | 4.4 | 10.0 | 8.0 | 15.0 |
| not applicable | | 0.0051 | 0.0200 | 0.0177 | 0.0200 |
| 0.2 | 2.0 | 0.25 | 2.0 | 1.3 | 2.0 |
| 0.1 | 3.0 | 0.1 | 3.0 | 0.7 | 3.0 |
| 0.1 | 4.0 | 0.8 | 4.0 | 0.4 | 4.0 |
| 1.4 | 10.0 | 4.4 | 10.0 | 1.8 | 10.0 |
| 0.1 | 2.5 | 0.2 | 2.5 | 0.4 | 2.5 |
| 0.7 | 6.0 | 2.2 | 6.0 | 0.2 | 6.0 |
| 1.1 | 6.0 | 2.6 | 6.0 | 0.4 | 6.0 |
| 1.6 | 6.0 | 2.7 | 6.0 | 0.8 | 6.0 |
| 2.0 | 6.0 | 2.1 | 6.0 | 0.6 | 6.0 |
| 0.1 | 1.0 | 0.03 | 1.0 | 0.08 | 1.0 |
| 0.1 | 3.0 | 0.07 | 3.0 | 0.4 | 3.0 |

All Stackpole Type RC-32 and RC-42 Coldite 70+ Resistors withstand standard tests of 1000 volts r.m.s. at atmospheric pressure for 5 secands as well as 625 volts r.m.s. at 3.4 inches of mercury for 5 seconds withaut damage, arcing, ar breakdown.

All Stackpole Coldite 70+ Resistors withstand the standard 5-paund pull test.

# Commercial & Military Equipment Producers

# Coldite 70+® FIXED COMPOSITION RESISTORS

*Electronic Components Division*

**STACKPOLE CARBON COMPANY,** *St. Marys, Pa.*

In Canada: Canadian Stackpole Ltd., 550 Evans Ave., Etobicoke, Toronto 14, Ont.

**SAMPLES . . .**

*for your critical appraisal*

available either from your local electronic parts distributor or direct from Stackpole.




Circle 13 on Inquiry Card, page 103

# Electronic Industries' News Briefs

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

## EAST

**BENDIX AVIATION CORP.** has opened a new district office to handle sales, service and applications of its general-purpose electronic computer and accessories in the New York area.

**WESTINGHOUSE ELECTRIC CORP.** has added a new wing to its Air Arm Division, Baltimore, which increases the area by 100,000 sq. ft.

**GE'S TECHNICAL PRODUCTS DEPT.** has been awarded a $5-million contract for production of over-the-horizon scatter communications.

**BALLANTINE LABORATORIES, INC.,** is celebrating its 25th anniversary.

**UNITED STATES RADIUM CORP.** has revealed a new process for marking and finishing lacquered instrument dials which extends functional life under extreme environmental and operating conditions by as much as 100%.

**MINNESOTA MINING & MFG. CO.** has appointed Vitex Plastics Co., 830 Broadway, New York City, as distributor for "Fura-Tone" NC 1002, a new liquid molding material from which highly-detailed vacuum-forming molds can be made.

**A. B. DU MONT LABORATORIES, INC.,** has announced the development of an all electronic contact analog generator. The device presents an all weather flying aid, contact analog, on a standard CRT.

**ANACHROME CORP.,** Affiliate Company of Anadite, Inc., in conjunction with Hughes Aircraft Co., has developed a new process of insulating circuitry chassis which has greatly increased the dielectric strength. The new process equally distributes the heat from the transistor.

**PHILCO CORP.** has announced a new line of "field accelerated" transistors—Micro Alloy Diffused-base Transistor (MADT). They should make possible the transistorization of high gain, high frequency amplifiers, high speed computers, etc.

**BENDIX-SCINTILLA** has appointed Airwork Corp. in Miami as a jobber to assemble all types of Scinflex connectors.

**D. S. KENNEDY & CO.,** designers and builders of the MIT antenna at Westford, Mass. which is being used for research in ballistic missile defense will have 5 new additions completed within a few weeks for the U. S. "downrange" for guided missiles.

**AUDIO DEVICES, INC.** has created a new manufacturing division to produce silicon rectifiers. The new division will occupy a plant in Santa Ana, Calif., with 30,000 sq. ft. of operating space.

**GENERAL TRANSISTOR CORP.** has leased an additional 16,000 sq. ft. building at 87-11 130th St., Richmond Hill, N. Y. The new one-story structure will be used to house the new Diode Manufacturing Div.

**RADIO RECEPTOR CO.,** the semiconductor division subsidiary of General Instrument Corp., has introduced a versatile subminiature silicon junction diode, 1N658. It features high conductance, fast recovery, high peak inverse voltage, and a broad operating temperature range.

**RAYTHEON MFG. CO.** has been awarded a Navy contract for 133 small-boat radars for small landing craft. They will be used to help invasion troops at strategic, tactical beachhead positions in fog or other conditions of zero visibility day or night.

**GULTON INDUSTRIES** have established an Alkaline Battery Div. for the production and marketing of nickel cadmium, nickel iron batteries and associated charging equipment.

**UNITED STATES GASKET,** Plastics Div. of the Garlock Packing Co., is now in limited production with Teflon 100-x tetrafluoroethylene resin.

## MID-WEST

**CHICAGO TELEPHONE SUPPLY CORP.** has expanded the territory covered by its Eastern office in Haddonfield, N. J., to include New York City and the entire New England seacoast.

**MINNEAPOLIS-HONEYWELL REGULATOR CO.** has completed enlargement of production and engineering facilities of the Heiland Div. The added 12,000 sq. ft. will be used to increase production of oscillographic instruments.

**FANSTEEL METALLURGICAL CORP.** has appointed Eastern Radio Corp., Clifton, N. J., as its authorized rectifier-capacitor products distributor.

**LENZ ELECTRIC MFG. CO.** has released a new sample board of shielding and grounding braid. Actual samples of the various standard sizes of braid are provided.

**MOTOROLA COMMUNICATIONS & ELECTRONICS, INC.,** has constructed a new administrative headquarters for the 10-state southern sales area at Dallas, Tex.

**TEXAS INSTRUMENTS INCORPORATED** has opened a new sales office at 401 Monument Bldg., 11 W. Monument St., Dayton 2, Ohio.

**BELDEN MFG. CO.** has become a participant in the Howard W. Sams engineering analysis and Photofact listing services.

**DALE PRODUCTS, INC.,** has completed a new 16,000 sq. ft. resistor production facility at Columbus, Nebraska. The new space will be used for precision wire wound and deposited carbon resistor production.

## FOREIGN

**PYE TELECOMMUNICATIONS LTD.** has designed and built what is believed to be the world's first all-electronic telephone exchange for commercial use.

**MARCONI'S WIRELESS TELEGRAPH CO., LTD.,** is supplying equipment for the new Cyprus television service which will be located near Nicosia, the capital.

**RADIO CORP. OF AMERICA** has received an order for 38 AVQ-10 weather avoidance radar units from Sud-Est, one of France's largest aircraft manufacturers. An order for 34 similar units has been received from Trans-Canada Airlines.

## WEST

**PLASTIC FACTORS, INC.,** has moved to expand facilities in a 9,000 sq. ft. modern production plant at 926 Broadway, Redwood City, Calif.

**WESCON, IRE-LOS ANGELES, WCEMA** have moved into new and larger quarters at 1435 S. La Cienega Blvd., Los Angeles, Calif. Telephone number is OLeander 5-8462.

**HOFFMAN RADIO DIV.** has appointed Merchandising Distributors, Inc., San Diego, as its distributor in San Diego and Imperial counties.

**CANNON ELECTRIC CO.** has begun production in its new 106,000 sq. ft. Santa Ana Div. It is expected to employ 1,500 within 3 years.

**NATIONAL CASH REGISTER CO.,** Electronics Div., recently conducted a seminar on digital computer techniques. The purpose of the course was to acquaint government personnel with the latest advances.

**BEAUMONT ELECTRONICS** has received a sub-contract to produce miniature electrical connectors for the Deutsch Co. The company is completely tooled up for the job and has gone into immediate production.

**CURTISS-WRIGHT CORP.** has purchased all the outstanding stock of H. A. Wagner Co., Van Nuys, Calif., a corporation devoted to design and production of missile systems and components.

**CALIFORNIA TECHNICAL INDUSTRIES** will manufacture a three-axis dynamic flight simulator, and an associated dynamic altitude simulator. Both are developments of Air Arm Div. of the Westinghouse Electric Corp.

**INTERNATIONAL BUSINESS MACHINES CORP.** will install its first two production models of its 305 RAMAC, computer and accounting machine at the Denver operational headquarters of United Air Lines. United will lease the systems to speed the processing of thousands of ticket reservations made daily.

**AUTONETICS DIV.,** North American Aviation, Inc., has received a contract from Republic Aviation Corp. for a monopulse radar.

**SPRAGUE ELECTRIC CO.** will expand its Pacific coast manufacturing operations with construction of a new plant covering more than 21,000 sq. ft. at Visalia, Calif.

**FILTORS, INC.,** have opened a West Coast branch office at Suite 208, 13273 Ventura Blvd., Studio City, Calif. R. B. Moon is manager of the new branch.

**INTERNATIONAL RECTIFIER CORP.** is supplying full calibration data with its new zener diodes which feature exceptionally low temperature coefficient and zener impedance over the voltage range.

**HELIPOT DIV., BECKMAN INSTRUMENTS, INC.,** officially dedicated its new $3-million facility in Newport Beach, Calif. The ultra-modern 156,000 sq. ft. building overlooks Balboa-Newport Bay.

**RAMO-WOOLDRIDGE CORP.** has presented the John Tracy Clinic of Los Angeles with a "Teletac" unit, a new device which will provide the deaf with additional means of instant communication.

# Formica helps solve rocket thermal insulation problems

## New Formica laminated plastic thermo-insulator provides protection from hot launching gases

In cooperation with Rocket Fuels Division, Phillips Petroleum Company, Formica application engineering applied Grade FF-34 (modified) with the precise characteristics for protection against hot gases.

This Formica fabricated liner protects the steel blast tube through a time cycle of intense heat in a new target drone.

This solution called for three of the Formica-4 services that assure the right laminated plastic for every requirement.

1. Application engineering to select the right grade
2. Research to adapt it to this particular application
3. Fabricating to produce a complete component ready for assembly. A fourth—Customer Stock Service—provides a ready supply of sheets and rods for prompt shipment.

This unique laminated plastics service can be of assistance to you in your own product design problems. For complete information, send for free Formica-4 bulletin 584. Formica Corporation, a subsidiary of American Cyanamid, 4536 Spring Grove Ave., Cincinnati 32, Ohio.

Save your engineers' time . . . use Formica-4, the complete laminated plastics service

CYANAMID FORMICA 4

1. Application Engineering 2. Research 3. Fabricating 4. Customer Stock Service

Circle 14 on Inquiry Card, page 103 FI-1586

# *Announcing*

## NEW EECO "T-SERIES"

## *Germanium*

## TRANSISTOR PLUG-IN CIRCUITS


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

**SAVE TIME!**

**SAVE COST!**

**SAVE SPACE!**

### FEATURES

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

### AVAILABLE CIRCUITS

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

### ALSO AVAILABLE SOON

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

### GUARANTEED SPECIFICATIONS

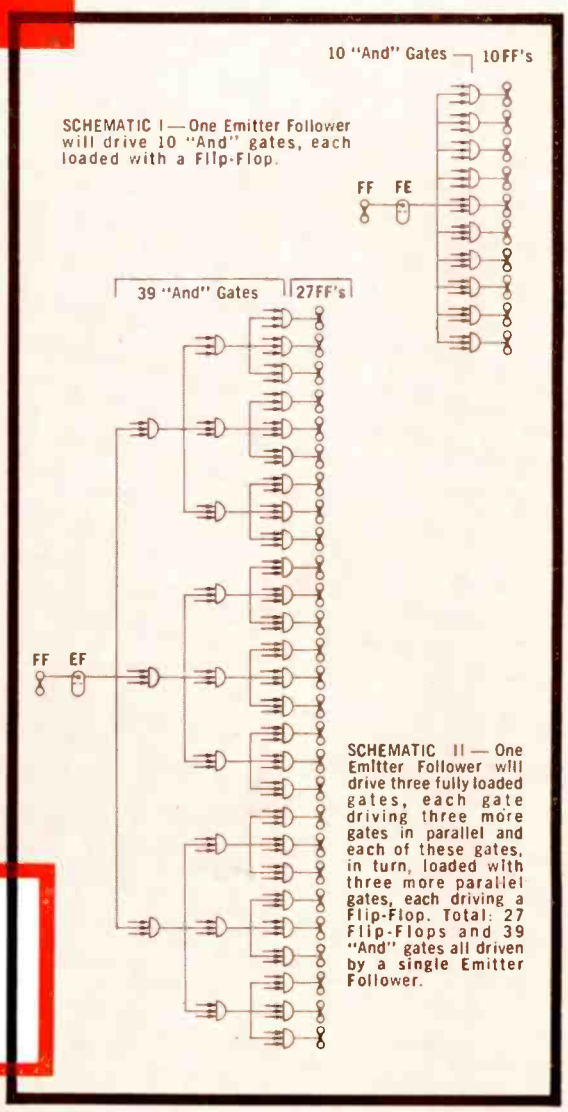
- **Dimensions:** Body ⅞" diameter; seated height 2¼"; mount on 1" centers.
- **Frequency Range:** 0-250 kc.
- **Temperature Range:** −45°C to +65°C.
- **Power Requirements:** −12 volts dc ±10%. (If diode logic is used, a second voltage of +12 volts dc ±10% is also required.
- **Signal Range:** "0" is — 10 volts
  "1" is — 3 volts
- **Rise Time:** (Positive-going output) 0.8 μs or better
  (Negative-going output) 2.0 μs nominal
- **Emitter Followers:** One Emitter Follower will drive 10 "And" gates, each loaded with a Flip-Flop (see Schematic I);
  OR
  will drive three fully loaded gate legs. (See Schematic II for example of three gates fully loaded. Note that this totals 27 Flip-Flops and 39 "And" gates all driven by a single Emitter Follower.)

### DESIGN CRITERIA

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

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

51 Plug-in Circuits mounted on a 19" x 3½" panel.




**WRITE FOR FULL INFORMATION AND PRICE LIST**

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

EE CO ENGINEERED ELECTRONICS Company

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

506 East First Street • Santa Ana, California



Circle 15 on Inquiry Card, page 103

# ALL VIDEO TRANSMISSION TEST

## STANDARDS in a suitcase

The Original Full Rack and the Portable Unit Produce the same Precise Test Signals.

TELECHROME INCORPORATED

**Model 1003-B**

**Video Transmission Test Signal Generator**

★ Completely self contained ★ Portable
★ Multi-frequency burst ★ Stairstep ★ Modulated stairstep
★ White window ★ Composite sync ★ Regulated power supply.

Now, Telechrome Video Transmission Test Equipment is available as a completely portable 12¼" standard-rack mounting unit.

Everyday these test signals generated by Telechrome equipment, are transmitted Coast-to-Coast by NBC, CBS, ABC, the Bell System, Canadian Bell and leading independent TV stations throughout the U.S. and Canada. Hundreds of network affiliated TV stations and telephone TV centers thus check incoming video signals.

The compact, inexpensive, portable Model 1003-B is all that is required to generate signals for local and remote performance checking of your entire video, cable, or micro-wave facilities.

**DELIVERY 30 DAYS**

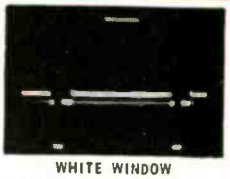
*Literature on the above and more than 100 additional instruments for monochrome and color TV by TELECHROME are available on request.*

TELECHROME INCORPORATED

The Nation's Leading Supplier of Color TV Equipment

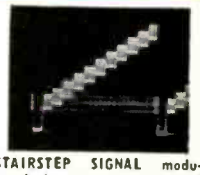
28 Ranick Drive Amityville, N. Y.
Lincoln 1-3600

MULTI-FREQUENCY BURST AMPLITUDE vs FREQUENCY. Check wide band coaxial cables, microwave links, individual units and complete TV systems for frequency response characteristics without point to point checking or sweep generator.



WHITE WINDOW

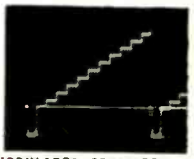
LOW & HIGH FREQUENCY CHARACTERISTICS. Determine ringing, smears, steps, low frequency tilt, phase shift, mismatched terminations, etc. in TV signals or systems.



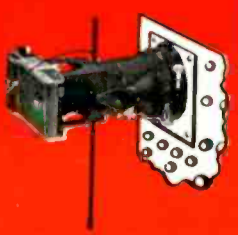
STAIRSTEP SIGNAL modulated by crystal controlled 3.579 mc for differential amplitude and differential phase measurement. Checks amplitude linearity, differential amplitude linearity and differential phase of any unit or system.
Model 1003-C includes variable duty cycle stairstep (10-90% average picture level).

Model 608-A HI-LO CROSS FILTER for Signal analysis.

MODULATED STAIRSTEP signal thru high pass filter. Checks differential amplitude.



MODULATED STAIRSTEP signal thru low pass filter. Checks linearity.

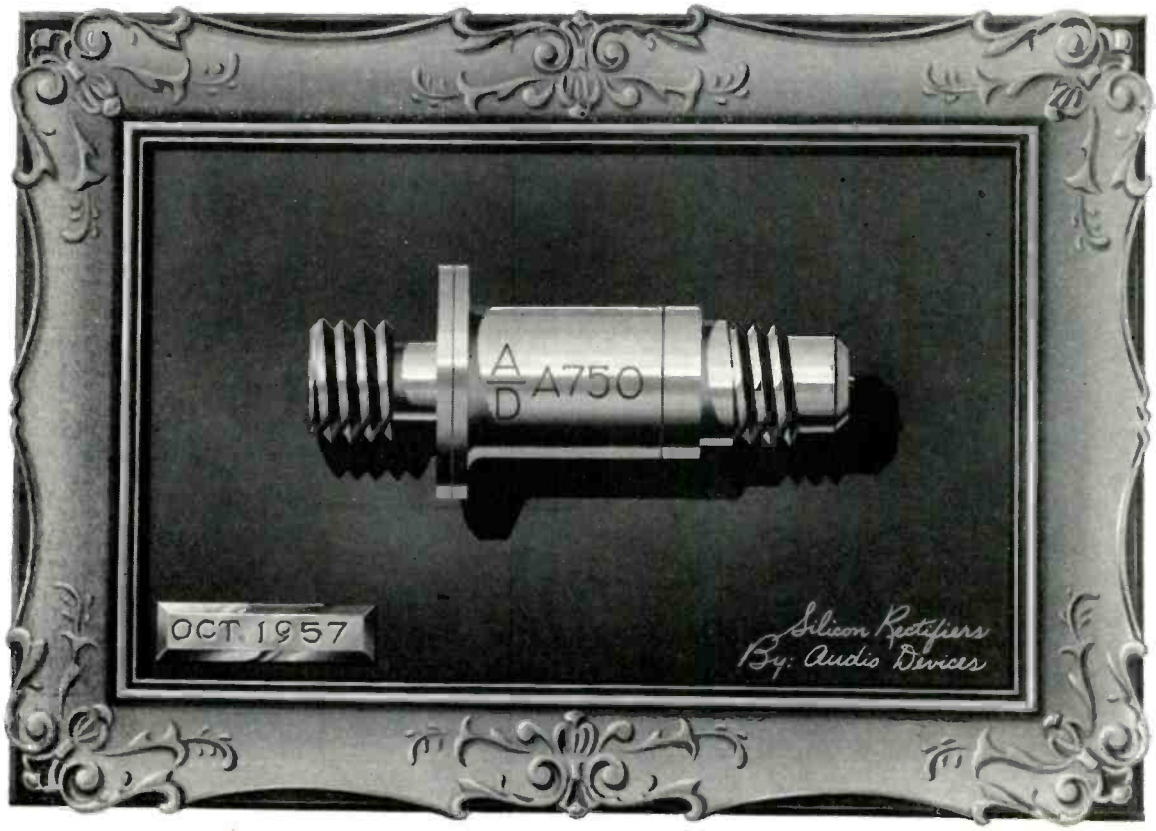


1521-A OSCILLOSCOPE CAMERA—Polaroid type for instantaneous 1 to 1 ratio photo-recording from any 5" oscilloscope.

1004-A VIDEO TRANSMISSION TEST SIGNAL RECEIVER for precise differential phase and gain measurements. Companion for use with 1003-B.

# IT'S NEW!

## *A Masterpiece...*




...a Silicon Rectifier
which SCREWS and PLUGS in too!

*for powering your Radio/Television/and Electronic Devices*

Write for further information on Replacement Kits, Power Rectifiers for Military and Commercial uses.

**AUDIO DEVICES. INC.** | Rectifier Division

620 EAST DYER ROAD • SANTA ANA • CALIFORNIA



Circle 17 on Inquiry Card, page 103

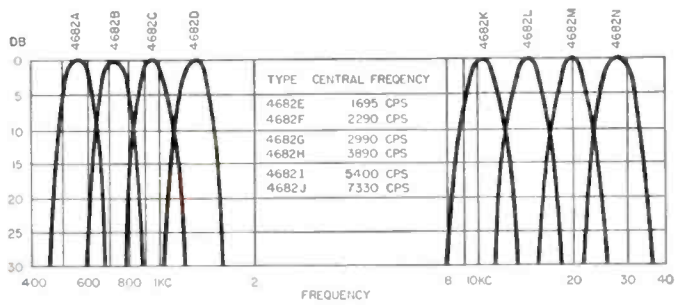
Circle 18 on Inquiry Card, page 103 →

OUR MILLIONTH FILTER SHIPPED THIS YEAR...

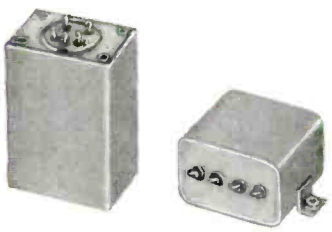
# FILTERS
## FOR EVERY APPLICATION

### TELEMETERING FILTERS

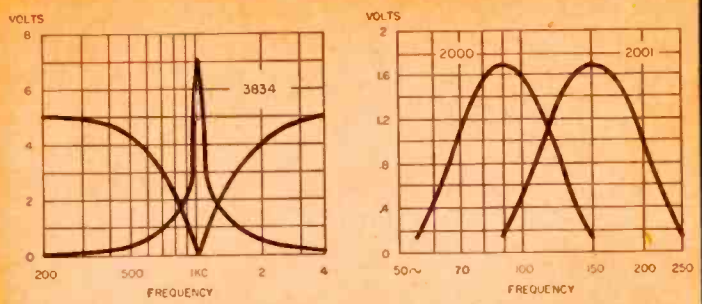
UTC manufactures a wide variety of band pass filters for multi-channel telemetering. Illustrated are a group of filters supplied for 400 cycle to 40 KC service. Miniaturized units have been made for many applications. For example a group of 4 cubic inch units which provide 50 channels between 4 KC and 100 KC.




Dimensions:
(4682A) 1½ x 2 x 4"



Dimensions:
(3834) 1¼ x 1¾ x 2-3/16".
(2000, 1) 1¼ x 1¾ x 1⅝".



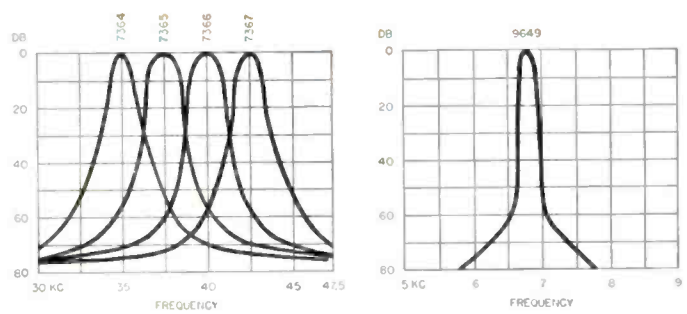

### AIRCRAFT FILTERS

UTC has produced the bulk of filters used in aircraft equipment for over a decade. The curve at the left is that of a miniaturized (1020 cycles) range filter providing high attenuation between voice and range frequencies.

Curves at the right are that of our miniaturized 90 and 150 cycle filters for glide path systems.

### CARRIER FILTERS

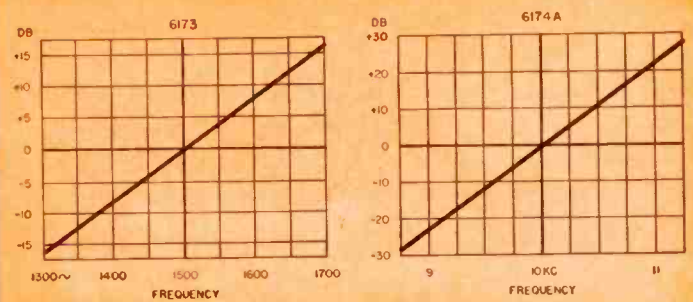
A wide variety of carrier filters are available for specific applications. This type of tone channel filter can be supplied in a varied range of band widths and attenuations. The curves shown are typical units.




Dimensions:
(7364 series) 1⅝ x 1⅝ x 2¼".
(9649) 1½ x 2 x 4".

### DISCRIMINATORS

These high Q discriminators provide exceptional amplification and linearity. Typical characteristics available are illustrated by the low and higher frequency curves shown.




Dimensions:
(6173) 1-1/16 x 1⅜ x 3".
(6174A) 1 x 1¼ x 2¼".

For full data on stock UTC transformers, reactors, filters, and high Q coils, write for Catalog A.


**UNITED TRANSFORMER CORP.**
150 Varick Street, New York 13, N. Y.
EXPORT DIVISION: 13 EAST 40th STREET, NEW YORK 16, N. Y. CABLES: "ARLAB"
PACIFIC MFG. DIVISION: 4008 W. JEFFERSON BLVD., LOS ANGELES 16, CALIF.

# 3 will get you 12!

## —in the new Du Mont potted—circuit MULTIPLIER PHOTOTUBES

Another way to do it—with Du Mont! Du Mont potted circuit multiplier phototubes require only three connections instead of the usual twelve, thus minimizing chances of leaky or noisy connections, as well as pickup between long leads. The resistor network for the bleeder system is *encapsulated within the base of the tube* eliminating the need for this associated circuitry in an external unit.

**Do it the better way—do it with Du Mont. Send for complete details on Du Mont potted circuit multiplier phototubes. Available in a wide range of sizes and characteristics...**

**DU MONT**

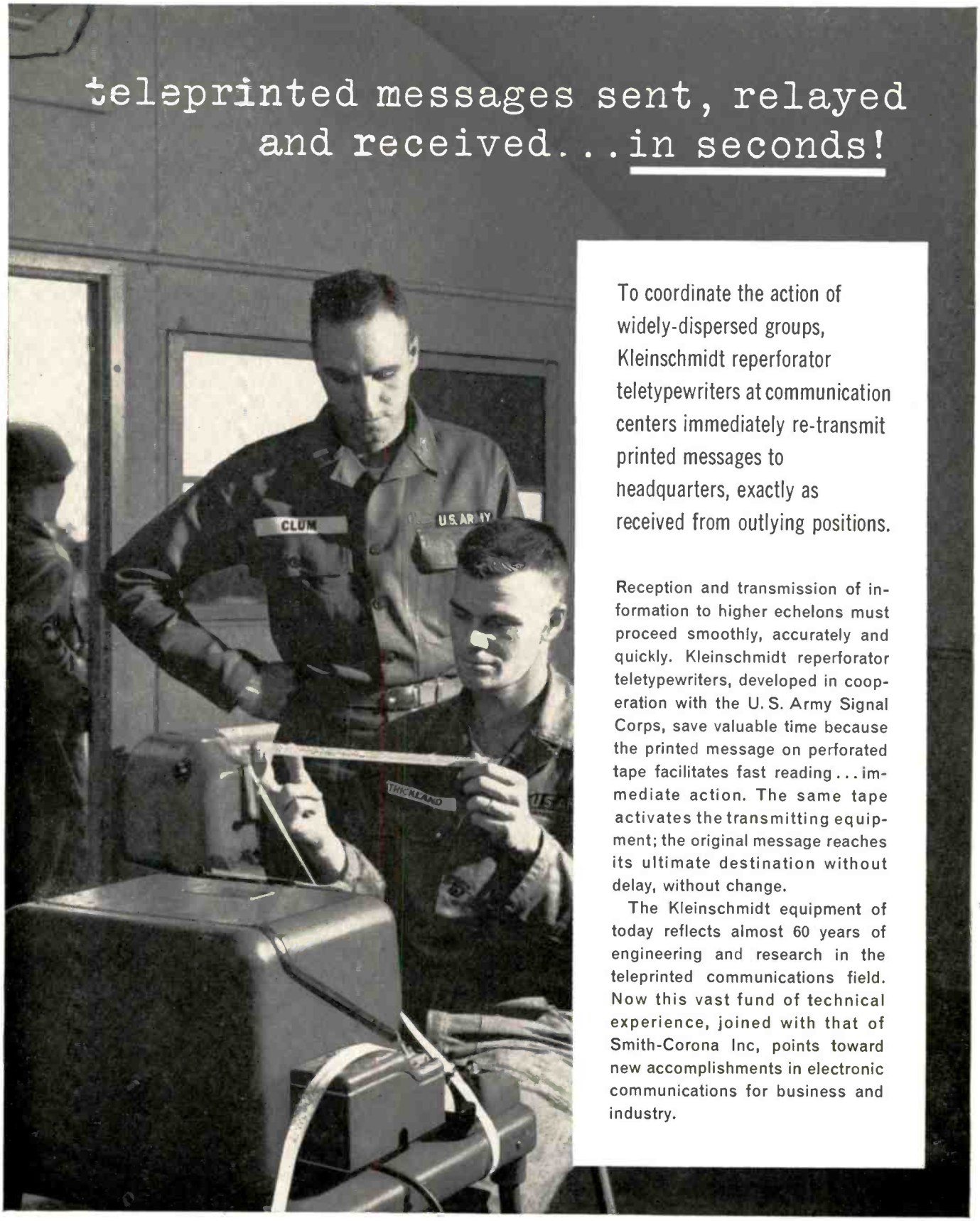
*Industrial Tube Sales*

**ALLEN B. DU MONT LABORATORIES, INC.**
2 Main Ave., Passaic, N. J.



Circle 19 on Inquiry Card, page 103

# teleprinted messages sent, relayed and received...in seconds!




To coordinate the action of widely-dispersed groups, Kleinschmidt reperforator teletypewriters at communication centers immediately re-transmit printed messages to headquarters, exactly as received from outlying positions.

Reception and transmission of information to higher echelons must proceed smoothly, accurately and quickly. Kleinschmidt reperforator teletypewriters, developed in cooperation with the U. S. Army Signal Corps, save valuable time because the printed message on perforated tape facilitates fast reading...immediate action. The same tape activates the transmitting equipment; the original message reaches its ultimate destination without delay, without change.

The Kleinschmidt equipment of today reflects almost 60 years of engineering and research in the teleprinted communications field. Now this vast fund of technical experience, joined with that of Smith-Corona Inc, points toward new accomplishments in electronic communications for business and industry.

**KLEINSCHMIDT LABORATORIES, INC.**

*PIONEER IN TELEPRINTED COMMUNICATIONS EQUIPMENT*

A SUBSIDIARY OF SMITH-CORONA INC • DEERFIELD, ILLINOIS



Circle 20 on Inquiry Card, page 103

# Tele-Tips

**FOUR R's** of another sort are needed to keep engineers happy and contented says Walter W. Finke, of Minneapolis-Honeywell. He calls for: Recognition, Respect, Responsibility and Reward. There are too many wrong conceptions about engineers, he said, and chief among them are: the idea that engineers are anti-social; that they put professional prestige far above economic stature; that they are indifferent to the "commercial" problems of industry.

**THE ELECTRONIC INDUSTRY** is the fifth largest in the U. S., with a sales volume of over $10 billion a year, yet electronics standards account for less than 2% of the 1,700 American standards.

**WORLD'S ROCKET PIONEER** has been identified as the 15th century Chinese scholar, Wan-Hoo, the first man to be transported by rockets. Wan contrived an ingenious flying chair. He attached two large kites, and on the rear, 47 of the largest rockets he could find. He carefully instructed his assistants how to light the rockets and then strapped himself into the chair. The blast-off proved Wan was right—but unfortunately Wan went in several directions at once.

**THE SATELLITE** was made an unwilling accomplice to a N. Y. advertising stunt. Sputnik signals picked up by technicians at RCA Laboratories in Riverhead, L. I. were amplified and used to trip a switch that lit up a 35-by-80 ft. whisky advertisement.

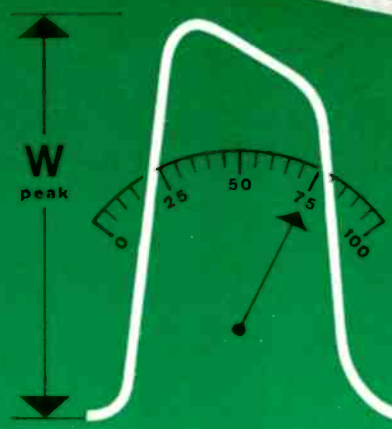
**UNDERWATER TV** camera solved a knotty problem for the Tennessee Valley Authority—how to inspect the face of Wheeler Dam for cracks and erosion. Bludworth Marine demonstrated a unit that not only clearly detected signs of deterioration but also magnified the cracks 2 or 3 times normal size on the system monitor.

(*Continued on page* 32)

# New PEAK POWER METER gives direct indication


**630 PEAK POWER METER SPECIFICATIONS**

REPETITION RATE: 50 to 5000 pps
RISE TIME: 0.15 microsecond
VIDEO OUTPUT (RF Pulse): 300 millivolts
SIZE: 19 in. long x 8¾ in. high x 10 in. wide
WEIGHT: Approx. 20 lbs.
MOUNTING: Standard relay rack type
CASE: Integral shield and dust cover
FREQUENCY RANGE: Depends on barretter mount used
BARRETTER MOUNT: Any mount with less than 100mmf output capacitance
BARRETTER: Microline 823 or 825 barretter
POWER RANGES: 0-30, 0-100, 0-300 mw
ACCURACY: ±10%
PULSE WIDTH: 0.25 to 10 microseconds




Meter indicates actual peak of power pulse, regardless of width, shape, rate, or duty cycle.

This new Sperry development now makes it possible to measure peak power directly and continuously. It eliminates tedious calculation and risky guesswork in evaluating pulsed microwave systems.

Designed as a laboratory instrument for development work and production testing, the Microline® 630 Peak-Power Meter eliminates chance of error by replacing less accurate average power methods which require conversion of pulse shape and duty cycle factors. Employing the barretter integration-differentiation method, the 630 supplies indication independent of input pulse width, pulse shape and repetition rate. In addition, video output is available for observing input pulse shape. Internal calibrating circuit eliminates the necessity for auxiliary calibrating equipment.

This new Sperry meter requires only an appropriate low-capacitance barretter mount to perform measurements at any microwave frequency. For further information, write our Microwave Electronics Division.

MICROWAVE ELECTRONICS DIVISION

SPERRY GYROSCOPE COMPANY
Great Neck, New York

DIVISION OF SPERRY RAND CORPORATION

BROOKLYN • CLEVELAND • NEW ORLEANS • LOS ANGELES
SEATTLE • SAN FRANCISCO. IN CANADA: SPERRY GYROSCOPE COMPANY OF CANADA, LIMITED, MONTREAL, QUEBEC.

## Tele-Tips

(*Continued from page 30*)

**EAST GERMAN TV** changed to Western technical standards to tap the large potential audience in West Germany. Nine new TV stations have gone on the air in the Soviet satellite countries.

**THE WORST FATE!** The council of Blaydon-on-Tyne, England warned the tenants of municipally owned houses who were behind in their rent to either pay up or their television sets would be taken away.

**VERSATILE CAR RADIO** being offered in 1958 Oldsmobiles can also double as a portable radio.

**SEMICONDUCTOR** theory may explain some of the mysteries surrounding photosynthesis, the process by which sun energy is stored by the green plants. Chemists had formerly considered it primarily a chemistry problem. New tests indicate that the electrical resistance of dried chloroplasts changes as heat is applied, which would seem to mean that trapped electrons are being freed, much as happens in semiconductors.

**EDUCATIONAL TV** already has an audience of 12,000,000 viewers.

**IGY ROCKET** fired in the Arctic region located massive sheets of electric current, estimated as high as 10,000,000 amperes, forming a 3-mi. thick cap over the northern sky. Scientists believe that these highly charged areas explain the phenomena of the Northern Lights.

**TAPED FEAR.** At Floyd Bennett Field in Brooklyn, N. Y. pilots complained that sea gulls were being sucked into jet engines or smashed against windshields. Since it is illegal to kill sea gulls, there seemed little hope of driving them away. But base personnel came up with the idea of driving a jeep down the middle of the runway, playing a tape-recorded cry of frightened sea gulls. It worked!


**More materials:** Rugged, versatile compositions to resist impact, stress, vibration, pressure, heat, thermal shock, wear, chemical reactions. Superior electrical characteristics for higher temperatures and frequencies.

**More equipment:** Complete and separate production facilities devoted exclusively to finer quality AlSiMag Aluminas.

**More "know how":** Years of experience in formulating and fabricating Aluminas. The wider range of exacting designs produced have led to new, improved techniques. Precision tolerances. Dependable uniformity. Constant research.

Bring your problem to the source most apt to supply the right answer! Send blueprint with details of operating procedure for complete information.

# AlSiMag®

## *best source for* ALUMINA CERAMICS

A Subsidiary of Minnesota Mining and Manufacturing Company

**AMERICAN LAVA CORPORATION**

CHATTANOOGA 5, TENN.
56TH YEAR OF CERAMIC LEADERSHIP

**For service, contact Minnesota Mining & Manufacturing Co. Offices in these cities (see your local telephone directory):** Atlanta, Ga. • Boston: Newton Center, Mass • Buffalo, N. Y. • Chicago, Ill. • Cincinnati, O. • Cleveland, O. • Dallas, Texas • Detroit, Mich. • High Point, N. C. • Los Angeles, Calif. • New York: Ridgefield, N. J. • Philadelphia, Pa. • Pittsburgh, Pa. • St. Louis, Mo. • St. Paul, Minn. • So. San Francisco, Calif. • Seattle, Wash. **Canada:** Minnesota Mining & Manufacturing of Canada, Ltd., P. O. Box 757, London, Ont. **All other export:** Minnesota Mining & Manufacturing Co., International Division, 99 Park Ave., New York, N. Y.

# Letters
## to the Editor

### "Diode Specifications"

Editor: ELECTRONIC INDUSTRIES:

In view of the widespread interest in my group in your publication of the 1958 Semiconductor Diode Specification in the December 1957 issue of ELECTRONIC INDUSTRIES AND TELE-TECH, I am writing to ask if it is possible to obtain copies of this table.

I would like to take this opportunity to thank you for giving me a subscription to ELECTRONIC INDUSTRIES AND TELE-TECH. In my opinion, it is the most interesting and valuable magazine of its type being published today. I receive four other magazines of this type and as far as the publication of reference data, design articles and articles of general interest is concerned, you're tops.

MARTIN RABB
Senior Engineer, Data and Display Laboratory, Research and Development Division.
Allen B. Du Mont Laboratories, Inc.

---

Editors, ELECTRONIC INDUSTRIES:

Some dirty rat made off with my copy of your very fine September, 1957, issue of TELE-TECH. Would you please send me another copy if it is available.

Thank you for this and for your fine magazine.

Ira Ritow
Asst. Chief Dynamics Engineer

Republic Aviation Corp.
Farmingdale, L. I., N. Y.

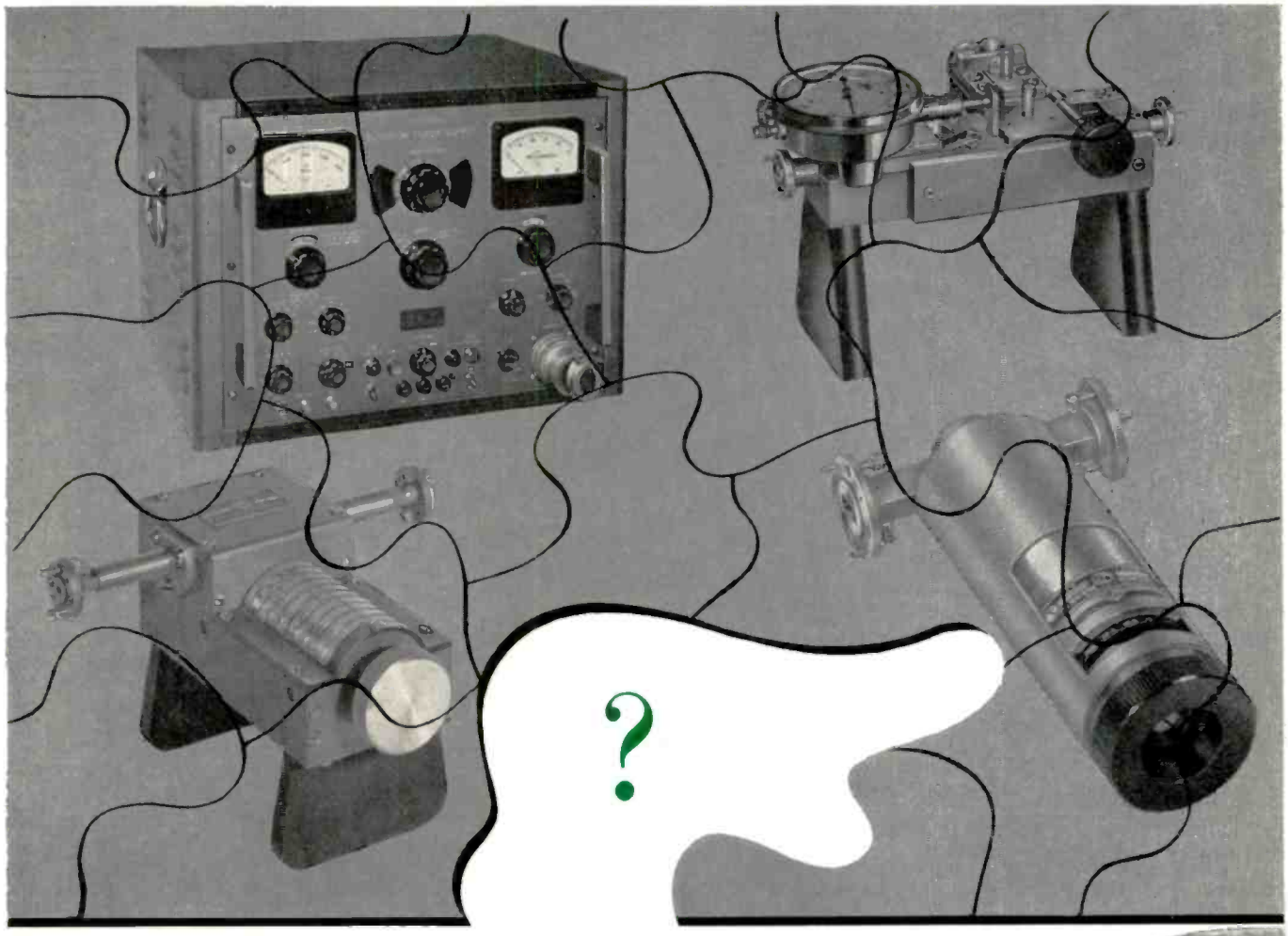
*Ed.: We're more than happy to send Reader Ritow another copy—*

### "Polarize The Plugs"

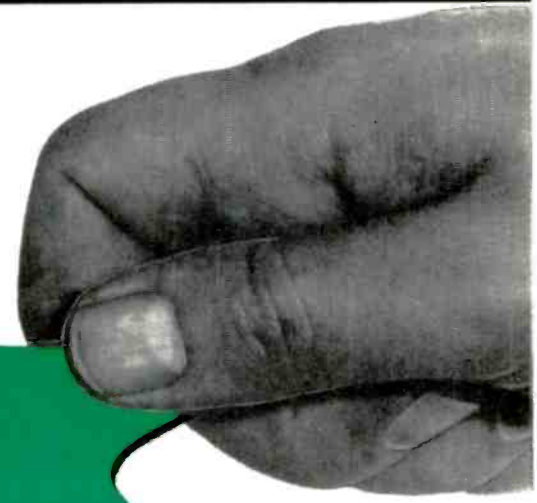
Editor, ELECTRONIC INDUSTRIES:

Your September editorial "Polarize the Plugs" is to be commended. Here in Canada the Canadian Standards Association, in conjunction with the Provincial Governments, has been pushing the use of the NEMA three-point, polarized (compatible), receptacle for several years, and with considerable success. Your closing remark, that it has not been enforced, is not true here. The Canadian Electrical Code Part I (somewhat similar to your National Electrical Code) requires the use of such receptacles in locations where grounded metal is prevalent, i.e., kitchens, laundry rooms, basements, etc. Where perimeter heating is used they would probably be required throughout the home. Compliance with the C.E. Code is a legal requirement in practically all provinces.

(*Continued on Page* 36)




# NEED DELIVERY?



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*Representatives:*

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| **AHMCO**<br>**BOEING FIELD**<br>**KING CITY AIRPORT**<br>**SEATTLE 8, WASH.** | WASHINGTON<br>OREGON |
| **A & M ASSOC.**<br>**1145 19th ST., N.W.**<br>**WASHINGTON, D. C.** | WASHINGTON, D. C. |
| **HYTRONIC**<br>**MEASUREMENTS INC.**<br>**1295 S. BANNOCK ST.**<br>**DENVER 23, COLORADO** | COLORADO<br>NEW MEXICO<br>UTAH<br>WYOMING |
| **KADELL SALES ASSOC.**<br>**5875 N. LINCOLN ST.**<br>**CHICAGO 45, ILLINOIS** | ILLINOIS<br>INDIANA<br>WISCONSIN |
| **VAN GROOS CO.**<br>**21051 COSTANSO ST.**<br>**WOODLAND HILLS, CALIF.** | CALIFORNIA<br>ARIZONA |
| **SZUCS INT'L CORP.**<br>**50 BROAD STREET**<br>**NEW YORK 4, N. Y.** | EXPORT |

ELECTRONICS & X-RAY DIVISION · F-R MACHINE WORKS, INC. · FXR

*for* **Precision Microwave Test Equipment**

*Electronics & X-Ray Division*

**F-R MACHINE WORKS, Inc.**
Woodside 77, N. Y
AStoria 8-2800



Circle 26 on Inquiry Card, page 103

# Letters

## to the Editor

(*Continued from Page 34*)

You may be interested to know that much of our electronic equipment, purchased in the United States, is now being received with the compatible (NEMA U-ground) plugs and receptacles you mention.

W. G. Hoyle
Defense I Section
National Research Council of Canada
Ottawa 2, Ontario

### "Closed Circuit TV Standards"

Editors, ELECTRONIC INDUSTRIES:

Regarding the editorial in the July issue of ELECTRONIC INDUSTRIES calling for standardization in the field of closed circuit television:

Our EIA (formerly RETMA) Engineering Committee TR-17, on Closed Circuit Television has been active since December, 1954, and currently has four sub-committees operating in areas of Distribution Systems, Display Devices, Camera Chains and Environmental Conditions.

In addition, there is an Ad Hoc Committee of SMPTE studying the area, with which EIA is maintaining a close liaison in order to avoid wasteful duplication of effort.

Since the democratic formulation of industry standards is a lengthy process, there are, as yet no formally issued EIA Standards available. However, the first proposed standard will probably be circulated for industry comment by the end of 1957. This will cover certain phases of the R. F. distribution system.

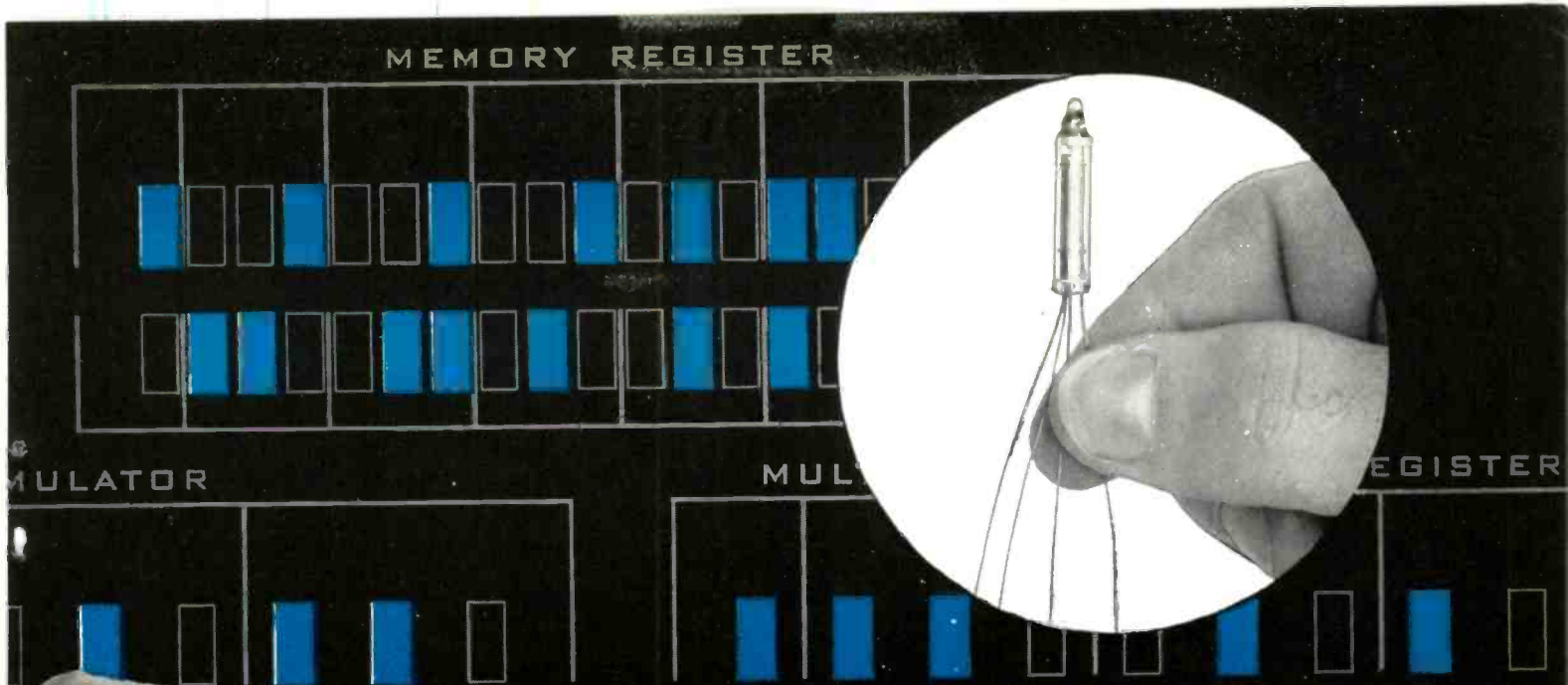
Industry as represented by EIA and SMPTE, is acutely conscious of the need for technical standardization in CCTV and is taking steps that should ultimately result in acceptable standards.

J. A. Caffiaux
Staff Engineer
Electronic Industries Association (EIA)

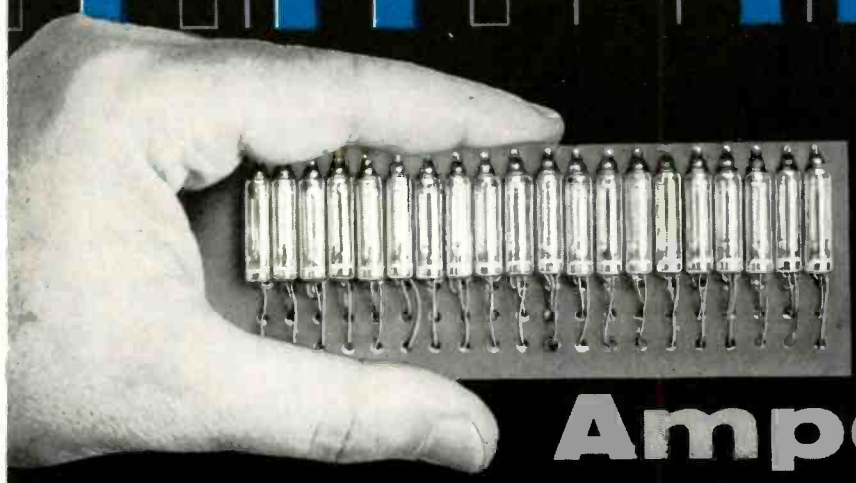
## IRE Awards Announced

The 1958 W. R. G. Baker Award of IRE will go to R. L. Kyhl and H. F. Webster of the Research Lab., General Electric Co., Schenectady, N. Y., for their paper, "Breakup of Hollow Cylindrical Electron Beams" which appeared in the October 1956 issue of IRE Transactions on Electron Devices.

Arthur Karp of Bell Telephone Labs, Holmdel, N. J., is the winner of the 1958 Browder J. Thompson Memorial Prize Award for his paper, "Backward-Wave Oscillator Experiments at 100 to 200 KMC," which appeared in the April 1957 issue of Proceedings of the IRE.




***The tube that makes present computer indicator system designs obsolete...***



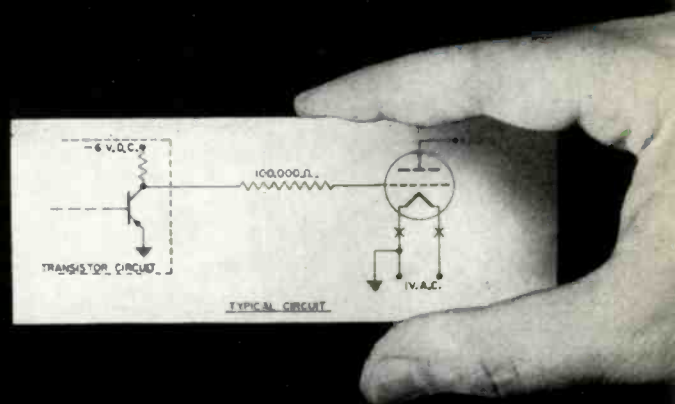
# Amperex® 6977

*subminiature indicator tube*

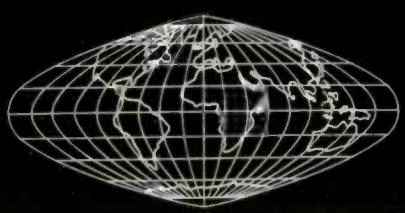
## Monitors Transistorized Circuits

- with higher information density
- with simpler associated circuitry
- without ionization- and deionization-time problems
- with increased circuit protection
- with lower power requirements
- with lower cost per unit
- with ultra-compact assembly on printed circuit boards

The AMPEREX 6977 is a high-vacuum filamentary subminiature indicator triode which gives a bright blue-green indication when the control grid is at zero potential. It has been developed specifically for transistorized computers, where its high input impedance and small signal requirements enable it to monitor the transistor circuits without loading them and affecting their operation. It replaces the conventional and much more expensive high-voltage transistor and neon lamp combination so far used in transistor computers for the same purpose. Since its high input impedance permits the use of a series grid resistor, it will not short out the transistor circuit if it should ever fail. Manufactured with special computer tube techniques, the 6977 is designed for 20,000 hours life.




Heater voltage is only 1 volt, 30 ma, AC or DC. The anode will draw only 0.5 ma from a 50 volt DC supply during the zero-bias "on" condition. A 3.0 volt DC voltage is sufficient to cut-off plate current and light. Write for data sheet to Semiconductor and Special Purpose Tube Division, Amperex Electronic Corp., 230 Duffy Avenue, Hicksville. L.I., N.Y.



ask **Amperex**

***about products and services for the computer industry***

AMPEREX ELECTRONIC CORP., 230 DUFFY AVENUE, HICKSVILLE, LONG ISLAND, N. Y.
In Canada: Rogers Electronic Tubes & Components, 11-19 Brentcliffe Road, Leaside, Toronto 17.

IMMEDIATE DELIVERY

# New 20kw Klystron for important L band

## Exclusive Space-Charge Focus assures long life and reliability

**Specify the SAL-81** when you are looking for a reliable tube in L band which will have extremely long service life.

**Exclusive Sperry Space-Charge Focusing** design eliminates heavy magnets—the SAL-81 is a complete microwave unit requiring no external equipment. This pulsed klystron amplifier features high gain and rugged construction to withstand shocks and vibrations.

**Available for immediate delivery,** the SAL-81 can be used as a driver for higher-powered klystrons in radar and linear accelerator systems, as a power source in laboratory work or in airborne navigation systems. Its unusually long service life and reliability make it the choice for systems' work in L band. Write or phone your nearest Sperry district office for details.

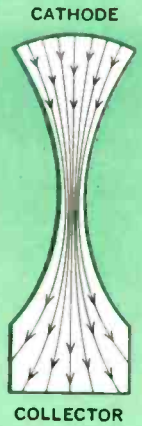
ELECTRONIC TUBE DIVISION
SPERRY GYROSCOPE COMPANY
Great Neck, New York

DIVISION OF SPERRY RAND CORPORATION

BROOKLYN · CLEVELAND · NEW ORLEANS · LOS ANGELES · SEATTLE · SAN FRANCISCO
IN CANADA: SPERRY GYROSCOPE COMPANY OF CANADA, LTD., MONTREAL, QUEBEC

**SAL-81 SPECIFICATIONS**

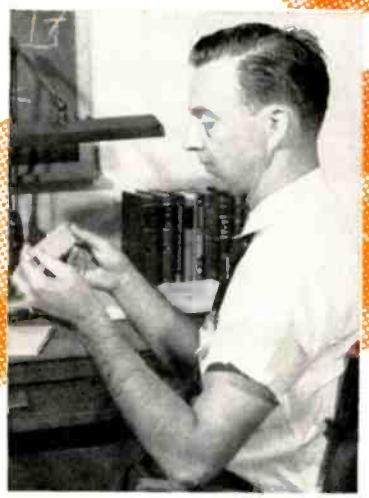
| | |
|---|---|
| Frequency Range | 1215-1365mc |
| Power Output | 20kw |
| Gain | 30db |
| Voltage Requirements | 18kv |




Sperry's Space-Charge Focus principle of beam control eliminates need for heavy, unwieldy magnetic structures. New Sperry tube design using this principle cuts weight, size, power consumption and cooling requirements.


Circle 29 on Inquiry Card, page 103

# when you have ken ✳ you can!





## ESC HAS THE KNOW-HOW AND EXPERIENCE REQUIRED TO PRODUCE CUSTOM-BUILT DELAY LINES TO YOUR EXACTING SPECIFICATIONS.

**1st** in sales!

**1st** company devoted *exclusively* to the manufacture of delay lines!

**1st** in research, design and development of custom-built delay lines!

**1st** to submit the most definitive laboratory reports with all custom-built delay line prototypes!

✳ **ken**—vision, knowledge, perception... as, ESC has the ken to produce the finest custom-built delay lines in use today.

*Exceptional employment opportunities for engineers experienced in pulse techniques.*

**ESC CORPORATION**

534 Bergen Boulevard, Palisades Park, New Jersey



Circle 30 on Inquiry Card, page 103

# Books

## *Basic Mathematics for Radio and Electronics*

*By F. M. Colebrook and J. W. Head. Published 1957 by Philosophical Library, Inc., 15 East 40th St., New York 16, N. Y. 359 pages. Price $6.00.*

This new addition is wider in scope and includes much new material. Primarily written for those interested in radio and electronic engineering, who find themselves handicapped by their lack of mathematical knowledge, it is suited to researchers in other subjects. The lively style has vitalized in human eyes what can so easily be made a dull subject.

The book deals with the basic principles of those branched in mathematics which many years of practical experience in radio and electronics has shown to be definitely necessary, or especially useful.

In recent years many radio engineers have found it increasingly necessary to become familiar with such subjects as operational, or Heaviside, calculus, linear differental equations, matrices, elementary statistics, and numerical computations.

## *Computers, Their Operation and Applications*

*By Edmund C. Berkeley and Lawrence A. Wainwright. Published 1956 by Reinhold Pub. Corp., 430 Park Ave., New York 22. 366 pages. Price $8.00.*

Late developments in both techniques and equipment of automatic computing are described, illustrated, and compared in this book.

Here, the reader will find the practical down to earth information needed on exactly how these machines work and what they can do. All the basic elements of digital, analogue, and miniature computers are fully explained, as are such important considerations as computer reliability advantages, imitations and maintenance.

A large chapter is devoted to present and potential application of computing machines in scientific laboratories, government, military installations, and many business markets.

## *Communication Engineering— Third Edition*

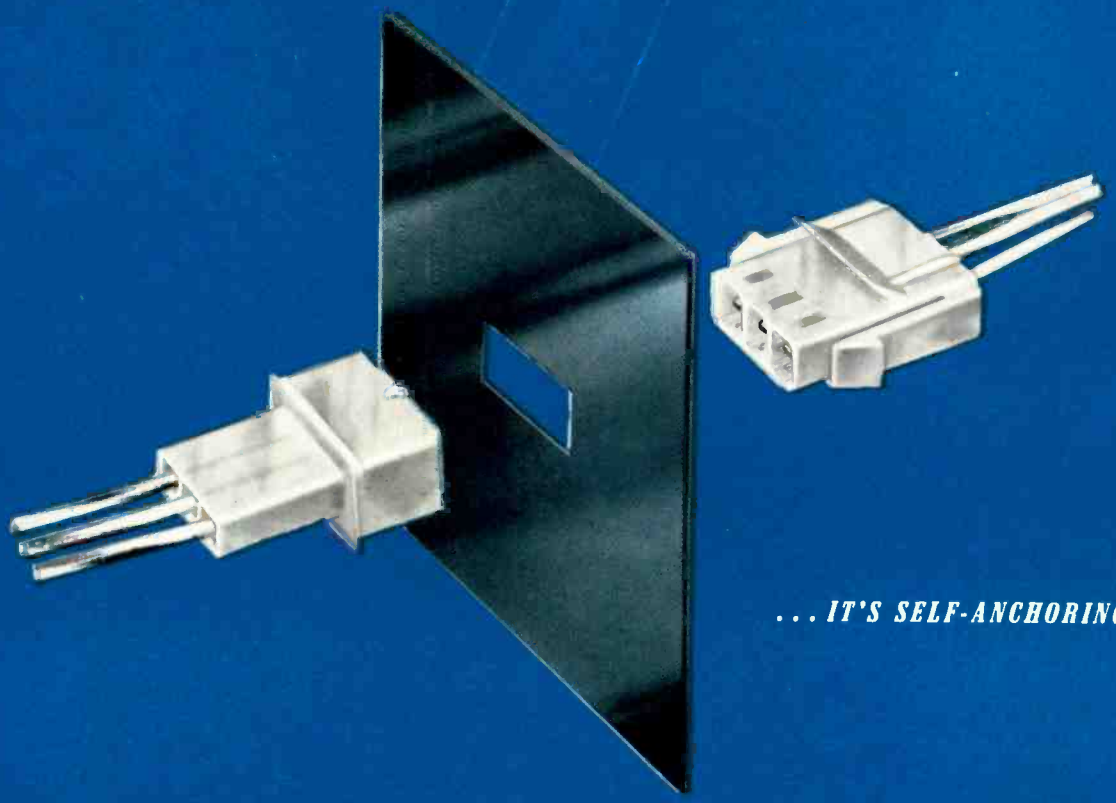
*By W. L. Everitt, Ph. D. and G. E. Anner. Published 1956 by McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36. 644 pages. Price $9.00.*

In this edition emphasis is placed on the area which must precede the study of all other division of communications, namely, the fundamentals on linear-network analysis and synthesis, including the use of interlateral elements. In order to demonstrate the design requirements which are imposed on the linear portions of communications systems networks,

(*Continued on Page* 48)

# AMP-lok

## the new concept in multiple connector design



*. . . IT'S SELF-ANCHORING*

AMP

AMP-lok eliminates the necessity for supplementary mounting devices in through panel multiple connector applications.

**Additional literature and samples available on request.**

AMP-lok obsoletes all it replaces because of the following design features:

- contacts are identical . . . self-cleaning recessed for safety
- finger grip engagement and disengagement
- polarized to eliminate circuit error
- wide panel thickness accommodation —one simple mounting hole required
- color-coding available

AMP-lok can be used as a safe, free-hanging multiple connector, also.

# AMP INCORPORATED

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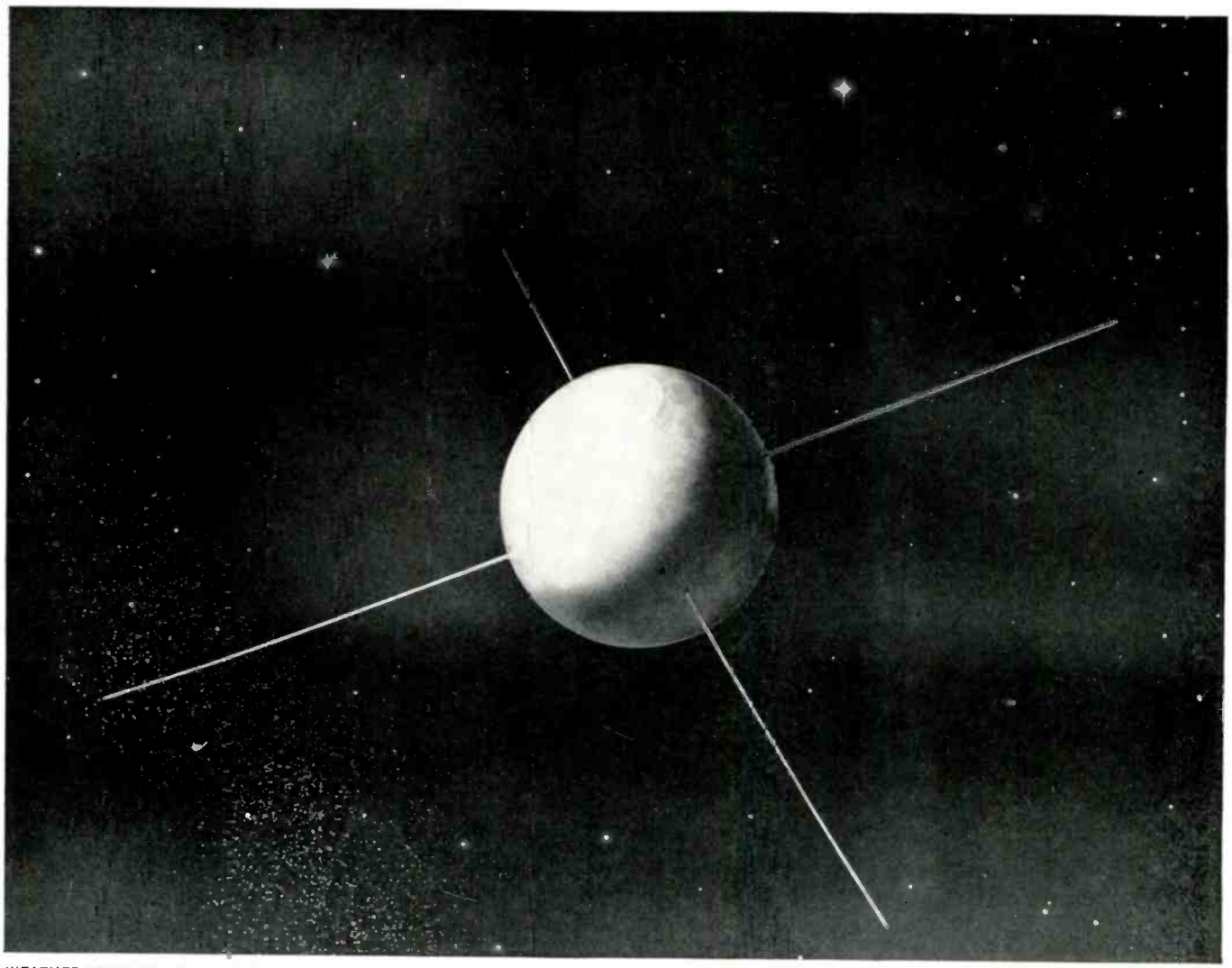
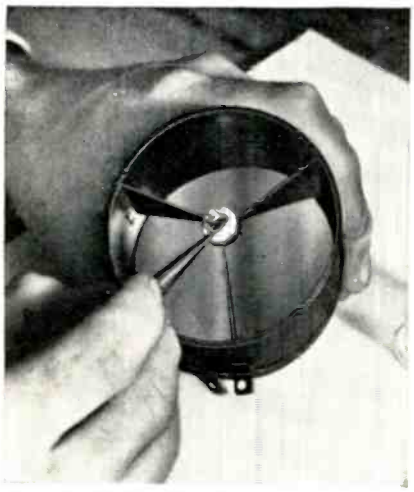
Wholly Owned Subsidiaries: Aircraft-Marine Products of Canada Ltd., Toronto, Canada • Aircraft-Marine Products (Great Britain) Ltd., London, England • Societe AMP de France, Le Pre St. Gervais, Seine, France • AMP — Holland N. V. 's-Hertogenbosch, Holland
Distributor in Japan: Oriental Terminal Products Co., Ltd., Tokyo, Japan

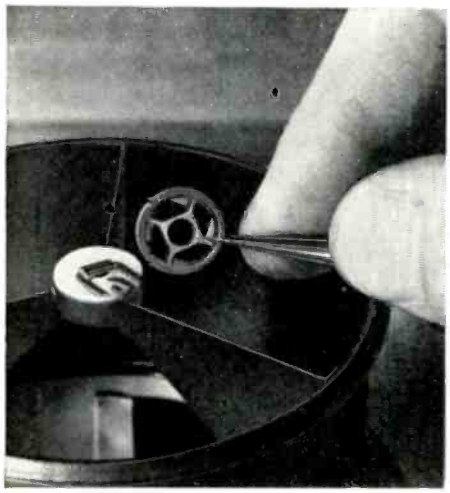
# THE NATIONAL SCENE



**WEATHER PREDICTIONS FROM OUTER SPACE.** Far more accurate weather forecasts will be one of America's scientific achievements during the International Geophysical Year. They will begin when America's earth satellite hurtles into space. Present predictions are based on data covering only 5% of the earth's surface. But forecasters soon will draw clues from cloud patterns, radiation, thickness, types and moisture content—revealed by our satellite orbiting around the earth. National's PHENOLITE will help.



**WEATHER EYES TO MEASURE CLOUD RADIATION.** In the U.S. satellite, two "Weather Eyes" will peer from outer space at earth's cloud layer. Planned by the U.S. Army Signal Corps Engineering Laboratories and developed by the Perkin-Elmer Corp., Norwalk, Conn. to measure cloud radiation, these 4-ounce instruments are hardly larger than a pack of cigarettes. Each uses an f/0.7 mirror to pick up infrared cloud radiation and focus it on a tiny detector unit.



**PHENOLITE WINS BERTH ON EARTH SATELLITE.** In the "Weather Eyes" and in the satellite's silicon solar battery system, tiny but essential pieces of National PHENOLITE laminated plastic serve as printed circuit base and insulating spacers. To qualify for this job, PHENOLITE had to meet stringent specifications in dimensional stability, light weight and ability to withstand a wide range of operating temperatures. Perkin-Elmer selected PHENOLITE Grade G-10-865 because it meets all of these requirements.

MAINTENANCE-FREE

INDEFINITE STORAGE

HIGH PEAK CURRENTS

HERMETICALLY SEALED

LONG LIFE

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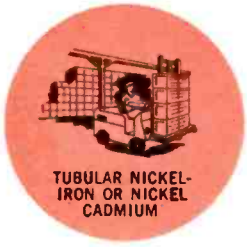
# the new miniature rechargeable nickel cadmium

# BUTTON·CELL BATTERY

Gulton Button·Cell batteries are available in capacities of 250 and 500 milliampere hours. Each Button·Cell has a nominal capacity of 1.2 volts. Multiple cells are packaged in any desired voltage combination to meet your specifications.

The Button Cell is only one of a complete line of nickel cadmium, nickel iron and battery and charger units from a new source — Gulton Industries Alkaline Battery Division.

**Write today for complete technical information — please mention your application.**



TUBULAR NICKEL-IRON OR NICKEL CADMIUM

POCKET NICKEL-IRON OR NICKEL CADMIUM

SINTERED PLATE NICKEL CADMIUM

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SELF-CONTAINED BATTERY AND CHARGER UNITS

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ALKALINE BATTERIES

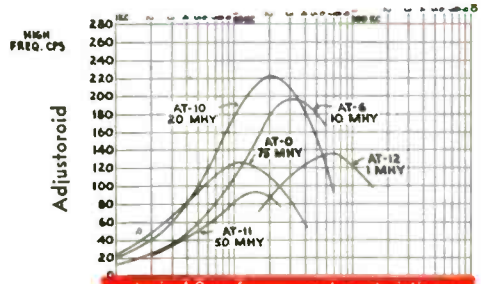
**Alkaline Battery Division**

**Gulton Industries, Inc.**

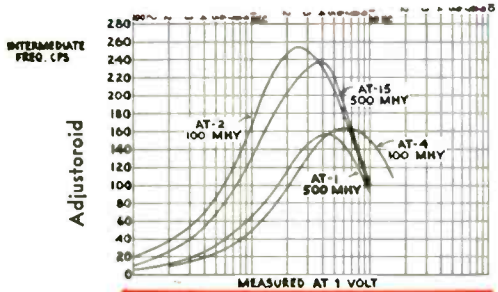
METUCHEN, NEW JERSEY

Circle 34 on Inquiry Card, page 103

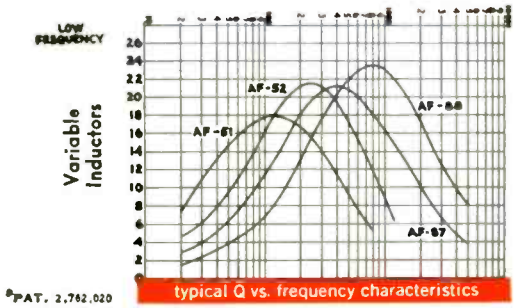
# NEW SUBMINIATURE BURNELL ADJUSTOROIDS® HANDLE BIG JOBS



typical Q vs. frequency characteristics



typical Q vs. frequency characteristics



typical Q vs. frequency characteristics

*PAT. 2,762,020

The new subminiature **Burnell Adjustoroids** utilizing an ingenious patented method of magnetic biasing cover a wide range of frequencies, occupy less space and are available at low cost.

New **Burnell Adjustoroids** possess in addition all the outstanding characteristics of non-adjustable **toroids:**

Precise continuous adjustment of inductance over a 10% range.
No need for external control current.
Hermetic sealing to meet Government MIL E # 15305-A specifications.

If your adjustoroid needs can't be met from our stock catalogue, we'll be glad to manufacture to your specifications.

| | Length/ Dia. | Width | Hgt. | Wt. | Useful Freq. Range | Max Q | Max L in hys |
|---|---|---|---|---|---|---|---|
| AT-0 | 1 1/16 | | 1" | 2 oz | 1 kc to 20 kc | 10 kc | 3 hys |
| AT-1 | 1 3/4 | 1 3/4 | 1 1/4" | 7 1/4 oz | 2 kc to 10 kc | 4 kc | 15 hys |
| AT-2 | 2 3/4 | 2 3/4 | 2 1/4" | 24 oz | Below 2.5 kc | 2.5 kc | 125 hys |
| AT-4 | 1 19/64 | | 1 1/4" | 4 oz | 1 kc to 16 kc | 6 kc | 15 hys |
| AT-6 | 1 1/16 | | 1" | 2 oz | 10 kc to 100 kc | 30 kc | .75 hys |
| AT-10 | 1 19/64 | | 1 1/4" | 4 oz | 3 kc to 50 kc | 20 kc | .75 hys |
| AT-11 | 45/64 | 45/64 | 3/4" | .83 oz | 2 kc to 25 kc | 15 kc | 5 hys |
| AT-12 | 45/64 | 45/64 | 3/4" | .83 oz | 15 kc to 150 kc | 60 kc | .5 hys |
| AT-15 | 1 31/32 | | 1 7/8" | 14 oz | Below 5 kc | 4 kc | 125 hys |
| AF-51 | 1 19/64 | | 2" | 5 oz | 30 cps to 500 cps | 120 cps | 1000 hys |
| AF-52 | 1 19/64 | | 2" | 5 oz | 50 cps to 1 kc | 250 cps | 1000 hys |
| AF-87 | 45/64 | 45/64 | 1 1/4" | 1.7 oz | 90 cps to 2 kc | 400 cps | 80 hys |
| AF-88 | 45/64 | 45/64 | 1 1/4" | 1.7 oz | 1.6 kc to 4 kc | 800 cps | 42 hys |

**Burnell & Co., Inc.**
first in toroids, filters and related networks

**EASTERN DIVISION**
10 PELHAM PARKWAY
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PELHAM 8-5000
TELETYPE: PELHAM 3633

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720 MISSION STREET
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RYAN 1-2841
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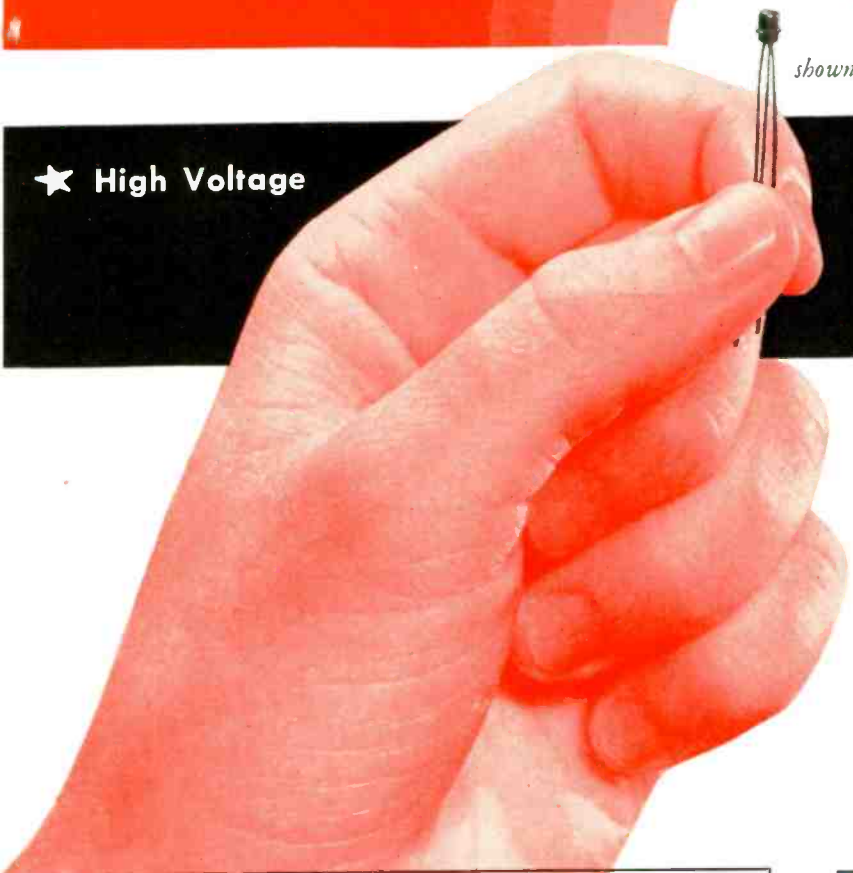
Dept. I-1

# First From PHILCO . . .

# New Micro-Miniature Transistor Family



*shown here actual size*

★ High Voltage

★ High Beta

★ Excellent Switch

★ Low Saturation Voltage

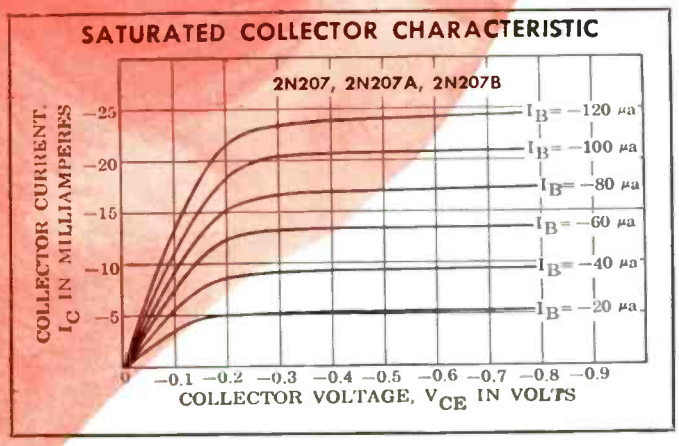
★ Outstanding Performance

Here is a completely new family of micro-miniature transistors, featuring proven reliability in industrial control systems, miniature hearing aid amplifiers, computers and business machines, direct-coupled amplifier and switching circuits, and audio output for miniature radios.

Among these six new transistors will be found the low-cost answer to a tremendous variety of important transistor problems. Our engineers will be happy to discuss specific applications with you.

*Make Philco your prime source of information for all transistor applications.*

***Write to Lansdale Tube Company, Division of Philco Corporation, Lansdale, Pa., Dept. EI-158***




**MICRO-MINIATURE FAMILY APPLICATION DATA**

MAX. DISSIPATION = 50 MW.

| TYPE | MAX. RATING | | TYPICAL PERFORMANCE | | |
|---|---|---|---|---|---|
| | $V_{CE}$ max. | $I_C$ max. | $f_{\alpha b}$ | $h_{fe}$ | NOISE FIGURE |
| 2N207 | 12 | 20 ma | | 100 | 12 db |
| 2N207A | 12 | 20 | | 100 | 9 db |
| 2N207B | 12 | 20 | | 100 | 4 db |
| 2N534 | 50 | 10 | | 100 | |
| 2N535 | 20 | 20 | 2.0 mc | 100 | 12 db |
| 2N536 | 20 | 30 | 2.0 mc | $V_{BE}$ = 0.3v and $V_{CE}$ = .06v with $I_C$ = 10 ma $I_B$ = 1 ma | |

# PHILCO® CORPORATION

## LANSDALE TUBE COMPANY DIVISION

## LANSDALE, PENNSYLVANIA

TRANSISTOR CENTER U.S.A.

# WATCH FOR THESE EVENTS IN ELECTRONIC INDUSTRIES

## MARCH ISSUE—IRE CONVENTION

You'll receive your March IRE issue a full month in advance of the 1958 IRE Convention. It will give you the complete convention program, topics of all technical papers, symposia, and their location.

This big issue will preview IRE Show exhibits, describe new products scheduled for unveiling at the show, and give the booth where they can be seen.

## JUNE ISSUE—ELECTRONIC DATA PROCESSING ADDS NEW DIMENSIONS TO 1958 DIRECTORY ISSUE

The Directory issue you receive in June will owe its extra usability to a high speed electronic data processing system. The directory will list more products than ever before. More precise distinctions will be made between similar products. You will find information previously unavailable in standard industry directories.

Data processing techniques developed by electronic engineers are now "feeding back" to produce the most comprehensive directory their own industry has ever seen.

## AUGUST ISSUE—WESCON

Eleventh hour review of the program lists, of technical papers, exhibitors, meetings, new western products. Two west coast directories will be included in this issue. A directory of west coast manufacturers and their products, and a directory of distributors and manufacturers representatives on the west coast. Both as a guide to WESCON and as a reference source on west coast electronic activity, you won't want to be without this August 1958 issue.

## THIS month . . . NEXT month . . . EVERY month . . .

More than 30,000 O.E.M. subscribers will read ELECTRONIC INDUSTRIES . . . all month

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Circle 37 on Inquiry Card, page 103

# No Grass Grows Here!


The 1958 IRE Convention and Show will be the source of new ideas for more than 50,000 radio engineers. Be sure you are there.

**MARCH 24-27**

## THE IRE NATIONAL CONVENTION

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INSTRUMENTS AND COMPONENTS

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Circle 38 on Inquiry Card, page 103

# Books

*(Continued from Page 40)*

both an analysis of various types of modulation and the transformation of transients from the time of frequency domain are developed.

### *Digital Computer Programming*

*By D. D. McCracken. Published 1957 by John Wiley & Sons, Inc., 440 4th Ave., New York 16, 253 pages, vii pages. Price $7.75.*

This volume treats the down-to-earth details involved in actually working with digital computers. In clear and logical terms, it discusses many of the points that are especially troublesome to beginners, and bares a sound understanding of programming by means of lucid presentation of its basic fundamentals. Its coverage is far more comprehensive than that provided by instruction manuals for specific computers, yet is on a more practical level than the broad surveys written primarily for non-users of computers.

## Books Received

### *Radio Aids to Air Navigation*

*By J. H. H. Grover. Published 1957 by Philosophical Library, Inc., 15 E. 40th St., New York 16. 138 pages, x pages. Price $6.00.*

### *V. H. F. Television Tuners*

*By D. H. Fisher. Published 1957 by Philosophical Library, Inc., 15 E. 40th St., New York 16. 136 pages, xii pages. Price $6.00.*

### *RCA Transistors and Semiconductor Diodes*

*Published 1957 by RCA Semiconductor Div., 415 S. 5th St., Harrison, N. J. 24 pages, paper bound. Price 25¢.*

### *Receiving Tubes Substitution Guide Book, 3rd Supplement*

*By H. A. Middleton. Published 1957 by John F. Rider, Publisher Inc., 116 W. 14th St., New York 11. 72 pages, paper bound. Price $1.35.*

### *Industrial Rectifying Tubes*

*Published 1957 by Philips Technical Library, Eindhoven, Holland. 116 pages. Price $2.15. To be ordered from your book seller.*

### *Registry of Radio Systems in Public Safety Services*

*Published 1957 by Communication Engineering Book Co., Radio Hill, Monterey, Mass. 132 pages, paper bound. Price $4.00.*

### *ASTM Standards on Thermo Installating Materials*

*Published 1957 by American Society for Testing Materials, 1916 Race St., Philadelphia 3. 214 pages, paper bound. Price $3.00.*

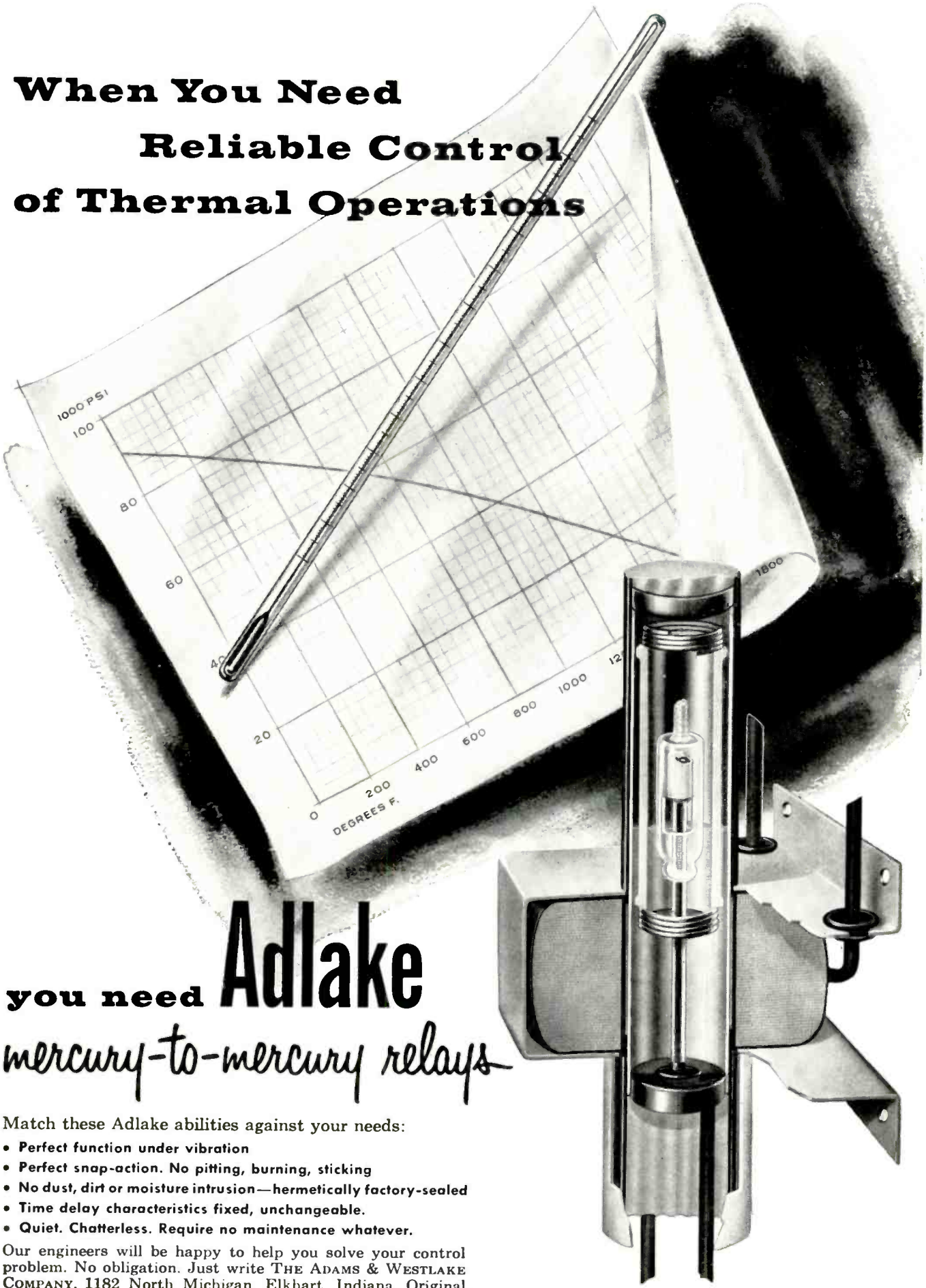
### *Servicing Color TV*

*By Robert G. Middleton. Published 1957 by Gernsback Library, Inc., 154 W. 14th St., New York 11. 224 pages, paper bound. $2.90.*

### *Symposium on Solder*

*Published 1957 by The American Society for Testing Materials, 1916 Race St., Philadelphia 3. 190 pages, paper bound. Price $3.00.*

# When You Need Reliable Control of Thermal Operations




## you need Adlake mercury-to-mercury relays

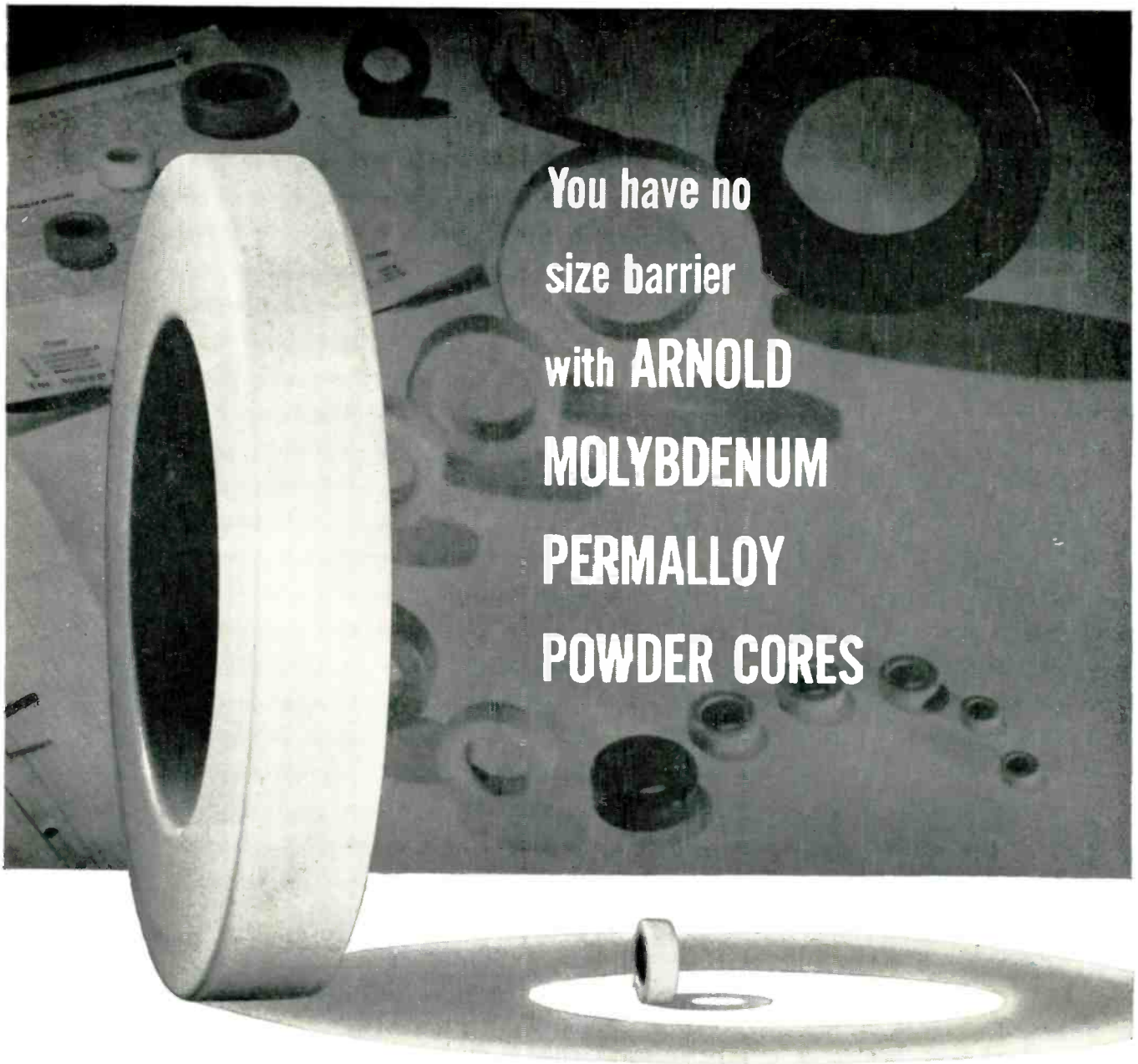
Match these Adlake abilities against your needs:

- **Perfect function under vibration**
- **Perfect snap-action. No pitting, burning, sticking**
- **No dust, dirt or moisture intrusion—hermetically factory-sealed**
- **Time delay characteristics fixed, unchangeable.**
- **Quiet. Chatterless. Require no maintenance whatever.**

Our engineers will be happy to help you solve your control problem. No obligation. Just write THE ADAMS & WESTLAKE COMPANY, 1182 North Michigan, Elkhart, Indiana. Original and largest manufacturers of plunger-type relays.



Circle 40 on Inquiry Card, page 103




Starting with the smallest up to the largest, Arnold leads the way in offering you a full range of Molybdenum Permalloy Powder cores for greater design flexibility . . . from 0.500″ O.D. to 5.218″ O.D.

As long ago as 1953 Arnold pioneered and developed for production use the small "Cheerio" core illustrated above. Today, hundreds of thousands of Arnold "Cheerio" cores are filling the requirement for miniaturization in circuit design in industrial and military applications. And even smaller sizes are now under development at the Arnold Engineering Company.

Arnold also is the exclusive producer of the largest 125 Mu core commercially available. A huge 2,000 ton press is required for its manufacture and insures its uniform physical and magnetic properties. This big core is also offered in the other three standard permeabilities of 60, 26 and 14 Mu.

Most core sizes can be furnished with a controlled temperature coefficient of inductance in the range of 30° F to 130° F. Many can be supplied temperature stabilized over the wide range covered by the MIL-T-27 specification of -55° C to +85° C . . . another of the special features only Arnold provides. ● Let us handle all your magnetic materials requirements from the most extensive line in the industry: Powder cores, tape cores, cast or sintered Alnico permanent magnets, and special magnetic materials.

WSW 6961

**For more information write for Bulletin PC-104B**

Lists complete line of Mo-Permalloy Powder cores . . . available in 23 sizes from 0.500″ O.D. to 5.218″ O.D. Furnished also with various types of temperature stability from Type "A" unstabilized to Type "W" stabilized over the temperature range of −65° F to +185° F.

**ADDRESS DEPT. T-81**

# THE ARNOLD ENGINEERING COMPANY

**Main Office & Plant: Marengo, Illinois**

**Repath Pacific Division Plant: 641 East 61st Street, Los Angeles, Calif.**

*District Sales Offices:*

*Boston:* 49 Waltham St., Lexington *Los Angeles:* 3450 Wilshire Blvd.

*New York:* 350 Fifth Ave. *Washington, D.C.:* 1001-15th St., N.W.

# Electron Tube News
## –from SYLVANIA

## Engineering New Developments—Everywhere in Electronics

## IN MOBILE COMMUNICATIONS...

### Sylvania designs the 12EK6, an RF-IF pentode for auto radio and two-way radio applications

Type 12EK6, a Sylvania-originated T-5½ RF-IF pentode, is available for wide application in vehicular radio. Originally intended for use in 12-volt AM or FM service, the type is finding growing application in two-way radio service for commercial, industrial, amateur and experimental mobile communications.

The new 12EK6 features high gain in IF and RF applications. It is controlled for operation at both 10.0 v and 15.9 v. These maximum ratings provide an increased safety factor for the wide voltage variations possible in mobile power supply systems. The 12EK6 is life-tested at the maximum rating of 15.9 v. to insure top performance.

### The new 12DY8 is a triode-tetrode designed for relay service in signal-seeker 12-volt hybrid auto radios

Sylvania introduces the 12DY8, a triode-tetrode specifically controlled for operating relays in signal-seeking hybrid auto radio. The new tube combines in one T-6½ package all of the requirements for signal-seeking operations, including cutoff controls at high supply voltage and zero bias plate control at low supply conditions.

Type 12DY8 can also be used as an audio amplifier-transistor driver in hybrid auto radios. Although primarily intended for automotive service, the new audio power tetrode is applicable wherever a 5 ma. relay on a 12 v system is used.

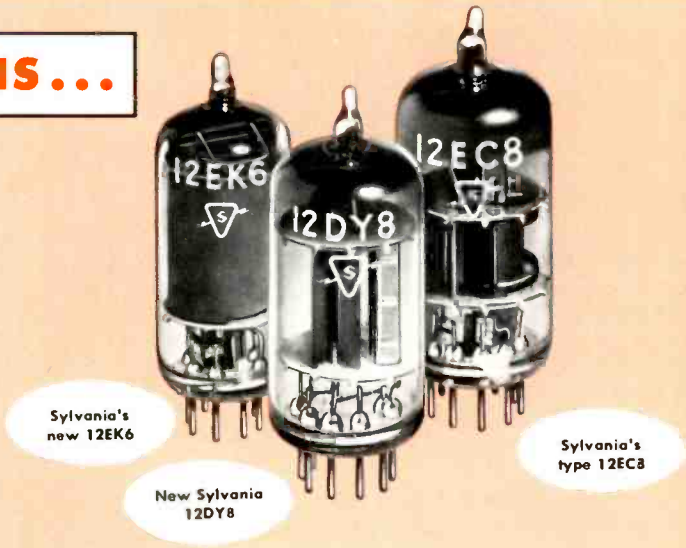
As in the new 12EK6, the heater ratings of the 12DY8 span the entire 10.0 volts- 15.9 volts range to provide a greater safety factor for possible wide variations in fluctuating battery system supply voltages.

### Type 12EC8, Sylvania's first mixer for FM service in hybrid communications receivers

New triode-pentode, type 12EC8, is now in production for broad application wherever 12-volt or 26-volt systems are in use. The 12EC8 is particularly well suited for good mixing action through the 100 MC FM band.

By superimposing even higher quality controls on its already exacting tube manufacturing processes, Sylvania has been able to insure steady long-life operation for the 12EC8.

As with Sylvania's other new tubes for vehicular communications, the heater ratings of the 12EC8 have been extended to cover the range from 10.0 volts to 15.9 volts—for an added safety factor in battery system operation.




**Type 12EK6**
**Typical Operating Conditions & Characteristics**

| | |
|---|---|
| Plate voltage | 12.6 volts |
| Grid #1 voltage | 0 |
| Grid #2 voltage | 12.6 volts |
| Grid #1 resistor | 2.2 megahms |
| Transconductance | 4200 umhos |
| Plate resistance (approx.) | 40,000 ohms |
| Plate current | 4.4 ma. |
| Screen current | 2.0 ma. |
| Grid #1 voltage for $I_b$=10 ua. | –4.2 volts |
| **Direct Interelectrode Capacitances** | **Without Shield** |
| Grid to plate: (g1 to p) max. | 0.032 uuf max. |
| Input: g1 to ($h+K+g^2+g^3$) | 10.0 uuf |
| Output: p to ($h+k+g^2+g^3$) | 5.5 uuf |

**Type 12DY8**
**Typical operating conditions and characteristics**

| | Triode | Tetrode |
|---|---|---|
| Plate Voltage | 12.6 | 12.6 volts |
| Grid #1 voltage | 0 | 0 |
| Grid #2 voltage | — | 12.6 volts |
| Grid #1 Resistor | — | 2.2 megohms |
| Grid #1 resistor bypass condenser | — | 1.0 uf |
| Transconductance | 1,500 | 5,400 umhos |
| Amplification Factor | 20 | — |
| Plate resistance (approx.) | 15,000 | 4,000 ohms |
| Zero Signal Plate Current | 1.0 | 14 ma |
| Zero Signal Screen Current | — | 3 ma |
| Relay Pull-In Plate Current | | 5 ma. min. |
| $E_b$=$E_{c2}$=$E_f$=10 volts; $E_{c1}$=0; $R_p$=1500 ohms; $R_g$=10 meg. | | |
| Relay Drop Out Plate Current | | 3 ma. max. |
| $E_b$=$E_{c2}$=$E_f$=15 volts; $E_{c1}$= -5.5 volts; $R_{g1}$=0; $R_p$=1500 ohms. | | |

**Type 12EC8**
**Typical Operating Conditions and Characteristics**

| | Triode | Pentode |
|---|---|---|
| Plate Voltage | 12.6 | 12.6 volts |
| Grid #2 voltage | — | 12.6 volts |
| Grid #1 voltage | 0 | 0 |
| Grid #1 Resistor | 4,700 | 33,000 ohms |
| Amplification Factor | 25 | — |
| Plate resistance (approx.) | 6,000 | 750,000 ohms |
| Transconductance | 4,700 | 2,000 umhos |
| Plate current | 2.4 | 0.66 ma |
| Grid #2 current | — | 0.28 ma |
| Grid #1 voltage for Ib=10 ua (approx.) | –2.2 | –1.6 volts |

# Engineering New Developments

## IN TELEVISION...

### Sylvania upgrades the 10DE7 for a better safety factor in 110° deflection circuits

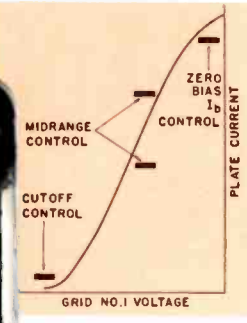
A new 10DE7 to give a better safety factor in 110° vertical deflection circuits has been designed by Sylvania. Most important upgrading in the new tube is:

• **Peak pulse plate voltage**—raised from 1,000 to 1,500 volts.

The reserve power of the 10DE7 is achieved through use of a newly designed plate which has been increased in size to provide greater power handling capacity.

Special care in manufacturing and extensive tests have paved the way for the increased peak pulse plate voltage in Sylvania's 10DE7.

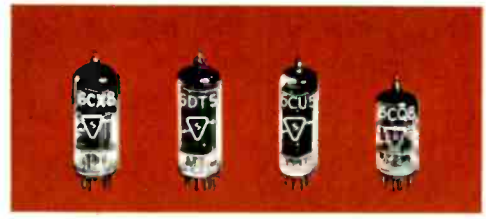

Sylvania's improved 10DE7




The transfer characteristics in the new 10DE7 are rigidly controlled for proper vertical deflection operation.

| Average Characteristics | Triode No. 1 | Triode No. 2 |
|---|---|---|
| Plate Voltage | 250 | 150 volts |
| Grid No. 1 Voltage | -11 | -17.5 volts |
| Plate Current | 5.5 | 35 ma |
| Transconductance | 2,000 | 6,500 umhos |
| Amplification Factor | 17.5 | 6.0 |
| Plate Resistance (approx.) | 8,750 | 925 ohms |
| Grid Voltage for $I_b$=10 ua | -20 | — volts |
| Grid Voltage for $I_b$=50 ua | — | -44 volts |
| Zero Bias Plate Current $E_b$=60 V/Ec=0 (Inst. Values) | — | 80 ma |

### Nine types are added to Sylvania's extensive line of receiving tubes for complete coverage of TV set requirements





Sylvania expands its broad line of TV receiving tubes with the addition of nine new types:

• **Types 6CX8 and 8CX8,** triode and sharp cutoff video pentodes. The pentode section of these types is designed for use as a video amplifier. The triode section is adaptable to a wide range of low frequency amplifier and oscillator applications.

• **Types 6DT5 and 12DT5,** miniature beam power pentodes featuring high zero bias plate current for 110° vertical deflection service. They are designed for superior performance with both plate and screen operating at the B power supply potential.

• **Types 6CU5 and 12CU5,** miniature beam power pentodes for TV audio output in low B+ TV receivers. Both the 6CU5 and 12CU5 exhibit characteristics similar to those of the 5OC5.

• **Type 6CQ8,** medium mu triode and sharp cutoff pentode for use in series string TV receivers. It is intended as a combined vhf oscillator and mixer tube.

• **Types 1J3 and 1K3,** high voltage rectifiers. The 1K3 is the short bulb version of the 1J3 and has identical characteristics.

These timely new additions indicate why more manufacturers contact Sylvania for complete tube service from one convenient source.

## IN GUIDED MISSILE TYPES...

### Full line of guided missile types is now in factory production to meet expanding military needs

Sylvania expands production of its Guided Missile line to meet growing military requirements as the U. S. missile program moves into high gear.

The entire line of Sylvania Guided Missile tubes from type 6943 to 6948 is designed specifically to meet and surpass the most stringent military specifications. The Guided Missile line passes Sylvania's many exacting quality tests such as the White Noise Tests, flicker shorts tests and fatigue tests.

| Type No. | Description |
|---|---|
| 6788 | Pentode audio voltage amplifier |
| 6943 | Sharp cutoff RF pentode |
| 6944 | Semi-remote cutoff RF pentode |
| 6945 | Audio beam power pentode |
| 6946 | Medium mu single triode |
| 6947 | Double, medium mu triode |
| 6948 | Double, high mu triode |

Sylvania's Guided Missile tube line goes into mass production

# Everywhere in Electronics

## IN RELIABLE TUBES...


Sylvania's New Gold Brand booklet

**New engineering booklet tells the story behind the Gold Brand lines**

Sylvania offers a new booklet on its Gold Brand lines with a full run-down on the characteristics, specifications, ratings and production techniques for the reliable tubes. The booklet tells why the Gold Brand has become the sign of premium dependability in reliable receiving tubes. It shows the extra critical specifications that are met throughout the entire manufacturing process. It illustrates how the Gold Brand has become the industry's assurance of military and industrial tubes with extra reliability and excellent performance.

For full information on Sylvania reliable tubes send for your copy of the new Gold Brand booklet.

## IN VIDEO AMPLIFIERS...

**Sylvania introduces type 6EB8, a high mu triode—sharp cutoff pentode in a T-6½ envelope**

Type 6EB8 is a high mu triode, sharp cutoff video pentode. The pentode section is controlled for low knee characteristics and high zero bias plate current. It provides substantially higher video output than its predecessors.

Sylvania's new 6EB8 may also be used to excellent advantage in oscilloscopes and other visual presentation instruments.

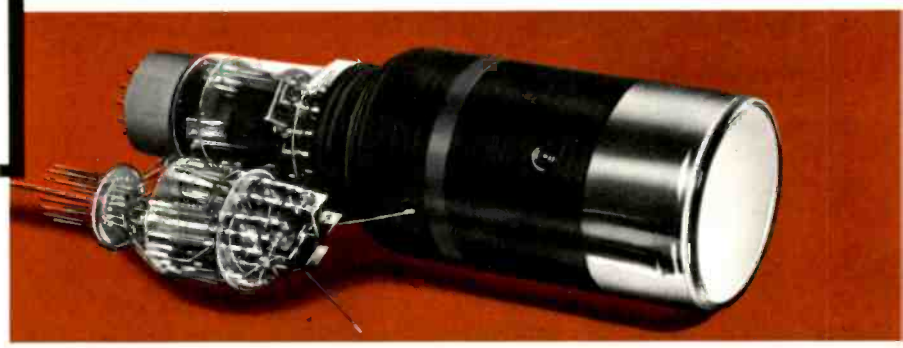

New Sylvania type 6EB8

Typical Operating Conditions and Characteristics, Class A1 Amplifier

| | Triode | Pentode |
|---|---|---|
| Plate voltage | 250 | 200 volts |
| Grid #2 voltage | — | 125 volts |
| Grid #1 voltage | -2 | 0 volts |
| Cathode bias resistor | — | 68 ohms |
| Amplification factor | 100 | — |
| Plate resistance (approx.) | 34,000 | 75,000 ohms |
| Transconductance | 2,700 | 12,500 umhos |
| Plate current | 2 | 25 ma |
| Grid #2 current | — | 7.0 ma |
| Grid #1 voltage (approx.) for Ib=100 ua | — | -9 Vdc |
| Grid #1 voltage (approx.) for Ib=20 ua | -5 | — Vdc |
| Zero Bias: With Eb=40 V; and Ec2=125 V; (Instantaneous values) | | |
| Plate Current | | 40 ma |
| Grid #2 current | | 15 ma |

## IN INDUSTRIAL AND MILITARY C-R TUBES...

**New multi-gun tube development nears completion as Sylvania pushes military and commercial designs**



Developmental model of multi-gun 6DP7

Out of Sylvania's broad basic experience in color TV picture tubes come new developments in multi-gun cathode-ray tubes for commercial and military applications. Sylvania engineers are now completing development of the type 6DP7 shown, an intricate triple gun C-R-T designed for special military purposes. Other multi-gun developmental types incorporating as many as five separate guns are in development.

For airborne use, Sylvania is developing the 5BCP7, a miniaturized lightweight C-R-T that meets the stringent requirements of today's aircraft.

Whatever the need in special cathode-ray tubes—from multi-gun types to wide-angle special-phosphor tubes—Sylvania's engineering know-how and unsurpassed manufacturing facilities can meet it. Discuss your special C-R tube problem with Sylvania's Industrial and Military Cathode-Ray Tube Department.

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**1740 Broadway**
**New York 19, N. Y.**

# Engineering New Developments Everywhere in Electronics

## IN 110° PICTURE TUBES . . .

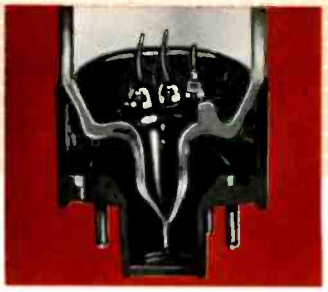
**Sylvania replaces hand tipping with a new automatic exhaust tip sealing process that increases 110° picture tube reliability**

Sylvania adds new and greater uniformity and reliability to its 110° picture tube line with an automatic tipping process. Now all Sylvania 110° types incorporate the rugged squared seal shown.

The extreme rigidity of the new ruggedized exhaust tip seal virtually eliminates cracking or breakage possibilities. By automating the old hand tipping process, uniform reliability is assured for complete tube runs.

The new automatic sealing process allows greater control of tip length as well as shape. This is of particular benefit where rigid pin bases are used. It results in more highly uniform base fitting and pin alignment.

Improvements such as the new tipping process indicate why Sylvania continues to lead the way in 110° picture tubes. All Sylvania 110° types, from the 14's and 17's to the newest 24's now incorporate the squared exhaust tip seal. In 110° picture tubes, it pays to specify Sylvania.



**1. "Old" Hand-Tip**—Cross section of earlier style base showing seal obtained employing previously used hand tipping

**2. "New" Automatic Tip**—Cross section of conventional base used on 110° picture tubes

**3. "New" Automatic Tip**—Cross section of rigid pin base used on 110° picture tubes

## IN NEW HEATER DESIGN . . .

Sylvania now offers the design engineer a broader horizon within which to explore, with the development of a sound and proven 300 ma., 6.3 volt heater for picture tubes.

Originally developed for export markets, the 300 ma., 6.3 volt heater can be made available in sample 90° and 110° tubes for the design engineer's evaluation.

# SYLVANIA

Sylvania Electric Products Inc.
1740 Broadway, New York 19, N. Y.
In Canada: Sylvania Electric (Canada) Ltd.
Shell Tower Bldg., Montreal

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Please send additional information on the items checked below:

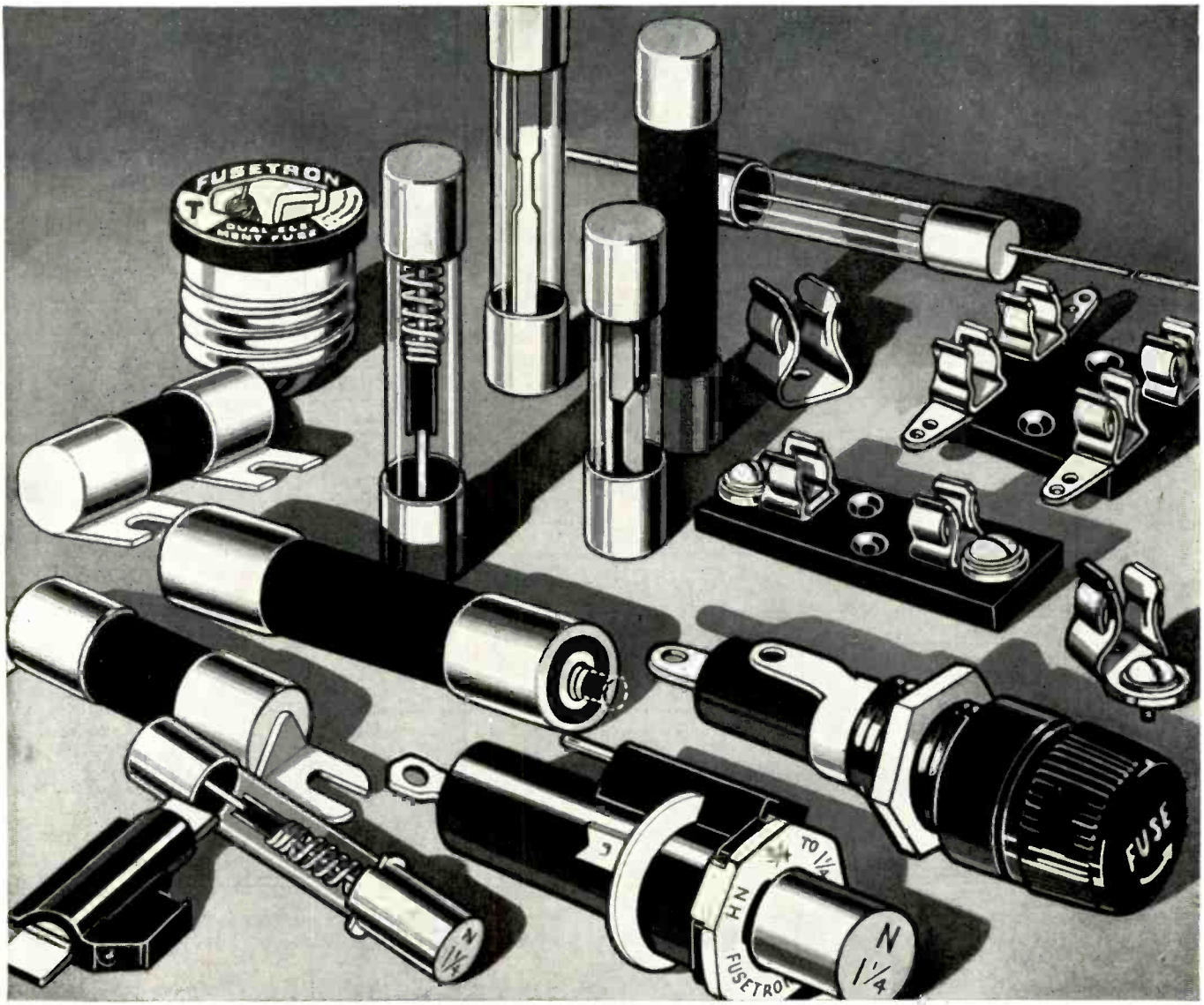
- ☐ Type 10DE7
- ☐ Type 12EK6
- ☐ Type 12DY8
- ☐ Type 12EC8
- ☐ Type 6EB8
- ☐ Types 6/8CX8
- ☐ Types 6/12DT5
- ☐ Types 6/12CU5
- ☐ Type 6CQ8
- ☐ Types 1J3, 1K3
- ☐ Gold Brand Brochure
- ☐ Guided Missile Line
- ☐ 110° Picture Tubes
- ☐ Industrial and Military C-R Tubes
- ☐ The 300 ma., 6.3 volt heater

Name_____

Address_____

Company_____

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




# You can rely on BUSS FUSES to operate as intended.

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The result,—BUSS fuses provide maximum protection against damage due to electrical faults. And just as important, they eliminate useless shutdowns caused by faulty fuses blowing needlessly.

With a complete line of fuses available, it is just good business to standardize on BUSS. The "trouble-free" operation of BUSS fuses helps to assure that your product will operate as intended . . . thus, BUSS fuses help to maintain the reputation of your product for quality and service.

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

For more information on BUSS and Fusetron small dimension fuses and fuseholders . . . Write for Bulletin SFB, Bussmann Mfg. Division, McGraw-Edison Co., University at Jefferson, St. Louis 7, Mo.

***BUSS fuses are made to protect – not to blow, needlessly***

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15M



Circle 43 on Inquiry Card, page 103

## Nominal Performance Characteristics of Typical SPRAGUE Magnetic Shift Registers

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| OPERATING FREQUENCY Maximum (kc) | 0-25 | | | 0-100 | | | 0-200 | | |
| Recommended (kc) | 0-20 | | | 0-90 | | | 0-190 | | |
| VOLTAGE SIGNAL LEVEL | 4 | 15 | 30 | 4 | 15 | 30 | 4 | 15 | 30 |
| SHIFT PULSE Nominal Operating Current (ma) | 160 | 160 | 160 | 140 | 200 | 200 | 220 | 220 | 220 |
| Voltage Drop per Stage (v) | 3.4 | 8.0 | 9.5 | 8.0 | 10.0 | 13.5 | 6.8 | 6.0 | 9.5 |
| Duration ($\mu$sec at ½ amplitude) | 7.0 | 6.5 | 5.8 | 2.0 | 2.0 | 2.5 | 1.2 | 1.2 | 1.2 |
| Rise Time ($\mu$sec) | 1.8 | 1.8 | 1.8 | 0.8 | 0.8 | 0.8 | 0.3 | 0.3 | 0.3 |
| Fall Time ($\mu$sec) | 0.9 | 1.8 | 0.9 | 0.8 | 0.8 | 0.8 | 0.3 | 0.3 | 0.3 |
| Peak Pulse Power (watts) | .55 | 1.5 | 1.6 | 1.12 | 2.0 | 2.7 | 1.5 | 1.4 | 2.1 |
| INPUT PULSE Amplitude (ma) | 15 | 10 | 5 | 15 | 10 | 15 | 15 | 10 | 10 |
| Duration ($\mu$sec) | 10 | 10 | 10 | 3 | 3 | 3 | 2 | 2 | 2 |
| PARALLEL OUTPUT PULSE Amplitude (ma) | 4 | 16 | 32 | 5 | 18 | 30 | 4.5 | 16 | 30 |
| Ratio (min.) | 10:1 | 10:1 | 10:1 | 10:1 | 10:1 | 10:1 | 8:1 | 8:1 | 8:1 |
| Load Impedance (ohms, min.) | 2000 | 6000 | 25,000 | 1800 | 8000 | 15,000 | 10,000 | 10,000 | 18,000 |
| DIODE TYPE (or equivalent) | T-7 | T-7 | T-7 | T-7 | T-7 | T-5 | T-7 | T-5 | T-5 |
| ENGINEERING DATA SHEET | 9111 | 9113 | 9115 | 9121 | 9123 | 9125 | 9131 | 9133 | 9135 |

# core-diode type magnetic shift register assemblies

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All standard packages are characterized by terminal spacing that simplifies external mounting of semi-conductor diodes, or they can be permanently packaged as integral assembly components in Sprague special designs.

Single and multiple stage register assemblies are available with read and write provisions to meet most system requirements. Standard designs can easily be modified with additional windings to perform various logical operations.

For Data Sheets on core-diode type magnetic shift register assemblies, write the Technical Literature Section, Sprague Electric Company, 233 Marshall St., North Adams, Massachusetts.

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ELECTRONIC INDUSTRIES

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

# WHAT'S AHEAD FOR '58

In 1957 some 4,365 manufacturers reported themselves engaged in making electronic products. Of the 4,365 manufacturers, 1000 are located in New York State, over 600 in California, 575 in Illinois and 500 in New Jersey. Other states with 200 or more manufacturers include Massachusetts, Pennsylvania, Connecticut and Ohio. The value of the products produced by the electronic industries total nearly $10.5 billion. Principal contributing segments were: military electronic equipment which accounted for $3.5 billion; radios, television sets, high fidelity equipment and other consumer electronic products had a retail value of approximately $4.5 billion; industrial electronic equipment swells the total by another $1.3 billion. Sales of new equipment for communications, which includes broadcasting, microwave relay systems and mobile radio systems, total more than $150 million.

## MILITARY

The rise of Sputniks I and II during the Fall of 1957 will trigger greater expenditures in military electronics during 1958. The Sputniks and the NATO meetings have undoubtedly been prime causes of program re-evaluations. This in turn could account for the relatively heavy fall-off in military business at year's end. A continual increase in military business is anticipated after the first quarter of 1958 with heaviest procurements occurring after June. For 1958 the total dollar volume for military electronics is expected to rise to $4.5 billion.

## RADIO & TELEVISION

Black and white television set sales were lower than anticipated in 1957. Production amounted to about 6,500,000 receivers. In 1958 production estimates are for 7,000,000 sets with the bulk of sales going to the portable designs. Portable set sales should account for about 35% of the total. Completely transistorized printed circuit designs still have not been announced, but with the transistor makers anticipating another doubling in production output, unit costs should come down and make their use more attractive to set makers.

Radio set production made unexpected gains in 1957. 15,500,000 units were produced. One explanation might be that the novelty of TV viewing is wearing off and programming such as music and news leaves the listener free to do other things. Another might be that with the constantly expanding interest in high fidelity equipment more and more consumers are listening to radio. FM broadcasting, which had been sagging continuously in past years, is on an upswing that should continue through 1958. In radio, portable designs will again account for about 25% of total sales. If the 1957 growth pattern for radio projects through 1958, production should be up by another 10%.

## INDUSTRIAL ELECTRONICS

Sales in the industrial electronic field are estimated at $1.3 billion for 1957. Principal segments include analog and digital computing devices, $180 million; electronic machine tool controls, $115 million; industrial ultrasonics, $30 million. Dielectric heating devices, X-ray equipment, nuclear instrumentation medical electronics, electronic timing and inspection devices are among the many other elements contributing to this phase of electronic activity. In 1958 many new facilities of expanding manufacturers should be in operation to swell this total to $1.5 billion.

## SEMICONDUCTORS

Transistor production in 1958 is expected to again more than double itself. 60 million units are anticipated with about 92% in germanium and 8% silicon. Approximately 15% of the production will be for automobile sets; radios and consumer electronic products, 50%; industrial electronic equipment, 25%; military applications, 10%. Power transistors will account for approximately 15% of production; high frequency transistor types, 45%; high temperature applications, 8%; special purpose semiconductors, 13%; all others, 20%. Considerable research is underway on new semi-conductor materials and announcements in this connection are anticipated during 1958.

# 1957-1958 Statistics of the

### 1958 ELECTRONIC MARKETS

| | |
|---|---|
| Consumer Goods | $ 4,500,000,000 |
| Military & Government | 4,500,000,000 |
| Industrial | 1,300,000,000 |
| Commercial Communications | 150,000,000 |
| | $10,450,000,000 |

### ANNUAL BILL OF U. S. FOR RADIO-TV 1957

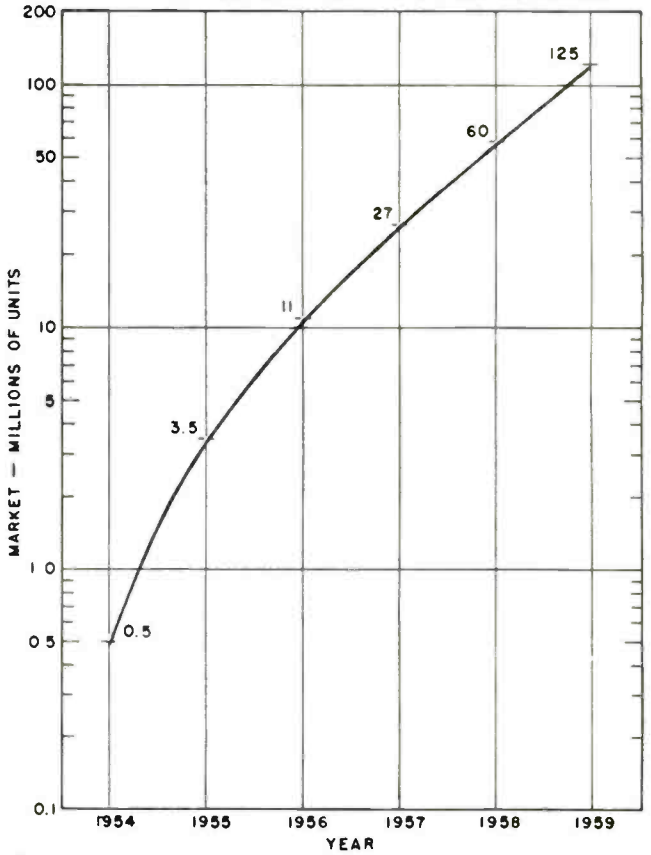
| | |
|---|---|
| Sale of Time By Broadcasters | $1,925,000,000 |
| Electricity, Batteries, etc., to operate 193,400,000 Radio & TV Receivers | 804,000,000 |
| 15,500,000 Radio Sets, at Retail Value | 603,000,000 |
| 6,500,000 Television Sets, at Retail Value | 1,270,000,000 |
| Hi-Fidelity Audio | 190,000,000 |
| Phono Records, 300,000,000 at Retail Value | 380,000,000 |
| Radio-TV Servicing and Installation (Retail Value): | |
| 182 Million Replacement Receiving Tubes | 310,000,000 |
| 6.3 Million Replacement TV Picture Tubes | 230,000,000 |
| Radio-TV Component Parts, Antennas, Accessories | 760,000,000 |
| Labor | 1,100,000,000 |
| TOTAL | 17,572,000,000 |

### SERVICE

During 1957 the annual retail bill for servicing of home electronic appliances is summarized:

| | |
|---|---|
| 182,000,000 replacement receiving tubes | $ 310,000,000 |
| 6,300,000 replacement picture tubes (Includes Rebuilds) | 230,000,000 |
| Antennas, components, parts, instruments | 760,000,000 |
| Labor | 1,100,000,000 |
| Total servicing bill | $2,400,000,000 |

### PROJECTED TOTAL TRANSISTOR MARKET




*"The Transistor Market in the United States" prepared for Philco Corp., Lansdale Tube Co., Div., by Stanford Research Inst.*

### U.S. PRODUCTION OF RADIO SETS—1922 TO 1957

| | Total Radio Sets Manufactured | | Total Receiving Tubes* Manufactured | | Automobile Sets Manufactured | | Auto Sets in Use | Homes with Radio Sets | Total Radio Sets in Use in U. S. | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Number | Retail Value | Number | Retail Value | Number | Retail Value | Number | Number | Number | |
| 1922 | 100,000 | $ 5,000,000 | 1,000,000 | $ 6,000,000 | | | | 260,000 | 400,000 | 1922 |
| 1923 | 550,000 | 30,000,000 | 4,500,000 | 12,000,000 | | | | 1,000,000 | 1,100,000 | 1923 |
| 1924 | 1,500,000 | 100,000,000 | 12,000,000 | 36,000,000 | | | | 2,500,000 | 3,000,000 | 1924 |
| 1925 | 2,000,000 | 165,000,000 | 20,000,000 | 48,000,000 | | | | 3,500,000 | 4,000,000 | 1925 |
| 1926 | 1,750,000 | 200,000,000 | 30,000,000 | 58,000,000 | | | | 5,000,000 | 5,700,000 | 1926 |
| 1927 | 1,350,000 | 168,000,000 | 41,200,000 | 67,300,000 | | | | 6,500,000 | 7,000,000 | 1927 |
| 1928 | 3,281,000 | 400,000,000 | 50,200,000 | 110,250,000 | | | | 7,500,000 | 8,500,000 | 1928 |
| 1929 | 4,428,000 | 600,000,000 | 69,000,000 | 172,500,000 | | | | 9,000,000 | 10,500,000 | 1929 |
| 1930 | 3,827,000 | 300,000,000 | 52,000,000 | 119,600,000 | 34,000 | $ 3,000,000 | | 12,048,762 | 13,000,000 | 1930 |
| 1931 | 3,420,000 | 225,000,000 | 53,000,000 | 69,550,000 | 108,000 | 5,940,000 | 100,000 | 14,000,000 | 15,000,000 | 1931 |
| 1932 | 3,000,000 | 140,000,000 | 44,300,000 | 48,730,000 | 143,000 | 7,150,000 | 250,000 | 16,809,562 | 18,000,000 | 1932 |
| 1933 | 3,806,000 | 180,500,000 | 59,000,000 | 49,000,000 | 724,000 | 28,598,000 | 500,000 | 20,402,369 | 22,000,000 | 1933 |
| 1934 | 4,084,000 | 214,500,000 | 58,000,000 | 36,600,000 | 780,000 | 28,000,000 | 1,250,000 | 21,456,000 | 26,000,000 | 1934 |
| 1935 | 6,026,800 | 330,192,480 | 71,000,000 | 50,000,000 | 1,125,000 | 54,562,500 | 2,000,000 | 22,869,000 | 30,500,000 | 1935 |
| 1936 | 8,248,000 | 450,000,000 | 98,000,000 | 69,000,000 | 1,412,000 | 69,188,000 | 3,500,000 | 24,600,000 | 33,000,000 | 1936 |
| 1937 | 8,064,780 | 450,000,000 | 91,000,000 | 85,000,000 | 1,750,000 | 87,500,000 | 5,000,000 | 26,666,500 | 37,600,000 | 1937 |
| 1938 | 6,000,000 | 210,000,000 | 75,000,000 | 93,000,000 | 800,000 | 32,000,000 | 6,000,000 | 28,000,000 | 40,800,000 | 1938 |
| 1939 | 10,500,000 | 354,000,000 | 91,000,000 | 114,000,000 | 1,200,000 | 48,000,000 | 6,500,000 | 28,700,000 | 45,300,000 | 1939 |
| 1940 | 11,800,000 | 450,000,000 | 115,000,000 | 115,000,000 | 1,700,000 | 60,000,000 | 7,500,000 | 29,200,000 | 51,000,000 | 1940 |
| 1941 | 13,000,000 | 460,000,000 | 130,000,000 | 143,000,000 | 2,000,000 | 70,000,000 | 8,750,000 | 29,700,000 | 56,000,000 | 1941 |
| 1942 | 4,400,000 | 154,000,000 | 87,700,000 | 94,000,000 | 350,000 | 12,250,000 | 9,000,000 | 30,800,000 | 59,340,000 | 1942 |
| 1943 | ..... | ..... | 17,000,000 | 19,000,000 | ..... | ..... | 8,000,000 | 32,000,000 | 58,000,000 | 1943 |
| 1944 | ..... | ..... | 22,000,000 | 25,000,000 | ..... | ..... | 7,000,000 | 33,000,000 | 57,000,000 | 1944 |
| 1945 | 500,000 | 20,000,000 | 30,000,000 | 35,000,000 | ..... | ..... | 6,000,000 | 34,000,000 | 56,000,000 | 1945 |
| 1946 | 14,000,000 | 700,000,000 | 190,000,000 | 200,000,000 | 1,200,000 | 72,000,000 | 7,000,000 | 35,000,000 | 60,000,000 | 1946 |
| 1947 | 17,000,000 | 800,000,000 | 220,000,000 | 260,000,000 | 3,200,000 | 194,000,000 | 9,000,000 | 37,000,000 | 66,000,000 | 1947 |
| 1948 | 14,090,000 | 600,000,000 | 200,000,000 | 230,000,000 | 4,100,000 | 293,000,000 | 11,000,000 | 40,000,000 | 74,000,000 | 1948 |
| 1949 | 10,000,000 | 500,000,000 | 190,000,000 | 350,000,000 | 3,500,000 | 240,000,000 | 14,000,000 | 42,000,000 | 81,000,000 | 1949 |
| 1950 | 14,600,000 | 721,000,000 | 383,000,000 | 644,000,000 | 4,760,000 | 248,000,000 | 17,000,000 | 45,000,000 | 90,000,000 | 1950 |
| 1951 | 13,000,000 | 605,000,000 | 430,000,000 | 640,000,000 | 4,800,000 | 255,000,000 | 20,000,000 | 45,850,000 | 100,000,000 | 1951 |
| 1952 | 10,000,000 | 500,000,000 | 330,000,000 | 740,000,000 | 2,750,000 | 148,000,000 | 25,000,000 | 46,000,000 | 114,500,000 | 1952 |
| 1953 | 13,400,000 | 536,000,000 | 410,000,000 | 920,000,000 | 4,800,000 | 250,000,000 | 29,000,000 | 48,000,000 | 120,500,000 | 1953 |
| 1954 | 10,000,000 | 400,000,000 | 400,000,000 | 880,000,000 | 4,300,000 | 220,000,000 | 32,000,000 | 50,000,000 | 127,000,000 | 1954 |
| 1955 | 14,400,000 | 559,000,000 | 481,000,000 | 852,000,000 | 6,900,000 | 346,000,000 | 35,700,000 | 52,000,000 | 138,700,000 | 1955 |
| 1956 | 14,000,000 | 553,000,000 | 465,000,000 | 906,000,000 | 5,000,000 | 258,000,000 | 37,500,000 | 53,200,000 | 143,500,000 | 1956 |
| 1957 | 15,500,000 | 603,000,000 | 450,000,000 | 882,000,000 | 5,500,000 | 303,000,000 | 39,600,000 | 53,400,000 | 146,400,000 | 1957 |

* Tubes used as replacements accounted for about 35% in 1957.

# Radio-TV-Electronic Industries

## VITAL TELEVISION STATISTICS 1946-57

| | Total TV Sets Manufactured | | Receiving Tubes Used in New TV Sets and for Replacements | | Total TV Picture Tubes Manufactured | | Total AM-FM-TV Receiving Sets Manufactured | TV Stations on the Air | Total TV Sets in Use in U. S. | At Close of |
|---|---|---|---|---|---|---|---|---|---|---|
| | Number | Retail Value | Number | Retail Value | Number | Retail Value | | | | |
| 1946 | 10,000 | $ 5,000,000 | 350,000 | $ 588,000 | 20,000 | $ 1,000,000 | 14,010,000 | 5 | 8,000 | 1946 |
| 1947 | 250,000 | 100,000,000 | 8,500,000 | 15,000,000 | 300,000 | 15,000,000 | 17,250,000 | 20 | 230,000 | 1947 |
| 1948 | 1,000,000 | 350,000,000 | 32,200,000 | 53,000,000 | 1,500,000 | 75,000,000 | 17,000,000 | 44 | 1,000,000 | 1948 |
| 1949 | 3,000,000 | 950,000,000 | 87,000,000 | 146,000,000 | 3,500,000 | 210,000,000 | 13,000,000 | 100 | 3,800,000 | 1949 |
| 1950 | 7,500,000 | 2,700,000,000 | 225,000,000 | 378,000,000 | 8,000,000 | 400,000,000 | 22,100,000 | 107 | 10,500,000 | 1950 |
| 1951 | 5,600,000 | 2,100,000,000 | 161,000,000 | 270,000,000 | 6,000,000 | 300,000,000 | 19,100,000 | 108 | 15,750,000 | 1951 |
| 1952 | 6,300,000 | 2,360,000,000 | 168,000,000 | 380,000,000 | 6,500,000 | 260,000,000 | 16,300,000 | 123 | 21,800,000 | 1952 |
| 1953 | 7,300,000 | 1,675,000,000 | 210,000,000 | 400,000,000 | 9,000,000 | 360,000,000 | 20,700,000 | 350 | 28,000,000 | 1953 |
| 1954 | 7,300,000 | 1,278,000,000 | 215,200,000 | 409,000,000 | 10,300,000 | 360,500,000 | 17,700,000 | 415 | 33,000,000 | 1954 |
| 1955 | 7,800,000 | 1,263,600,000 | 220,000,000 | 407,000,000 | 10,600,000 | 371,000,000 | 20,000,000 | 457 | 39,400,000 | 1955 |
| 1956 | 7,590,000 | 1,237,500,000 | 200,000,000 | 400,000,000 | 11,000,000 | 318,000,000 | 21,900,000 | 491 | 42,300,000 | 1956 |
| 1957 | 6,500,000 | 1,270,000,000 | 175,000,000 | 371,000,000 | 10,000,000 | 340,000,000 | 22,000,000 | 519 | 45,500,000 | 1957 |

## ELECTRONIC FIRMS —BY STATES

**Headquarters offices by number and state for the 4,365 electronic manufacturers**

| STATE | NO. OF COMPANIES |
|---|---|
| Alabama | 2 |
| Arizona | 7 |
| Arkansas | 2 |
| California | 617 |
| Colorado | 11 |
| Connecticut | 200 |
| District of Columbia | 14 |
| Delaware | 10 |
| Florida | 24 |
| Georgia | 5 |
| Illinois | 571 |
| Indiana | 87 |
| Iowa | 21 |
| Kansas | 4 |
| Kentucky | 7 |
| Louisiana | 5 |
| Maine | 3 |
| Maryland | 42 |
| Massachusetts | 254 |
| Michigan | 89 |
| Minnesota | 56 |
| Mississippi | 2 |
| Missouri | 51 |
| Nebraska | 8 |
| Nevada | 1 |
| New Hampshire | 24 |
| New Jersey | 485 |
| New Mexico | 9 |
| New York | 999 |
| North Carolina | 8 |
| Ohio | 230 |
| Oklahoma | 10 |
| Oregon | 12 |
| Pennsylvania | 292 |
| Rhode Island | 31 |
| South Carolina | 5 |
| Tennessee | 10 |
| Texas | 43 |
| Utah | 5 |
| Vermont | 7 |
| Virginia | 17 |
| Washington | 13 |
| West Virginia | 2 |
| Wisconsin | 69 |
| Wyoming | 1 |
| | 4,365 |

## RECORDERS

(non-commercial)

Estimated 1958 tape recorder sales in new units and retail $ volume

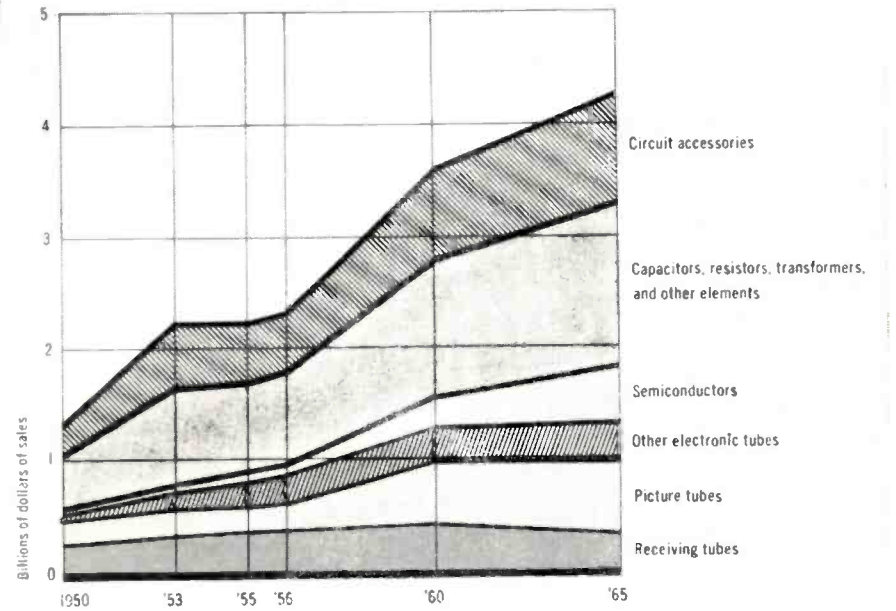
| | | |
|---|---|---|
| 1955 | | |
| 325,000 | | $48,750,000 |
| 1956 | | |
| 425,000 | | $63,750,000 |
| 1957 | | |
| 475,000 | | $95,000,000 |
| 1958 | | |
| 535,000 | | $100,000,000 |

## PHONOGRAPHS

Estimated 1958 sales of phono players in new units and retail $ volume

| | | |
|---|---|---|
| 1955 | | |
| 4,000,000 | | $120,000,000 |
| 1956 | | |
| 4,150,000 | | $124,500,000 |
| 1957 | | |
| 4,700,000 | | $142,000,000 |
| 1958 | | |
| 5,000,000 | | $147,000,000 |

**The Electronic Components Industry**




*—NEDA Journal, Sept. 1957, Vol. 13—No. 9*

## APPROPRIATIONS AND EXPENDITURES FOR MILITARY AVIATION

(Millions of Dollars)

| Fiscal Year | U. S. Air Force | | Naval Aviation | |
|---|---|---|---|---|
| | Total Cash Appropriations | Expenditures | Total Cash Appropriations | Expenditures |
| 1939 | $ 71.1 | $ 83.4 | $ 48.2 | $ 47.9 |
| 1944 | 23,656.0 | 13,087.7 | 4,583.7 | 4,490.1 |
| 1949 | 939.8 | 1,059.2 | 588.3 | 875.1 |
| 1953 | 22,076.2 | 15,089.6 | 4,873.0 | 3,061.3 |
| 1956 | 15,681.3 | 16,748.8 | 1,711.7 | 2,836.1 |
| 1958 (estimate) | 16,481.0 | 17,383.3 | 2,810.0 | 2,710.0 |

*—Aircraft Industries Association of America, Inc.*

# 1957-58 Statistics *(Continued)*

**TOTAL RADIO & TV TALENT COSTS**

1956 ..... $1,780,000,000
1957 ..... $1,925,000,000
1958 ..... $2,085,000,000

CHART BELOW describes the approximate quantities produced of the principal components used in radio and TV receivers. The quantities indicated include both components used in original equipment and those used for replacement purposes.

**Broadcast Stations in the U.S.**

| | AM | FM | TV |
|---|---|---|---|
| Stations on Air | 3,124 | 498 | 429 VHF<br>90 UHF |
| Under Construction | 184 | 98 | 47 VHF<br>122 UHF |
| (commercial) | | | 9 VHF |
| (educational) | | | 15 UHF |
| Applications | 327 | 44 | 87 VHF<br>32 UHF |

## PRODUCTION OF PRINCIPAL COMPONENTS USED IN RADIO-TV RECEIVERS

| Year | Trans-formers (Iron Core) | Coils | Capacitors (Electrolytic) | Capacitors (Mica) | Capacitors (Ceramic) | Capacitors (Paper) | Resistors (Composition) | Resistors (Wire Wound) | Loud-speakers | Year |
|---|---|---|---|---|---|---|---|---|---|---|
| 1946 | 49 | 149 | 22 | 69 | 284 | 155 | 477 | 29 | 14 | 1946 |
| 1947 | 70 | 193 | 27 | 84 | 349 | 196 | 608 | 37 | 17 | 1947 |
| 1948 | 46 | 250 | 28 | 86 | 357 | 212 | 654 | 42 | 17 | 1948 |
| 1949 | 39 | 196 | 25 | 74 | 310 | 218 | 670 | 50 | 13 | 1949 |
| 1950 | 65 | 332 | 44 | 106 | 417 | 351 | 1090 | 70 | 22 | 1950 |
| 1951 | 47 | 288 | 38 | 90 | 394 | 284 | 862 | 59 | 19 | 1951 |
| 1952 | 56 | 305 | 42 | 100 | 433 | 312 | 948 | 67 | 17 | 1952 |
| 1953 | 63 | 323 | 43 | 103 | 455 | 325 | 900 | 69 | 21 | 1953 |
| 1954 | 54 | 276 | 37 | 88 | 390 | 278 | 770 | 59 | 18 | 1954 |
| 1955 | 50 | 274 | 51 | 86 | 378 | 338 | 852 | 41 | 24 | 1955 |
| 1956 | 43 | 283 | 45 | 88 | 423 | 369 | 963 | 35 | 25 | 1956 |
| 1957 | 39 | 272 | 38 | 74* | 463 | 267* | 934 | 33 | 24 | 1957 |

* Drop in capacitor production reflects the increased use of printed circuits.
Figures are in millions of units.

# ELECTRONIC MANUFACTURERS—BY PRODUCT CATEGORY

**The 1957 Electronic Industries Directory lists some 4,365 manufacturers. The directory reflects the many products of the electronic industries in 101 major categories. Here broken down are the number of manufacturers reporting products in each of the major categories.**

| | |
|---|---|
| Amplifiers, Audio | 313 |
| Amplifiers, RF-IF | 241 |
| Amplifiers, Special Purpose | 582 |
| Amplifiers, Television | 76 |
| Analyzers | 314 |
| Antennas, Commercial | 241 |
| Antennas, Home | 226 |
| Antenna Accessories | 406 |
| Aviation Auxiliary Electronic Equipment | 609 |
| Batteries, Chargers & Accessories | 99 |
| Cabinets, Racks, Panels & Accessories | 295 |
| Capacitors, Fixed | 139 |
| Capacitors, Variable | 94 |
| Chassis Accessories | 353 |
| Chemicals, Coatings & Related Products | 413 |
| Chokes | 150 |
| Coils | 508 |
| Communications Systems | 233 |
| Computers | 390 |
| Connectors & Terminals | 381 |
| Control Equipment, Communications | 126 |
| Control Equipment, Industrial | 715 |
| Crystals, Accessories & Cores | 343 |
| Detectors | 195 |
| Dials & Front Panel Accessories | 228 |
| Filters | 373 |
| Gages | 119 |
| Hardware | 550 |
| Headphones | 29 |
| Indicators | 346 |
| Industrial Electronic Equipment | 352 |
| Insulation Materials & Compounds | 354 |
| Insulators | 315 |
| Kits | 111 |
| Lighting Equipment & Accessories | 150 |
| Magnetics | 213 |
| Measurement & Test Equipment—Bridges | 108 |
| Measurement & Test Equipment—Counters | 186 |
| Measurement & Test Equipment—Decade Boxes | 35 |
| Measurement & Test Equipment—Generators | 217 |
| Measurement & Test Equipment—Monitors | 68 |
| Measurement & Test Equipment—Oscillators | 326 |
| Measurement & Test Equipment—Oscillographs | 69 |
| Measurement & Test Equipment—Special Purpose | 558 |
| Measurement & Test Equipment—Standards | 59 |
| Medical Electronic Equipment | 186 |
| Metals | 403 |
| Meters, Audio | 87 |
| Meters, Electrical Measurement | 224 |
| Meters—RF | 107 |
| Meters, Special Purpose | 215 |
| Microphones | 67 |
| Microphone Accessories | 122 |
| Microwave Components | 303 |
| Military Equipment | 396 |
| Military Systems Engineering | 291 |
| Missiles | 282 |
| Mobile Communications Equipment | 108 |
| Mobile Communications Accessories | 212 |
| Motion Picture Equipment | 67 |
| Motion Picture Equipment Accessories | 112 |
| Motian Picture Film | 12 |
| Motors & Generators | 352 |
| Navigation Systems | 111 |
| Nuclear Products | 314 |
| Photoelectric Equipment | 123 |
| Power Supplies & Converters | 463 |
| Printed Circuits | 389 |
| Production Machinery & Equipment | 398 |
| Radar Devices | 184 |
| Receivers, Communication | 180 |
| Receivers, Home | 153 |
| Receivers—Navigation & Special Purpose | 82 |
| Recorders, Audio | 105 |
| Recorders, Special Purpose | 303 |
| Recording Accessories | 152 |
| Rectifiers | 102 |
| Relays | 340 |
| Resistors & Volume Controls | 289 |
| Seals | 132 |
| Semi-Conductors | 56 |
| Services, Broadcast | 230 |
| Services, Industrial | 616 |
| Sound Reproducing Equipment, Disc | 197 |
| Sound Reproducing Equipment Magnetic | 67 |
| Sound Systems, Intercommunicators & Hearing Aids | 212 |
| Speakers | 62 |
| Speaker Accessories | 118 |
| Studio Equipment | 268 |
| Studio Accessories | 130 |
| Switches | 348 |
| Testers | 265 |
| Tools, Hand | 181 |
| Transformers | 334 |
| Transmitters | 184 |
| Transmitter Accessories | 103 |
| Tubes | 149 |
| Tube Parts | 272 |
| Tuners | 82 |
| Wire & Cable | 429 |

# Three Output Immittance Theorems

*Formulated here are theorems designed to assist the engineer in treating linear networks in transistor circuitry. Their validity is not disturbed by variations in the power supply.*

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WHILE the principles behind these theorems are well recognized in the network analysis and synthesis fields, the existence of theorems such as the Thevenin-Norton theorem and the Maximum Power Transfer theorem does not generally imply the existence of direct methods for the calculation of output immittance.

With the advent of the transistor, the calculation of output immittance, i.e., output impedance or output admittance, became paramount, partly because of increased need for maximum output, and partly because the input circuit of one transistor amplifier can scarcely be defined unless the output conditions of the previous transistor amplifier are known.

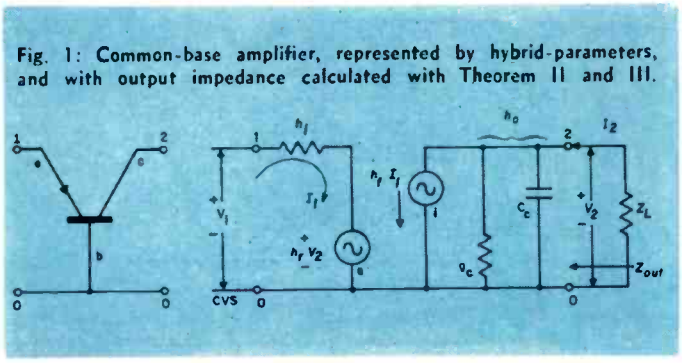



Fig. 1: Common-base amplifier, represented by hybrid-parameters, and with output impedance calculated with Theorem II and III.

A typical example of a transistor amplifier, represented by means of its hybrid-parameters, is shown in Fig. 1. We wish to know how one calculates the output immittance directly and quickly. This problem will be solved later with the aid of the presented theorems.

For conventional methods of calculating output immittance, consider the networks shown in Fig. 2, which do not necessarily represent transistors. Fig. 2a shows an active network represented by its equivalent TEE with an internal constant-voltage-source, cvs, $E$, Fig. 2b shows the same active network represented by its equivalent PI with an internal constant-current-source, ccs, $I$.

First, we will assume that the cvs $E$ and the ccs $I$ are not present. If then both networks represent equivalent circuits of one and the same "physical model," we may at a specified frequency consider one of the networks obtained from the other one by means of TEE-PI and PI-TEE transformation respectively. A simple method of carrying out such transformation from memory, without the use of hand-book formulas, has been given in the literature.[1].

# Immittance Theorems *(continued)*

### *Symbolic Notation*

Employing symbolic notation for the periodic steady state, we may use either $V_1 = \mathrm{V}_1$ or $I_1 = \mathrm{I}_1$ as reference quantity, essentially, but not necessarily, dependent upon whether the network is exposed to cvs-driving or ccs-driving.[1, 5] The input and output loop impedances $Z_i$ and $Z_o$, Fig. 2a, are defined for the selected side as input side and the opposite side ac open-circuited, in accordance with the "open-circuit impedance" concept. $Z_r$, as indicated by the subscript $r$, is the reverse transfer impedance, obtained with a signal current applied to port 2-0, and with port 1-0 ac open-circuited.

Similarly, $Z_f$ designates the forward transfer impedance, with a signal current applied to port 1-0, and port 2-0 ac open-circuited. These symbols are the most recent ones adopted in the transistor field, and apply both to passive and active two-port networks.[2] $Z_r = Z_f$ obtains only for passive networks.

The most fundamental and direct method for calculating input and output immittance of passive networks is the Element Combination Method, in which we refrain from introducing currents and voltages. In accordance with this method we obtain from Fig. 2, with // signifying "in parallel with," with $Z_{2L} = Z_2 + Z_L$, and for cvs drive ($\mathrm{V}_1$ produced by a zero impedance source):

$$Z_{in} = Z_3 + Z_3//Z_{2L} = Z_i - \frac{Z_r^2}{Z_o + Z_L}, \qquad (1)$$

$$Z_{out} = Z_2 + Z_3//Z_1 = Z_o - \frac{Z_r^2}{Z_i}. \qquad (2)$$

In Fig. 2b, we have used the "short-circuited admittance" concept.[2,6] The input and output admittances $Y_i$ and $Y_o$ are defined for the selected side as input side, and the other side ac short-circuited. $Y_r$ is the reverse transfer admittance, obtained with a signal voltage applied to port 2-0 and with port 1-0 ac short-circuited.

Similarly, $Y_f$ designates the forward transfer admittance, obtained with a signal voltage applied to port 1-0 and with port 2-0 ac short-circuited.

Continuing the idea of cvs-drive from Fig. 2a, we obtain from Fig. 2b equations similar to Eqs. 1 and 2. The Element Combination Method holds equally well here, and if the final results for $Y_{in}$ and $Y_{out}$ are inverted, it will be found that they agree precisely with $Z_{in}$ and $Z_{out}$.

If the 2 networks in Fig. 2 operate with ccs-drive ($\mathrm{V}_1$ produced by an infinite voltage in series with an infinite impedance, the ratio of the 2 being the input current), then $Z_{in} = 1/Y_{in}$ will remain the same, while $Z_{out} = 1/Y_{out}$ will become different from the value calculated in Eq. 2. It is seen that in this case $Z_{out} = 1/Y_{out} = Z_o$.

Under all circumstances, as long as we observe whether the input should be ac open-circuited or ac short-circuited, the Element Combination Method always gives the correct result, and saves us the trouble of introducing voltages and currents with associated possibility of a wrong sign.

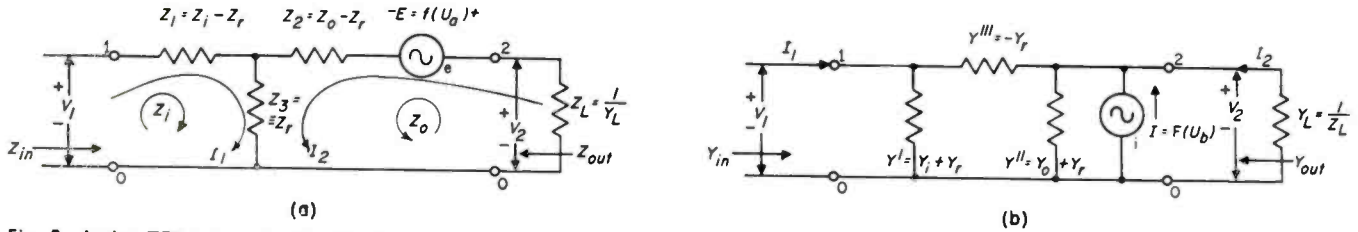
### *Transfer Functions*

Still restricting the discussion to passive circuits, we should note that the transfer functions

$$A_V(\omega) = \frac{V_2}{V_1}, \; A_I(\omega) = \frac{I_2}{I_1}$$

may be read-off from either one of the networks in Fig. 2, since they are equivalent. Further, they can be read-off directly, without calculation, if the practical variable divider method is used. (This method is discussed in reference 1 under the name "Potentiometer Method").

The Variable Divider Method implies that the variable, whether voltage or current, is proportioned to




(a) (b)

Fig. 2: Active TEE (a) and active PI (b) networks, which may represe ent transistor amplifier. Input and output immittance to be determined

fit the existing pattern of the network. Accordingly, applying the Voltage Divider Method to the network in Figs. 2a and 2b, respectively, we obtain directly

$$A_V(\omega) = \frac{Z_L}{Z_{2L}} \cdot \frac{Z_3//Z_{2L}}{Z_1 + Z_3//Z_{2L}}, \qquad (3)$$

$$A_V(\omega) = \frac{Y'''}{Y''' + Y_L''} = \frac{-Y_r}{Y_o + Y_L}, \qquad (4)$$

where $Y_L'' = Y'' + Y_L$.

Similarly, applying the Current Divider Method to the network in Figs. 2a and 2b, respectively, we obtain directly

$$A_I(\omega) = -\frac{Z_3}{Z_3 + Z_{2L}} = -\frac{Z_r}{Z_o + Z_L}, \qquad (5)$$

$$A_I(\omega) = -\frac{Y_L}{Y_L''} \cdot \frac{Y'''//Y_L''}{Y' + Y'''//Y_L''}. \qquad (6)$$

It is significant to note that Eqs. 4 and 5 are very much simpler than the other 2 equations; they are "naturals" also when written in terms of short-circuit and open-circuit parameters. The reason for this is quite obvious: the $Y'$-branch "disappears" in voltage ratio calculations, and the $Z_1$-arm "disappears" in current ratio calculations; transform-

ing the PI and TEE, respectively, to simple ELLS (i.e., L-formed sections).

If we have a free choice in deriving equivalent circuits for a "physical model," it is quite desirable that we settle for a PI, if we wish to calculate $A_V(\omega)$, and a TEE to calculate $A_I(\omega)$. There may be some other factor present, however, forcing our hand in the choice of equivalent circuit.

It is seen that the simple writing in Eqs. 4 and 5 is due to 2 simultaneous, beneficial actions, (1) choice of proper equivalent circuit, and (2), the application of the Variable Divider Method. It will be shown later how the existence of the simple "three-quantity formulas" of the type shown in Eqs. 4 and 5 make possible the formulation of Output Immittance Theorem II, which is perfectly general, although originated under conditions which at first may appear restricted.

### *Transformation Characteristic of A(ω).*

One may ask at this time why the Thevenin-Norton theorem was not used in obtaining the output immittance. Actually, the Element Combination Method to find looking-in immittance is precisely the method adopted in the most conventional application of the Thevenin-Norton theorem.

We will now relax our requirement on a passivated



circuit, and include the internal function-sources $E$ and $I$, Fig. 2. If we maintain that the networks in this figure are equivalents, both representing one and the same "physical model," then we note, (1) that the passive parts of the networks are not related via PI-TEE-PI transformation, and (2) the networks have been obtained merely by solving the common basic equation system in 2 different ways.

To obtain the network in Fig. 2a, we write the equation system in terms of Kirchhoff's voltage-sum equations; the network in Fig. 2b, in terms of Kirchhoff's current-sum equations.[2, 3, 6]

In an attempt to obtain the output immittance of the complete "physical model," we may first be inclined to apply the Thevenin-Norton theorem, but will find this to no avail, since the Thevenin-Norton theorem applies only to networks with constant sources; our networks being provided with function-sources. In other words, we cannot *directly* recognize a Thevenin generator or a Norton generator in the 2 networks in Fig. 2.

We may, however, be able to transform the function-sources to constant sources, whereupon we are free to utilize the Thevenin-Norton theorem as indi-

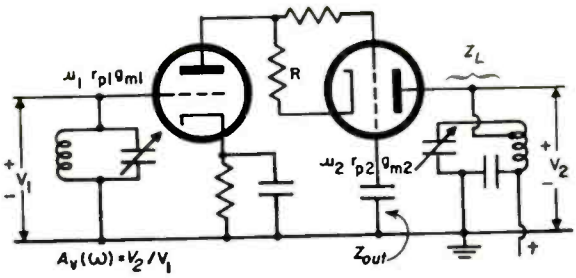



Fig. 3: Unknown ckt demonstrates use of known transfer function.

cated. Before discussing this possibility, we may recall that one of the most common methods in use for the calculation of output immitttance is the Applied Source Voltage-Current Ratio Method. We substitute the source $V_o$,$I_o$ for the load $Z_L$, and if the output impedance is required, we make $V_o = V_o$ the reference quantity; if the output admittance is required, we make $I_o = I_o$ the reference quantity.[5]

One attraction of this method is that it appears the same way on paper, as when it is used in the laboratory, the output immittance being measured by means of ac ammeters, voltmeters, or immittance bridges. The ratio $V_o/I_o$, or $I_o/V_o$, yields the output immittance to prime direction part and j-part, or to magnitude and phase angle.

The method is very useful when function-sources such as $f(U_a)$ and $F(U_b)$ are involved, where $U_a$ and $U_b$ could be any of several possible variables, considering both tube circuits and transistor circuits. As an example, $U_a$ may represent $I_1$ (for the common-base transistor), but may instead represent $V_1$, or $I_1 + I_2$, or $0.3\ I_1 + 0.7\ I_2$, or any such combination.

For non-linear functions, when the treatment is restricted to linear properties of the network, techniques such as the ones developed in the frequency-conversion field may be adopted to allow us to circumvent the problem of non-linearity.

### *Special Case*

A special case is at hand when $E$ and $I$ are functions of their local current or voltage, so that the application of Compensation Theorem I transforms the function source into an impedance or an admittance.[1] In such a case the prime direction parts may be negative, thus providing stimulance (negative resistance or negative conductance).

In either case, within the realms of stability, and for the simple type function-sources assumed, a new network free from internal sources apparently results. The method then degenerates right back to the simple Element Combination Method. When a voltage or a current from another part of the circuit is involved, however, this degeneration does not take place, and we are forced to employ the Applied Source Voltage-Current Ratio Method, or other equally powerful method.

Returning to the approach of making the network look either like a Thevenin generator or a Norton

(*Continued on page* 153)

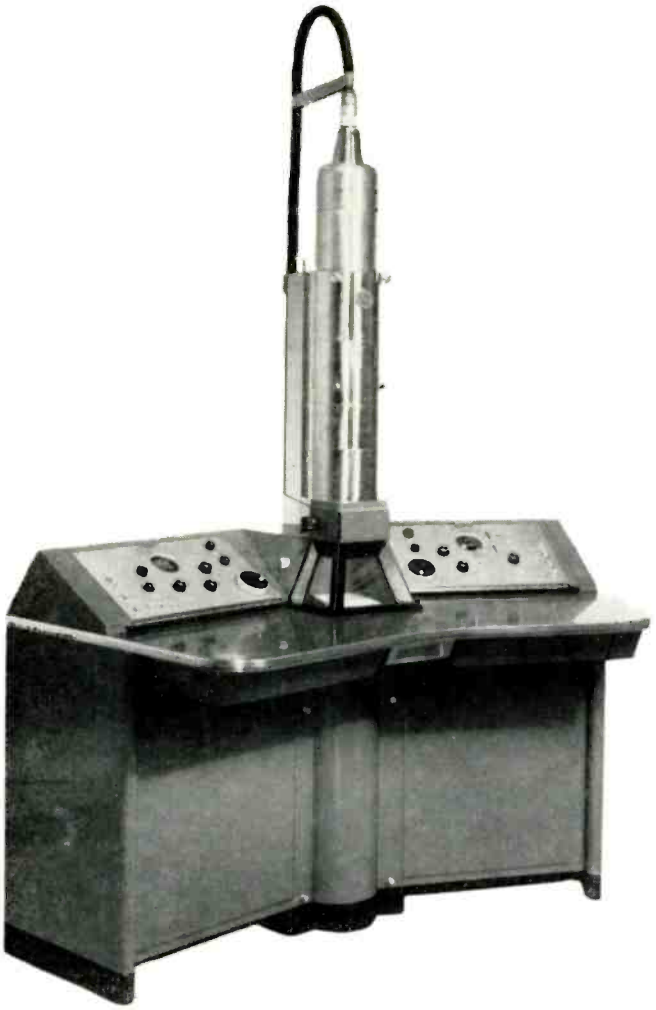


Fig. 1: The electron microscope: an original instrument in medical electronics.

## A Prospectus on . .

# Medical Electronics

**By RICHARD G. STRANIX**
*Assistant Editor*
*ELECTRONIC INDUSTRIES & Tele-Tech*

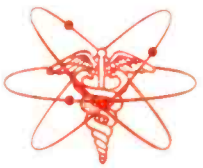
- *A quick survey of recent developments*
- *A calculated guess of what's anticipated*
- *How to get into this interesting field*
- *Selling to the medical profession*

**Part One of Two Parts**

OVER five years ago the Institute of Radio Engineers (IRE) formally recognized the potentialities of electronics in the medical field by creating the Professional Group on Medical Electronics (PGME), to "implement the use of electronic theory and techniques in problems of medicine and biology." The membership of the group has now grown to almost 2000.

Most biologists, physicians, and others in similar fields had no major interest in electronics, so a way had to be devised to attract them to the group. The problem was solved with the institution of the Affiliate grade on January 4, 1957. Open to IRE nonmembers who have an interest in some phase, or joint science, covered by one of the Professional Groups, applicants must belong to organizations in the affiliate science recognized by the PG., e. g., the AMA.

Though Affiliate membership in the PGME is still less than fifty, the picture is actually much brighter. Not contradicting the former statement, there are several physicians, biologists, and others, men with a keen interest, who joined the IRE as Associates or qualified for other membership grades before the institution of the affiliate grade.



It must be remembered that this new grade is less than a year old. Publicity has been mainly by word-of-mouth. When national recruiting gets under full speed and the biologists and physicians are approached directly, it is anticipated that the Affiliate grade membership will mushroom.

To insure proper professional coordination the IRE-PGME has a medical advisory committee composed of six outstanding members of the medical profession. It also has a liaison committee with the Council on Medical Physics of the American Medical Association (AMA).

In spite of the activity in the last decade, electronic engineers should not feel ignorant if they are

Ed.—This article is based on a paper that Mr. Stranix presented at MAECON, Nov. 14, 1957

unaware of the field. Actually, nothing, per se, has been accomplished which could be considered a major contribution to the practicing medical profession. That is, nothing that has a direct bearing on the general public; contributions such as the Salk Polio Vaccine.

## DIAGNOSTIC DEVELOPMENTS

Familiar to us all are such devices as X-ray machine, audiometers, phonocardiographs, ballistocardiographs, and various other "G's," such as EK, EE, and EM. These devices have been in use for some time and are pretty well accepted by all in the medical profession. We will not consider these as recent developments.

Not so well known are the microscopes utilizing ultraviolet (u-v) radiation. In this category we have a great deal of activity in the study of many types of cells including cancer cells. These cells transmit visible light with a high degree of uniformity. Under this condition, details of cell structure and the chemical constituents of various parts of the cell can not be clearly distinguished. There is a considerable degree of variation in light transmittance over the cell structure when u-v radiation is used.

U-V photographic techniques which have been and are still being used with unstained cells suffer from three disadvantages: First, the u-v irradiance required to adequately expose the photographic plate generally proves lethal to the cells; second, when using quartz refractive optics the focal length of the lens is a function of the wavelength of the u-v irradiance used and a number of pictures must be taken with different lens setting to obtain a high resolution picture; and, third, the process is slow because the photographic plates must be developed.

### *Ultraviolet Microscopy*

Presently, most forms of u-v microscopy incorporate closed-circuit television (CCTV). One well-known system, used by Dr. Philip O'B. Montgomery, Southwestern Medical School, Dallas, and the Philco Corporation uses the flying-spot scanning technique, in which each elemental area of the specimen is scanned in a time sequential manner by a small spot of u-v having a diameter of approximately 0.25 microns. In addition, as shown in Fig. 2, the u-v radiation passes through the microscope in reverse of what we might consider the conventional manner. A small scanned rectangle, or raster, is produced on the face of the u-v flying spot scanner tube. The raster image is then projected down through the eyepiece and objective lens utilizing Grey optics, a type of lens which holds a constant focal length through the visible and deep into the u-v portions of the spectrum. This focusses the greatly reduced raster on the specimen under observation.

The amount of radiation emerging from each elemental area of the specimen is inversely related to the u-v absorption of each minute portion of the specimen.

The emerging radiance is channelled through a grating monochromator which selects a wavelength band to selectively produce contrast of the displayed

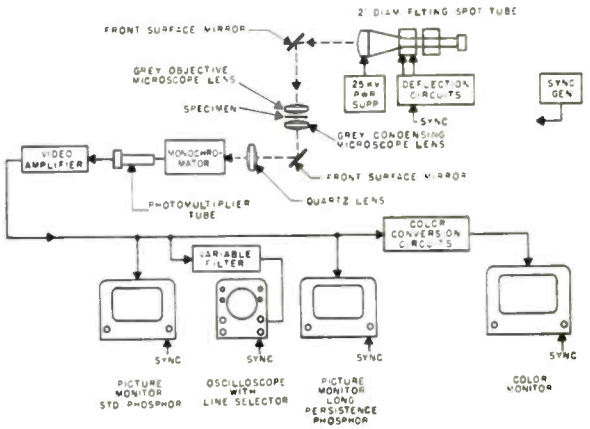



Fig. 2: This u-v microscope uses the flying spot technique.

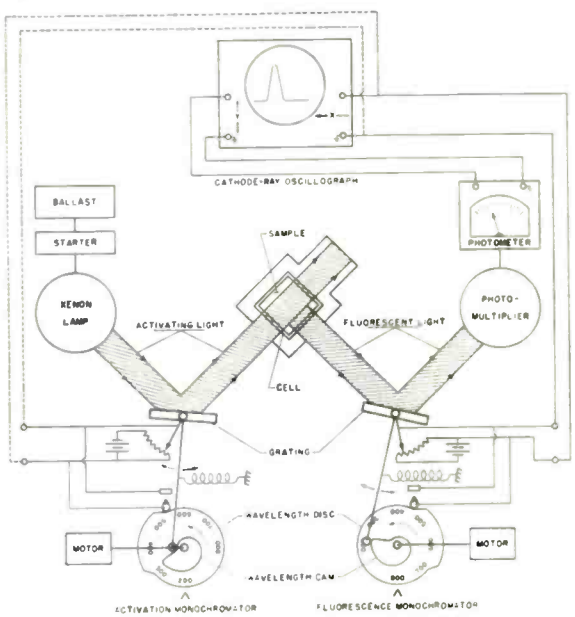
image. An u-v sensitive photo-multiplier tube converts this radiance into an electrical signal which is channelled through an amplifier to a viewing monitor employing a long persistence phosphor. Time-lapsed movies are then made. Living cancer cells have been viewed for over ten hours on this system.

The u-v flying spot scanner tube used in this system was developed in the laboratories of the Philco Corp.

The equipment used by Dr. Montgomery at the Southwest Medical School, Dallas, employs a slow scan television system, in which each field is scanned once every two seconds. In standard television each field is scanned in 1/60 of a second. This slow scan equipment was designed by Dr. Roberts and Mr. Bonner of the Southwest Medical School. The Philco Corporation is presently working on a similar system employing different methods of scanning. By means of the flying spot system any small selected area of a cell may be irradiated if desired.

Another system, developed by Dr. Vladimir K. Zworykin, Rockefeller Institute, stains cells electronically with arbitrarily selected colors—red, green, and blue. It should be pointed out here for those un-

Fig. 3: Operating details of the spectrophotofluorometer



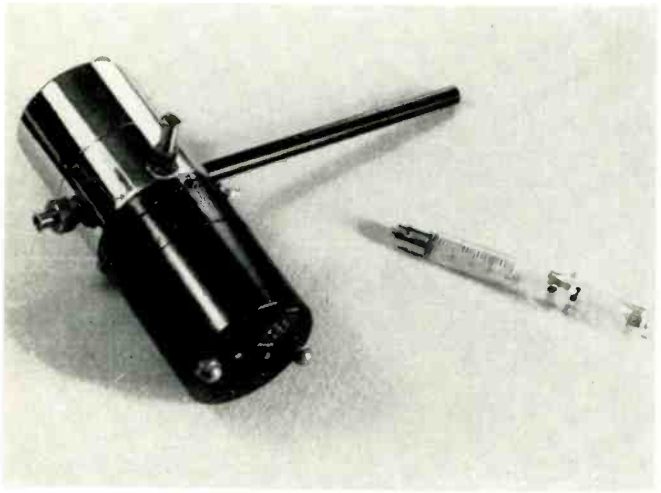
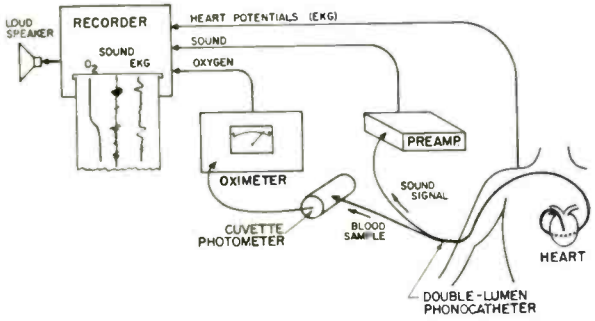


Fig. 4 (above): Cuvette photometer is used with an oximeter to measure the amount of oxygen in the blood.

Fig. 5 (below): Typical use of oximeter and phonocatheter.



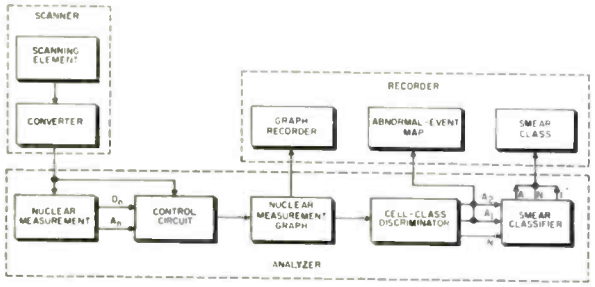
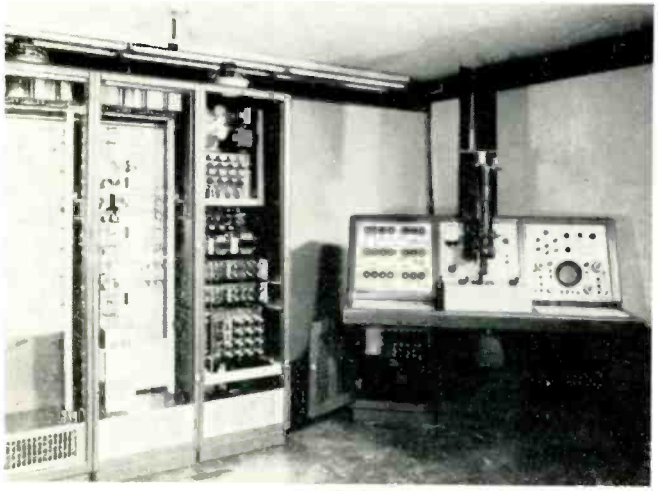




Fig. 6 (above): The function diagram of a cytoanalyzer.

Fig. 7 (below): The cytoanalyzer will be used in large programs to distinguish exfoliated from abnormal cells.



familiar with microscopy that biologists, studying cellular anatomy by means of visible light must stain, or otherwise modify, the cells to make the structures more visible. This treatment not only kills the cells but may also alter the natural state of the cells, sometimes killing them. The U-V, Color-Translating Television Microscope (UCTM), Fig. 9, is the first practical instrument to "translate" u-v absorption data of living cells into colors instantly by TV methods.

Different materials selectively absorb, or soak up, different wavelengths of u-v radiation. The UCTM provides a translation of these selective absorptions into color. It thus helps to show the location in the cell of the various absorbing chemical constituents. This system uses a pulsed radiation, in which the u-v radiation is applied to the cells in short bursts which helps prevent lethal damage.

Closed-circuit TV probably is the most readily applied device in the electronic sphere to the problems of medicine. A runner-up for this distinction must be the counter. Already there are numerous blood cell counters and a few bacteria counters on the market.

### *Analyzers*

A practical Oximeter incorporating a cuvette photometer, Fig. 4, has been developed by American Electronic Laboratories. This is a device which measures the amount of oxygen in the blood. It can be used in conjunction with its intracardiac phonocatheter, a device which is used for acoustic mapping within the heart. Typical employment of the two is shown in Fig. 5. By using a double lumen catheter, a sample of the blood may be removed from the heart and its oxygen content determined while the sounds within the heart are being recorded. The second lumen could have been used for measuring the blood pressure instead, if desired.

The Spectrophotofluorometer, developed by Dr. Robert L. Bowman, N. I. H. is finding its way into almost every pharmaceutical house in the country. The device, Fig. 3, marketed by American Instrument Co., activates and measures fluorescence throughout the visible and ultraviolet regions. Rapid quantitative assays are obtained in less than a minute by the appearance of a fluorescent spectrum on the CRT screen.[1]

### *Radiography*

Television equipment using flying spot scanner techniques and special video circuits have been developed to provide contrast enhancement of X-Ray negatives. The objective as to obtain more diagnostic information from X-Ray films that is possible by conventional means. By means of special video circuits, minute differences of contrast between adjacent areas which are hardly perceptible to the human eye are increased in contrast so as to be readily perceptible on a monochrome picture monitor. This equipment was recently developed in the laboratories of the Philco Corporation.

# THERAPEUTIC DEVELOPMENTS

It is appropriate that we make mention of our ultrasonics policy at this point. We will consider this as a branch of electronics because the main components of an ultrasonic system are an electronic generator and a transducer.

The diathermy console is a familiar sight in most medical offices. But two new forms of diathermy equipment have made their debut in the last few years—microwave (we're probably all familiar with the commercial advertising for the two minute roasts, etc.), and ultrasonic. In the final analysis the latter may not be considered diathermy, but rather, a purely therapeutic tool in itself.

### *Defibrillator*

A device which has had a quick rise to popular usage is the defibrillator. Ventricular fibrillation is a rapidly fatal condition occurring in organic diseases of the heart and following ordinary cardiac surgery in which various groups of the heart's muscle fibers beat independently and without rhythm. A defibrillator is a piece of electronic equipment which may be used internally or externally. When used internally, the chest is opened and the two defibrillator electrodes are held against the sides of the ventricles in firm contact with the myocardium. Controlled pulses of current up to three amperes are passed through the heart from one electrode to the other, forcing the fibrillating heart muscles into one massive contraction —producing defibrillation and putting the ventricles into standstill. Sometimes the heart will then begin its own normal sinus rhythm. If it doesn't, drugs, massage, and continuous controlled pulses are combined to restore the normal rhythm of the heart.

Externally, it is applied through the unopened chest.

Heart associations have recognized the value of electro-shock and have prescribed it as standard procedure for ventricular fibrillation. Further, they specify that a defibrillator should be readily available in every surgery. Each average-sized hospital can anticipate about 1 cardiac arrest in 1000 operations, a major number of these occur with good-risk

### *Ultrasonic Surgery*

Probably the most well-known use of ultrasonics for surgery is that involving the brain. An outstanding treatment of this operation has recently been published in a comprehensive review of ultrasonics in the medical and dental professions.[2]

Prefrontal Lobotomies have been performed with sound waves, both with and without removing the skin and skull bone. Heating effects, secondary phenomena of sound wave treatment, result from the fact that some tissues have high acoustic absorption coefficients.[3] It has been found that more consistent results can be obtained, if skin and bone are removed. Also, it has been pointed out that bone is highly absorping at ultrasonic frequencies and therefore must be removed to prevent overheating.

*(To be continued next month)*

Fig. 8 (above) Keeping eyes on patient, surgeon requests atmospheric correction from this distant controller. Electronic sensing and control fulfills his desire.

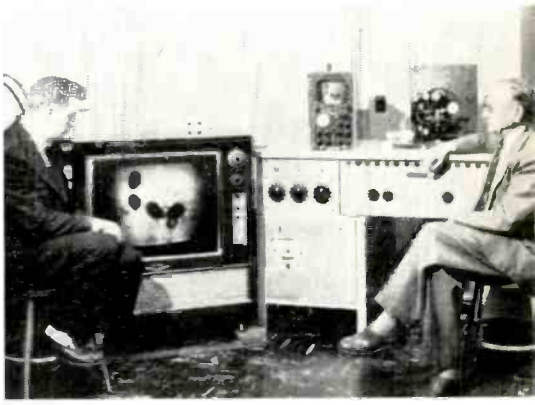


Fig. 9 (right): The UTCM, which instantly translates u-v absorption data of living cells into colors, uses pulsed radiation to help prevent lethal damage to cells.

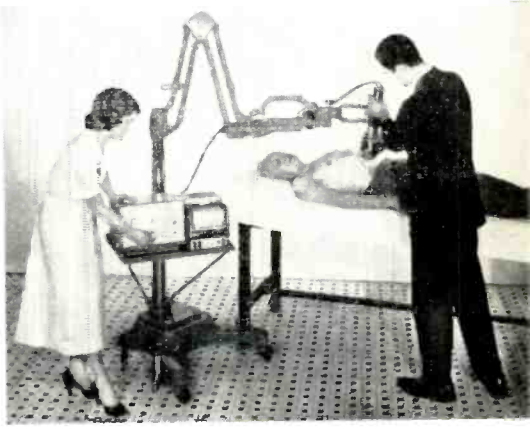


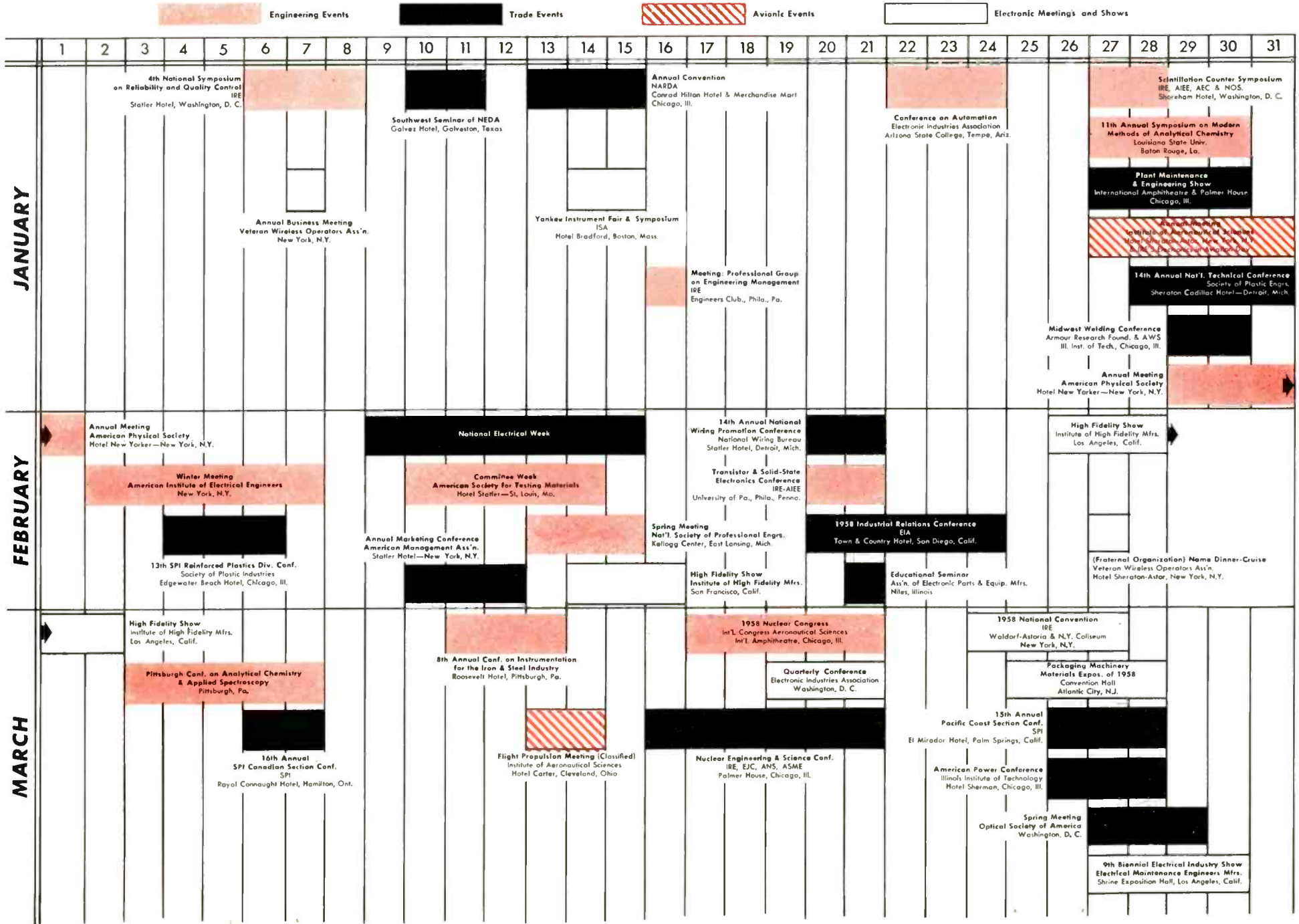
Fig. 10 (right): A scintillation detector is used in performing the radioiodine labelled rose bengal test which evaluates functioning of the liver and gall bladder.

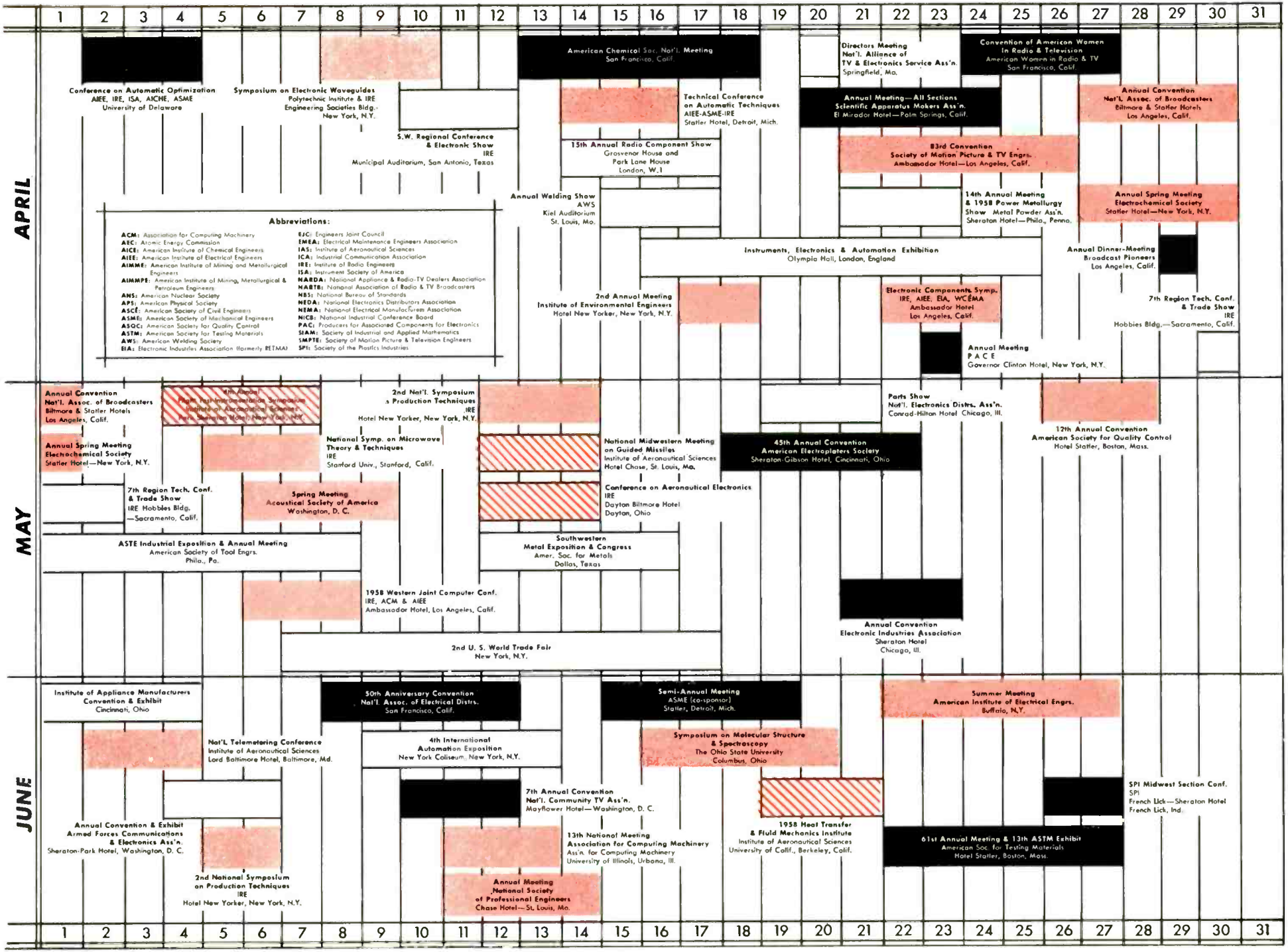
Fig. 11 (below): An electronic thermistor, used here for oral measurements, can record temperature of the body to an accuracy of 0.1° in less than 30 seconds.

# 1958 Coming Events Calendar

*Portraying important electronic events ahead from January to June*

ELECTRONIC INDUSTRIES




1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
APRIL
MAY
JUNE
Conference on Automatic Optimization
AIEE, IRE, ISA, AIChE, ASME
University of Delaware
Symposium on Electronic Waveguides
Polytechnic Institute & IRE
Engineering Societies Bldg.
New York, N.Y.
S.W. Regional Conference & Electronic Show
IRE
Municipal Auditorium, San Antonio, Texas
American Chemical Soc. Nat'l. Meeting
San Francisco, Calif.
Technical Conference on Automatic Techniques
AIEE-ASME-IRE
Statler Hotel, Detroit, Mich.
15th Annual Radio Component Show
Grosvenor House and Park Lane House
London, W.1
Annual Welding Show
AWS
Kiel Auditorium
St. Louis, Mo.
Directors Meeting
Nat'l. Alliance of TV & Electronics Service Ass'n.
Springfield, Mo.
Annual Meeting—All Sections
Scientific Apparatus Makers Ass'n.
El Mirador Hotel—Palm Springs, Calif.
Convention of American Women in Radio & Television
American Women in Radio & TV
San Francisco, Calif.
83rd Convention
Society of Motion Picture & TV Engrs.
Ambassador Hotel—Los Angeles, Calif.
14th Annual Meeting & 1958 Power Metallurgy Show
Metal Powder Ass'n.
Sheraton Hotel—Phila., Penna.
Annual Convention
Nat'l. Assoc. of Broadcasters
Biltmore & Statler Hotels
Los Angeles, Calif.
Annual Spring Meeting
Electrochemical Society
Statler Hotel—New York, N.Y.
Instruments, Electronics & Automation Exhibition
Olympia Hall, London, England
Annual Dinner-Meeting
Broadcast Pioneers
Los Angeles, Calif.
2nd Annual Meeting
Institute of Environmental Engineers
Hotel New Yorker, New York, N.Y.
Electronic Components Symp.
IRE, AIEE, EIA, WCEMA
Ambassador Hotel
Los Angeles, Calif.
7th Region Tech. Conf. & Trade Show
IRE
Hobbies Bldg.—Sacramento, Calif.
Annual Meeting
PACE
Governor Clinton Hotel, New York, N.Y.
Abbreviations:
ACM: Association for Computing Machinery
AEC: Atomic Energy Commission
AICE: American Institute of Chemical Engineers
AIEE: American Institute of Electrical Engineers
AIMME: American Institute of Mining and Metallurgical Engineers
AIMMPE: American Institute of Mining, Metallurgical & Petroleum Engineers
ANS: American Nuclear Society
APS: American Physical Society
ASCE: American Society of Civil Engineers
ASME: American Society of Mechanical Engineers
ASQC: American Society for Quality Control
ASTM: American Society for Testing Materials
AWS: American Welding Society
EIA: Electronic Industries Association (formerly RETMA)
EJC: Engineers Joint Council
EMEA: Electrical Maintenance Engineers Association
IAS: Institute of Aeronautical Sciences
ICA: Industrial Communication Association
IRE: Institute of Radio Engineers
ISA: Instrument Society of America
NARDA: National Appliance & Radio-TV Dealers Association
NABTE: National Association of Radio & TV Broadcasters
NBS: National Bureau of Standards
NEDA: National Electronics Distributors Association
NEMA: National Electrical Manufacturers Association
NICB: National Industrial Conference Board
PAC: Producers for Associated Components for Electronics
SIAM: Society of Industrial and Applied Mathematics
SMPTE: Society of Motion Picture & Television Engineers
SPI: Society of the Plastics Industries
Annual Convention
Nat'l. Assoc. of Broadcasters
Biltmore & Statler Hotels
Los Angeles, Calif.
4th Annual Flight Test Instrumentation Symposium
Institute of Aeronautical Sciences
Park Sheraton Hotel, New York, N.Y.
2nd Nat'l. Symposium on Production Techniques
IRE
Hotel New Yorker, New York, N.Y.
Parts Show
Nat'l. Electronics Distrs. Ass'n.
Conrad-Hilton Hotel Chicago, Ill.
12th Annual Convention
American Society for Quality Control
Hotel Statler, Boston, Mass.
Annual Spring Meeting
Electrochemical Society
Statler Hotel—New York, N.Y.
National Symp. on Microwave Theory & Techniques
IRE
Stanford Univ., Stanford, Calif.
National Midwestern Meeting on Guided Missiles
Institute of Aeronautical Sciences
Hotel Chase, St. Louis, Mo.
45th Annual Convention
American Electroplaters Society
Sheraton-Gibson Hotel, Cincinnati, Ohio
7th Region Tech. Conf. & Trade Show
IRE Hobbies Bldg.
—Sacramento, Calif.
Spring Meeting
Acoustical Society of America
Washington, D. C.
Conference on Aeronautical Electronics
IRE
Dayton Biltmore Hotel
Dayton, Ohio
ASTE Industrial Exposition & Annual Meeting
American Society of Tool Engrs.
Phila., Pa.
Southwestern Metal Exposition & Congress
Amer. Soc. for Metals
Dallas, Texas
1958 Western Joint Computer Conf.
IRE, ACM & AIEE
Ambassador Hotel, Los Angeles, Calif.
Annual Convention
Electronic Industries Association
Sheraton Hotel
Chicago, Ill.
2nd U. S. World Trade Fair
New York, N.Y.
Institute of Appliance Manufacturers Convention & Exhibit
Cincinnati, Ohio
50th Anniversary Convention
Nat'l. Assoc. of Electrical Distrs.
San Francisco, Calif.
Semi-Annual Meeting
ASME (co-sponsor)
Statler, Detroit, Mich.
Summer Meeting
American Institute of Electrical Engrs.
Buffalo, N.Y.
Nat'l. Telemetering Conference
Institute of Aeronautical Sciences
Lord Baltimore Hotel, Baltimore, Md.
4th International Automation Exposition
New York Coliseum, New York, N.Y.
Symposium on Molecular Structure & Spectroscopy
The Ohio State University
Columbus, Ohio
SPI Midwest Section Conf.
SPI
French Lick—Sheraton Hotel
French Lick, Ind.
7th Annual Convention
Nat'l. Community TV Ass'n.
Mayflower Hotel—Washington, D. C.
Annual Convention & Exhibit
Armed Forces Communications & Electronics Ass'n.
Sheraton-Park Hotel, Washington, D. C.
13th National Meeting
Association for Computing Machinery
Ass'n. for Computing Machinery
University of Illinois, Urbana, Ill.
1958 Heat Transfer & Fluid Mechanics Institute
Institute of Aeronautical Sciences
University of Calif., Berkeley, Calif.
61st Annual Meeting & 13th ASTM Exhibit
American Soc. for Testing Materials
Hotel Statler, Boston, Mass.
2nd National Symposium on Production Techniques
IRE
Hotel New Yorker, New York, N.Y.
Annual Meeting
National Society of Professional Engineers
Chase Hotel—St. Louis, Mo.

# New Technique for Winding Subminiature Coils

*Coils for subminiature transformers create a manufacturing problem because conventional winding forms can not be used. This new method uses modification of an established process and adhesive-coated wire to make self-supporting coils.*

IN miniature repeater and pulse circuit work, the need frequently arises for subminiature cup transformers, as in Fig. 1. The winding in this transformer is a tiny solenoid, perhaps 10 turns long and 2 to 10 layers high. When the transformer is assembled, this winding is completely encased in ferrite.

The inside diameter of this typical winding is 0.140 in., and the cross-section at most 0.030 x 0.030 in. These dimensions exclude the possibility of using permanent winding forms, so a machine was designed to make self-supporting coils using the adhesive properties of Bondeze wire.

Handling these small coils and safely putting them in the window of the ferrite core can be a taxing and delicate operation. With this in mind, certain features were incorporated in this machine and its arbor to make the handling operation comparatively simple.

The machine, Fig. 2, has an arbor 0.140 in. in diameter, two adjustable collars to control the width of the winding, a wire guide controlled by a micrometer, a counter, and facilities for sliding the coil into the groove of a transformer cup.

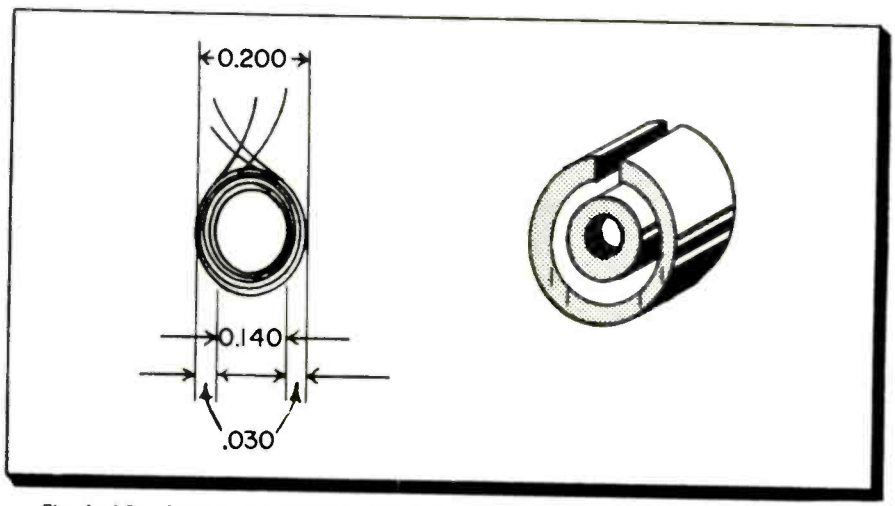
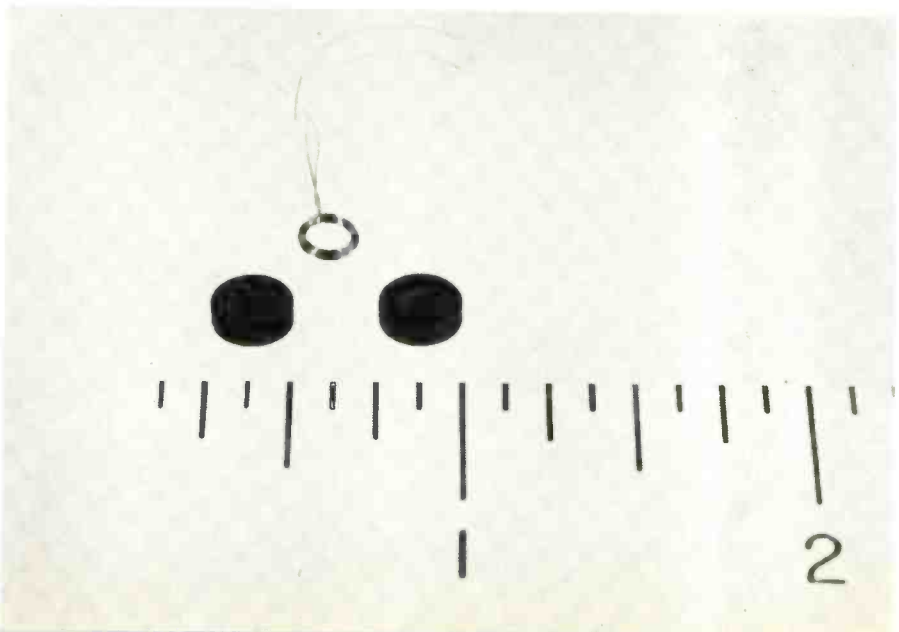



Fig. 1: I.D. of this coil is 0.140 in. With ferrite cup it forms subminiature transformer.



**By W. F. KALLENSEE**

*Electrical Communications Groups*
*Bell Telephone Laboratories, Inc.*
*Murray Hill, New Jersey*

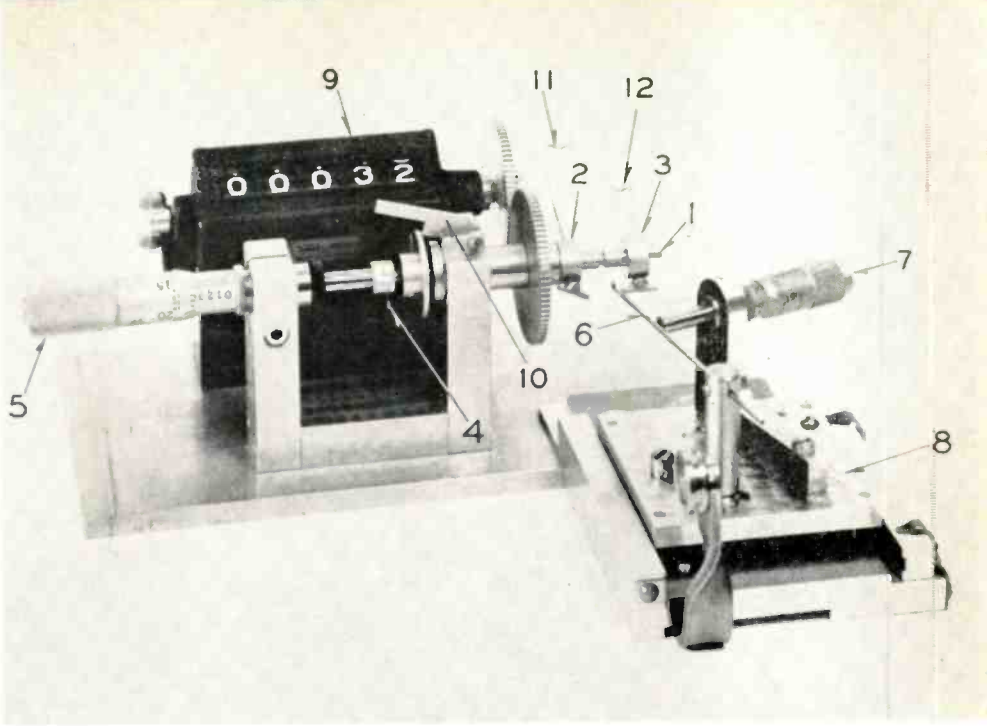



Fig. 2: Principal parts of winding machine are: (1) arbor, (2 & 3) adjustable collars, (4) coupling between adjusting micrometer (5) and arbor, (6) wire guide, (7) micrometer to control guide, (8) movable platform for wire guide, (9) counter, (10) lock for arbor, (11 & 12) outriggers.

Micrometer 5 is employed to set the width of the winding space. Collars 2 and 3 are held tightly against the driving gear; collar 3 being locked to the arbor. Micrometer 5 is advanced the required amount, depending on the desired coil width, and collar 2 is pushed back against the driving gear and locked to the arbor. Fig. 3 shows the collar arrangement after the coil width has been set.

The wire is threaded through the wire guide which is held against micrometer 7 by spring pressure. The guide is therefore accurately controlled by the micrometer. After fastening the wire to outrigger 11, the coil is wound with the required number of turns and the wire brought out and fastened to outrigger 12. If multiple windings are required, this process is repeated.

After the winding is finished, a drop of ethyl alcohol is placed on the Bondeze wire. This softens the adhesive and after drying for 5 to 10 min., the wire will be bonded together.

When the coil has thoroughly dried, collar 3 is removed. The arbor lock is dropped in place to keep the arbor from turning as it is retracted by the micrometer. The transformer cup is placed on the stud at the end of the arbor as shown in Fig. 4, and the coil pushed into the slot by retracting the arbor. In this way the coil is slid directly off the arbor into the slot in the ferrite cup with very little danger of damaging the winding.

Details of this machine may be altered to adapt it to winding a wide variety of subminiature coils.



Fig. 3: Collar (3), locked to arbor, is moved by micrometer to coil width. Collar (2), held to driving gear, is then locked to arbor.

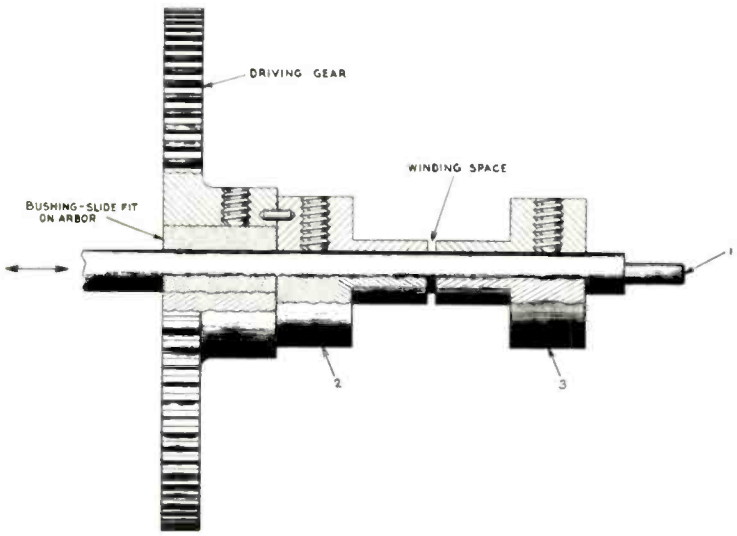
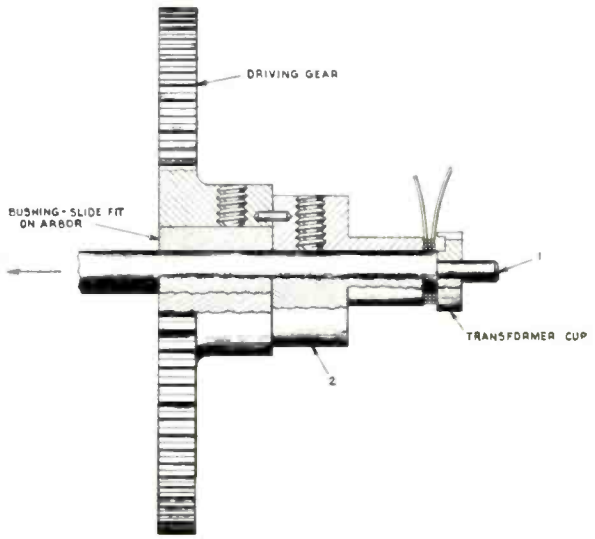



Fig. 4: Transformer cup is placed on stud at the end of the arbor and the coil is then pushed into slot by retracting the arbor.



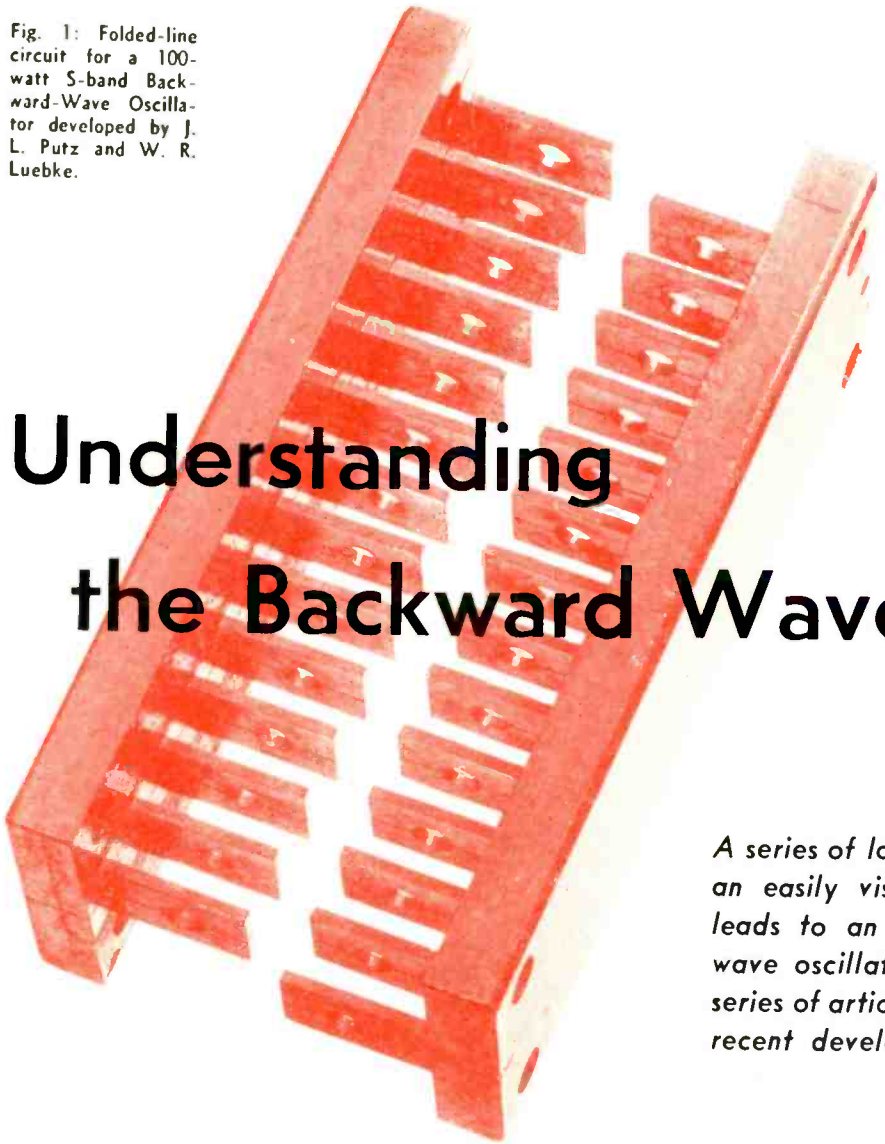


Fig. 1: Folded-line circuit for a 100-watt S-band Backward-Wave Oscillator developed by J. L. Putz and W. R. Luebke.

**By DR. DONALD A. DUNN**
*Research Associate*
*Stanford Electronics Labs.*
*Stanford University*
*Stanford, California*

# Understanding the Backward Wave Oscillator

*A series of logical steps, each representing an easily visualized physical occurrence, leads to an understanding of backward-wave oscillation. This is the second in a series of articles on the basic principles and recent developments in microwave tubes.*

THE essential elements of a backward-wave oscillator are shown schematically in Fig. 2. As in the traveling-wave amplifier,* the beam travels near the slow-wave structure at a velocity near the phase velocity of the wave on the circuit, the only difference being that here the circuit must carry power in the direction opposite to the direction of beam travel to provide a wave having a phase velocity in the direction of beam travel.

In this device, power fed in at the collector end of the tube will be amplified in traveling toward the output at the gun end of the tube. With perfect terminations at each end of the circuit the system will reach a condition of oscillation, if sufficient beam current is supplied. The oscillation results from a process of continuous feedback along the circuit and is not dependent on reflections from the ends of the circuit. As a result, the system is capable of oscillating at any beam voltage, given sufficient beam current and no discrete "modes."

An inherent property of a circuit having oppositely directed phase and group velocities is that the phase velocity varies continuously with frequency. As a result, this device, when operated as an oscillator, tunes continuously over the frequency range of the circuit when the beam voltage is varied. When operated as an amplifier, the device has a very narrow range of frequencies over which it will give gain. The center frequency of this bandpass amplification curve may be changed by varying the beam voltage. In both cases, no tuning adjustment is required other than changing the beam voltage.

Dr. D. A. Dunn

### *Amplification*

The amplification process of this device is somewhat different from the process occurring in the traveling wave amplifier, but the same form of analysis may be employed. First, visualize a constant-amplitude applied field wave applied to the circuit of Fig. 2. This wave is introduced at the r-f input at the collector end and has a power flow from right to left and a corresponding phase velocity from left to right. Insofar as the beam is concerned, the picture is just as in the traveling-wave amplifier. Electrons are injected into a field having a phase velocity substantially equal to the electron velocity,

*See Dr. Dunn's *Understanding the Traveling Wave Amplifier* in November ELECTRONIC INDUSTRIES.

with the result that the electrons form into bunches. The density of the bunches increases as the square of the distance traveled, providing a current which increases as the square of distance traveled from gun towards the collector.

### *Bunched Beam*

The next step in the analysis is to consider the field wave induced on the circuit by the bunched beam. It is at this point that the backward-wave circuit exhibits an essentially different behavior from the forward-wave amplifier circuit. Fig. 3 shows a beam traveling near a backward-wave circuit. The tube is considered to be divided into many infinitesimal gaps of length $dz$, and, as before, the ac current induces infinitesimal field waves on the circuit at every point along the circuit. Each field wave is propagated (i.e., power flows) both to the left and to the right; and the sum of all these infinitesimal waves forms a total wave traveling with a group velocity to the left and a similar wave traveling with a group velocity to the right.

Consider the field waves $dE_1$ and $dE_2$ in Fig. 3. The portions of these waves propagated to the right in the direction of beam travel will, in this case, almost cancel, if we consider paired elements a quarter wavelength apart, because in this circuit power flow to the right corresponds to a phase velocity to the left, i.e., a decrease in phase as the power travels to the right. In Fig. 3, the current at $z_2$ will have advanced 90° in phase in traveling from $z_1$ to $z_2$, and hence will induce a field $dE_2$ that is 90° advanced in phase with respect to the field induced at $z_1$. The field $dE_1$ that has been traveling to the right on the circuit has been decreasing in phase, because in this type of circuit the direction of power flow must be associated with a decrease in phase. Thus, when the portion of $dE_1$ that travels to the right arrives at $z_2$ it has decreased in phase by 90°, and is therefore 180° out of the phase with $dE_2$. There is not a perfect cancellation because the inducing current grows with distance.

### *Phase Relationships*

For the backward-wave circuit the induced field waves traveling in the direction opposite to the direction of beam travel add in phase. The current at $z_2$ is 90° advanced over the current at $z_1$ so $dE_2$ starts 90° ahead of $dE_1$. The wave $dE_2$ traveling to the left decreases 90° in phase in traveling back to $z_1$ from $z_2$ so that it arrives at $z_1$ in phase with the portion of $dE_1$ traveling to the left.

The phase advance experienced by any current element in traveling a distance $z$ is exactly cancelled by the decrease in phase experienced by the wave traveling back over the same distance. Thus all induced field waves traveling from collector to gun add to form a total induced field wave that grows with distance from the collector to the gun. The form of this growth may be obtained in exactly the same fashion that the induced field wave for the traveling-wave amplifier was obtained except that here waves from $L$ to $z$ must be added, instead of waves from $O$ to $z$. The inducing current may here be written as $i = i_0 z^2$ where $z$ is now distance measured from gun to collector, with $z = 0$ at the gun and $z = L$ at the collector. Then $dE = Ki_0 z^2 dz$, and adding all $dE$'s from $L$ to $z$, again neglecting phase factors because this is an addition of in phase quantities, we obtain

$$\text{Total induced field at } z = \int_L^z dE = \int_L^z Ki_0 z^2 dz$$

$$= -\frac{Ki_0 L^3}{3}\left[1 - \left(\frac{z}{L}\right)^3\right]$$

The induced field thus is zero at $z = L$ and rises to a maximum value at $z = 0$, Fig. 4. As in the amplifier analysis, an infinite series of waves may be obtained by repeating this process. Each field wave induces a current wave and each current wave re-induces a field wave, *ad infinitum*. One qualitative difference between the forward-wave and backward-wave tubes is evident from Fig. 4. Each induced field wave in the backward-wave tube increases from zero at the collector to a maximum at the gun end, where the current is zero. There is thus a strong induced field available at the input to start the next current wave each time.

Fig. 2: Schematic diagram of a backward-wave amplifier. Note that power flows in a direction opposite to that of the electron stream.

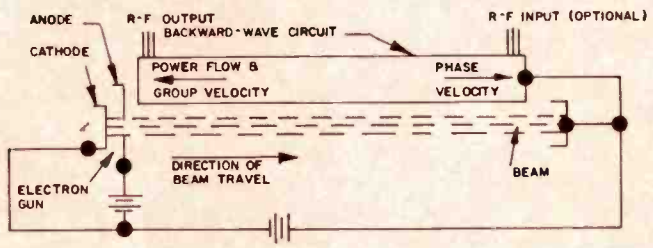
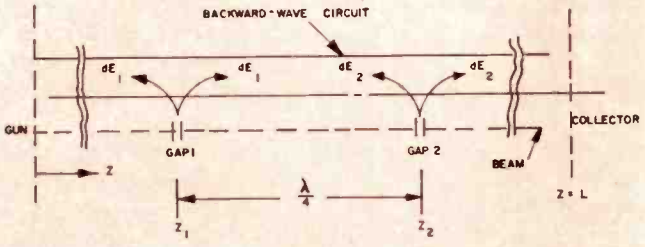



Fig. 3: Schematic diagram of the mechanism by which an electromagnetic field is induced on backward-wave circuit by electron stream.




The form of the secondary induced current wave will be very similar to the primary wave except near the collector where it will grow less rapidly than the primary wave. If, however, the tube is long enough, the first induced field wave will be larger than the applied wave at the gun end. In this case a secondary current wave can be induced that is greater than the primary current wave at every value of $z$. The tertiary field wave will then, of necessity, be greater than the secondary wave and all subsequent waves will be successively higher. Mathematically, the series expression for the field at the gun end will ultimately

# Backward Wave Oscillator
*(Continued)*

be a divergent series with each term greater than the previous term for a tube of sufficient length.

### *Oscillation*

The condition for which a divergent series first occurs, as length is increased, corresponds to a condition of start oscillation. This condition may be met by a series with decreasing successive terms but with an infinite sum, and need not be quite as extreme as the case described above.

It should also be noted that the physical length of the tube is not the only parameter of importance in determining start oscillation. In the detailed analysis, it is found that an increase of the ratio of current to voltage can perform the same function as an increase in length. Also "length" is of fundamental importance in terms of the number of wavelengths in the structure rather than the actual physical length.

### *Gain Factor*

An additional factor in the gain of a backward-wave amplifier, or the condition for start oscillation in a backward-wave oscillator, is the relative phase-shift between the induced waves which occurs over the length of the structure. If the beam and the circuit waves on the structure have exactly synchronous velocities, each induced field wave travels at the synchronous velocity and each successive wave lags the previous one by 90° throughout the entire length of the structure. This means that, at the output (gun end) of the tube, each successive induced wave adds at a 90° phase angle to the previous wave, and, hence, alternate induced waves cancel each other if they are of equal amplitude.

The series expression for field at the gun thus diverges very slowly, even when each successive wave is greater than the previous one. If, however, there is a slight difference between wave and beam velocity, each induced field wave will have a phase shift different from 90° relative to the previous wave.

### *Optimum Voltage*

For a given circuit velocity, there is an optimum beam voltage at which the net phase difference between successive induced waves at the gun end of the structure is a minimum. It turns out that this condition is met at start oscillation when the net phase shift over the length of the structure between a wave traveling at the circuit velocity is approximately 180°. Typical phasor diagrams are shown in Fig. 5. Thus, although start oscillation can occur for the case of equal circuit and beam velocities where a divergent series is obtained with successive terms 90° out of phase, for the same current and voltage there will normally be another frequency at which the circuit velocity is slightly different and at which the difference between circuit velocity and beam velocity is such as to provide optimum phase addition of the induced waves at the gun end of the tube. The tube may be considered to be beyond start oscillation for both frequencies, but it will prefer to oscillate at the frequency for which the phase condition is optimum. The condition of optimum phase addition of the waves at the gun end of the structure permits a minimum value of length to provide a divergent series. So, two simultaneous conditions are imposed at each frequency to determine start oscillation.

### *Summary*

To summarize, the backward-wave amplifier or oscillator is an intrinsically regenerative device. Field waves induced by ac current in the beam and traveling in the direction opposite to the direction of beam travel add in phase, supplying a total induced field wave rising from zero at the collector to a maximum value at the gun. Such an induced field wave can effectively provide its own ac current, if the tube is sufficiently long, since the new field wave can re-induce an ac current of greater magnitude than the current which set it up. This is the first condition for start oscillation in this device.

When the phase difference between the applied field wave on the circuit and a wave traveling at the beam velocity is about 180° over the length of the structure, an optimum phase addition of the infinite series of field waves on the circuit takes place at the gun end. This is the second condition for start oscillation, and it assures a minimum value of tube length to provide an infinite sum for the series expression for output field for a finite applied input field.

### *Simple Circuit*

In conclusion, an explanation will be given of one

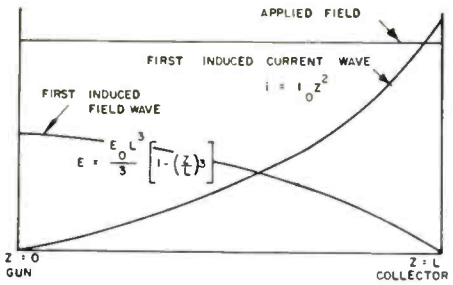



Fig. 4: Field and current component amplitudes obtained from simplified BWO theory.

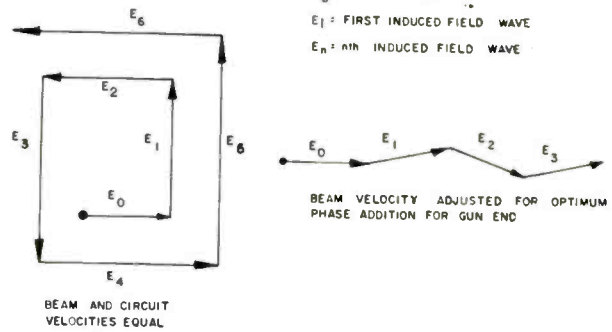



Fig. 5: Gun-end field waves just above start-oscillation current.

of the simplest sorts of circuit capable of supporting a "backward" wave (a wave with oppositely directed phase and group velocities). The basic concept involved is that of space harmonics, or "Hartree" harmonics. In the device shown in Fig. 6, two parallel plates are used to propagate a wave from left to right. These plates have periodic corrugations in them which slow down the wave to a velocity in the z-direction considerably smaller than the velocity of light. Electrons pass through the hole in the center indicated in the end view.

Consider a wave traveling from left to right at the velocity of light along the wrapped-up path. It may have a wavelength much longer than the distance around one corrugation or fold. For example, in Fig. 6 a field plot has been indicated in which the fundamental wave has about one-half wavelength over the entire distance shown.

From the standpoint of an electron, the important field component is the field in the axial direction at the position of the hole. It will be noted that, at any instant of time, there is an intrinsic reversal of this field at each corrugation. This field will now be examined from the standpoint of an electron traveling through the hole.

First, consider an electron traveling from left to right in Fig. 6 at a velocity $u_o$, lower than the velocity in the z-direction of the circuit wave. If an electron travels from $A$ to $B$ during the time it takes a small fraction of a cycle of the circuit wave to pass this hole, the electron will have experienced a field of constant direction, but of slightly varying amplitude. The amplitude is varying slightly due to the spatial variation in field from $A$ to $B$ and due to the time variation resulting from the sinusoidal variation in amplitude of the wave passing by. Next, the electron finds itself between $B$ and $C$, which is a region of very weak longitudinal field.

If the transit time of the electron from $A$ to $C$ (a distance $d$) is made equal to the time it takes the wave in the structure to move forward along the wrapped up path a half wavelength plus the distance around the bend from $AB$ to $CD$ (a distance $L$), each electron will see a field between $C$ and $D$ having the same amplitude and phase as the field experienced between $A$ and $B$. If the free space wavelength is long in comparison with the distance $L$, the circuit wave must move past the electron very rapidly to provide a reversal in the direction of the field at $CD$ by the time the electron arrives there.

In other words, the electron must be traveling at a velocity much lower than the axial velocity of the wave in the circuit, to see a field at $CD$ that is equal to the field it saw at $AB$. The net result is the same as if the electron were traveling in a constant-amplitude field of lower amplitude than the peak field present on the structure. The "space-harmonic amplitude" is the amplitude of this equivalent constant amplitude field, in this case the space harmonic is what is normally denoted as the $+1$ space harmonic. The condition for synchronism with the $+1$ space harmonic may be formulated mathematically as follows:

$$\text{Transit time of electron} = \frac{d}{u_o}$$

$$\text{Transit time of wave} = \frac{\lambda_o}{2c} + \frac{L}{c}$$

$$\frac{d}{u_o} = \frac{\lambda_o}{2c} + \frac{L}{c}$$

$$\frac{c}{u_o} = \frac{\lambda_o}{2d} + \frac{L}{d}$$

where:

$c$ = velocity of light

$\lambda_o$ = free space wavelength

$u_o$ = electron velocity

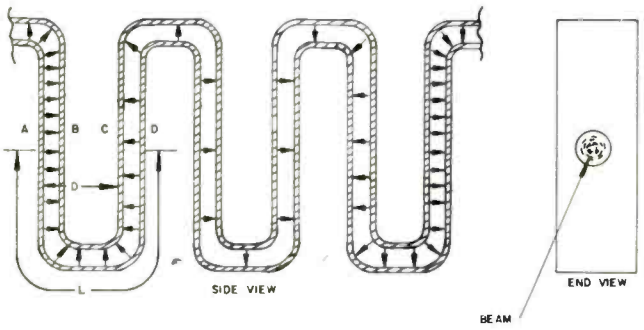



Fig. 6: "Serpentine" structure is one of the simplest backward-wave circuits. Interaction of beam and wave is at discrete points only.



Insofar as this type of interaction is concerned, it makes no essential difference to the electrons whether they are going in the same direction as the wave or in the opposite direction. In either case they can see essentially a constant-direction axial field, if they travel at the correct velocity. An electron traveling from right to left in Fig. 6 must travel from $D$ to $B$ during the time it takes the circuit wave to progress a halfwavelength minus the distance $L$, i.e., a little faster than an electron traveling in the same direction as the wave. As before, the electron would see a strong field from $D$ to $C$, only a very weak field from $C$ to $B$, and again a strong field from $B$ to $A$ in the same direction as the field experienced between $D$ and $C$.

The equivalent constant-amplitude field seen by a beam traveling in the opposite direction to the direction of power flow, as described above, would be called the $-1$ space harmonic amplitude. This is the only field "seen" by electrons traveling at the specified velocity, for all practical purposes. An electron automatically integrates the effects of the time varying

# Backward Wave Oscillator
## *(Concluded)*

field it sees to produce a total displacement equivalent to that which would be caused by the constant-amplitude space harmonic. The condition for synchronism with the $-1$ space harmonic is:

$$\text{Transit time of electron} = \frac{d}{u_o}$$

$$\text{Transit time of wave} = \frac{\lambda_o}{2c} - \frac{L}{c}$$

$$\frac{d}{u_o} = \frac{\lambda_o}{2c} - \frac{L}{c}$$

$$\frac{c}{u_o} = \frac{\lambda_o}{2d} - \frac{L}{d}$$

For a free space wavelength much greater than $L$, the velocity required for synchronism with the $+1$ harmonic is almost equal to that required for the $-1$ harmonic:

$$\frac{u_o}{c} \cong \frac{2d}{\lambda_o}$$

An important feature of a backward-wave circuit based on the space harmonic principle is the fact that the phase velocity of the $-1$ space harmonic intrinsically varies as a function of frequency. This feature makes possible an oscillator utilizing backward-wave interaction that is voltage tunable. From the preceding formula, it is seen that for an electron to be in synchronism with either the $+1$ or $-1$ space harmonic, it must have a velocity that varies in inverse proportion to the free-space wavelength (in direct proportion to the frequency). Since electron velocity is proportional to the square root of voltage, frequency in a backward-wave oscillator is approximately proportional to the square root of voltage. To cover a 2 to 1 frequency range requires a 4 to 1 change in beam voltage. At frequencies where the distance $L$ becomes comparable to a fundamental wavelength, more voltage change is required to accomplish the same change in frequency, typically 10 to 1 in voltage to give 2 to 1 in frequency.

It is possible to regard the field in the hole of the circuit of Fig. 6 purely from the circuit point of view, as a sort of traveling field with regular "pulses" of spatial variation. These "pulses," when subjected to an analysis that is analogous to a Fourier-series analysis of a time-varying function, turn out to be representable by an infinite series of constant-amplitude waves each traveling at a different velocity. Their relative velocities are related to each other by the spatial "period" of the structure.

Restating the above argument, a periodic structure having spatial variations of the sort shown in Fig. 6 can be thought of as carrying power in one direction in a series of constant-amplitude waves traveling in both directions. One of these waves having a phase velocity in the opposite direction to the direction of power flow is seen by electrons traveling at a velocity very near the phase velocity of such a wave as the total field of a circuit that appears to propagate a wave having intrinsically oppositely directed phase and group velocities.

It is easy to visualize a circuit having a phase velocity in the opposite direction to the group velocity. It is also evident that, if an electron can see a field of constant direction in traveling in the direction opposite to the direction of power flow and group velocity on the circuit of Fig. 6, the circuit has provided a wave at the position of the electron beam having oppositely directed phase and group velocities.

It is less obvious that the circuit of Fig. 6 can be treated as if it were a circuit having the intrinsic property of propagating all waves on it with oppositely directed phase and group velocities. It is more convenient to establish this latter fact with the aid of a mathematical analysis of the fields in this circuit, and the present discussion is primarily aimed at lending an air of plausibility to the fact that oppositely directed phase and group velocities in a physical circuit are obtainable.

### Additional References Helpful in Obtaining A Physical Understanding of Traveling-Wave Tubes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4. H. J. Reich, P. F. Ordung, H. L. Krauss, and J. G. Skalnick, *Microwave Theory and Techniques*, Van Nostrand, New York, 1953, esp. Ch. 15.
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6. R. Kompfner and N. T. Williams, *Backward-Wave Tubes*, Proc. I.R.E., 41: 1602-1611 (1953).
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## *Gassing of Dry Cells*

The National Bureau of Standards has been investigating the production of gas in dry cells to find some relationship between the rate of gassing and battery life.

Runs were made at 21°, 35°, 45° and 55°C because these temperatures have previously been used in shelf-life studies of dry cells. Some cells were left on open circuit and some were subjected to two different standard specified discharge rates. One of these discharges is intermittent through a 6.67-ohm resistor, and the other continuous through an 83.33-ohm resistor.

On open circuit, gassing proceeds at a nearly constant rate for any given temperature. The rate is greatly affected by temperature; for the temperatures given above, the cells evolved respectively 0.1, 0.6, 2.0, 6.0 ml of gas per day.

Conclusions from the electrical discharge tests are that evolution of a certain volume of gas during storage of a cell at high temperature is less detrimental than at low temperature. However, the time required to produce a given volume at higher temperatures is far less than at lower temperatures.

For each temperature and type of cell, there appears to be a critical volume of gas a cell may evolve before there is a substantial loss in its capacity to generate current. Once the critical volume has been evolved, the cell deteriorates more rapidly.

It appears that no correlation exists between the rate of gassing and the initial capacity of the cell when the discharge test begins. When the cell is put on discharge, the immediate effect is to reduce the rate of gassing.

# Page from an Engineer's Notebook

# #41—Transistor Impedance Changer

**By I. F. BARDITCH and J. D. SULLIVAN**
*Westinghouse Electric Corp.*
*Air Arm Div., Baltimore, Md.*

THE schematic diagram and equivalent circuit are shown in Fig. 1. This configuration produces an input impedance of better than one megohm at temperature ranging from 28 C° to over 110° C and with proper use of shunt-series peaking coils the frequency response ranges from dc to better than 3 MC. Fig. 2 shows that the unit is made very small and by potting is made shock, moisture, and vibration resistant.

The input impedance was found to be dependent on the value of the grounded emitter current gain or $h_{fe}$. The actual input is always parallel shunted by the 5.1 megohm balancing resistors. The dependence of the input impedance on $h_{fe}$ can be seen from the approximate expression for input impedance $Z_{in} = h_{fe}^2 R_L$ where $R_L$ is the load resistance.

The output impedance depends on the internal source impedance, but in no case can it exceed the maximum value of the load, $R_L$, which is here 10K ohms. The equality condition would occur when the source impedance is infinite. The output impedance is also dependent on operating conditions, such as loading of the output- and input-signal levels.

A damped peaking coil inserted in the emitter of the first transistor will isolate it from the input capacitance of the second transistor and improve the high-frequency performance.



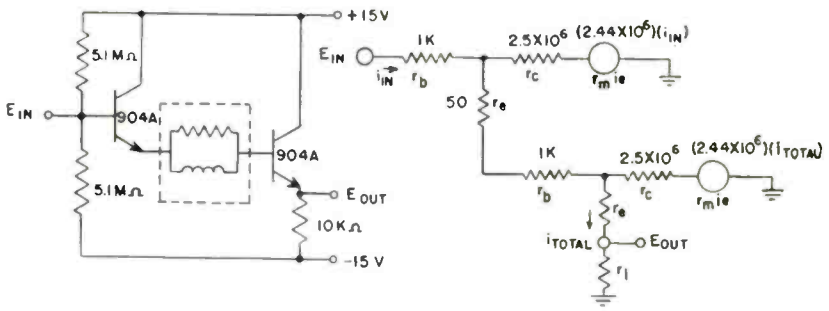



Fig. 1: Schematic and equivalent circuit for the transistor impedance changer.

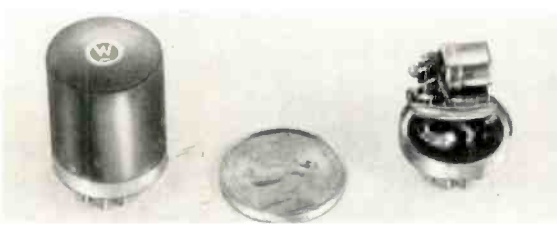


Fig. 2: Entire circuit can be potted in tiny case.

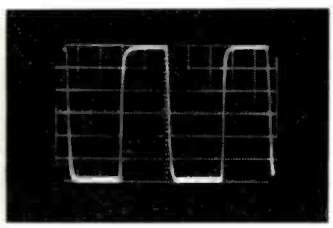


Fig. 3: Impedance changer response.

## THEORETICAL CALCULATIONS

Assume the following values for a typical 904A transistor:

$r_b = 1000\ \Omega$ $\qquad r_c = 2.5 \times 10^6\ \Omega$

$r_e = 50\ \Omega$ $\qquad r_m = 2.44 \times 10^6\ \Omega$

Input impedance

$$Z_{in} = r_b + r_e \left[ \frac{r_c + r_b + r_e \left( \frac{r_c + R_L}{r_c - r_m + r_e + R_L} \right)}{r_c - r_m + r_b + r_e \left( \frac{r_c + R_L}{r_c - r_m + r_e + R_L} \right)} \right]$$

$Z_{in} = 2$ meg.

Out impedance $Z_{out} = r_e + (r_c - r_m) \left[ \dfrac{r_b + r_e + (r_c - r_m) \left( \dfrac{r_b + R_g}{r_b + r_e + R_g} \right)}{r_c + r_b + (r_c - r_m) \left( \dfrac{r_b + R_g}{r_b + r_e + R_g} \right)} \right]$

$Z_{out} = 75\ \Omega$ for $R_g = 0$

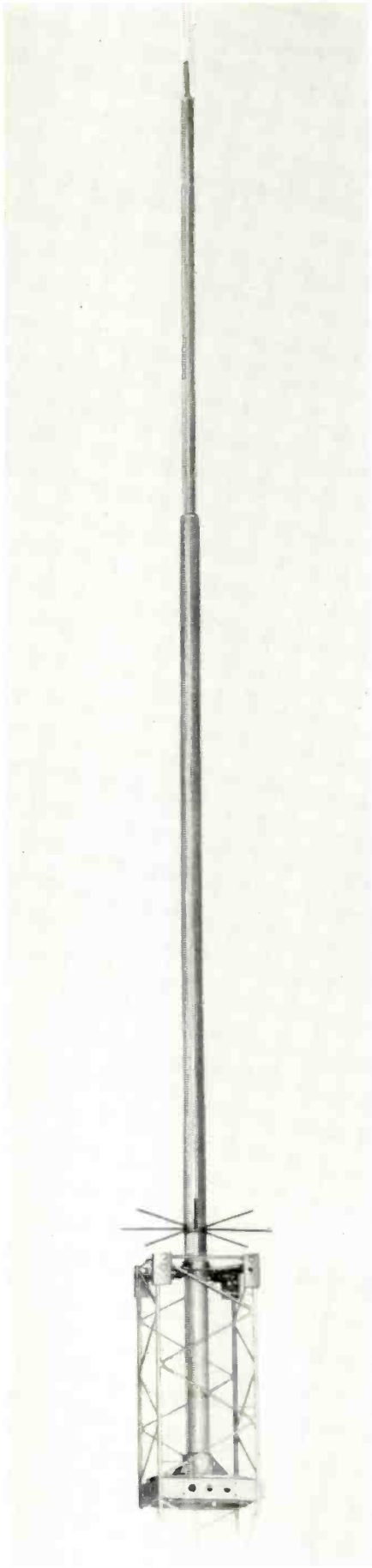
$Z_{out} = 1500\ \Omega$ for $R_g = \infty$

V.G. Stage 1 = 0.99979

V.G. Stage 2 = 0.99265

Total Gain = 0.99246

$$\text{V.G.} = \frac{R_L}{r_e + r_b \left( 1 - \dfrac{r_m}{r_c} \right) + R_L}$$



This antenna uses the new suppressor element to obtain a 10 db gain vertically polarized radiator for the 460 MC range.

*By Controlling Radiation*

# Suppressor Improves Pattern

*A new type element, properly applied on a long conductor at half wavelength intervals, "shielding" portions normally causing cancellation, has been evolved. Its effectiveness offers opportunities for wide application in systems with extensive conducting elements.*

**By M. W. SCHELDORF**
*Engineering Consultant*
*Andrew Corp., Chicago, Ill.*

HIGH gain communication antennas involve vertically disposed linear conductors many wavelengths long. A major contribution to the commercial success of these arrays can be achieved by a reduction of the number of feed points.

Normally, when a conductor is excited at one end, alternate sections with phase opposition are produced. The result is an end-fire pattern and low radiation, normal to the conductor.

A direct general solution is made possible by the development of a new suppressor element.* This development permits the use of a long conductor, with the new elements properly applied at approximately half wavelength intervals to "shield" the portions which normally cause cancellation.

In one form, this element consists of a half wavelength cylinder mounted over the conductor to be "shielded," and two additional quarter wavelength cylinders over the first one connected to produce cooperative choking conditions. A cross-sectional view of such a device

*Patent applied for.

M. W. SCHELDORF has just been named a Fellow of the IRE for outstanding contributions in radio frequency transmission lines and radiating systems.

is indicated in Fig. 1. The chokes prevent waves from traveling over the unit, so there is little current on the external surfaces.

The coaxial line produced by the main conductor and the long cylinder forms a very useful one-to-one transformer. Waves at one end are duplicated at the other through this relationship. By this means, a series of half wave radiators can be fed from one end in an effective manner. The ANDREW Type 212 Communication Antenna utilizes this prnciple to obtain a 10 db gain vertically polarized radiator for the 460 MC range.

Tests for the effectiveness of the new element as a radiation suppressor were performed on a loop antenna. Fig. 2 shows the E-plane pattern of a square loop with sides a half wavelength long. Due to symmetry about both diagonals of the square there are 4 nulls and, consequently, a 4 lobe pattern, as indicated.

Fig. 3 shows the effect secured by "shielding" the radiator on two sides of the square. Radiation from these two sides is essentially eliminated, and only two radiation lobes remain.

### *Effectiveness*

The effectiveness of the suppression is indicated by the depth of the nulls in the pattern and the absence of second order pattern features. Numerous applications of this interconnection of radiators can be made. For example, this method can be used to feed more than one element without destructive interference from directly excited currents on conductors joining them. Another application is to eliminate the danger of parasitic radiation from other forms of coupling circuits.

With a slight modification, the element can also be used as a very effective radiation choke.* This change consists of the addition of a short circuit between the main conductor and the long cylinder at its mid-point, as indicated in Fig. 4. Note that there are 4 choking points in this structure within a physical length of a half wavelength. Two pairs of choke points are within a quarter wavelength spacing. This is especially effective in its overall wave suppression ability.

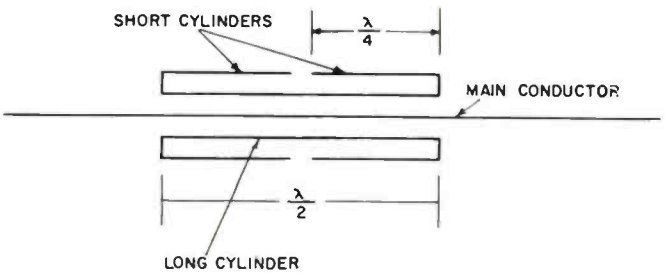



Fig. 1: One form of the element: various cylinders mounted over main conductor are connected to produce cooperative choking conditions.

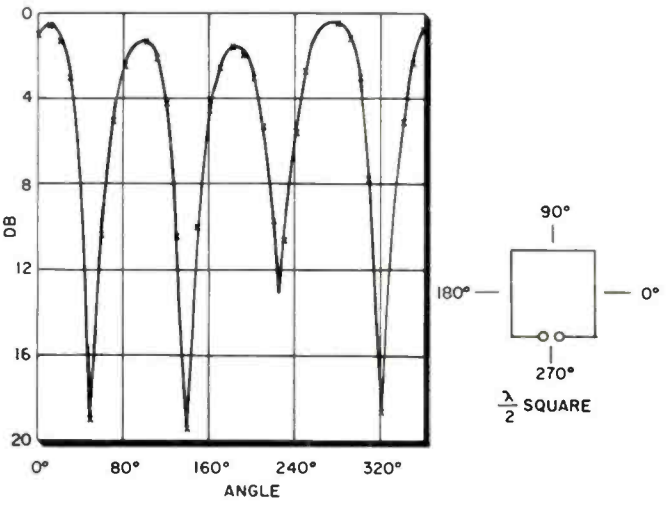



Fig. 2: The E-plane pattern of a square loop with sides a half wavelength long.



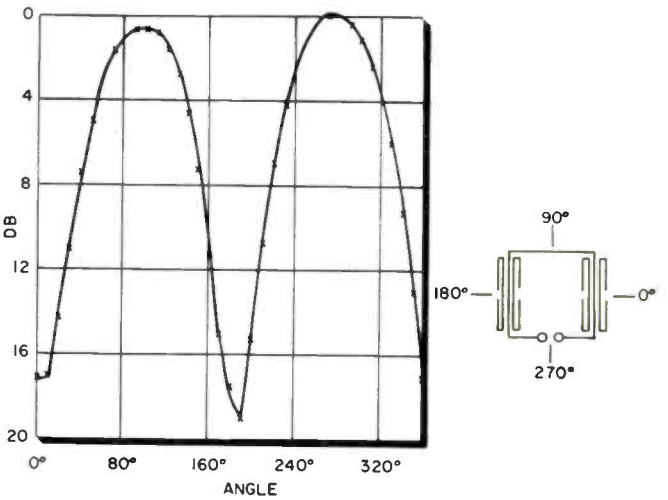



Fig. 3: E-plane pattern of the same square loop but with 2 suppressors added.

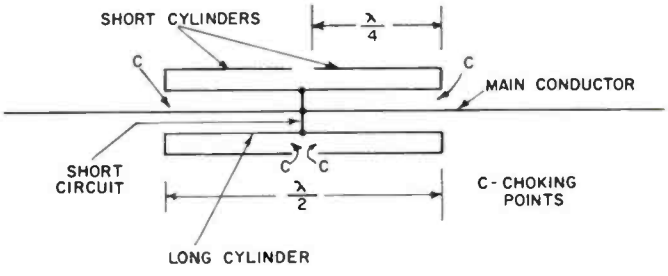



Fig. 4: By shorting the main conductor and the long cylinder at its mid-point, the element can be used as an effective radiation choke.

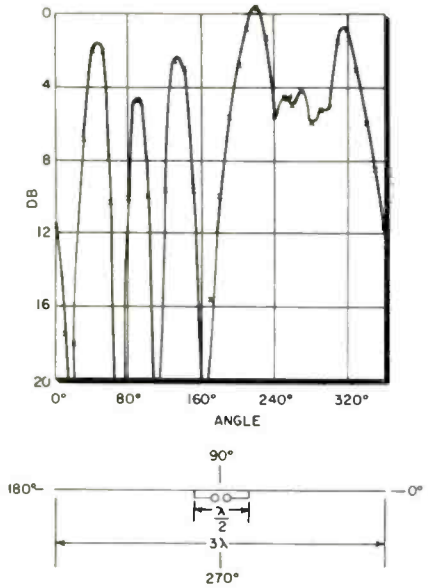



Fig. 5: Folded dipole with extended arms and its attendant multilobe pattern.

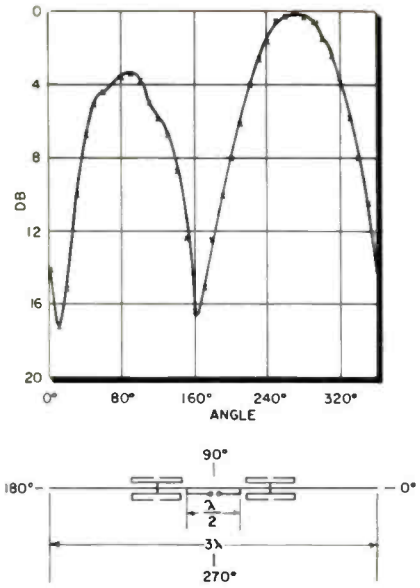



Fig. 6: Radiation is restricted to the portion confined by the suppressor chokes.

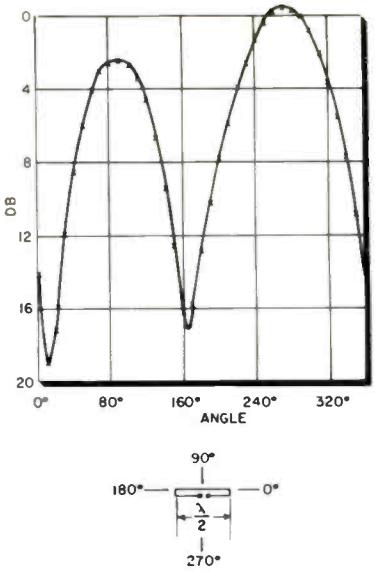



Fig. 7: Folded dipole pattern verifies feed system as cause of Fig. 6 lobe unbalance.

## Radiation Control *(Concluded)*

To demonstrate its suppression features, we provided the long antenna of Fig. 5 with its attendant multilobe pattern, with low radiation perpendicular to the length of the long conductor. Next, two of these suppressor chokes were added over the long conductors to confine a half wavelength space at the center, as indicated in Fig. 6. The resultant pattern shows that radiation has been restricted entirely to the portion confined by the new chokes. The effectiveness of this system is indicated by the low magnitude of the side lobes present.

The unbalance in the lobes of Fig. 6 can be attributed to the feed system used. This is verified by a pattern taken without any extending arms; see Fig. 7.

# What's New . . .

## Transistorized Clock

EVEN clocks can be transistorized! A French patent has been granted for a magnetically driven balance and hairspring assembly using a self-switching transistor circuit.

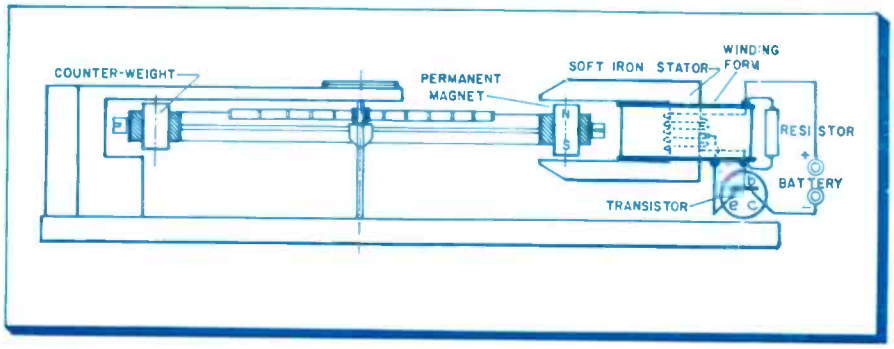
In its simplest form, the circuit comprises a tapped winding, resistor, transistor, and energy source. In the prototype, the coil form terminals serve as a convenient mount for the resistor and the transistor. This invention eliminates all moving elements except for the balance wheel, resulting in great inherent ruggedness.

Our illustration shows a balance wheel with a small permanent magnet on its rim. As this magnet passes through a stator, it generates a trigger pulse in a winding of the stator coil. This pulse triggers a transistor to send a propulsive pulse through the stator windings. The advantages of a free-swinging balance can be achieved by having the stator operate a gear-train stepping armature.

Data for the prototype illustrated here include a 1.0-gram balance 1.75 cm diameter, driven by a mechanical input of 8.0 microwatts at a 5.0000 beat rate with a total excursion of 540°. The Alnico V magnet measures 1.0 mm diameter and 2.0 mm long. Duration of the electrical impulses is .005 second. An initial deflection of 20° will start the balance operating.

**MORE WHAT'S NEW on P. 118**

Electronically driven balance wheel and hairspring assembly



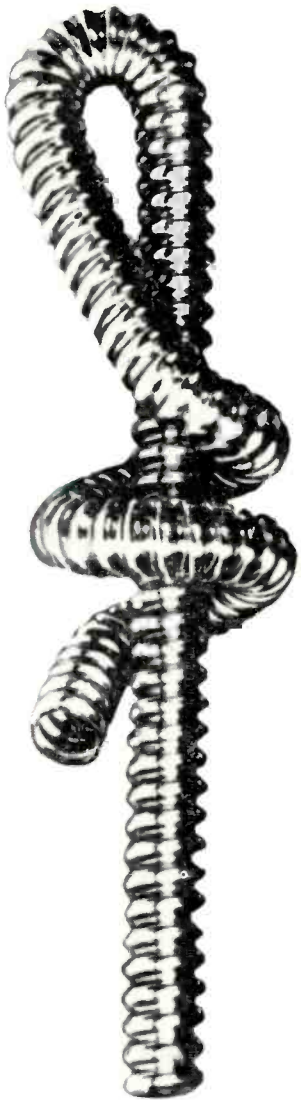


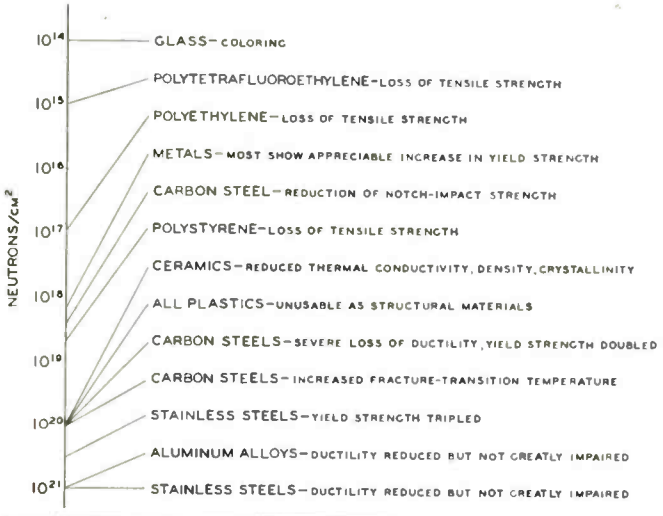
Fig. 1: Corrugated outer conductors of Heliax provides high degree of flexibility.

# Raising the Limits for Coaxial Cables

*This progress report reviews present knowledge and practical experience with coaxial cables at very high temperatures. The need for improvement is great, and several likely approaches are under investigation.*

**By E. T. PFUND, JR., W. F. CROFT, and BARD SUVERKROP**

Fig. 2: Sensitivity of material properties to radiation. Irradiation dose is in epithermal neutrons. (Prepared from material by O. Sisman and J. C. Wilson, "Engineering Use of Damage Data," Nucleonics, September, 1956.)

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*W. F. Croft, United Electrodynamics (presently with Filtron Corp., Culver City, Calif.)*
*Captain Bard Suverkrop, Electronic Components Lab., WADC, Dayton, Ohio*

AIRCRAFT and missiles now being designed will generate internal temperatures not previously encountered by electronics equipment. This rapid improvement of modern aircraft has accentuated the limitations of presently available coaxial cables.

To meet the anticipated need for low-loss, high-temperature coaxial cables, the Electronic Components Laboratory of the Wright Air Development Center has sponsored an investigation of suitable dielectric and conducting materials, coaxial designs, and methods of cable fabrication (Contract AF-33(616)-3607). RG type cables have been excluded from this study, since their maximum temperature limitation is 250°C, and their characteristics up to that temperature are well known.

Specifically, cables of 50-ohm characteristic impedance and 300°C to 500°C environmental capabilities are needed. The outer conductor of such cables will probably be solid rather than braided in order to meet the requirements of attenuation, shielding effectiveness, and temperature range. Consequently, semiflexible "cables," at best, can be realized.

### *Present Cables*

Outside of the United States, only one English com-

## Table 1

COMMERCIALLY AVAILABLE "HIGH-TEMPERATURE" COAXIAL CABLES

| | INORGANIC | | ORGANIC | |
|---|---|---|---|---|
| | ANDREW 83A | ANDREW 83AL | ROCKBESTOS NA | AMPHENOL ALJAK 21-608 |
| Impedance: | 50 ohms | | 50.81 ohms | 50 ohms |
| Attenuation: | 400 mc/s 3.4 db/100 ft<br>1000 mc/s 6.44 db/100 ft<br>3000 mc/s VSWR 1.5 | | 100 mc/s 1.2 db/100 ft<br>1000 mc/s 3.72 db/100 ft<br>3000 mc/s 5.6 db/100 ft | 100 mc/s 1.4 db/100 ft<br>1000 mc/s 6.0 db/100 ft<br>3000 mc/s 12.0 db/100 ft |
| Weight: | 18 lb/100 ft | 8.8 lb/100 ft | 12.8 lb/100 ft | 10.3 lb/100 ft |
| Outside Dia.: | 0.375 in. | | 0.509 in. | 0.325 in. |
| Flexibility: | Satisfactory for Aircraft Installation Without the Use of Special Tools. | | | |
| Min. Bend Radius: | 10 x dia. | | 10 x dia. | |
| Pressurization: | Accomplished by a hand-operated dry-air pump | | | |
| Fittings: | Type N or C Connectors | | Type N (IPC-90550) | Type N or C Connectors |
| Dielectric Strength: | 500V rms at sea level<br>1500V rms at 300 lb/sq. in. pressurization | | 7,100V rms | |
| Nominal: | 24.5 uuf/ft. | | 23.9 uuf/ft. | |
| Miscellaneous: | Solid outer and inner copper conductors. A semiflexible bead-supported line. | Solid outer conductor of aluminum. Solid inner conductor of copper. A semiflexible bead-supported line. | Dielectric consists of a threaded-teflon core. Solid outer and inner conductors of aluminum. | Solid outer conductor of aluminum. Inner conductor stranded 7/20 silver copper. Regular RG 87A/U teflon dielectric. |

## Table 2

WADC HIGH-TEMPERATURE COAXIAL CABLE DESIGN OBJECTIVE

| Characteristic | Objective |
|---|---|
| Impedance: | 50 ohms |
| Attenuation: | The theoretical minimum possible over the frequency range of 10 to 10,000 megacycles at temperatures to 300° C. |
| Weight: | 15 lbs/100 ft. |
| Outside Diameter: | 0.5 inches nominal |
| Flexibility: | Satisfactory for aircraft installation without use of special tools. |
| Minimum Bend Radius: | 5 to 10 × diameter |
| Pressurization: | Pressurization is not preferred. However, if necessary, all components needed to accomplish pressurization should be simple enough to permit use in the field. |
| Shielding Effectiveness: | 40 db/ft. greater than RG 9A/U |
| Fittings: | The cable shall preferably be capable of assembly with United States Military type "N" or type "C" fittings. |
| Vibration Requirements: | 10 to 3,000 cycles per second at +15g |
| Temperature Range: | Usable from −65° to +300° C. |
| Dielectric Strength: | 10,000V RMS |
| Corona Level: | 5,000V RMS at a temperature range from −65° C to +250° C and an altitude of 80,000 ft. |
| Maximum Operating Voltage: | 4,000V RMS |
| Nominal Capacitance: | 25 mmf/ft. |

## Table 3

DIELECTRIC PROPERTIES OF SOME MATERIALS

Values for tan are multiplied by $10^4$: frequency given in c/s.

| | T°C | f | 1x10⁷ | 1x10⁸ | 3x10⁸ | 3x10⁹ | 1x10¹⁰ | 2.5x10¹⁰ |
|---|---|---|---|---|---|---|---|---|
| 1. Glasses | | | | | | | | |
| Fused Silica 915c | 25 | ε | 3.78 | 3.78 | 3.78 | ..... | 3.78 | |
| | | tan δ | 0.1 | 0.3 | 0.5 | ..... | 1.7 | |
| Fused Quartz | 25 | ε | 3.78 | 3.78 | ..... | 3.78 | 3.78 | 3.78 |
| | | tan δ | 1 | 1 | ..... | 0.6 | 1 | 2.5 |
| 2. Misc. Micas | | | | | | | | |
| Ruby mica | 26 | ε | 5.4 | 5.4 | ..... | 5.4 | | |
| | | tan δ | 3 | 3 | 2 | 3 | | |
| Muscovite Crystal Strength, volts/mil | | | 2800 | | | | | |
| Fluoro-Phlogopite Crystal (Synthetic) Strength, volts/mil | | | 2200 | | | | | |

(Data taken from A. Von Hippel, "Dielectric Materials & Application," Technology Press of MIT, 1954, and R. A. Humphrey, "Data on Synthetic Mica," Mycalex Corporation of America.)

## Table 4

DIELECTRIC PROPERTIES OF SYNTHETIC FLUOR-PHLOGOPITE MICA*

| | Single Crystal | Barium Di-Silicic |
|---|---|---|
| Dielectric Constant (1 MC) | 6.3 | 7.6 |
| Power Factor (1 MC) | .0002 | .0003 |
| Melting Point °F | ..... | 2550 |
| Softening Point °F | ..... | 2000 – 2200 |
| Thermal Stability Limit for Constant Use °F | ..... | 1475 |

* (From material by R. A. Humphrey, "Data on Synthetic Mica," Mycalex Corporation of America and Theodore B. Merrill, Jr., "Three Forms of Synthetic Micas," Materials and Methods, August, 1954, and Brush Beryllium Company.)

## Table 5

DIELECTRIC PROPERTIES OF SYNTHETIC BARIUM MICA AND WOLLASTONITE VERSUS TEMPERATURE

| | Power Factor (%) | | Dielectric Constant | |
|---|---|---|---|---|
| Temperature | Wollastonite | Barium Mica | Wollastonite | Barium Mica |
| 20 | 0.07 | 0.04 | 6.77 to 6.83* | 7.74 |
| 100 | ..... | 0.04 | 6.84 | 7.76 |
| 125 | .12 | 0.05 | 6.87 | 7.78 |
| 150 | .17 | 0.05 | 6.90 to 6.93* | 7.80 |
| 175 | .17 | 0.06 | 6.90 | 7.81 |
| 200 | .20 | 0.07 | 6.93 | 7.82 |
| 225 | .16 | 0.11 | 6.94 | 7.86 |
| 250 | .20 | 0.17 | 6.96 | 7.89 |
| 275 | .22 | 0.26 | 6.98 | 7.90 |
| 300 | .24 | 0.39 | 7.01 | 7.93 |
| 325 | .29 | 0.59 | 7.04 | 7.98 |
| 350 | .34 | 0.77 | 7.06 to 7.21* | 8.02 |
| 375 | .40 | 1.04 | 7.11 | 8.06 |
| 400 | .58 | 1.40 | 7.13 | 8.12 |
| 425 | .71 | ..... | 7.17 | 8.17 |
| 450 | ..... | ..... | 7.23 | 8.28 |

* Measurements by two different laboratories.

(From material prepared by J. E. Comeforo and R. A. Hatch, "Synthetic Mica Investigations IV, Dielectric Properties of Hot-Pressed Synthetic Mica and Other Ceramics at Temperatures up to 400°C," Journal of the American Ceramic Society, [34] 7, 1954, pages 317-322.)

# Coaxial Cables *(Continued)*

pany is manufacturing cables capable of continuous operation up to 250°C (utilizing polytetrafluoroethylene dielectrics).

Among the high-temperature resistant, low-loss cables that are commercially available (Table 1), the solid sheathed (aluminum or copper) Teflon coaxials may be useful at 300°C, and the ceramic-beaded lines can be used up to temperatures of 760°C to 980°C depending on the required life and protective coatings applied to copper tubing.

Other commercial cables of interest, due to the manufacturing techniques employed, are the Heliax[2] cables offered by the Andrew Corporation and Hackethal of Hanover, Germany; the mineral insulated cables[3, 4] manufactured by the General Cable Corporation, and a series of disc-spaced coaxial cables manufactured by Siemens and Halske of Munich, Germany.

The use of clad and/or corrugated seamed outer conductors, as well as helical[2, 5, 6] and mineral insulation techniques, is of special interest for high-temperature, low-loss, applications. A corrugated seamed outer conductor provides a high degree of flexibility and facilitates plating, while helical insulation provides the lowest loss wide-band coaxial cables presently known. Mineral insulation can withstand temperatures to 2800°C.

Experimental cables, now in industrial laboratories, show additional promise. Dielectric materials and configurations (based on Refrasil, ceramics, and irradiated polymers) not previously used in coaxial applications are being tried.

A test program is underway at United Electrodynamics to test the suitability of several representative coaxial cables for operation at high temperatures and high altitudes. Preliminary test data for several of these cables are shown in Fig. 3.

The attenuation characteristics of various experimental silicone rubber cables are shown in Fig. 4. A wide variety of flexible solid-silicone-rubber coaxial cables are available from the Suddeutsche Kabelwerke of Mannheim, Germany. These are rated for a continuous temperature of 200°C for some two to three years. At 300°C, their estimated useful life is about 48 hours.

### *Dielectric Materials*

Numerous potential high temperature resistant dielectric materials have been categorized and classified. For the most part, these materials are based on silicon —either the oxide or the silicates—and include Refrasil, Fiberfrax, Forsterite, fused and crystalline quartz and silica, Wollastonite, Microcel-1C, mica, and Cab-O-Sil. The electrical characteristics of some of these materials are shown in Figs. 5 through 9 and Tables 3 through 6.

*Fused quartz* has one of the lowest dissipation factors of the known inorganic materials.[7] "Micronized" fused quartz powder in 4-10 microns size is commercially available.[8]

*Refrasil*[9] is a special fibrous silica material designed for effective continuous insulation of temperatures in

Legend: ⊙ Amphenol, Aljak #21-608, 0.325" diameter
▫ Andrews, 83A and 83AL, 0.375" diameter
△ Rockbestos, # NA 0.509" diameter

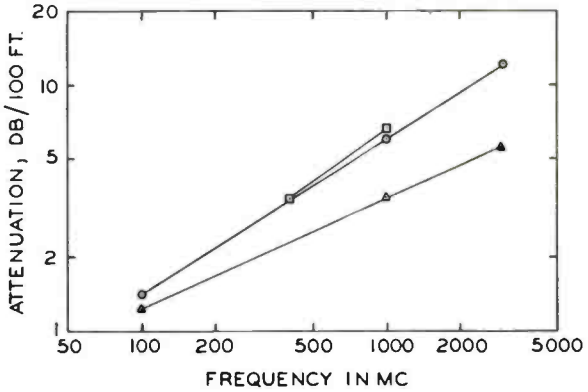



Fig. 3: Manufacturers data on 50-ohm "High-Temperature" coaxial cables—attenuation vs frequency.

Legend: ⊙ Dow Corning, Silcoax, 71.5 ohms.
Phelps Dodge, Silicone Spirafil of
▫ Silastic 80, 0.421" diameter, 47.2 ohms.
△ Phelps Dodge, Wagon-Wheel of
Silastic 80, 0.25" diameter, 50 ohms

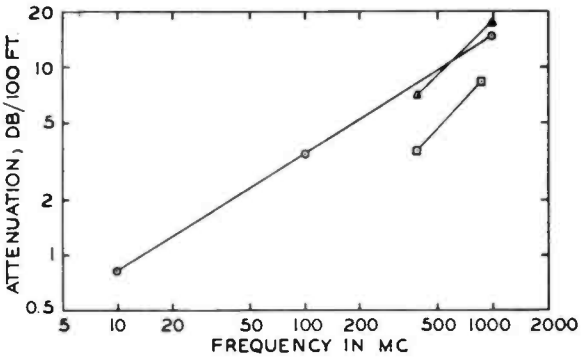
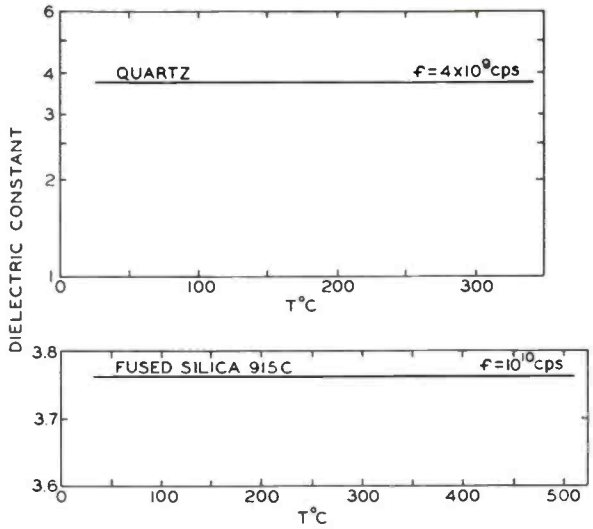



Fig. 4: Attenuation vs frequency of experimental silicone rubber coaxial cables.

Fig. 5. Dielectric constant vs temperature for quartz and fused silica.




(Prepared from material by A. Von Hippel, "Dielectric Materials and Applications," Technology Press of MIT and F. Gross "Temperaturgang Des Verlustwinkels Und Der Dielektrizitätskonstante Fester Isolierstoffe Im Bereich Um 4,000 MHz", Nachrichtentechnische Zeitschrift, March 1956, pages 124-128.)

**Table 6**

**RADIATION EFFECTS ON CERAMOPLASTICS AND GLASS-BONDED MICA***

(Dosage — 3.7 x $10^{18}$ gamma photons per square centimeter; — 1.7 x $17^{17}$ fast neutrons per square centimeter)

| Type | Temp. of Irradiation °F | Specimen Thickness | Breakdown Voltage Before | Breakdown Voltage After | Resistance Before $10^9$ | Resistance After $10^9$ | Remarks |
|---|---|---|---|---|---|---|---|
| 410 | 660 | 0.150" | 4100V | 2200V | 50 | 50 | no appreciable change in appearance or dimension |
| 410X | 660 | 0.136" | 3200V | 3200V | 50 | 50 | no change in dimensions |
| 500 | 660 | 0.298" | 4400V | 4000V | 50 | 50 | no change in dimensions or Rockwell Hardness |

* Measurements by General Electric Company, Hanford Works—Courtesy Mycalex Corporation of America.

**Table 7**

**DECREASE IN COPPER SHEATH THICKNESS AS A FUNCTION OF TIME AT VARIOUS TEMPERATURES**

| Decrease in Sheath Thickness, Mils* | 250 C, Years | 400 C, Years | 800 C, Hours |
|---|---|---|---|
| 1 | 2.57 | 0.0583 | 0.259 |
| 2 | 10.3 | 0.233 | 1.04 |
| 5 | 64.3 | 1.46 | 6.48 |
| 10 | 257 | 5.83 | 25.9 |

* 1 mil 0.001 inch.

(From C. A. Jordan and G. S. Eager, "Mineral-Insulated Metallic-Sheathed Cables," Power Apparatus and Systems, April, 1955.)

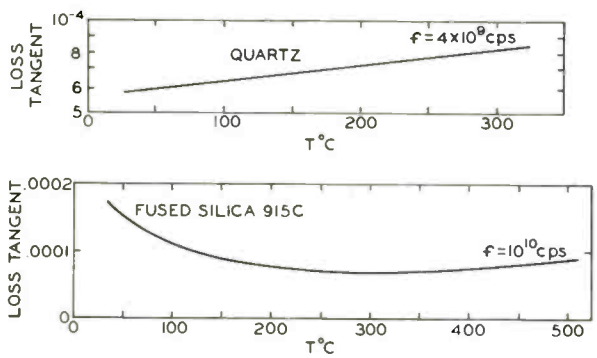



Fig. 6: Loss tangent vs temperature for quartz and fused silica—same sources as Fig. 5.

the 980°C range. Several cable manufacturers are now experimenting with this material. It appears that its hygroscopic character can be modified by treatment.

*Forsterite*[10] dielectrics are produced from compositions containing talc to which magnesium oxide has been added. Forsterite, or magnesium orthosilicate, is presently used to fabricate ceramic beads for solid-sheathed coaxial lines and has the facility to form strain-free vacuum-tight seals with metal alloys of the nickel-iron type because of similar coefficients of expansion.

*Wollastonite*[10, 11] is a low-loss dielectric material based on the mineral calcium silicate. Ca Si $O_3$.

*Microcel 1-C*[12] is a diatomaceous silica product consisting of hydrated synthetic calcium silicate powder.

*Cab-O-Sil*[13] is a submicroscopic particulate silica characterized by high chemical purity and extremely

# Coaxial Cables

## *(Continued)*

fine particle size. These three materials may find high-frequency cable applications similar to existing mineral insulated coaxial cables.

*Natural mica* is a silicate of aluminum and potassium with hydroxyl (and sometimes fluorine) ions in the complex molecule.[11, 14] Semiproduction quantities of synthetic barium di-silicic mica have been commercially available in powdered form. See Tables 4 and 5. Fluor-phlogopite (synthetic) mica characteristics are shown in Table 4.[15]

*Fiberfrax*[16] is an aluminum silicate fibrous material capable of continuous service at temperatures around 980°C. The minor percentage of organic carrier fiber content is lost at elevated temperatures.

*High temperature plastics* were also surveyed. Significant research is underway, both foreign and domestic, on high-temperature-resistant plastic materials. Soviet scientists report some interesting compounds based on polybutadiene.[17] Laboratories in the United States are investigating organoborons, boron-phosphorus and nitrogen phosphorous combinations, perfluorinated compositions, phosphonitrilic chloride (a completely inorganic polymer), polybutadiene polymers, polyparaxylene, and isocyanate-treated silicon-and-boron-base polymers.[18, 19, 20, 21, 22] In Italy, irradiated polypropylene is being evaluated.[17, 23, 24, 25, 26]

It is only natural that the most stable of known polymers, polytetrafluoroethylene (Teflon), is serving as the basis of a search for high-temperature polymers.[27, 28, 29] For the 300°C coaxial-cable application, the limiting factor of polytetrafluoroethylene is not particularly its gaseous decomposition or its thermal stability, but more its temperature coefficient of expansion, especially with respect to the conducting materials concerned.

### *Radiation*

Where cables are considered for use near high-energy-particle sources, consideration must be given to the sensitivity of the materials to nuclear radiation (See Fig. 2). "In addition to the permanent change that is caused by radiation, there is a temporary effect on the insulation properties of material caused by the presence of the radiation field."[30] For example, the volume resistivity may decrease by several orders of magnitude.[10]

In general, ceramics are much more radiation-resistant than organic materials, but probably suffer more damage than most metals. Not much loss in strength has been reported for moderate periods of exposure to radiation, although swelling, or a decrease in density, has been observed by Sisman and Wilson[30] for most ceramics. These factors provide additional arguments for the use of low-loss ceramic materials in high-temperature coaxial cables for airborne applications.

Some materials show improved characteristics when irradiated. For example, some irradiated polyethylenes can be operated for extended periods at 200°C, for a few hours at 300°C and, in an inert atmosphere, can possibly sustain 350°C.[31] At elevated temperatures decomposition may take place, but the resulting products are nontoxic and noncorrosive.

### *Conducting Materials*

The creation of a cable for continuous operation at elevated temperatures requires not only special dielectric material but also the selection of suitable metallic conductors. Time of exposure and high temperatures cause accelerated degradation of electrical characteristics of metals through corrosion.

Corrosion can cause a conducting, semi-conducting, or dielectric layer to be formed on the surface of the base metal.[32] If the surface corrosion product is a non-conductor, microwave currents will flow beneath the dielectric layer, and any increase in losses will be due primarily to the roughening of the conducting surface. Small losses may also occur in the surface insulating layer, and the characteristic $Z_0$ of the cable itself may change.

If the corrosion product is a semi-conductor or conductor, increased losses will be realized from current flow in the corroded layer, as well as from the surface roughening. It should be pointed out that deviations between measured and theoretical values of surface resistivities for deposited metal films are caused by corrosion, porosity, density and roughness. Major increases in the surface resistivity value for metals have been measured by Lending[32] in coaxial samples and waveguide tubing after exposure to various atmospheres and after corrosion.

A great difference in the ability of metal alloys of the same nominal composition to withstand nuclear radiation has been noted.[30] Unfortunately, one of the first cable choices for the high temperature coaxial cable application, carbon steel, suffers radiation damage at doses considerably lower than many other metals, especially the stainless steels and some of the aluminum alloys. (Fig. 2.)

Carbon steels also show hardening and loss of ductility on irradiation. On the other hand, radiation damage to aluminum is generally slight, although some loss of ductility is observed.[33, 34] According to Kittel,[34] boron and boron carbide show extensive damage while cadmium shows none. No radiation-induced change in properties has yet been reported for liquid metals.

### *Copper*

The apparent temperature limit of some existing coaxial cables is the melting point of copper, 1,083°C. The practical upper limit of a cable with a solid copper outer conductor is actually determined by the progressive oxidation of the sheath and is about 250°C.[3] (Table 7.)

The surface resistivity of waveguide samples of copper has been observed by Lending[32] to rise after aging and corrosion. (The same mechanism involved is applicable to the coaxial configuration.) When the corroded surface layer was removed, the surface resis-

(*Continued on page* 132)

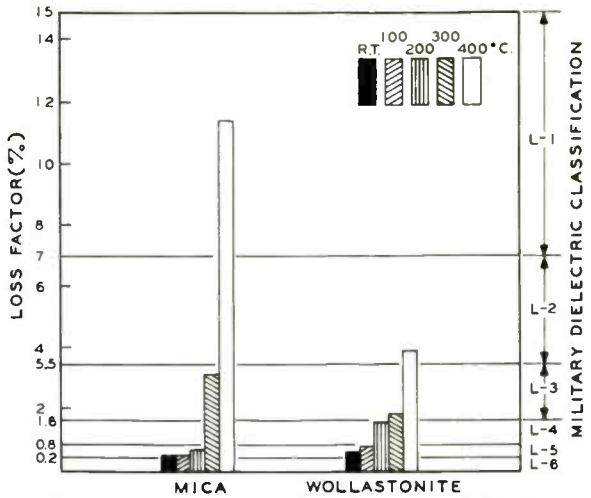
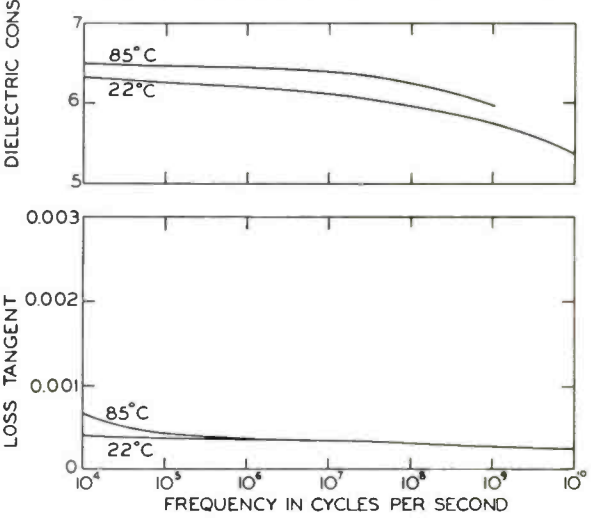


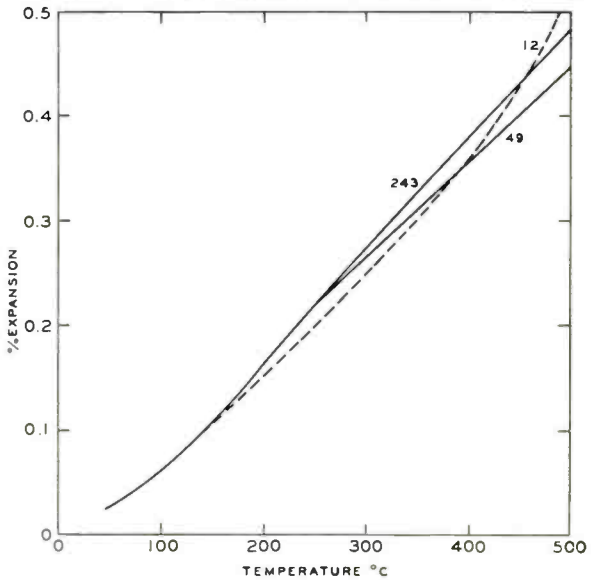

Fig. 7 (above): From J. E. Comeforo and R. A. Hatch, "Journal of the American Ceramic Society, 1954."

Fig. 8 (below): Frequency characteristic of dielectric constant and power factor for Forsterite Ceramic 243.




(Prepared from material by A. Von Hippel, "Dielectric Materials and Applications," Technology Press of MIT.)

Fig. 9 (below): Linear thermal expansion of Corning G-12 glass, Forsterite Ceramic 243, and Ni-Fe No. 49 of Carpenter Steel Company.




(Prepared from material by A. Von Hippel, "Dielectric Materials and Applications," Technology Press of MIT)

# WASHINGTON News Letter

**SINGLE PACKAGE** — The FCC has received an avalanche of approximately 200 comments in its frequency study in the 25-890 MC range. Comments on this, FCC's most important assignment in 1958, came from the entire communications field. Most of the Commission's major spectrum allocation problems of recent years were virtually wrapped up in a single package containing the views from all segments of the radio industry. The comments with one copy from each of the organizations filing their views would be about a foot thick!

**WORLD CONFERENCE USE**—The FCC study will probably resolve into limited hearings on specific facets of the frequency allocation problem, rather than extended proceedings with much repetition of testimony from previous allocation presentations. The material will be helpful in preparing the United States position for the 1959 international radio conference to be held at Geneva, Switzerland.

**UNIQUE PROPOSAL**—Most unique and interesting position on FCC spectrum study was the proposal by Electronic Industries Association's Land Mobile Communications Section. This group outlined a new "functional allocations philosophy" which would rearrange the entire radio communication frequency range between 15 KC and 30 KMC on a functional basis. EIA also proposed a new order of priority among the present users of radio frequencies.

**EIGHT CATEGORIES** — The EIA section's plan would group communication uses of the spectrum into eight functional categories listed in order of importance to the national interest. They are: national defense; public safety; travel safety (aviation, etc.); commercial (communications and industrial); education and entertainment (broadcasting-television); research and development; public correspondence; and personal convenience. Under this plan, governmental radio uses not specifically connected with national defense would come under separate categories—for example, FBI radio operations would be placed in the public safety category.

**NATURAL RESOURCE POLICY**—The EIA section stressed that its proposal was aimed at developing a framework philosophy "on which the administration and development of the use of the spectrum as a natural resource can be built." The first step should be a determination of the present allocation between 25 and 890 MC, the FCC was told. The EIA section gave an analysis of the present spectrum distribution: education and entertainment has 59.5% of the frequencies; the federal government (including national defense), 25.7%; research and development, 5.2%; travel safety (including aviation), 4.4%; commercial, 2.3%; public safety, 1.7%; personal convenience, 0.7%; and non-communications functions a "negligible" percentage.

**TECHNICAL CONSIDERATIONS**—EIA urged FCC to consider the technical aspects of the spectrum division among these eight functional categories. The EIA proposal pointed out that radio provides the only practical means of communications to a mobile unit, and this should be given proper weight in the technical consideration. The physical nature of propagation at various frequencies and its effect on the service to be performed will have to be considered. Thought must also be given to the basic distinction in the use of the spectrum between omnidirectional and point-to-point services with recognition of range limits for omnidirectional services and flexibility of point-to-point radio including multiple relaying.

**IMPLEMENTATION AND FUTURE** — Allocations will have to be determined, the EIA stressed, so all users have incentive to increase their individual efficiencies in the use of the spectrum. The FCC must carefully consider the immediate and long range economic impact on both present users and possible future users. The allocation plan must be examined in terms of what might happen 10 years, 20 years, or even 50 years from now, since well oriented and directed plans based on sound fundamental principles "should be virtually timeless." The EIA concluded in its recommendation to the FCC that "a dynamic allocation and assignment policy is necessary."

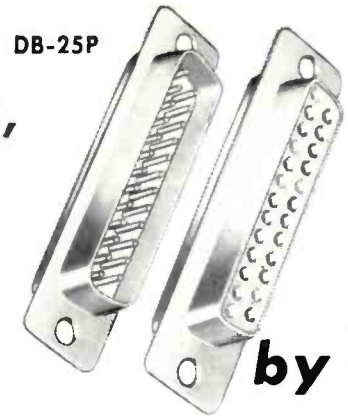
**BROADBAND ALLOCATION NEED**—The American Telephone & Telegraph Co. again has stressed to the FCC that the need for a "broadband" frequency allocation for common carrier mobile radio service "is more urgent now than ever"—and is the best approach for the establishment of low-cost, adequate mobile radio service. The Bell System wants a broadband multichannel system of at least 200 channels in the 60-500 megacycle band. Motorola opposed the Bell System proposal, urging the position of independent manufacturers and mobile radio users that private systems provide a greater frequency utilization than broadband systems, in terms of number of users.

*National Press Building*
*Washington 4*

*ROLAND C. DAVIES*
*Washington Editor*

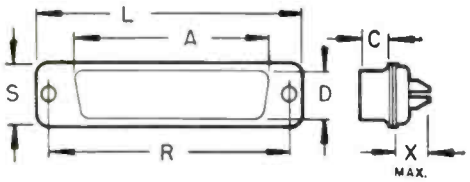
# ☆ CANNON D SUB-MINIATURE, DPA and DPX SERIES

# CONNECTORS




## by CINCH

### D SUB-MINIATURES:
Standard Pin and Socket Inserts.




| size | A | C | D | L | R | S | X | weight |
|---|---|---|---|---|---|---|---|---|
| DA-15P | 1 1/64 | 15/64 | 23/64 | 1 17/32 | 1.312 | 31/64 | 5/16 | .013 |
| DA-15S | 1 3/32 | 15/64 | 5/16 | 1 17/32 | 1.312 | 31/64 | 5/16 | .014 |
| DB-25P | 1 9/16 | 15/64 | 23/64 | 2 3/64 | 1.852 | 31/64 | 5/16 | .023 |
| DB-25S | 1 33/64 | 15/64 | 5/16 | 2 3/64 | 1.852 | 31/64 | 5/16 | .031 |
| DC-37P | 2 13/64 | 15/64 | 23/64 | 2 23/32 | 2.500 | 31/64 | 5/16 | .035 |
| DC-37S | 2 11/64 | 15/64 | 5/16 | 2 23/32 | 2.500 | 31/64 | 5/16 | .035 |
| DD-50P | 2 7/64 | 15/64 | 15/32 | 2 5/8 | 2.406 | 39/64 | 5/16 | .035 |
| DD-50S | 2 3/64 | 15/64 | 27/64 | 2 5/8 | 2.406 | 39/64 | 5/16 | .040 |
| DE-9P | 45/64 | 15/64 | 23/64 | 1 13/64 | .984 | 31/64 | 5/16 | .011 |
| DE-9S | 41/64 | 15/64 | 5/16 | 1 13/64 | .984 | 31/64 | 5/16 | .012 |

FRACTIONS ±1/64 Tolerance  DECIMALS ±0.005 Tolerance

More than thirty years experience in the design and manufacture of standard electronic components insure Cannon Connectors by CINCH to be of the highest quality materials, fabricated to specifications to maintain consistent quality of product; highest standards throughout all operations.

### D SUB-MINIATURE SPECIFICATIONS:

Shell, including flange — steel or brass; Finish — Cadmium plate or Irridite. Contacts — No. 20, 5 ampere rating — Copper base alloy, gold plate finish.

Insert arrangements — 5 plus coaxials in 9, 15, 25, 37 and 50 contacts.

Insulation material — Zytel 101 or DIALL.

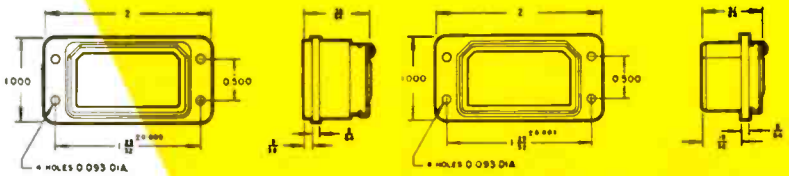
Polarization — Keystone cornered shell.

Operating temperature —67° to +310°F.

DPA 32-34P

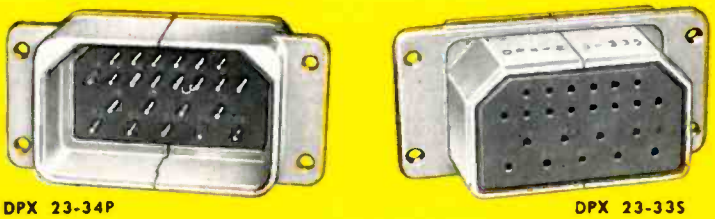
DPA 32-33S

### DPA CONNECTORS:
Shell with retaining plate. Pin and Socket Inserts.

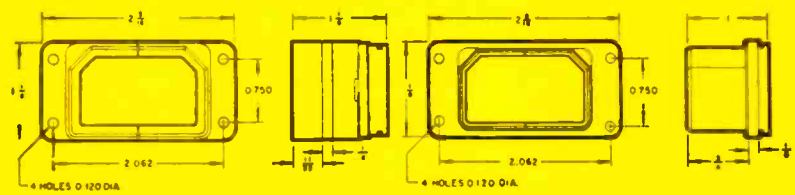



*Send for illustrated Catalog No. 157 with details of "D" Sub-Miniature, "DPA" and "DPX" Series.*

### DPX CONNECTORS:
Split shell. Pin and Socket Inserts.



DPX 23-34P  DPX 23-33S




For your connector requirements—you can depend on CINCH.

Centrally located plants at Chicago, Illinois; Shelbyville, Indiana; LaPuente, California; St. Louis, Missouri.

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**CINCH MANUFACTURING CORPORATION**
1026 South Homan Ave., Chicago 24, Illinois
Subsidiary of United-Carr Fastener Corporation, Cambridge, Mass.
Circle 45 on Inquiry Card, page 103

# Personals

**Dr. George H. Brown** has been appointed chief engineer, Industrial Electronic Products, Radio Corporation of America.

**Dr. J. R. Madigan** is now chief engineer of the Semiconductor Division of Hoffman Electronics Corporation.

**Dr. E. M. T. Jones** has been appointed head of the microwave group in Stanford Institute's Antenna Lab. **Dr. William G. Madow** has joined the staff as senior research mathematical statistician.

**Kenneth F. Hoagland** has been named director of engineering for the tube operations section of the Allen DuMont Laboratories.

K. F. Hoagland

L. Gunter, Jr.

**Lee Gunter, Jr.** has been named chief products engineer for Shure Brothers, Inc. He has been with the company more than twelve years.

**Paul W. Felten**, formerly division manager of engineering planning, has been named division chief engineer in Sylvania Electric Products Chemical and Metallurgical Div.

**Robert V. Airhart** has been appointed a field engineering supervisor in the San Francisco District of the ElectroData Div. of Burroughs Corp.

**James H. Peterman** is now a staff engineer in the sales department of Clevite Transistor Products.

**Frank Hadrick** has joined the Simpson Electric Company as chief engineer, test equipment.

**Eugene F. Grant** has been promoted to vice-president, engineering, for the National Company, Inc.

**Harold G. Towlson** is now manager of engineering for the General Electric Company's Technical Products Dept.

**Stuart R. Hennies** has been appointed manager of applications engineering for Granger Associates, Palo Alto, Calif.


Circle 46 on Inquiry Card, page 103

# DELCO'S FAMILY OF HIGH POWER TRANSISTORS


## Typical Characteristics at 25°C

| | DT100 | **2N174A | 2N174 | 2N173 | 2N443 | 2N278 | 2N442 | 2N277 | 2N441 |
|---|---|---|---|---|---|---|---|---|---|
| Maximum Collector Current | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 amps |
| Maximum Collector Voltage (Emitter Open) | 100 | 80 | 80 | 60 | 60 | 50 | 50 | 40 | 40 volts |
| Saturation Voltage (13 amp.) | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 volts |
| Max. Square Wave Power Output at 400 ~ P-P* | 400 | 310 | 310 | 225 | 225 | 180 | 180 | 135 | 135 watts |
| Max. Sine Wave Power Output at 400 ~ P-P* | 180 | 140 | 140 | 100 | 100 | 80 | 80 | 60 | 60 watts |
| Power Dissipation (Stud Temperature 25°C) | 70 | 70 | 70 | 70 | 55 | 55 | 55 | 55 | 55 watts |
| Thermal Gradient from Junction to Mounting Base | 1.0° | 1.0° | 1.0° | 1.0° | 1.2° | 1.2° | 1.2° | 1.2° | 1.2° °C/watt |
| Nominal Base Current $I_B$ ($V_{EC}$ = —2 volts, $I_C$ = —1.2 amp.) | -19 | -19 | -19 | -13 | -24 | -13 | -24 | -13 | -27 ma |

*Adequate Heat Sink

**Designed to meet MIL-T-19500/13 (USAF) 18 JUNE 1957

*Offer a wide range of performance characteristics to meet your switching, regulation or power supply requirements*

These nine Delco Radio alloy junction germanium PNP power transistors are now in volume production. They are characterized by high output power, high gain, and low distortion. And all are normalized to retain superior performance characteristics regardless of age.

Check the data chart above—see how they fit your particular requirements in current switching, regulation or power supply. Write for detailed information and engineering data. Delco Radio maintains offices in Newark, N. J. and Santa Monica, Calif. for your convenience.

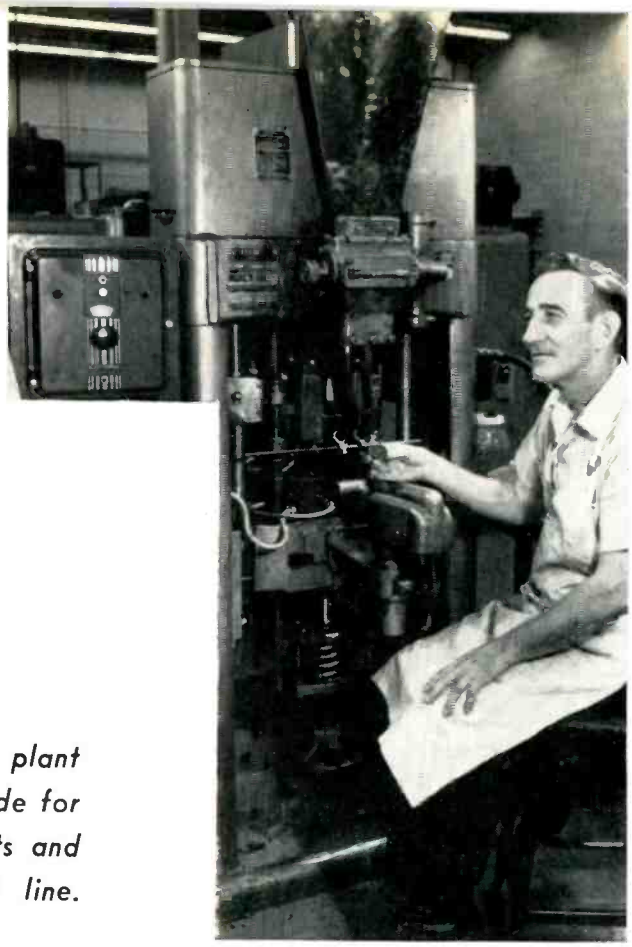
## DELCO RADIO

**Division of General Motors**
**Kokomo, Indiana**



Circle 47 on Inquiry Card, page 103

← A parade of a few of the 200 parts made by compression or injection molding, casting, and encapsulation at L & N.



→ Operator prepares to check controller after examining keyed vibrator base formed by Stokes Automatic Compression Molder, Model 200 ($4,000).

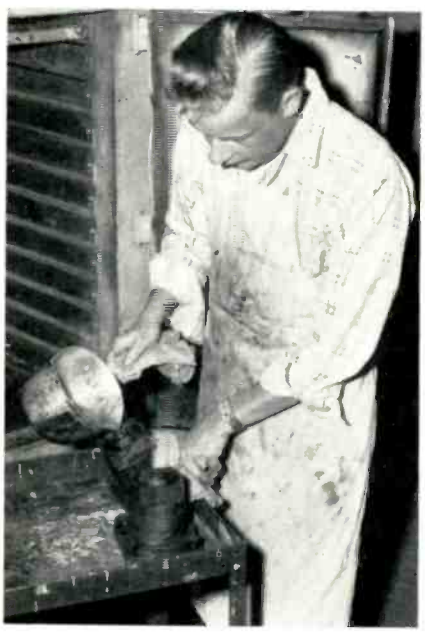
## Setting-Up

# A Plastics Section

*When Leeds & Northrup Co. built its modern plant at North Wales, Pa., 3000 sq. ft. were set aside for a Plastics Section to manufacture components and small engineering models for their product line.*

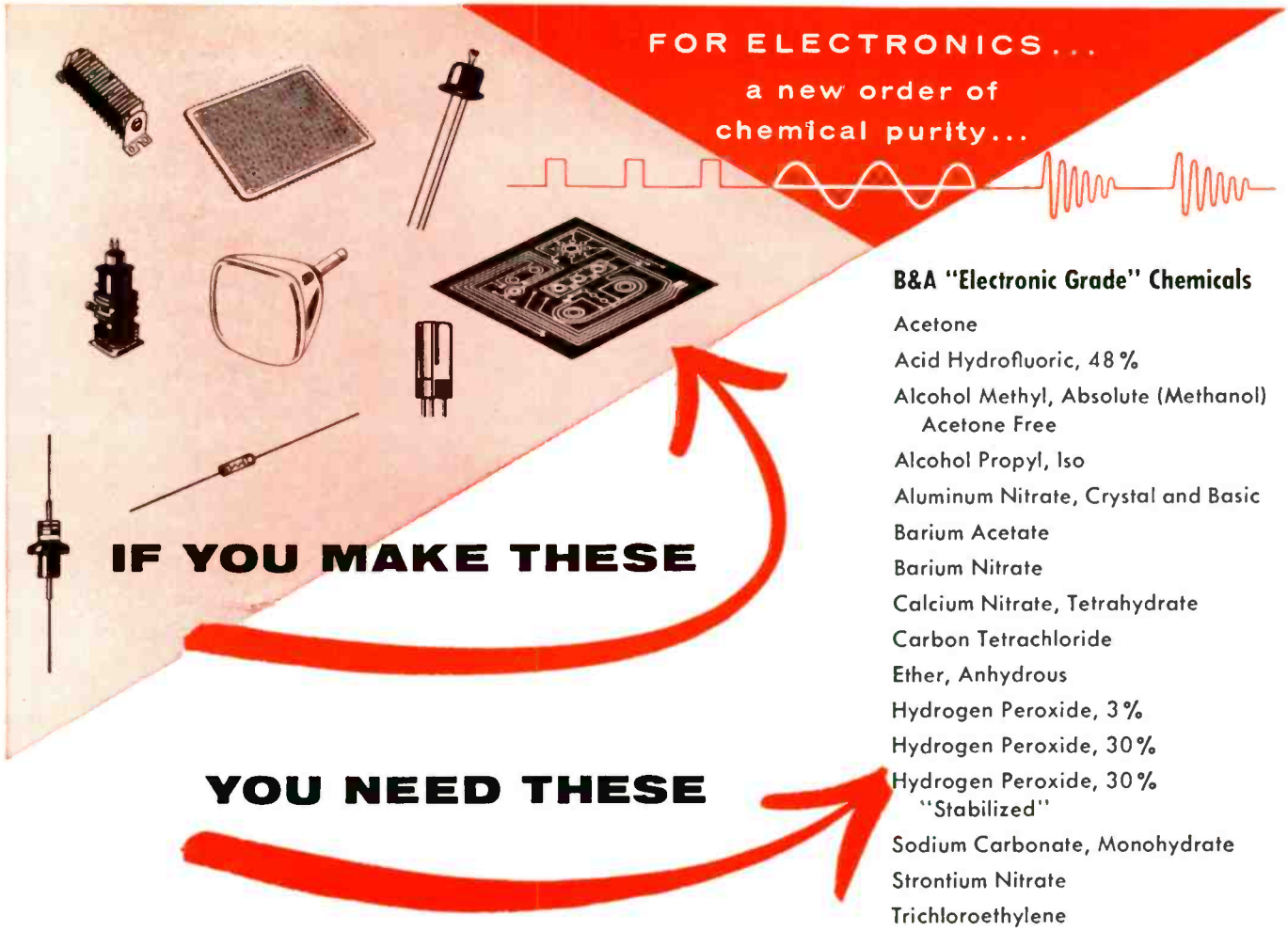
↑ EI's R. Stranix, right, discusses operation of Plastics Section with L&N engineers W. Thomas, left, and B. Langsdorf.

↑ A nylon camshaft, used in L&N recorders, has just been completed in a Van Dorn Injection Molder, 2 oz. Model ($4,800).



← Possibly the only epoxy casting in the Phila. Metropolitan area, a ph flow assembly component is being poured. It will then be baked in the large Dispatch Oven, Model Y-29-2 ($650), in rear.

→ Quality control and short runs are the main reasons for an electronics manufacturer having a plastics section. Tolerance of 0.001 in. can be held; 0.003 in. is usual requirement.




**B&A "Electronic Grade" Chemicals**

Acetone
Acid Hydrofluoric, 48%
Alcohol Methyl, Absolute (Methanol) Acetone Free
Alcohol Propyl, Iso
Aluminum Nitrate, Crystal and Basic
Barium Acetate
Barium Nitrate
Calcium Nitrate, Tetrahydrate
Carbon Tetrachloride
Ether, Anhydrous
Hydrogen Peroxide, 3%
Hydrogen Peroxide, 30%
Hydrogen Peroxide, 30% "Stabilized"
Sodium Carbonate, Monohydrate
Strontium Nitrate
Trichloroethylene

## "ELECTRONIC GRADE" CHEMICALS offer carefully controlled assay . . . remarkably low limits on impurities

B&A "Electronic Grade" chemicals are a special group of extremely high purity chemicals developed to meet the exacting requirements of the electronics industry. All the products listed above are "Electronic Grade." They are distinguished by closely controlled assay, and exceptionally low limits on metallic and other undesirable impurities.

Other high purity chemicals you may need are available from Baker & Adamson in Reagent A.C.S. grades, or can be custom-made to your requirements. As the country's leading producer of laboratory and scientific chemicals, we are well equipped to offer expert assistance with your problems . . . and products that meet your most stringent requirements.

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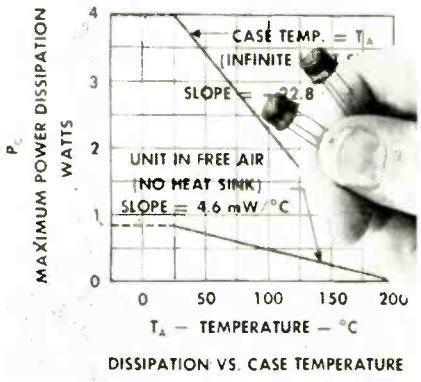
# New Products . . . for the Electronic Industries

## SILICON TRANSISTORS

Two new transistors are rated 4 watt at 25°C and 1 watt at 150° C case temperature dissipation ratings. Both n-p-n transistors feature a typical saturation resistance of 20



DISSIPATION VS. CASE TEMPERATURE

ohms at 25°C plus an operating range of −65° C to +200°C. Both are encased in short, round welded packages. The 2N497 is a 60 v. transistor for use with 28 v. power supplies in military aircraft. The 2N498 is a 100 v. device for use in higher voltage applications. Texas Instruments Incorporated, P. O. Box 312, Dallas, Texas.

Circle 195 on Inquiry Card, page 103

## GERMANIUM TRANSISTOR

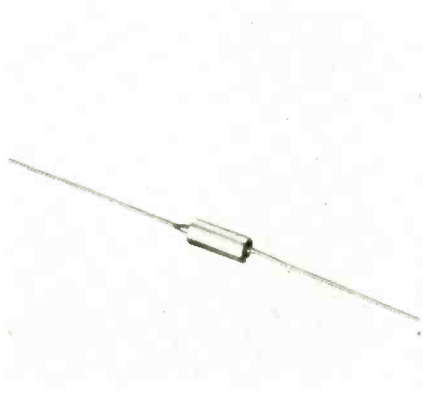
Type 2NR62 transistor is available in production quantities. The outstanding feature is its bilateral (sometimes known as symmetrical) characteristics. Applications include


complementing circuits, bi-directional switches, bi-directional amplifiers, and phase detectors. It has good high voltage, current, and gain ratings. Maximum collector (or emitter) voltage is 40v; maximum collector current is 200 ma. DC current amplification factor ($h_{FE}$) is typically 45, in either direction. Philco Corporation, Philadelphia, Pa.

Circle 197 on Inquiry Card, page 103

## TANTALUM CAPACITORS

A complete line of solid electrolyte tantalum capacitors known as "Tan-Sol" type TAS are available. The electrolyte is a solid semi-conducting material that is not subject to cor-

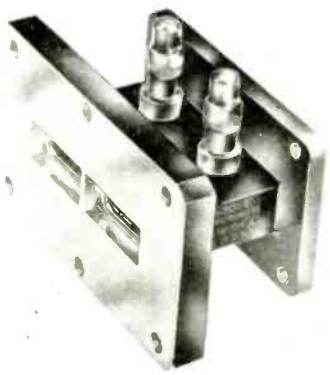


rosion. Capacitors have good stable capacity and dissipation factor over the range from −80° to +85°C. Shelf life is indefinite. They have axial lead construction, with hermetic glass-to-metal end seals. Leads are approximately 1½ in. long—of .020 in. wire, nickel-tinned. Available in standard EIA capacities. P. R. Mallory & Co., Inc., Indianapolis, Ind.

Circle 199 on Inquiry Card, page 103

## DUPLEXER TUBE

A 500 kw. dual TR tube intended for use with short-slot hybrid couplers has been introduced. The new duplexer tube was developed for improved duplexer reliability and longer operating life at high incident peak and average powers in X-band pulsed radars. Special design features have

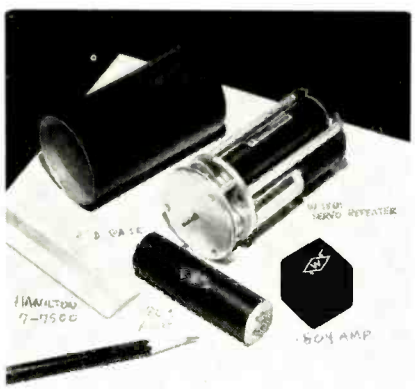


been incorporated to sharply reduce arc loss. Input and output flanges mate with hybrid couplers in RG-51/U and RG-52/U waveguides respectively. Microwave Associates, Inc., Burlington, Mass.

Circle 196 on Inquiry Card, page 103

## SERVO REPEATER SYSTEM

The Model W1801 servo repeater system includes a transistorized servo amplifier, motor, synchro, power supply and gear train, all in a housing 2 in. in dia. x 4 in. long. Power requirements are 10 w., 400 cps, at either 115 v or 26 v. Weight is 12 oz. This is the first of a new line of pack-

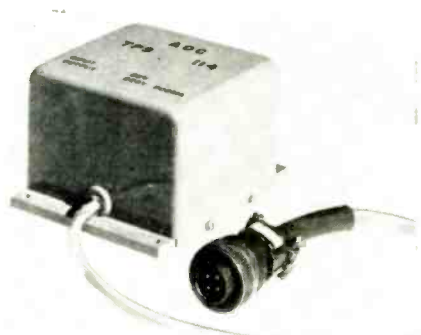


aged servo systems, which will include integrators, differentiators, coordinate converters and vector solvers. They are designed to meet MIL specs. Waldorf Instruments Co., Wolf Hill Rd., Huntington Station, N. Y.

Circle 198 on Inquiry Card, page 103

## POWER SUPPLY

A transistor power supply designed for use on vehicles subject to high shock and vibration environments has been developed. Designated TPS-5, the transistor operates in ambient temperatures from −40° F. to +70° C., and converts 28 vdc at 3 amps to 225 vdc at 300 ma. for operating mo-



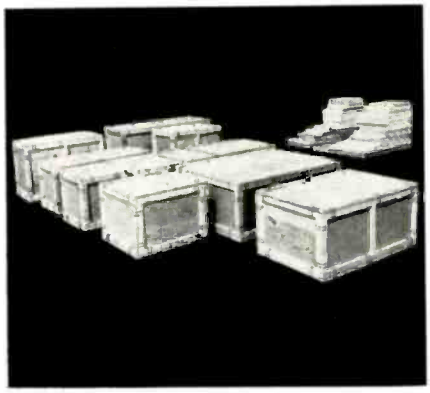
bile electronic systems or devices. Package dimensions are 2½ x 3½ x 4½ in. including mounting flanges. The unit weighs 1.5 lbs. Aerophysics Development Corp., P. O. Box 689, Santa Barbara, Calif.

Circle 200 on Inquiry Card, page 103

# New Products . . . for the Electronic Industries

## CRATE FASTENERS

The new fastening system uses fixed-size, interchangeable panels made from cleated plywood, paper overlaid veneer or fiberboard. A maximum number of box sizes are

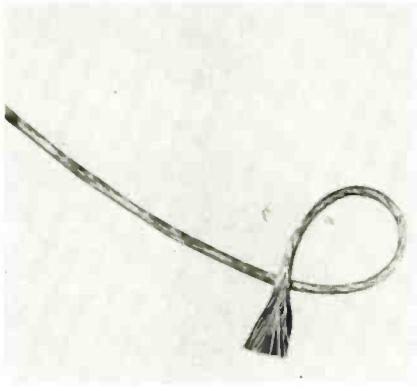


engineered from minimum panel inventory. Labor savings and re-use or value recovery of panels are gained. Each panel can be re-used in several combinations of box sizes and shapes. A box closed with Klimp fasteners can be completely disassembled and its panels stacked for re-use in less time than it takes to remove the lid from a nailed box. Navan Products, Inc., 1318 2nd St., Santa Monica, Calif.

Circle 201 on Inquiry Card, page 103

## ZIPPER TUBING

A new harnessing and cabling technique reduces to just the slide of a zipper, the time and labor needed to group, mark, protect and harness cable. Constructed of polyvinylchlor-

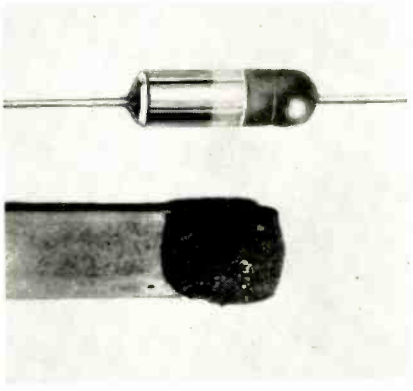


ide plastic, it is strong, flexible, durable and low-cost. General purpose type ZIP-31 meets MIL-I-631C specs. Type ZIP-44 (A. F. approved) meets MIL-I-7444A (Amend. 1) specs. Standard wall thickness is .020" ± .001". Tubing can be sealed permanently with a liquid sealer. Available in 10 to 100 ft. lengths in clear or black. Sizes from ½ in. to 4 in. I.D. Alpha Wire Corp., 200 Varick St., New York 14, N. Y.

Circle 203 on Inquiry Card, page 103

## TANTALUM CAPACITORS

Primarily designed for low voltage dc applications such as transistorized audio amplifiers, Type WT wire tantalum capacitors feature small size and operating temperature range of



−20° C to +50° C with adequate storage life. Of polar construction, the capacitor case and attached lead form the cathode terminal. Available in insulated and non-insulated construction. The anode tantalum wire extends through the teflon bushing to which a solderable lead is attached. It is encapsulated in a thermosetting resin. Aerovox Corp., New Bedford, Mass.

Circle 205 on Inquiry Card, page 103

## TELEMETERING OSCILLATOR

Voltage controlled telemetering oscillator, the "Little Jewel," features only one-hundredth the power requirements of the smallest VCO formerly available, yet has improved stability and linearity. Employing subminiature tubes and printed circuitry; nine plug-in oscillators, and operational mixer, and a self contained power supply are all packaged in a unit less

than 0.09 cu. ft. Power requirement per oscillator is 30 milliwatts and linearity is ±0.5% of F.B.W. while drift is held to less than ±3%. Dorsett Laboratories, Inc., Norman, Okla.

Circle 202 on Inquiry Card, page 103

## PRESSURE TRANSMITTER

Series 70-2000 Compu-Tran pneumatic transmitters are ½% pressure pickups for converting fluid pressure inputs to exact electrical equivalents. Output is in the form of precision resistance proportional to the input pressure. High level signals may be used without amplification in control, telemetering, or remote recording circuits. Unit has been designed for

low cost application. Available in 5 ranges, from 0-15 to 0-200 PSIG. It is 2¼ in. in dia. by 1¾ in. International Resistance Co., 401 N. Broad St., Phila. 8, Pa.

Circle 204 on Inquiry Card, page 103

## ULTRASONIC CLEANER

A new one-gallon portable ultrasonic cleaning unit is now available for industrial and laboratory use. In addition to cleaning, the unit is effective for degreasing, decontamination, removal of excess flux, mixing, and emulsifying. Unit consists of a generator that features a built-in timer, tuning knob and visual control, and produces an output of 50 w. average

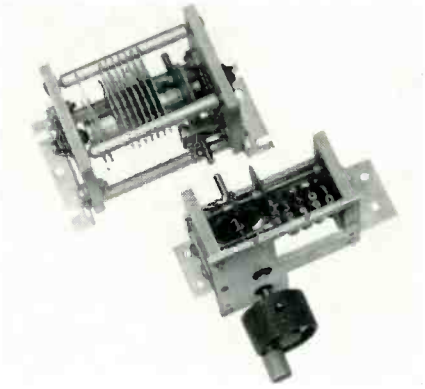
with a peak of 200 w.; and a stainless steel one-gallon tank equipped with 3 transducers capable of handling production jobs. Hermes Sonic, 13-19 University Place, New York 3, N. Y.

Circle 206 on Inquiry Card, page 103

# New Products

## PRECISION DRIVE

Linear direct reading precision drive and condenser is for use in precision direct-setting interpolation type oscillators. 2000:1 gear ratio permits precision setting of capacity

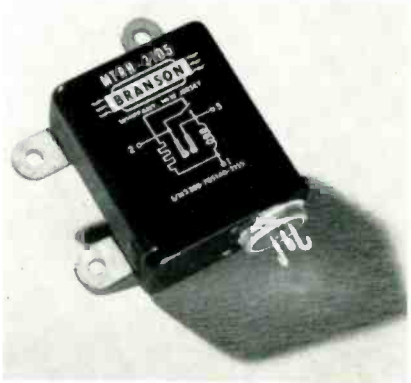


to within ±5 parts in $10^4$. Features smooth operating precision bearings for maximum resetability accuracy; silver ground brushes provide secure grounding of rotor assembly; ⅝ in. dia. rotor shaft provides good stability and accuracy. The design and materials result in a temperature stable unit. National Company, Inc., Malden 48, Mass.

Circle 207 on Inquiry Card, page 103

## TIME DELAY RELAY

Accurate, repeatable delays of multiple switching are available from 10 msecs. to 120 sec. Featuring temperature compensation and for special applications, voltage compensation and extremely high speed recovery. It provides a new basis for accurate switching in the small volume, low weight category. A completely hermetically sealed unit the Type MTRH




meets present military relay requirements. Overall dimensions are approximately ⅞ x 1½ x 1¾ inch high weighing 3 to 4 oz. Branson Corp., P. O. Box 234, Whippany, N. J.

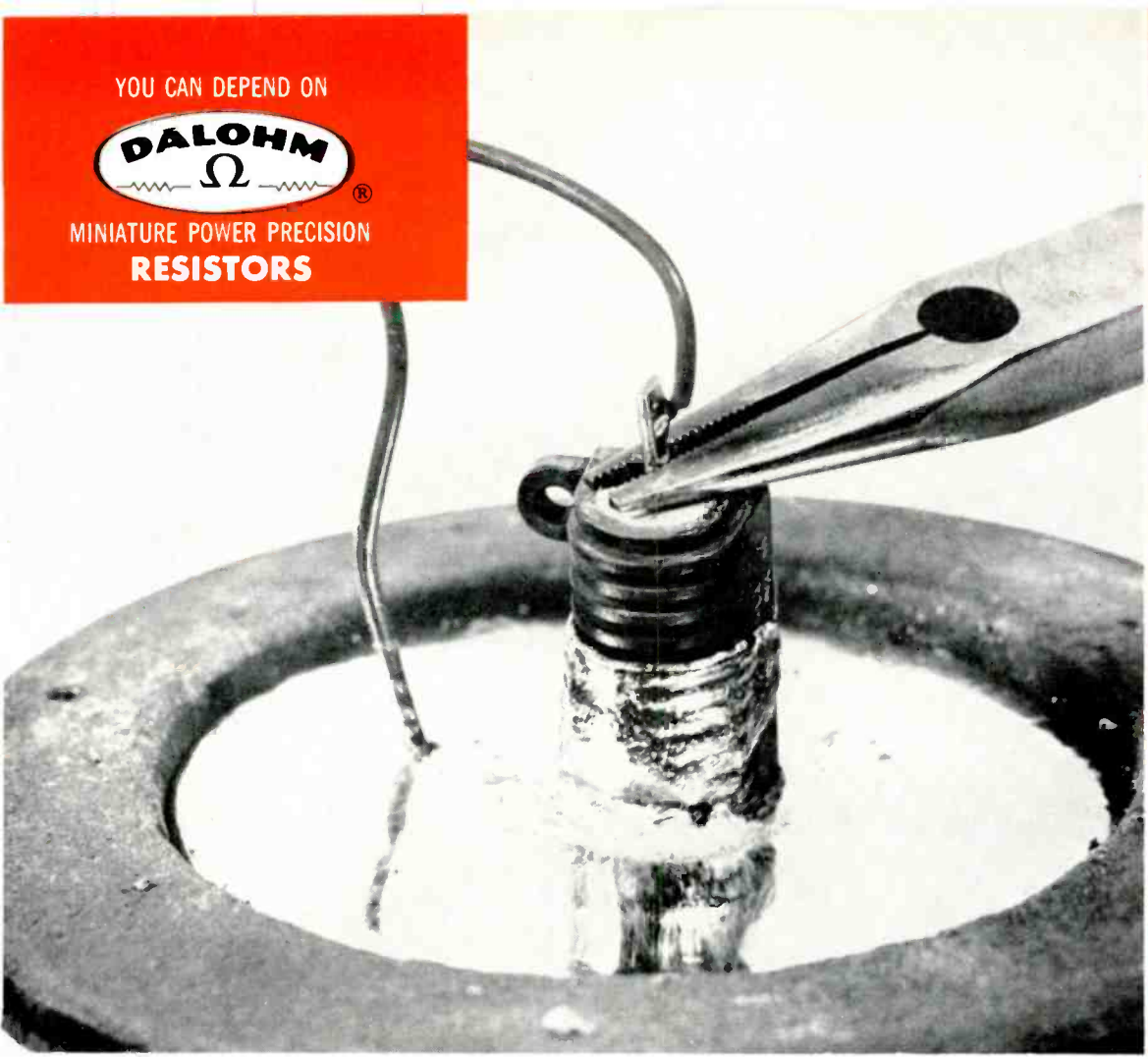
Circle 208 on Inquiry Card, page 103

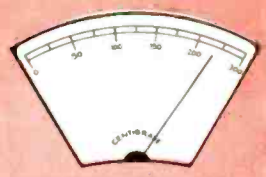
YOU CAN DEPEND ON

DALOHM Ω ®

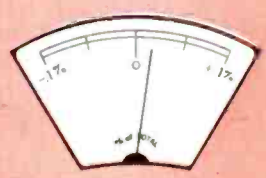
MINIATURE POWER PRECISION

**RESISTORS**

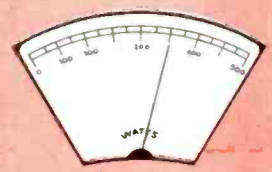




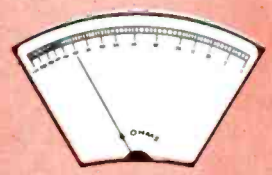
**HI-TEMPERATURE**
– 65° C to + 275° C



**HI-PRECISION**
± 0.05% to ± 3%



**HI-WATTAGE**
10 to 250 WATTS



**HI-RESISTANCE**
0.1 Ohm to 100K Ohms

# Dipped in MOLTEN SOLDER . . . yet retains 100% reliability!

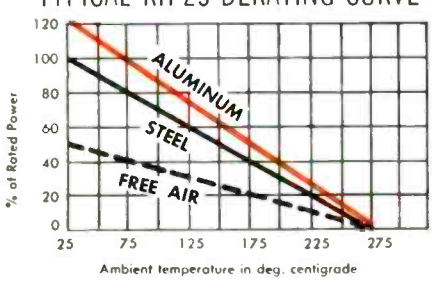
Most requirements for DALOHM RH and PH wire wound resistors will not be as severe as the molten solder dip shown above. But, here are the tough parameters RH and PH types will meet.

- Operating temperature range: – 65° C. to 275° C.
- Precision tolerance range: ± 0.05%, ± 0.1%, ± 0.25%, ± 0.5%, ± 1% and ± 3%.
- Powered at 10, 25, 50, 100 and 250 watts.
- Resistance range from 0.1 Ω to 100,000 Ω.
- Surpasses requirements of MIL-R-18546B
- Temperature coefficient: 0.00002/degree C.
- Complete protection from vibration, moisture and salt spray.
- Insulation breakdown: 1000 V AC or DC.

**RH-10**

10 watts, derating to 0 at 275° C.; 5 Ω to 30K Ω; ± 0.05% to ± 3%. Max. Working voltage: 500 volts.

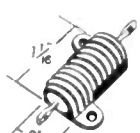
TYPICAL RH-25 DERATING CURVE




DALOHM RH and PH resistors are advanced design wire wound precision power resistors for applications under severe operating conditions, coupled with tight space requirements. These miniature powerhouse resistors offer complete protection from mechanical shock, vibration, moisture and salt spray.

DALOHM four point "ruggedized" construction provides 100% reliability with: 1. Precision wire wound resistor element. 2. All welded construction from terminal to terminal. 3. Suspension in special shock absorbing compound. 4. Insertion and sealing in radiator finned, anodized aluminum housing for maximum heat dissipation on panel mounting.

Careful advanced production techniques, backed by years of experience, and total progressive inspection assure reliability in all DALOHM resistors.



**RH-25**

25 watts, derating to 0 at 265° C.; 1 Ω to 15K Ω; ± 0.05% to ± 3%. Max. Working Voltage: 800

**RH-50**

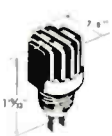
50 watts, derating to 0 at 265° C.; 3 Ω to 100K Ω; ± 0.05% to ± 3%. Max. working voltage: 1000 V DC or AC

**RH-250**

250 watts, derating to 0 at 265° C.; 3 Ω to 35K Ω; ± 0.05% to ± 3%. Max. working voltage: 1000 V DC or AC

**PH TYPE**

New hole mounted power resistor in shock absorbing compound and in black anodized aluminum radiator finned housing.



**PH-25**

25 watts, derating to 0 at 265° C.; 1 Ω to 60K Ω; ± 0.05% to ± 3%. Max. working voltage 800 V DC or AC

**PH-100**

100 watts, derating to 0 at 275° C.; 5 Ω to 35K Ω; ± 0.05% to ± 3%. Max. working voltage: 1000 V DC or AC.

## JUST ASK US

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

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

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

Circle 52 on Inquiry Card, page 103

# New Products

## MATCHED TRANSISTORS

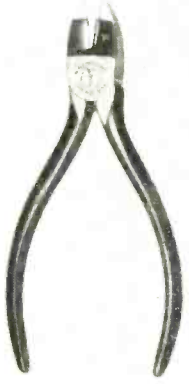
Two new high-efficiency power transistors which are supplied in matched pairs for low distortion in audio and servo push-pull power amplifier applications are now avail-


able. The 2N399 and the 2N401 can readily dissipate up to 25 w. Typical Class B undistorted output power for both types is 8 w. The 2N399 is a high gain transistor and the 2N401 is a medium gain power output transistor. Both feature welded construction with a vacuum-tight seal. Red Bank Div., Bendix Aviation Corp., 201 Westwood Ave., Long Branch, N. J.

Circle 209 on Inquiry Card, page 103

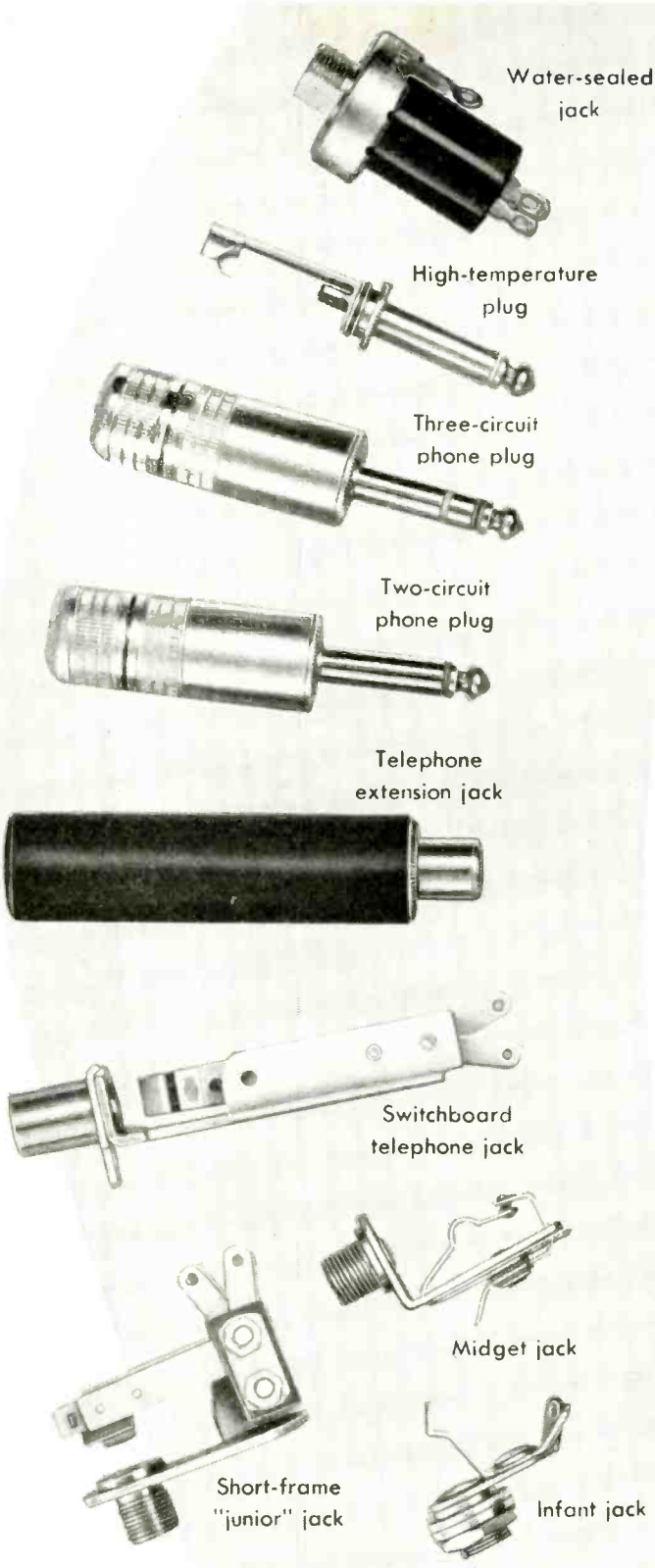
## WIRE CUTTER

A new shear cutting oblique plier No. 207-5C is available. The plier is 5½ inches long and the shear cutting blade will cut dead soft or extremely hard wire quite readily. Blades may be replaced; hence, the plier never needs sharpening, merely replace the blades. Regular cutting knives in the



nose add to the usefulness and a coil spring keeps the jaws apart ready for instant use. Mathias Klein & Sons, 7200 McCormick Road, Chicago 45, Illinois.

Circle 210 on Inquiry Card, page 103




# *For jacks and plugs—* make it MALLORY!

Whenever you need a jack and plug for use in telephone, radio, communications, hi-fi sets, laboratory equipment . . . either commercial or military . . . it pays to look through the variety of standard Mallory designs. All are built for quality . . . engineered by Mallory specialists with long experience in designing special components, and manufactured to highest standards of precision by Mallory methods that assure absolute dependability.

Some typical Mallory jacks and plugs are shown here. If you don't see the exact type you need for your product, we may have a standard model that will match your requirements. Or if you need something special, our staff is well qualified to design the model you need . . . and produce it economically to specifications. Write or call for a consultation.

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**Electromechanical** — Resistors • Switches • Tuning Devices • Vibrators
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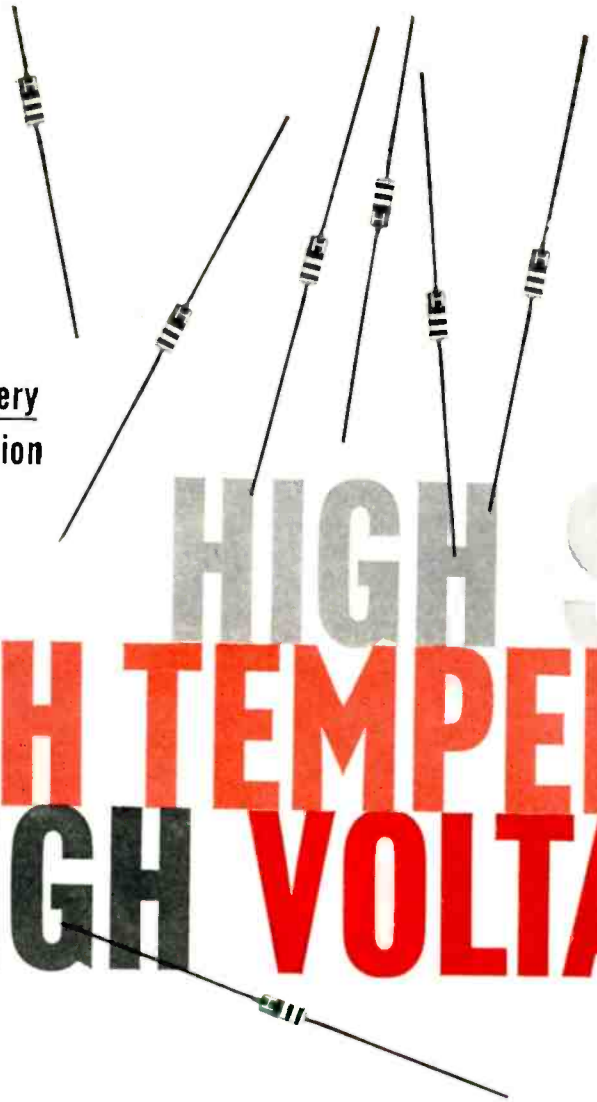
Circle 54 on Inquiry Card, page 103



Hughes
Quick Recovery
Silicon Junction
Diodes

# HIGH SPEED
# HIGH TEMPERATURE
# HIGH VOLTAGE

Now, in circuits where germanium once provided the only possibility, you can use quick recovery silicon diodes from Hughes. Speeds are fast enough for most high frequency or fast switching applications. And every diode is well able to stand up under high voltages at high temperatures. In fact, the breakdown voltage *increases* with temperature, thereby providing maximum protection when temperatures reach unexpected levels. This is real ruggedness, the kind that ensures reliability under the most severe operating conditions.

**NEW HIGHER CONDUCTANCE TYPES** — Here's a new group of related diodes, each with excellent voltage and temperature characteristics plus the added advantage of higher forward current.

*Special high conductance types are available in *all* voltage classes covered by the standard line.

**SPECIFICATIONS** *

| Type Numbers | WIV (min.) | Forward Current @ 1.5V (min.) | Reverse Current at Specified Voltage @ 25°C (max.) | @ 100°C (max.) | Recovery (mod. IBM "Y" test circuit) |
|---|---|---|---|---|---|
| 1N625 | 30V | 4mA | 1 $\mu$A @ −10V<br>10 $\mu$A @ −20V | 50 $\mu$A @ −20V | 15 K$\Omega$ (min.) in 0.15 $\mu$sec |
| 1N626 | 50V | 4mA | 20 $\mu$A @ −35V | 100 $\mu$A @ −35V | 400 K$\Omega$ (min.) in 1 $\mu$sec |
| 1N627 | 100V | 4mA | 20 $\mu$A @ −75V | 100 $\mu$A @ −75V | 400 K$\Omega$ (min) in 1 $\mu$sec |
| 1N628 | 150V | 4mA | 20 $\mu$A @ −125V | 100 $\mu$A @ −125V | 400 K$\Omega$ (min.) in 1 $\mu$sec |
| 1N629 | 200V | 4mA | 20 $\mu$A @ −175V | 100 $\mu$A @ −175V | 400 K$\Omega$ (min.) in 1 $\mu$sec |
| HD6573 | 150V | 6mA | 20 $\mu$A @ −125V | 100 $\mu$A @ −125V | 400 K$\Omega$ (min.) in 1 $\mu$sec |
| HD6635 | 50V | 15mA | 20 $\mu$A @ −35V | 100 $\mu$A @ −35V | 400 K$\Omega$ (min.) in 1 $\mu$sec |
| HD6641 | 150V | 15mA | 20 $\mu$A @ −125V | 100 $\mu$A @ −125V | 400 K$\Omega$ (min.) in 1 $\mu$sec |
| HD6642 | 50V | 6mA | 20 $\mu$A @ −35V | 100 $\mu$A @ −35V | 400 K$\Omega$ (min.) in 1 $\mu$sec |

Ambient Operating Temperature Range: −80°C to +150°C

*Perhaps you would like to discuss your particular requirements with us. If so, please write:*

**SEMICONDUCTOR DIVISION • HUGHES Aircraft Company**
*International Airport Station, Los Angeles 45, California*

*Creating a new world with ELECTRONICS*

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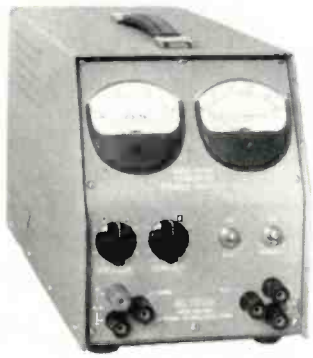
**HUGHES PRODUCTS**

# New Products

## POWER SUPPLIES

Portable power series offers a general purpose instrument for laboratory, field or industrial use combining features of ruggedness, compactness and portability. Special features are:

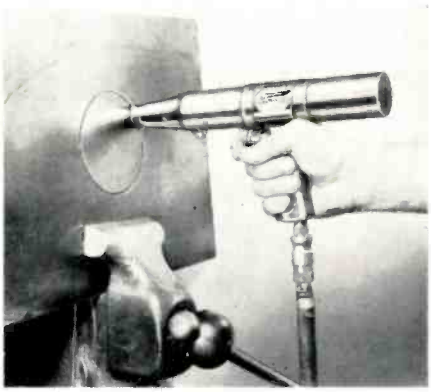


continuously variable output; high voltage vernier adjustment; regulated output; rated for full load over entire voltage range and easy to read. 2½ in. meters. Input is 105-125 vac; dc output is Model PR-100 for 120-300v 0-100 Ma., Model PR-200 for 120-300v 0-200 Ma. Nutron Mfg. Co., Inc., 67 Monroe Ave., Staten Island 1, N. Y.

Circle 211 on Inquiry Card, page 103

## POWER SAW

Testing under on-the-job conditions, a portable pneumatic power saw and file has been developed which quickly and easily does good key hole, deadend and scroll cutting when plastic materials are involved. Tests were made on hard thermo setting and thermo plastics as well as on rigid "Vinylite." cellulose acetate, polystyrene, fiberglass reinforced plastics, and "Plexiglas." Operating speed and cutting stroke of the saw are easily adjusted. Only two moving parts means long saw life. Air-Speed Tool Co., 1502 W. Slauson Ave., Los Angeles, Calif.

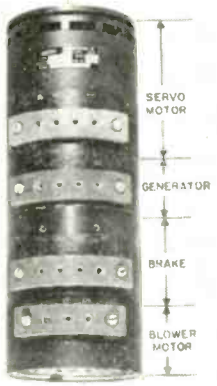


Circle 212 on Inquiry Card, page 103

# New Products

## SERVO COMBINATION

Type 23-MTG-6327-01 is a versatile single unit combining a size 23 1/15th hp at 6000 RPM servo motor; a damping tach generator with an output of 1.5 v per 1000 rpm nominal and null

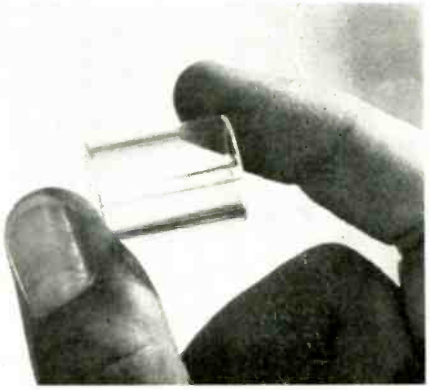



voltage of 0.150, and linearity of ± 2% up to 6000 RPM; 28 vdc brake; and a blower capable of cooling the entire unit. The unit is available in any desired combination of its components. Designed for driving antennas and other self-cooled drive motor applications. Overall dimensions are 8.100 long max. x 2.88 ± .010 in. diameter. John Oster Mfg. Co., 1 Main St., Racine, Wis.

Circle 221 on Inquiry Card, page 103

## SILICA GLASS TUBING

Precision bore 96% silica glass tubing with inside diameter tolerances up to ±.0005 in. is available. Vycor brand tubing can be manufactured with precision bores in diameters ranging from ⅛ to 3 in. Special slots or indentations on the inside can also be made with precision tolerances. Low thermal expansion, good dielectric characteristics and chemical



stability give it good properties for high standard electronic equipment. Currently being used as the coil form in a long-life transformer. Corning Glass Works, Corning, N. Y.

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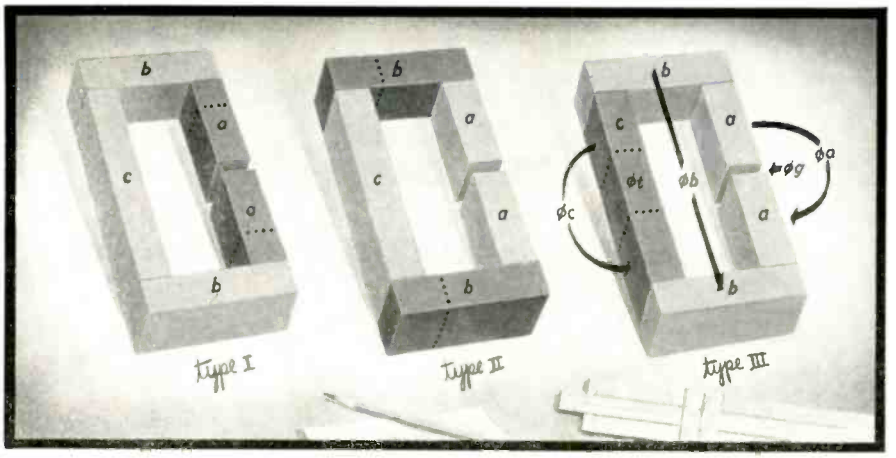


# How You Can Save Time Estimating Leakage Factors for Magnetic Circuits

Computing even approximate values for leakage flux in magnetic circuits is a time consuming job. The research department of Indiana Steel recently undertook a series of studies, supported by the U.S. Air Force, to simplify these computations. Dr. R. K. Tenzer reported the results of this work, which reduce the time in computing leakage flux up to 90% by diminishing the number of mathematical operations necessary.

The investigations were done on circuits with permanent magnets; the results were also found applicable to unsaturated electromagnetic circuits when the coil-covered parts were treated as permanent magnet parts.

After checking values obtained by this method with actual measured values for many Type I, II, and III magnetic circuits, deviations were found to be less than ± 10%.

### Leakage Flux, Leakage Factor

Because of magnetic leakage, only a part of the total flux through the neutral zone of the permanent magnet is found in the air gap. The difference between these two values is known as leakage flux. Mathematically this is:

$$\phi_L = \phi_t - \phi_g. \tag{1}$$

In practical design, leakage is best considered as a factor stated thus:

$$\sigma = \frac{\phi_t}{\phi_g} = 1 + \frac{\phi_L}{\phi_g}. \tag{2}$$

For simplification, the flux can be assumed to follow three basic, probable paths: $\phi_a$ between parts $a$, $\phi_b$ between parts $b$, and $\phi_c$ along part $c$. The equation above then becomes:

$$\sigma = 1 + \frac{\phi_a + \phi_b + \phi_c}{\phi_g}. \tag{3}$$

With $\phi = mmf \times P$, this formula can be written:

$$\sigma = 1 + \frac{1}{P_g}\left(\frac{mmf_a}{mmf_g}P_a + \frac{mmf_b}{mmf_g}P_b + \frac{mmf_c}{mmf_g}P_c\right). \tag{4}$$

Letting the *mmf* ratios be denoted by $K$,

$$\sigma = 1 + \frac{1}{P_g}\left(K_aP_a + K_bP_b + K_cP_c\right). \tag{5}$$

This becomes the basic equation for numerical calculations of leakage factors after introducing simple expressions for leakage permeances and mmf ratios.

### Simplified Leakage Permeances

The following formulas have been found satisfactory for leakage permeances between soft steel parts:

$$P_a = 1.7 \times U_a \times \frac{a}{a + L_g} \text{ where } U \text{ is} \tag{6}$$

cross-section perimeter;

$$P_b = 1.4 \times b \times \sqrt{\frac{U_b}{c} + .25} \tag{7}$$

where $U_b/c$ is greater than .25 and less than 4. The total length of part $b$ is used.

Since permanent magnets have a neutral zone which does not contribute to leakage, the value of 2/3 of the magnet's total length is used when computing leakage permeances—this is the effective length $a'$ and $b'$ to compute $P'$; thus the two equations above become:

$$P'_a = 1.7\ U_a \frac{.67a}{.67a + L_g} \tag{6a}$$

and

$$P'_b = 1.4 \times .67b\sqrt{\frac{U_b}{c} + .25} = .67\ P_b. \tag{7a}$$

When part $c$ consists of a permanent magnet (Type III) its permeance can be calculated as:

$$P_c = .5\ U_c. \tag{8}$$

The permeance of the air gap itself is

$$P_g = A_g/L_g. \tag{9}$$

### Simplified MMF Ratios

Simplifying the *mmf* ratios is done by neglecting the reluctance in *soft steel parts*; so

$$mmf_a = mmf_b = mmf_g \text{ or } K_a = K_b = 1$$
$$(mmf_c = 0 \text{ so } K_c = 0). \tag{10}$$

Since the *mmf along permanent magnet parts* is not constant, integral values ($\overline{mmf}$) are used. Experiments showed that 2/3 of the $mmf_g$ was the effective *mmf* for leakage flux between permanent magnet parts; thus

$$\overline{mmf_a} = \overline{mmf_b} = \overline{mmf_c} = 2/3\ mmf_g$$

or

$$K_a = K_b = K_c = 2/3. \tag{11}$$

### Basic Formulas

By inserting the permeances for soft steel into equation (5), the general formula becomes:

$$\sigma = 1 + \frac{L_g}{A_g}\left(K_a \times 1.7\ U_a \frac{a}{a + L_g} + K_b \times 1.4\ b\sqrt{\frac{U_b}{c} + .25} + K_c \times .5\ U_c\right). \tag{12}$$

This formula contains only constants and dimensions; and by the two following rules this can be modified into the three basic equations for the Type I, Type II, and Type III circuits.

*Rules:* (1) For leakage flux paths between soft steel parts, use total lengths and constant $K$ of 1. (2) For leakage flux paths between permanent magnet parts, use 2/3 of lengths and $K$ of .67.

The following provide the leakage factors for the three types of circuits:

*Type* I:

$$\sigma = 1 + \frac{L_g}{A_g} \times .67 \times 1.7\ U_a \frac{.67a}{.67a + L_g}$$

*Type* II:

$$\sigma = 1 + \frac{L_g}{A_g}\left(1.7\ U_a \frac{a}{a + L_g} + .67 \times .67 \times 1.4b\sqrt{\frac{U_b}{c} + .25}\right)$$

*Type* III:

$$\sigma = 1 + \frac{L_g}{A_g}\left(1.7\ U_a \frac{a}{a + L_g} + 1.4b\sqrt{\frac{U_b}{c} + .25} + .67 \times .5\ U_c\right)$$

For variations on these basic formulas, write today for the April-June issue of *Applied Magnetics* which also shows examples of the formulas in use.

**NEW DESIGN MANUAL READY**

Write today for your copy of the newest edition of the Indiana Permanent Magnet Design Manual No. 6. Write to Dept. N 1.

# SPEED

## Research and Development!

**PRECISION**

# Trimmer Piston Capacitors

**for expediting experimental circuitry design**

*actual size*

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**Communication • Guidance Systems • Missiles**
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At your fingertips the JFD Trimmers you want *when* you want them—when you keep these versatile JFD Piston Capacitor Kits on hand. Complete with electrical characteristic charts and handy dust-proof styrene case. Also available—comprehensive PK260 Laboratory Assortment—260 essential JFD Piston Capacitors in compact metal cabinet. Write for engineering bulletins.


No. **PK10 KIT** Glass & Quartz Trimmers *(Panel Mount Type)*

| Cat. No. | Quantity | Cap. (mmf) |
|---|---|---|
| VC5 | 1 | 0.6-6 |
| VC11 | 1 | 0.8-10 |
| VC12 | 1 | 9-21 |
| VC1G | 1 | 0.7-9 |
| VC3G | 1 | 0.7-9 |
| VC4G | 1 | 0.8-18 |
| VC8GA | 1 | 1-8 |
| VC11G | 1 | 0.6 to 14 |
| VC13GA | 1 | 1.5-12 |
| VC30G | 1 | 0.8 to 30 |

No. **PK11 KIT** Miniature Trimmers *(Panel Mount Type)*

| Cat. No. | Quantity | Cap. (mmf) |
|---|---|---|
| VC20G | 1 | 0.8-8.5 |
| VC21G | 1 | 0.8-4.5 |
| VC22G | 1 | 0.7-12 |
| VC23G | 1 | 0.8-18 |
| VC24G | 1 | 1-30 |

No. **PK12 KIT** Miniature Printed Circuit Trimmers *(Lug and Lead Type)*

| Cat. No. | Quantity | Cap. (mmf) |
|---|---|---|
| VC9G | 1 | 0.8-8.5 |
| VC10G | 1 | 0.8-4.5 |
| VC31G | 1 | 0.8-12 |
| VC32G | 1 | 0.8-18 |
| VC43G | 1 | 0.8-30 |

No. **PK13 KIT** Miniature Printed Circuit Trimmers *(4 Wire Lead Type)*

| Cat. No. | Quantity | Cap. (mmf) |
|---|---|---|
| VC9GW | 1 | 0.8-8.5 |
| VC10GW | 1 | 0.8-4.5 |
| VC31GW | 1 | 0.8-12 |
| VC32GW | 1 | 0.8-18 |
| VC43GW | 1 | 0.8-30 |

No. **PK14 KIT** Glass Dielectric Split Stator Trimmers *(Standard Panel Mount Type)*

| Cat. No. | Quantity | Cap. (mmf) |
|---|---|---|
| VC16G | 2 | *0.8-2.5<br>0.5-5.0 |
| VC17G | 2 | *1.1-4.5<br>0.6-8.5 |
| VC18G | 1 | *1.8-7.5<br>0.7-14.0 |

No. **PK15 KIT** Quartz Dielectric Split Stator Trimmers *(Standard Panel Mount Type)*

| Cat. No. | Quantity | Cap. (mmf) |
|---|---|---|
| VC80 | 1 | *0.4-1.0<br>0.3-2.0 |
| VC81 | 1 | *0.6-1.6<br>0.4-3.2 |
| VC82 | 1 | *0.85-2.8<br>0.5-5.5 |
| VC83 | 1 | *3.0-6.0<br>4.8-11.0 |

* PLATE TO PLATE

No. **PK16 KIT** Glass Dielectric Trimmers *(Standard Panel Mount Type)*

| Cat. No. | Quantity | Cap. (mmf) |
|---|---|---|
| VC1G | 1 | 0.7-9 |
| VC3G | 1 | 0.7-9 |
| VC4G | 1 | 0.8-18 |
| VC5G | 1 | 0.8-18 |
| VC6GA | 1 | 0.8-18 |
| VC7G | 1 | 2-30 |
| VC11G | 1 | 0.6-14 |
| VC13GA | 1 | 1.5-12 |
| VC30G | 1 | 0.8-30 |

No. **PK17 KIT** Quartz Dielectric Trimmers *(Standard Panel Mount Type)*

| Cat. No. | Quantity | Cap. (mmf) |
|---|---|---|
| VC2 | 1 | 0.7-4.5 |
| VC5 | 1 | 0.6-6 |
| VC11 | 1 | 0.8-10 |
| VC12 | 1 | 9-21 |

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40 Adams & Westlake Company, The—Mercury-to-mercury relays
116 Aircraft Radio Corporation — Ceramic insulated connectors
79 Alford Manufacturing Co., Inc.—Stand-by TV antennas
120 Allen-Bradley Co. — Ceramic feed-thru filters
61 Allied Radio—Electronic supply guide
106 Alpha Wire Corp.—Wire catalog
107 Alpha Wire Corp., Alphlex Tubing Div. —Harness tubing
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24 American Lava Corporation—Alumina ceramics
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100 Andrew Corporation—Parabolic antennas
87 Applegate & Co., C. J.—Filament and transistor power supplies
41 Arnold Engineering Company, The—Magnetic materials & components
4 Artos Engineering Company—Automatic wire cutting & stripping machines
73 Audio Devices, Inc.—Magnetic recorded tapes
17 Audio Devices, Inc., Rectifier Division—Threaded silicon rectifier
68 Blaw-Knox Company, Equipment Division—Microwave towers
98 Bliley Electric Company—Crystals & ovens
105 Blonder-Tongue Labs., Inc.—TV monitors, camera
102 Bruno-New York Industries Corp.—Pigtail machine
35 Burnell & Co., Inc.—Subminiature adjustable toroids
43 Bussmann Mfg. Division, McGraw-Edison Co.—Fuses and fuseholders
78 Camera Equipment Co., Inc.—Microwave relay tripod
39 Canoga Corporation — Electronic swept frequency signal generator
67 Celco Constantine Engineering Labs—Yokes
150-151 Centralab, A Division of Globe-Union, Inc.—High dissipation variable resistors
5 Chicago Telephone Supply Corporation—Bobbinless wire resistors
45 Cinch Manufacturing Corp., Subsidiary of United-Carr Fastener Corp.—Subminiature connectors
85 Columbian Carbon Co., Mapico Color Unit—Red ferric oxides for ferrites
94 Connecticut Hard Rubber — Silicone sponge rubber
76 Conrac, Inc.—TV monitors, tuners
31 Cornell-Dubilier Electric Corp. — Subminiature electrolytic capacitors
52 Dale Products, Inc.—Wire wound resistors
47 Delco Radio Division of General Motors —High power transistors
21 Deutsch Company, The—Miniature electrical connectors
89 Dilectrix Corporation — Cast "Teflon" films
60 Dow Corning Corporation—Silicone dielectrics
70 DuMont Laboratories, Inc., Allen B., Scientific Instrument Sales Department —Pulse generator
19 DuMont Laboratories, Inc., Allen B., Industrial Tube Sales — Electronic tubes
117 Eisler Engineering Co., Inc. — Spot welders
15 Engineered Electronics Company—Transistor plug-in circuits
30 ESC Corporation—Custom delay lines
49 Fluocarbon Products Inc.—"Teflon" electronic components
14 Formica Corporation, A Subsidiary of American Cyanamid—"Formica" laminated plastics
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9 Kester Solder Company—Flux core solder
20 Kleinschmidt Laboratories, Inc., Subsidiary of Smith-Corona Inc.—Teleprinter communications equipment
501 Lockheed Aircraft Corp., Missile Systems Division—Engineering personnel
64 Magnetic Metals Company — Magnetic cores and shields
54 Mallory & Co., Inc., P. R.—Jacks and plugs
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33 National Vulcanized Fibre Co.—Laminated plastics
53 New Hermes Engraving Machine Corp. —Engraving machines
8 Ohmite Manufacturing Company—Variable transformer
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58 Packard Bell Electronics, Missile Equip. Sect., Tech. Prods. Div.—Missile support service

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# ADVERTISERS IN THIS ISSUE

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109 Penta Laboratories—Ribbed-anode power tube

80 Phelps Dodge Copper Products Corp.—Coaxial cables

36 Philco Corporation, Lansdale Tube Company Division—Micro-miniature transistors

10 Polarad Electronic Corp. — Microwave signal generators

74 Radio Corporation of America, Broadcast and Television Equipment—Color TV monitor

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1 Radio Materials Company—Small ceramic capacitors

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Employment—Use the handy card below to get more information on the engineering positions described in the "Professional Opportunities" Section which begins on page 159 of this issue.

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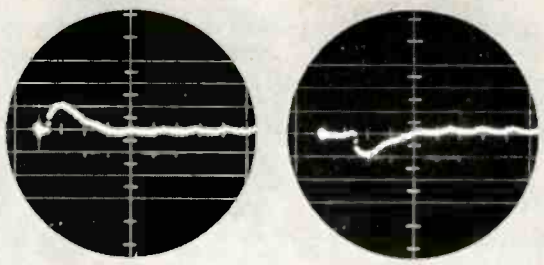
## ENGINEERING BEYOND THE EXPECTED

DESIGN—When time dictates, available equipment can be adapted to your specifications. But you receive custom design, *beyond the expected*, when you need it. For example, the transistorized MAGAMP power supply (right). This unit provides a faster response time . . . a lower overshoot and undershoot . . . and remote regulation at longer distances than has ever been achieved before with this type of power supply.

DELIVERY—A contract from Douglas Aircraft for "Thor" test equipment was awarded in March 1956. A total of 100 units, comprising 30 different units, was delivered before deadline in November. On-time delivery at its best . . . delivery *beyond the expected*.

This transistorized MAGAMP power supply delivers a 27V to 42V output at 0 to 300 amperes, *regulated at a load up to several hundred feet away.*



The MAGAMP has a surge capacity of 400% overload for 2 seconds. Regulation at the load is 1% or better. Recovery time is less than 50 milliseconds. Overshoot and undershoot are less than 25%, with a 30% change in load. (Scale in above photos: 5V/CM and 10MS/CM.)

**PACKARD BELL ELECTRONICS**
Missile Equipment Section
Technical Products Division
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Circle 58 on Inquiry Card, page 103

# New Products

## ATOMIC INSTRUMENTS

A complete line of hand-portable radiation-monitoring instruments is now available. These instruments combine to provide a complete safety monitoring package that consists of

a transistorized radiological survey meter, a transistorized dosimeter charger, and three safety dosimeters. The all-transistorized survey meter, Model UAC 700, is a rugged, lightweight unit that operates from standard flashlight cells for more than 250 hours of continuous use. It meets military specifications. Universal Transistor Products Corp., 143 E. 49th St., New York 17, N. Y.

Circle 239 on Inquiry Card, page 103

## SQUARE WAVE GENERATOR

Compact and stable, this variable amplitude direct coupled square wave generator Model #205 finds use as a modulator of signal generators and traveling wave tube amplifiers. It has a center frequency of one kilocycle. It delivers 60 volts maximum peak to


peak, has a positive ground, 0.4 microsecond rise, 5% overshoot, and zero to 5 kilohms internal impedance. Brocker Laboratories, P. O. Box 967, Sunnydale, California.

Circle 240 on Inquiry Card, page 103

DOW CORNING CORPORATION

# Silicone Dielectrics

ELECTRICAL AND ELECTRONIC NEWS No. 15

## Silicone Insulated Transformers Light-Weight, Maintenance Free

**Added proof that you get "more power per pound" and maximum reliability with silicone electrical insulation is provided by Moloney Electric Company's new line of 3-phase, nitrogen filled, dry-type transformers.**

Take the 1500 KVA rating, for example: these units weigh only 21,000 pounds and measure less than 9½ x 5½ x 10 feet. Silicone-insulated throughout, they can be safely installed almost anywhere regardless of high ambients, contaminated or dust laden atmospheres. In addition, these transformers are virtually maintenance-free; no liquids to maintain, no toxic fumes to guard against.

Contributing to the transformers' efficient performance are the strong, lightweight silicone-glass spacer bars laminated by Formica Company into U-shapes for maximum heat dissipation. Moloney also uses Formica's G-54 silicone-glass for phase barriers and layer insulation.

To complete this all-silicone insulating system, assembled cores and coils are impregnated with Dow Corning 997 Varnish; lead wires are covered with Silastic,* the Dow Corning silicone rubber. *No. 60*

*T.M. REG. U.S. PAT. OFF.

## SILICONE RUBBER ASSURES RELIABILITY OF ELECTRONIC "PACKAGES" ON B-58

**In reaching for new plateaus of performance and reliability, designers are getting an assist from Silastic*, the Dow Corning silicone rubber. Typical is the extensive use of Silastic to insulate and protect the delicate electronic "packages" in the fire control system on Convair's B-58 Hustler.**

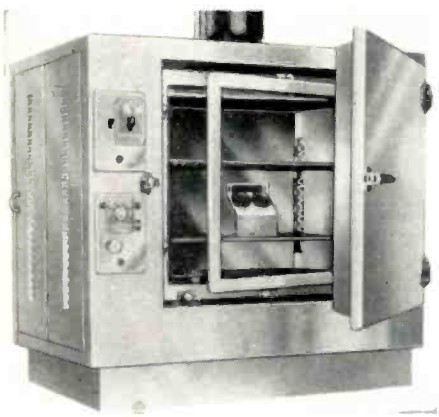
In developing the "packages," heat was a major problem encountered by the designers—the Electronics and Avionics Division of Emerson Electric Manufacturing Company. Certain rubber parts touch miniature tubes that operate at 350 F. Other rubber components, such as seals, cable grommets and clamps, are totally enclosed in packages where even the "cooling" air gets hot. Extreme cold is another problem. When the fire control system is shut off during high altitude flight, temperatures may drop to 65 below zero.

But Silastic easily withstands both extremes of temperature and physical punishment. It stays rubbery from —130 to 500 F, has excellent dielectric strength, moisture resistance and long life. That's why Emerson specified Silastic, and that's why more and more engineers are specifying Silastic for maximum serviceability and minimum maintenance cost in applications ranging from aircraft seals to industrial heaters, from traction motors to home appliances.

*T.M. REG. U.S. PAT. OFF. *No. 59*

## Silicone Fluids on Insulators Stops Shorts and Grounds

**Imaginative use of a silicone fluid has enabled Blue M Electric Company, Blue Island, Ill., to engineer faster response and more accurate heat control into its laboratory humidity cabinets.**



Moisture condensation on the steatite grommets that support the resistance wire heating elements was always a problem in these cabinets. Moisture caused such a low resistance to ground that the elements had to be sheathed. This, of course, reduced the heat-up speed and made it more difficult to maintain accurate temperatures in the cabinets.

Blue M now controls the condensation problem by simply coating the ceramic insulators with Dow Corning 200 Fluid. The resulting water-repellent silicone surface is so successful in preventing the formation of conducting moisture films that the treated insulators withstand 1000 volts to ground even with droplets of water on their surface. As a result, Blue M has been able to change to faster, more accurate "open" elements without fear of grounds or shorts.

Blue M uses a 2% solution of Dow Corning 200 Fluid in carbon tetrachloride. The insulators are dipped into this solution and baked for one hour at 575 F. *No. 61*

**Send Coupon for More Information**

DOW CORNING CORPORATION - Dept. 161
Midland, Michigan

Please send me 59 60 61

NAME _____

TITLE _____

COMPANY _____

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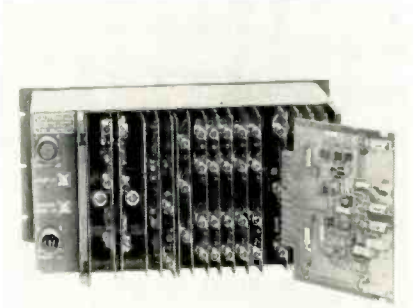
ATLANTA • BOSTON • CHICAGO • CLEVELAND • DALLAS • DETROIT • LOS ANGELES • NEW YORK • WASHINGTON, D. C.

**Canada:** Dow Corning Silicones Ltd., Toronto; **Great Britain:** Midland Silicones Ltd., London; **France:** St. Gobain, Poris

# New Products

## ANALOG CONVERTER

The Type 525 Encoder (analog to digital converter) is available. It is an all-electronic converter designed to provided precise dependale conversion of analog input data to digital output voltages. Particular

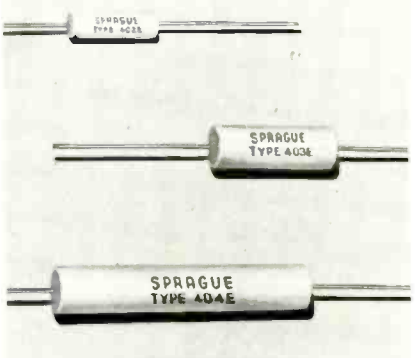


emphasis is placed upon accuracy and resolution. Operates over a wide range of environmental conditions. It makes possible the use of versatile, noise-free digital transmission and computing techniques to a greater degree of accuracy. With a Model 1002 Decoder, it can solve problems in many data processing applications. Avion Div., ACF Industries, Inc., 800 N. Pitt St., Alexandria, Va.

Circle 217 on Inquiry Card, page 103

## CARBON-FILM RESISTORS

A new line of ceramic-jacketed film resistors, called Filmistors, is available. They are intended for close tolerance applications in military, commercial, and telephone electronic equipment where small size and stability of electrical characteristics are important. Type 402E, 403E, 404E are furnished in hermetically-sealed dense ceramic cases using ceramic-to-metal solder seals. They are rated at ½, 1,

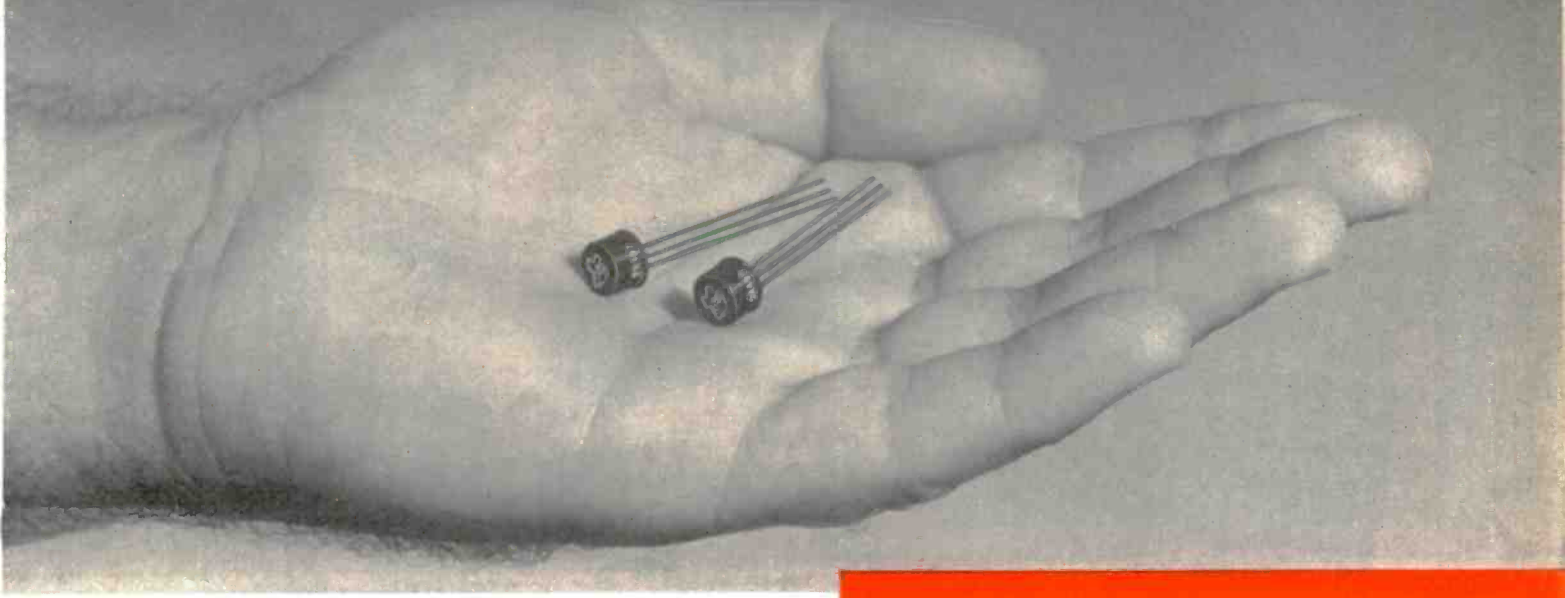



and 2 w. respectively and designed to meet requirements of Military Specification MIL-R-10509B. Sprague Electric Co., Marshall St., North Adams, Mass.

Circle 218 on Inquiry Card, page 103

# NEW
# TI DIFFUSION TRANSISTORS
# POWER TO 200°C!

## in a small package



## 4 W @ 25° C • 1 W @ 150° C
## 20 OHMS SATURATION (TYP.)
## -65 to 200°C OPERATION

YOU get low, low saturation resistance . . . highest dissipation factor yet, at even higher temperatures from these newest TI gaseous diffused silicon units — all stabilized at 215°C! You can control your circuits closely with the 3 to 1 beta spread and exploit the 8 V $BV_{EBO}$ for harder driving switchers in your heavy duty applications.

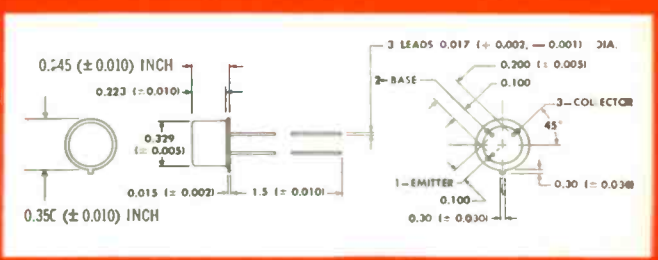
absolute maximum ratings @ 25°C (case temperature)

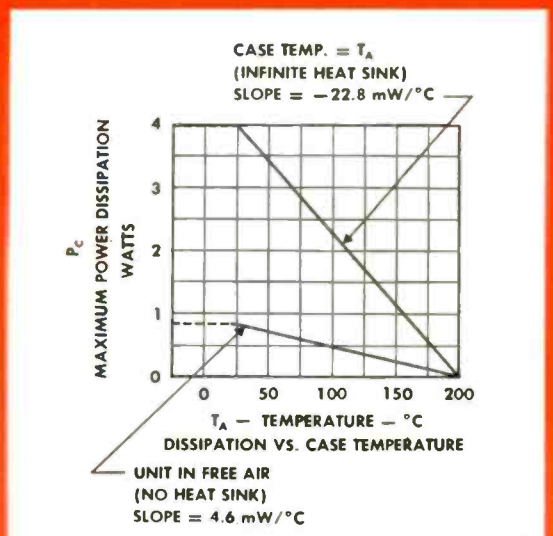
| | type 2N497 | type 2N498 | unit |
|---|---|---|---|
| $BV_{EBO}$ ($I_E$ = 250 μA) . . . . . | 8 | 8 | V |
| $BV_{CEO}$ ($I_C$ = 250 μA) . . . . . | 60 | 100 | V |
| $BV_{CBO}$ ($I_C$ = 100 μA) . . . . . | 60 | 100 | V |

design characteristics @ 25°C (case temperature)

| | min. | des. cen. | max. | unit |
|---|---|---|---|---|
| $R_{CS}$ ($I_B$ = 40 mA; $I_C$ = 200 mA) | — | 20 | 40 | Ohm |
| $h_{FE}$ ($V_C$ = 10 V; $I_C$ = 200 mA) | 12 | 20 | 36 | — |

Just as all TI semiconductors . . . your new 2N497's and 2N498's are fully guaranteed for one year from the date of delivery.




**IMMEDIATELY AVAILABLE IN PRODUCTION QUANTITIES!**

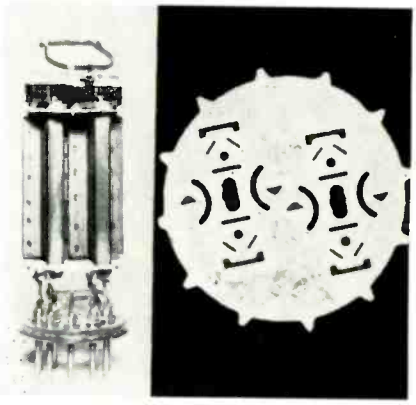
Circle 62 on Inquiry Card, page 103


SEMICONDUCTOR-COMPONENTS DIVISION
TEXAS INSTRUMENTS
INCORPORATED
POST OFFICE BOX 312 • DALLAS, TEXAS

# New Products

## COMPUTER TRIODE

A long-life, high perveance T-6½ medium mu double triode computer tube is available. Designated type 7044, it features high zero bias plate current, separate cathode connections, freedom from cathode interface and interelement leakage and long life characteristics. Structurally, it makes use of a protective shield mica to prevent deposition of getter material on micas and electrodes. Plate dissipation is 4.5 w. per plate with a total of 8 w. for the 2 sections. Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.



Circle 219 on Inquiry Card, page 103

## FERRITE ISOLATOR

A new broad band ferrite isolator of small size and weight has been developed. Model W177-1G-2 transverse field isolator consists of rectangular waveguide with permanent magnetic transverse field and ferrite sections built into the unit. Features area range of 8.5 to 9.6 KMC with isolation at 15 db min. and insertion loss of 1.0 db max. Other features include an input vswr of 1.10 to 1.5 max. Average power 200 w. and temperature-amb: 150°. Size is 1.000 deep x 2.100 high x 2.400 in. wide. Kearfott Co., 14844 Oxnard St., Van Nuys, Calif.

Circle 220 on Inquiry Card, page 103

**DESIGNews**

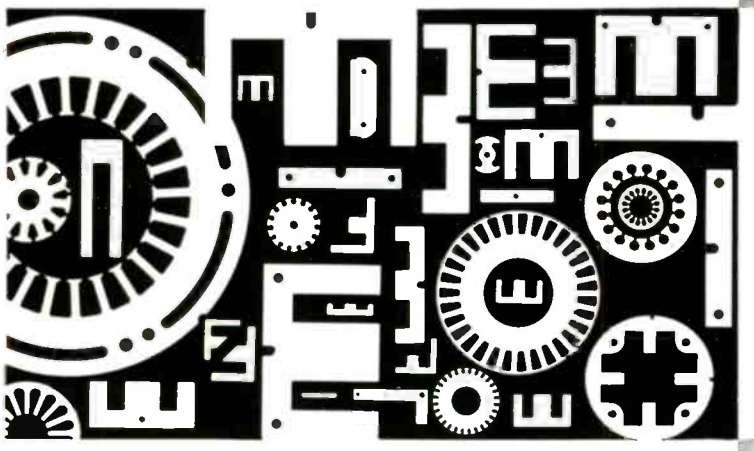
# Magnetic Metals Company designs and produces stamped and tape wound cores and shields for the electrical and electronic industries

The ultimate in tape wound cores

## CENTRICORES

Precision manufacturing methods are used to obtain closely matched magnetic characteristics, including high thermal stability. Centricores matched at room temperature will remain matched over wide temperature ranges.

► SEND FOR BULLETIN D7.

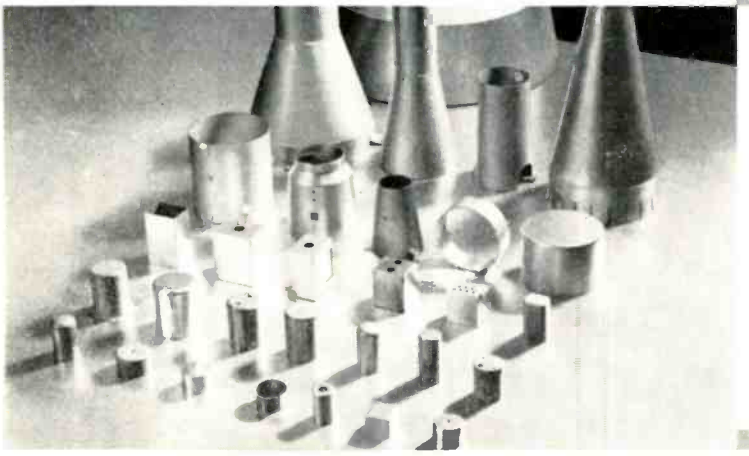


Mass-produced . . . Precision-made

## Magnetic Core Laminations

Motor laminations are produced to close specifications from customer-owned dies. Our representative will discuss your needs. Transformer laminations in a wide variety of shapes and sizes are made from standard dies.

► SEND FOR BULLETIN A1.



Drawn or formed

## MAGNETIC SHIELDS

Provide efficient protection of sensitive electrical equipment against stray magnetic fields, and effect a high ratio of field strength reduction. A wide range of single and multiple shield structures are available from existing tools.

► SEND FOR BULLETIN F1.

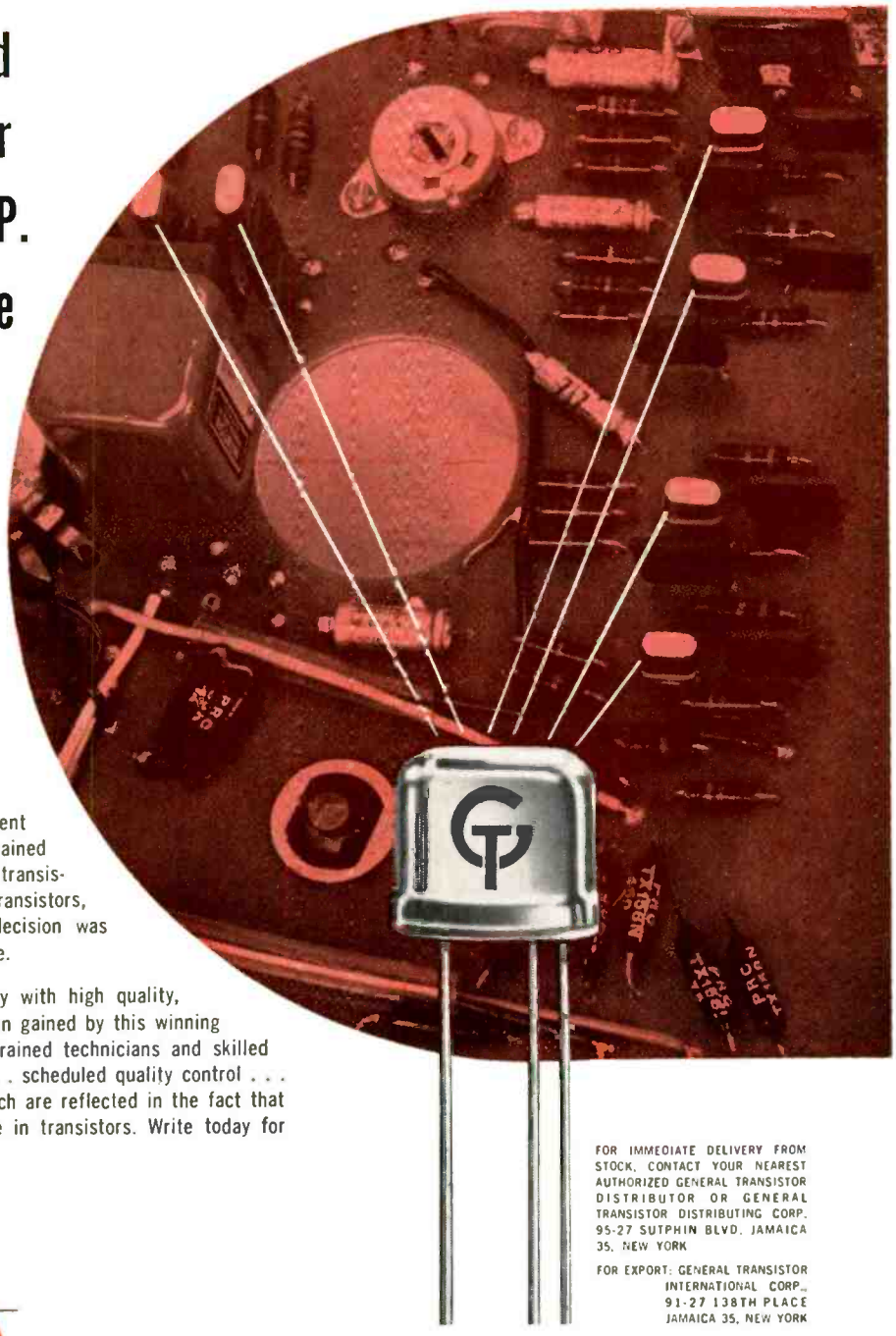
# MAGNETIC METALS COMPANY

ELECTROMAGNETIC CORE PARTS AND SHIELDS • HAYES AVENUE AT 21st ST. • CAMDEN 1, N. J.

*3 reasons why.....*

# GENERAL TRANSISTOR

## was specified for FEDERAL PRODUCTS CORP. electronic gage



1. HIGH, UNIFORM BETA
2. LOWER CUT-OFF CURRENT
3. ECONOMICAL COST

Federal's engineering staff set forth rigid requirements for the circuitry in their Model 230 P-2 Electro-Probe electronic gage system . . . small, lightweight, compact . . . and consistent reliability. This portable unit is a self-contained precision gaging instrument with a completely transistorized amplifier. When it came time to specify transistors, Federal's prints called for a GT type. Their decision was based on General Transistor's past performance.

Over the years, GT has supplied the industry with high quality, trouble free transistors. This reputation had been gained by this winning combination . . . experienced engineers . . . trained technicians and skilled production workers . . . select raw materials . . . scheduled quality control . . . exhaustive environmental testing . . . all of which are reflected in the fact that General Transistor is the fastest growing name in transistors. Write today for Bulletin G-100.

FOR IMMEDIATE DELIVERY FROM STOCK, CONTACT YOUR NEAREST AUTHORIZED GENERAL TRANSISTOR DISTRIBUTOR OR GENERAL TRANSISTOR DISTRIBUTING CORP. 95-27 SUTPHIN BLVD. JAMAICA 35, NEW YORK

FOR EXPORT: GENERAL TRANSISTOR INTERNATIONAL CORP., 91-27 138TH PLACE JAMAICA 35, NEW YORK

**GENERAL TRANSISTOR**

CORPORATION

91-27 138TH PLACE, JAMAICA 35, NEW YORK

THE FASTEST GROWING NAME IN TRANSISTORS

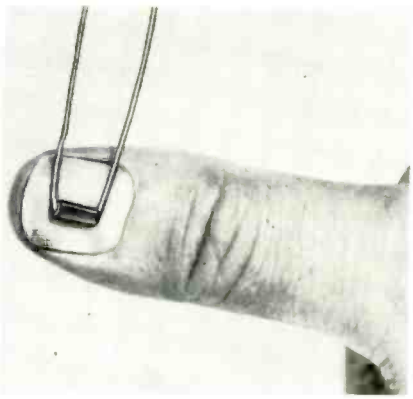


Circle 66 on Inquiry Card, page 103

# New Products

## PRECISION RESISTOR

Designed to meet the requirements of sub-miniaturization in the Electronic Industry, the NS6AZ is the smallest precision wire wound resistor in a full line of axial precision

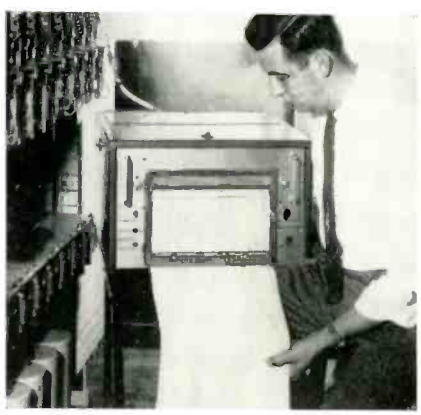


wire wound resistors. The NS6AZ (.125 x .250) is one in a line of over 15 sizes encapsulated to meet MIL R93A characteristic "A" and MIL R9444. Available with resistance values up to 125K with tolerance to 0.1%. This resistor will dissipate 0.1 watts at 125° C with no derating. Eastern Precision Resistor Corp., 675 Barbey St., Brooklyn 7, N. Y.

Circle 223 on Inquiry Card, page 103

## EVENT RECORDER

An Event Recorder, which instantly and simultaneously records up to 100 channels of on-off information in permanent chart record form is available. It is valuable in the checking of electrical and electronic sequences in missile and aircraft control systems, range timing readouts (time coding), the evaluation of telephonic communications systems, checking relay "chatter," contact-bounce, close-

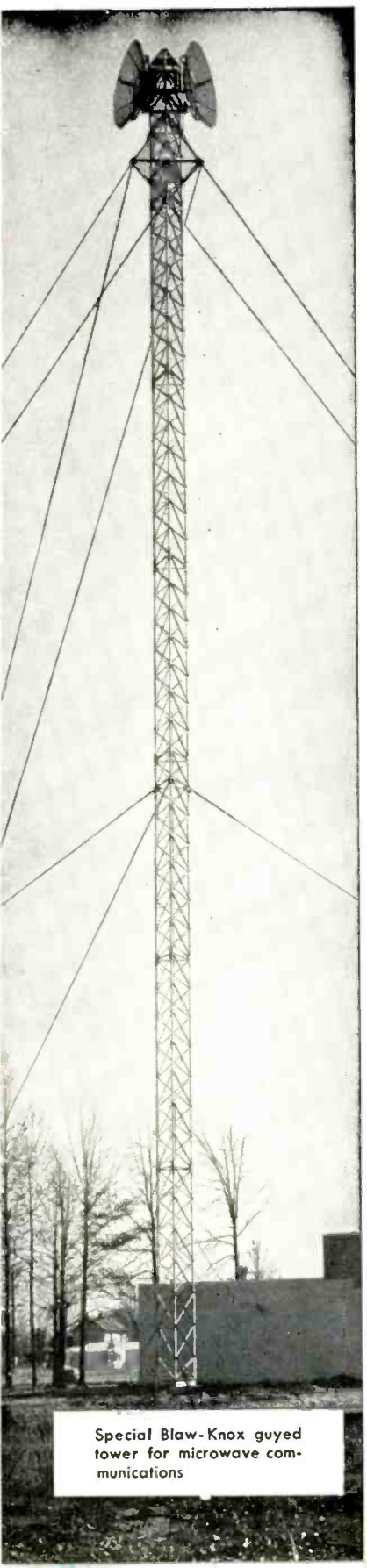


time, and many other applications. It indicates the events, the duration and correlation with others as a function of time. Brush Instruments, 3405 Perkins Ave., Cleveland 14, Ohio.

Circle 224 on Inquiry Card, page 103

# Planning better communications?

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



Special Blaw-Knox guyed tower for microwave communications

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

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

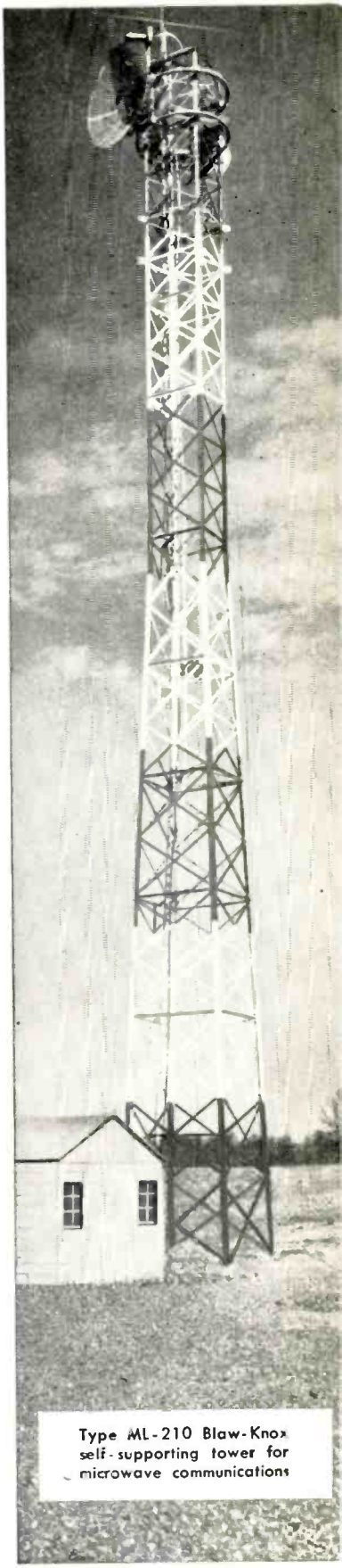
- The first Blaw-Knox Towers, four 300′ self-supporting towers erected over 40 years ago in Alaska, still stand in good service.

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

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

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

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



Type ML-210 Blaw-Knox self-supporting tower for microwave communications

BLAW-KNOX

**BLAW-KNOX COMPANY**
*Equipment Division*
*Pittsburgh 38, Pennsylvania*

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

Circle 68 on Inquiry Card, page 103

# Miniature Screen Room Checks ADF

Fig. 1: The tall unit on the shelf is the miniature screened ADF test enclosure.

One of the big problems in aircraft radio repair is checking low frequency ADF units. Ideally, the performance of an ADF is measured in a screen room not less than 10 feet on a side—an expensive and often unavailable facility. Now, Lear, Inc., Santa Monica, California, has come up with a portable test unit for bench use. As shown in Figures 1 and 2, the unit includes a miniature shielded enclosure for a small radiating antenna and the antenna loop of the unit under test. This test unit can be used to check if the ADF meets the minimum ADF sensitivity requirements.

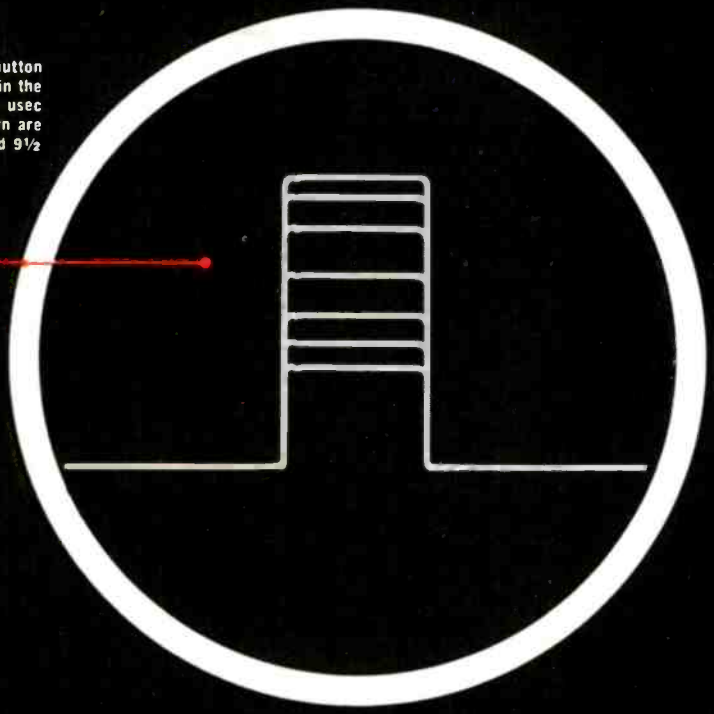
Fig. 2: The inverted test loop is mounted at the top of the enclosure, and the radiating loop is mounted at the bottom.

## New Radar Test Adapter

A RAPID, accurate test of the complete APG-30 airborne radar system used on the U. S. Air Force's first A-Bomb-carrying swept-wing fighter bomber, the F-84F Thunderstreak, is now performed by Republic Aviation Cor-

(*continued on page* 120)

Fidelity of 404 push-button attenuation is shown in the multiple exposure of a 1 usec pulse. The db levels shown are ½, 1½, 3½, 5½, 7½ and 9½



*0.018 usec*
*RISE TIME*

*100,000 pps*
*REP. RATE*

# Du Mont

404

# Pulse Generator

- Repetition rates up to 100,000 pps, manual trigger for single pulse
- 0.018 usec maximum pulse rise and fall time
- Pulse width continuously adjustable from 0.05 to 100 usec
- 50 volts maximum output into 50 ohm impedance
- 59.5 db of attenuation in 0.5 db steps with no pulse degradation
- Hard tube circuitry eliminates jitter due to hydrogen thyratron erratic firing.

The Du Mont 404 Pulse Generator sets new standards for stability and versatility, outmoding pulse generators employing hydrogen thyratrons. The performance of the 404 reflects the entirely new "hard-tube" circuitry concept employed.

The capabilities of the 404 provide excellent facilities for ultra-high frequency studies at moderate cost. Its hair-line firing of sharp-edged pulses, push-button stepped attenuation, high rep rate, minimum jitter, easy-to-use front panel and control layout, internal delay from 2 usec before trigger to 100 usec after—all add up to a multiple use instrument that's good for years of dependable performance.

Price $**675**

Rack-mounting model $690


***Write For Complete Technical Details . . .***

**DU MONT** SCIENTIFIC INSTRUMENT SALES DEPARTMENT, ALLEN B. DU MONT LABORATORIES, INC.

*One of the 400 Series*

(*continued from page* 118)

poration with a new test adapter, manufactured by The Narda Corporation, Mineola, New York. Through the use of the new Model 650 matching horn, energy is sampled directly from the radar output and a complete test is simulated on the ground, thereby increasing the reliability of radar operation during flight.

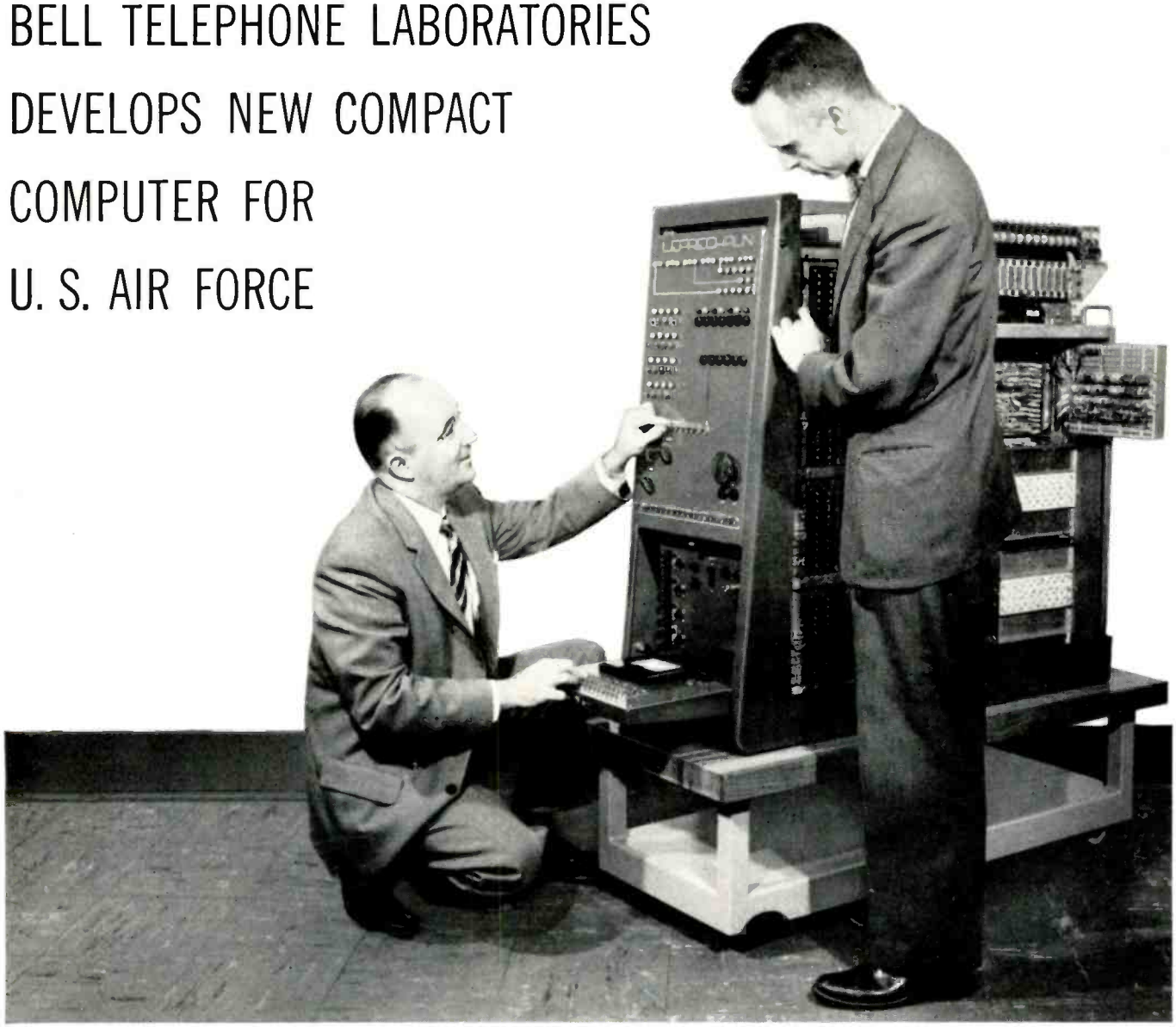
Prior to using the Narda Test Adapter, Republic employed the conventional method of sampling the power in the radar's waveguide transmission line through a built-in directional coupler. This technique provided performance evaluation of the radar unit but did not include the transmission line and antenna. In addition, it was necessary to "tap" into a portion of the radar output through the use of a directional coupler.

The radar system of Republic's F-84F Thunderstreak has its waveguide transmission line tested. Use of the Narda test adapter gives quick and accurate evaluation of the entire waveguide transmission line.

The new procedure saves time and does not require opening part of the aircraft.

The Narda Model 650, now successfully being used by Republic on production aircraft, consists of a pickup horn, a 20 db high power attenuator, and a waveguide-to-coaxial adapter. The pickup horn is provided with fasteners and supports for direct connection to the AN/APG-30 horn antenna mounted in the aircraft. To provide a good impedance match for the radar magnetron, the pickup horn is followed by a 20 db high power attenuator. The opposite end of the attentuator is connected to a Narda Model 601 waveguide-to-coaxial adapter, thus providing an output coaxial adapter which can be connected directly to the test cable.

# BELL TELEPHONE LABORATORIES DEVELOPS NEW COMPACT COMPUTER FOR U. S. AIR FORCE



J. A. Githens, B.S. in E.E., Drexel Institute of Technology, and J. A. Baird, Ph.D. in E.E., Texas A. & M., check the control panel of Leprechaun, a new high-speed computer which solves extremely complex problems in one-tenth of a second. Small size and low power are made possible by new design principles and Bell Laboratories' invention of the transistor.

The United States Air Force assigned Bell Labs an interesting assignment: develop a new kind of electronic computer. The major requirement was greater simplicity. Of course, no computer is simple, but this one (known as "Leprechaun" to its designers) is much smaller and simpler than most of the computers currently in use.

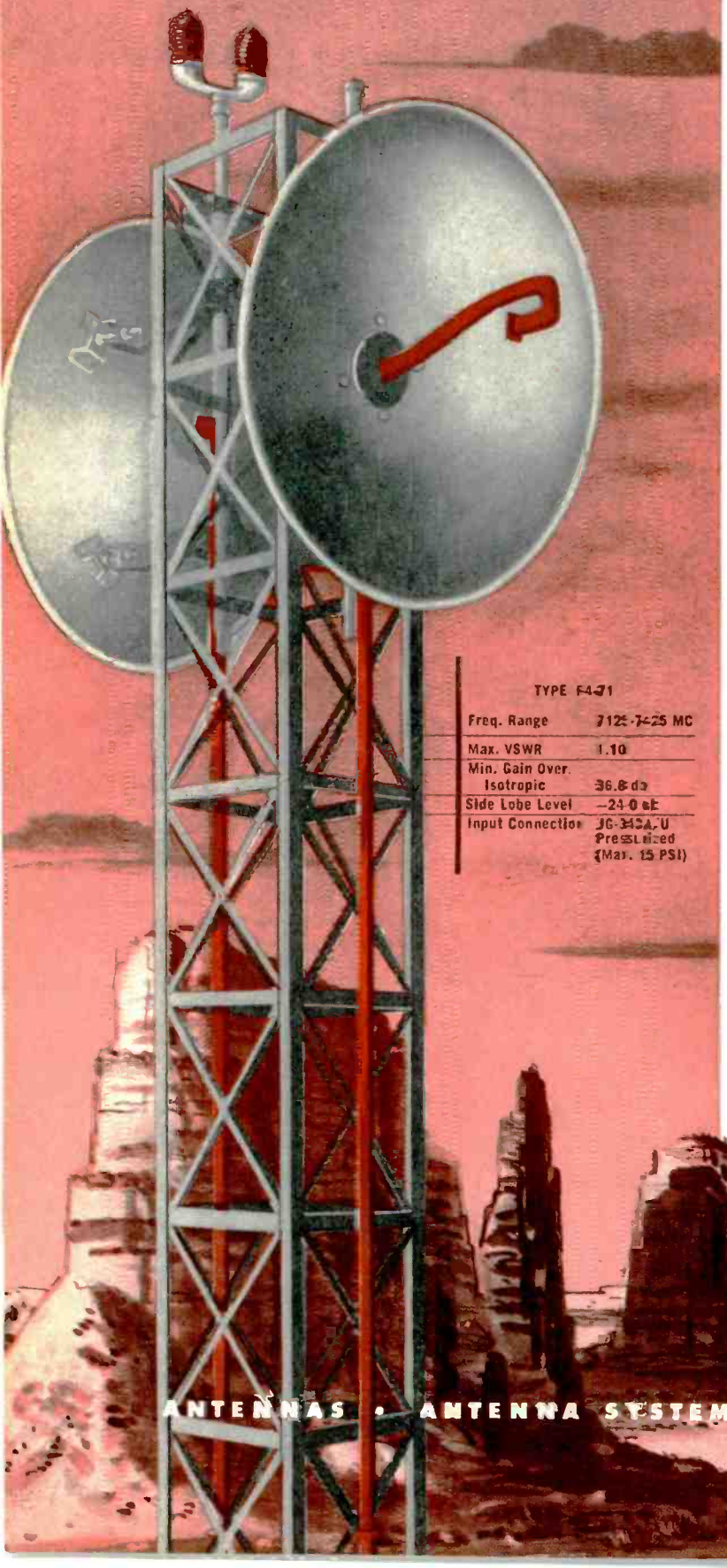
It has only some 9000 electrical components; 5000 of them are transistors. As a result, Leprechaun has less than one-third the components of conventional computers. This facilitates testing, experimentation, assembly and service.

Even in its experimental state, Leprechaun is a stimulating example of great strides in the simplification and miniaturization of circuitry . . . a problem of profound interest to all Bell Laboratories researchers as they develop radically new equipment for your future telephone service.

BELL TELEPHONE LABORATORIES

WORLD CENTER OF COMMUNICATIONS RESEARCH AND DEVELOPMENT

# Reliability




ANDREW

Isolated microwave relay installations must be reliable and require the extra performance factors of mechanical and electrical design found only in ANDREW Parabolic Antennas. Thousands of installations serving over a million channel miles of microwave have proven their superiority.

ANDREW offers a complete range of sizes and frequencies. Specify ANDREW Antennas for your microwave system. Here is a representative selection of stock antennas.

**TYPE NUMBERS OF STOCK PARABOLIC ANTENNAS**

| Frequency Range (MC) | ANDREW Type Number | | | |
|---|---|---|---|---|
| | 4 ft. dia. | 6 ft. dia. | 8 ft. dia. | 10 ft. dia. |
| 890 - 920 | 1004A-1 | 1006A-1 | | 1010A-1 |
| 920 - 960 | 1004A-2 | 1006A-2 | | 1010A-2 |
| 1700 - 1850 | 2004A-1 | 2006A-1 | 2008A-1 | 2010A-1 |
| 1850 - 1990 | 2004A-2 | 2006A-2 | 2008A-3 | 2010A-3 |
| 1990 - 2110 | 2004A-3 | 2006A-3 | 2008A-3 | 2010A-3 |
| 2450 - 2700 | | P6-24 | | P10-24 |
| 3750 - 4200 | | | PS8-37 | |
| 5925 - 6426 | P4-59 | P6-59 | P8-59 | P10-59 |
| 6575 - 7125 | P4-65 | P6-65 | P8-65 | P10-65 |
| 7125 - 7425 | P4-71 | P6-71 | P8-71 | P10-71 |

Specifications of these and other stock antennas and special design antennas are available by consulting the ANDREW Sales Engineer in your area or by writing to:

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Circle 100
on Inquiry Card

ANTENNAS · ANTENNA SYSTEMS · TRANSMISSION LINES

Tele-Tech's
# ELECTRONIC OPERATIONS

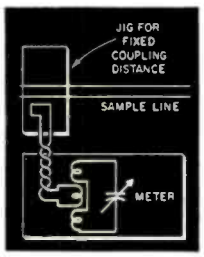
The Systems Engineering Section of ELECTRONIC INDUSTRIES · January 1958

## In This Issue



### Indiana Toll Road Communications 02

A comprehensive system of microwave links and VHF mobile communications ties together the operation of the 156-mile Indiana Toll Road.




### Antenna Matching 05

An inexpensive breadboard jig simplifies coupling for SWR indicators and provides a quick method of measuring mismatch.

## SYSTEMS—WISE . . .

**COLOR TV RECORDER**

T. A. Smith (r), RCA Vice-Pres., and Dr. Geo. H. Brown, RCA's Chief Engineer of Industrial Electronics, examine engineering prototype of new color TV tape recorder. Commercial models are due in late '59.

**▸ Video tape recording gained new stature recently when RCA and Ampex agreed to exchange patents in the field. Ampex monochrome recording and RCA color tape developments were involved.**

▸ Educational TV is being designed into an Ithaca College classroom. Recognizing the important new role of TV in education, designers of the new facility have included a complete TV studio as part of the classroom.

**▸ NAB (ex-NARTB) warns that reradiating TV devices can bring serious interference to other TV reception. NAB is sympathetic to the needs for such devices, but sees need for close regulation of boosters, satellites, translators, and the like.**

**▸ FCC Commissioner T. A. M. Craven has appointed William H. Watkins as his engineering assistant. Mr. Watkins has been with FCC since 1946, has been Assistant Chief of the Frequency Allocation and Treaty Division, Office of the Chief Engineer, since 1954. His early work with FCC included experimental, public safety and industrial mobile, and microwave matters.**

▸ National Association of Broadcasters will be the new-old name of National Association of Radio and Television Broadcasters (NARTB).

**▸ FCC has extended simplex-to-multiplex deadline to March 1, 1958, and will accept requests for waiver of the rules to permit simplexing of FM functional music operations beyond that time. Requests for waiver should be filed by January 15, 1958.**

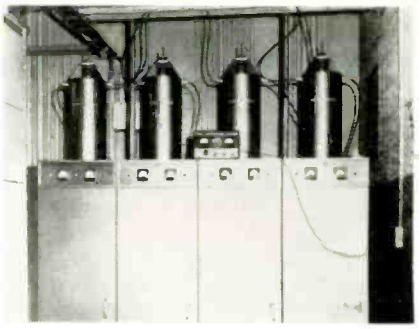
▸ Images via meteor trail—between stations 910 miles apart—that is the latest news on bounced-beam communications. RCA and NBS cooperated to send facsimile pictures, using system developed for Cambridge Research Center of ARDC.

**▸ Subliminal is now subnetwork. ABC, CBS, and NBC have banned the new technique from network programs. "Insufficient knowledge of effects and implications" were cited.**

▸ FCC has authorized all broadcast stations to use the CONELRAD attention signals prior to broadcasting Weather Bureau emergency warnings on a condition of immediate danger to life and property. CONELRAD receivers will thus be activated to receive emergency weather news.

This microwave relay station serves the Indiana Toll Road, one of the most recent of the nation's super-highways to be opened to the public. Backbone of the private communications network is a General Electric Microwave system, supplemented by GE VHF mobile equipment.

(Right) Two separate duplex VHF systems serve the Indiana State Police and turnpike maintenance personnel. The two transmitters are connected to one antenna through tuned cavities. The receivers are similarly cavity-linked to one antenna. Interaction is negligible.



# Indiana Turnpike Communications System

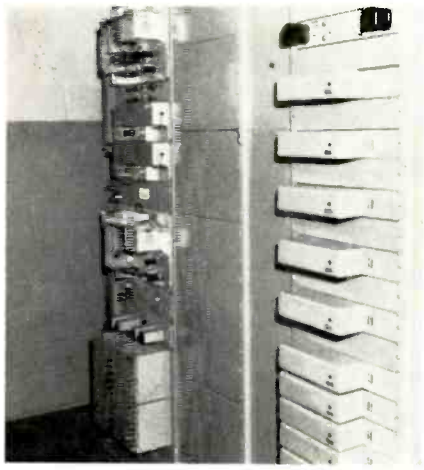
*The Indiana Toll Road, one of the nation's most recently opened super-highways, is equipped with a comprehensive system of microwave links and VHF mobile communications. Presented here are some of the highlights of the system.*

Mobile coverage of the entire turnpike is provided by 50-watt 150 MC wide-band base stations at each of the five maintenance buildings. All vehicles have 50-watt transmitters. Microwave links the base stations and provides teletype and automatic dial telephone channels.


Each VHF system uses identical equipment, with complete standby equipment. All signals on the VHF circuits are recorded on a special dual channel tape recorder which is started each time the circuit is keyed. A spare reel of tape is automatically cut in when the tape on the normal reel is nearly finished. Operational VHF handsets in use are shown by panel lights in the master console.

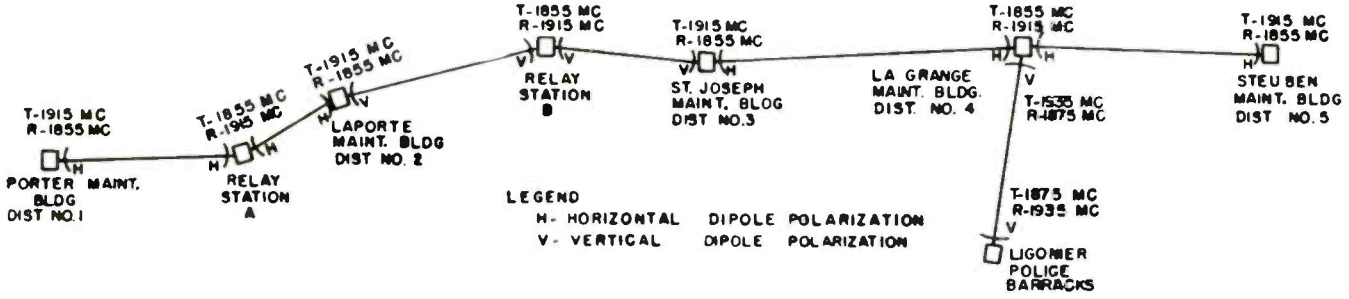
VHF equipment in the toll booth communicates with a base station at the nearest maintenance station, and thence by microwave into the central control console. A short audio tone precedes each transmission originating from a toll plaza, causing a tone receiver in the control console to light an identifying lamp.

The microwave equipment provides channels for the VHF mobile system, a selective calling teletype system, and a dial telephone system. It is capable of handling 24 voice channels, giving adequate expansion possibilities over the presently used 12 channels.



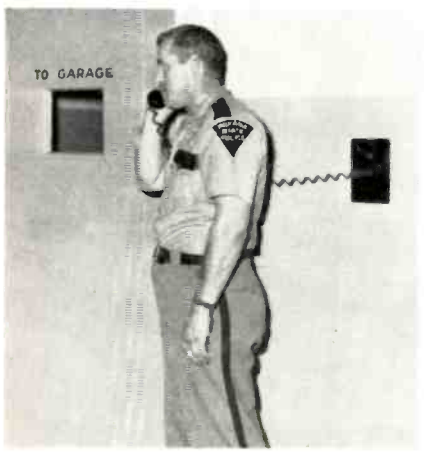
Five of these maintenance buildings are located along the 156 miles of roadway in the East-West toll system. Base stations and microwave link equipment are installed at each maintenance building. Dial switchboards with trunk repeaters and selectors are installed at each building, as well as a party-line communications maintenance circuit.

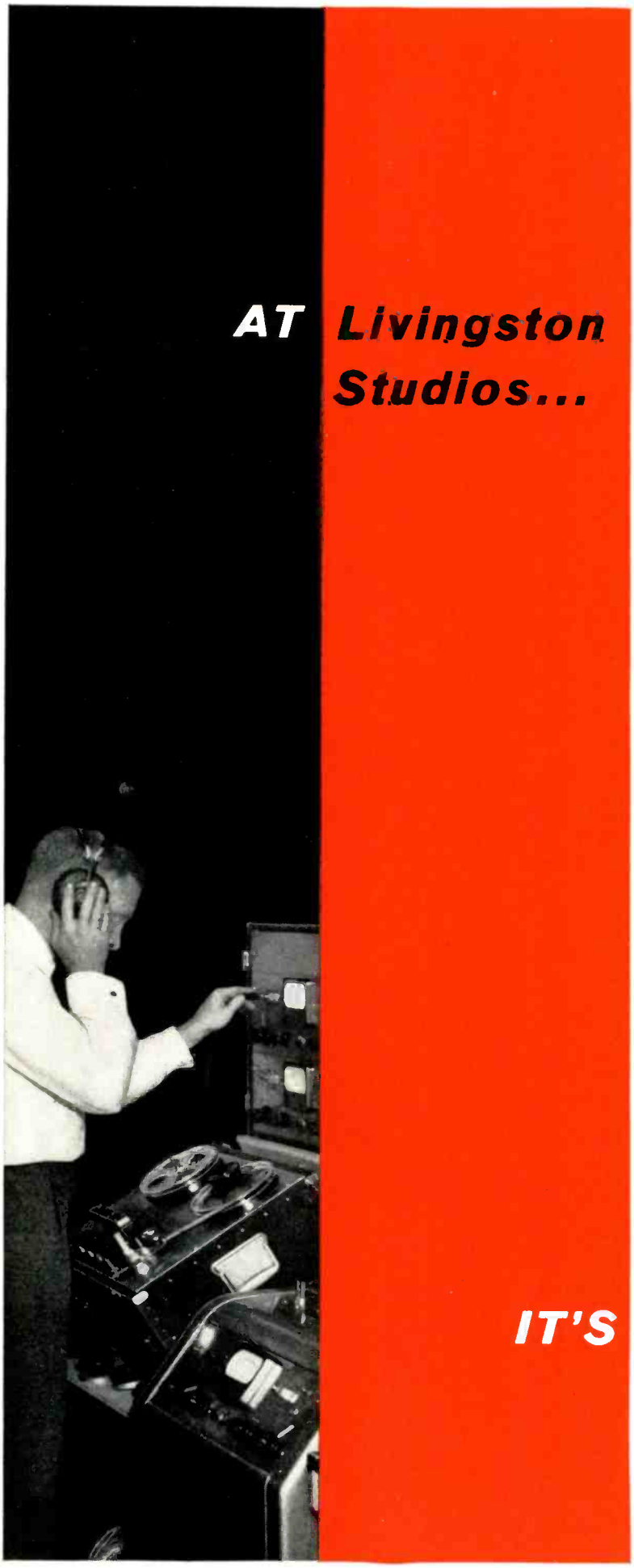
This article was prepared from material compiled by Ralph F. Lowe, of General Electric Co., and J. Schmid, Indiana Toll Road Commission.




Each patrol car is linked to all offices of the toll system, and with all other mobile units by the system of base stations and microwave links. All calls on the patrol circuit are constantly monitored by all other units in the system.


(Below) To avoid any interference between services, the maintenance department has its independent VHF communications system with which it can communicate with mobile maintenance units anywhere along the road.





# AT Livingston Studios...

## *recorded tapes get a quality boost with Audiotape*

Say "recorded tape" and chances are someone will say "Livingston." Livingston Audio Products in Caldwell, N. J., was one of the pioneers in the recorded tape field. Today, the Livingston library includes over 160 monaural tape titles and more than 90 stereos. And the list is expanding every month.

Art Cooper, executive vice-president at Livingston, says, "In this high fidelity age, the key to success in the recording business is quality. Our engineers have chosen equipment which they feel is the finest available. We make inspections and maintenance checks on this equipment every hour. And we approach magnetic tape in the same way—constantly testing and checking the quality. Our studies have shown that Audiotape consistently delivers outstanding performance. That's why we've been an Audiotape customer for years."

Livingston is just one of the hundreds of professional recording studios which rely on Audiotape for the finest sound reproduction.

The complete line of professional quality Audiotape offers a base material and thickness to meet every recording need. And no matter which type you select, you can be sure you're getting the very finest tape that can be produced. There's a complete range of reel sizes and types, too, including the easy-threading C-Slot reel for all 5 and 7-inch Audiotapes. Why settle for less, when professional-quality Audiotape costs no more?

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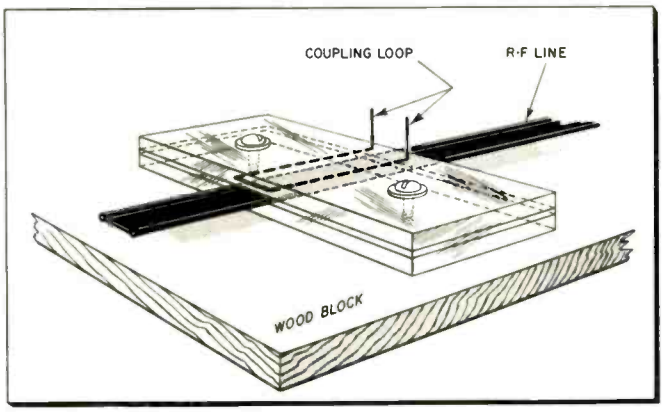
Circle 73 on Inquiry Card, page 103

By JOSEPH ZELLE

*Station WERE,*
*Cleveland, Ohio*




# A Simple Antenna Matching Indicator

*Inexpensive breadboard jig simplifies coupling for SWR indicators, provides quick method of measuring mismatch*

With the advent of VHF-UHF and TV, several very satisfactory and easy methods for measuring standing wave ratios have been developed. In general, though, these methods have required complicated or expensive equipment that would not be found in average installations. In addition, antenna adjustments and SWR measurements might occur only occasionally. Therefore, a simple and inexpensive layout which might be used for the one time or during an emergency during adjustments is highly desirable.

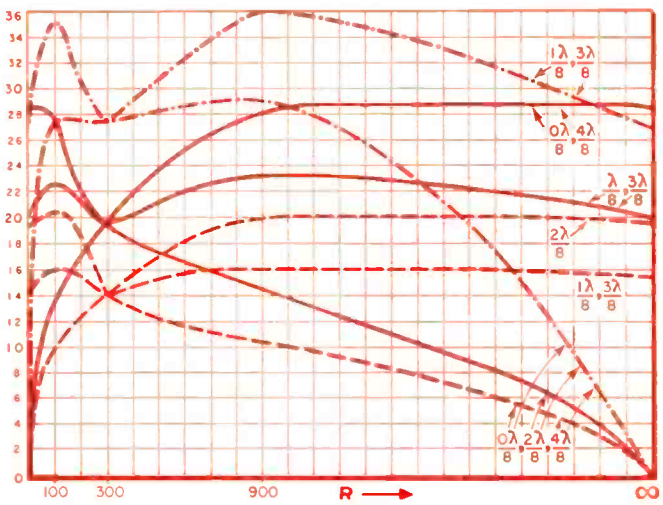
The method to be outlined here is based on the fact that any electrical line matched properly to a resistive load is a flat line. A current or voltage meter will remain constant in reading along a relatively short matched line.

Take, as an experiment, an open line, such as the 300-ohm twin lead, and connect one end to an r-f source such as a transmitter. A field strength meter can be placed at a convenient spot along the line. If we take a number of resistors of different values and terminate the line with one of them at a time, we shall obtain the broken line curve in *Fig. 1*. At one point, the 300-ohm point (for a 300-ohm line coupled for current), the current reading will represent a flat line. If voltage readings were taken, the solid line curve of *Fig. 1* would result. Here again, the 300-ohm point would represent a flat line condition. Lastly, if we drew a power curve, we would obtain the dot-dash curve of *Fig. 1*, which shows apparent power distribution as a function of resistive loading. The 300-ohm point represents true power and maximum efficiency for a 300-ohm line.

### *Terminating Line*

In a typical antenna installation then, with the antenna resonated to the operating frequency, it would only be necessary to set the SWR indicator conveniently on the line, as near to the transmitter as possible. Then the line would be disconnected at the antenna end and terminated with a pure non-reactive resistor equal to the characteristic impedance of the line. With the line properly terminated, and power applied, the SWR indicator will give a definite fixed reading. If the indicator coupling loop would be moved along the line, there would be no change in value of the reading (assuming identical coupling and a rela-

Fig. 1: Voltage, current and power curves over half-wavelength of line for various values of resistive load, at fixed distances



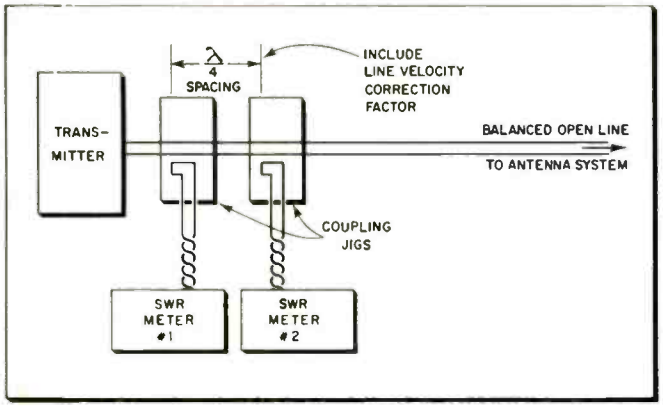



Fig. 2: Matching antenna with two SWR indicators on open balanced line. When both meters read the same, flat line conditions exist.

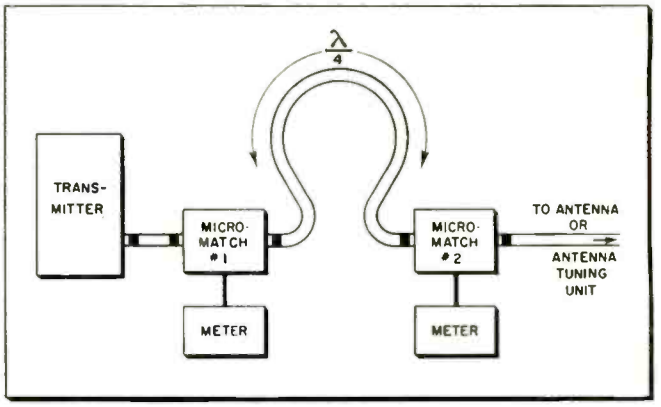



Fig. 3: Matching antenna with two SWR indicators spaced electrically ¼λ-wavelength. Line is flat when meters read identically.

# Antenna Matching Indicator *(Continued)*

A REPRINT
of this article can be obtained by writing on company letterhead to
Editor,
ELECTRONIC INDUSTRIES
Chestnut & 56th Sts., Phila. 39, Pa.

tively short line). Leaving all conditions the same, removing the terminating resistor and restoring the antenna, we have a reference value on the meter for obtaining matched conditions.

If the antenna is resonant to the operating frequency, it has a pure resistive value. It now remains to make adjustments on the matching device (stub, T, Gamma match, etc.). When the SWR meter reading returns to the reference value, the antenna has been matched to the line. No changes at the transmitter or to the line should be necessary, since as far as the line is concerned, both the terminating resistor and the input to the matching device represent correct conditions.

From the SWR curves given in the ARRL Antenna Handbook, it is obvious that two other points within a half wave length might indicate the same value as a matched condition. To avoid the possibility of faulty indications and to remove the ambiguity, it is advisable to move the meter coupling up or down the line for ⅛ to ¼ wavelength. If this is impractical, an extra ⅛ to ¼ wavelength of identical section of line should be inserted, preferably ahead of the indicator towards the antenna. Any change greater than a few percent will indicate a faulty condition. The antenna has not really been matched.

Such anomalous results can be completely eliminated by using two coupling systems spaced from ⅛ to ¼ wavelength apart, preferably the latter value. In a matched condition both meters will read the same. Therefore, while antenna matching is being done, changes can be made until both meters read practically the same. *Fig. 2* illustrates the two-meter system.

Of course, not everybody can terminate the line with the proper resistor right at the antenna. This difficulty can be obviated by resorting to a sample line which can simulate matched conditions. The sample line should be identical with the regular line going to the antenna. This sample line, several wavelengths long, is then connected to the transmitter in the normal manner. To it, near the transmitter end, is coupled the SWR meter. This coupling must be accomplished with a jig so that the open line will always be coupled exactly the same way to the SWR meter. The sample is then terminated in a resistor equal to the characteristic impedance of the line. With power applied, loosely, the SWR meter will give a definite reading for matched conditions, that is, a flat line. Leaving the entire setup unchanged, but the sample line removed, the regular line is set in the measuring jig. With the transmitter fired up, any deviation from the reading obtained on the sample line will indicate unmatched conditions. When the antenna is re-adjusted so that the meter reading on the regular line is the same as on the sample line, the regular line is flat. It will automatically indicate a matched condition. Here again, a ⅛ to ¼ wavelength of line should be added to see if any variations occur. If not, the line can be reasonably assumed to be balanced.

### *Shielded Cable*

Up to this point, the line under consideration has been an open line. If the line happens to be a shielded coaxial cable, such as the RG8/U, the *Micromatch* or similar indicating device is very handy. Simply take a sample length of the same cabling, two or three wavelengths long, and plug it into the output of the SWR meter. Terminate the cable with a pure resistor equal to the characteristic impedance of the line. With the transmitter feeding power, the meter can be adjusted to give a definite reading somewhere in the middle of the scale. With the sample disconnected, and the regular cable connected, the meter reading should be the same under identical conditions. Any

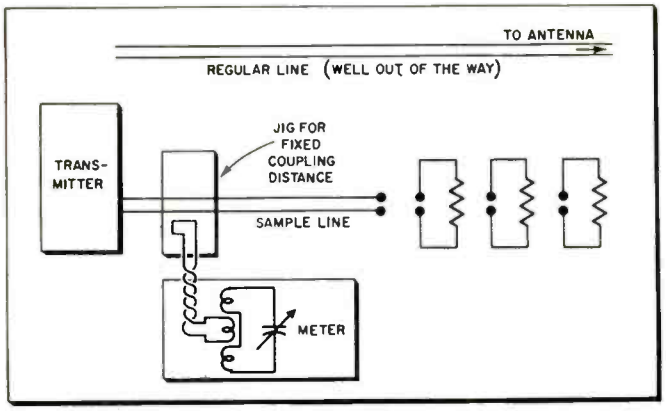



Fig. 4: Set-up for open line system, using one meter to obtain a fixed reference level for flat line condition.

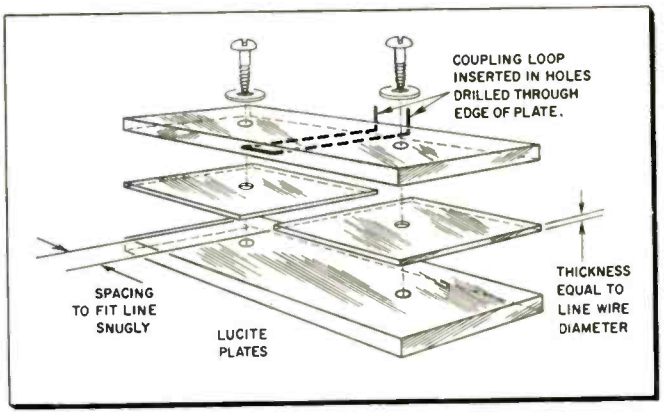



Fig. 5: Jig assembly. Reliability of readings will depend on the stability of coupling between the line and the measuring loop.

deviation from the sample reading will indicate unbalance and mismatch. Here again, a ⅛ to ¼ wavelength section of cable (corrected of course for propagation factor) should not change the meter reading appreciably. Two meter systems, spaced ¼ wavelength apart, will again eliminate the possibilities of anomalous conditions, the setup being illustrated in *Fig. 3*.

Several points must be borne in mind when making these measurements. First of all, the sample line, if it is of the open variety, must lie exactly in the position which the regular line will occupy when installed permanently. Secondly, the regular line should be removed sufficiently so that it and the associated antenna circuit will have almost no effect on the sample. Third, for lower frequencies, ordinary dummy loads, or even good carbon resistors can be used. When power is applied to a load, it should be as reduced as possible and for as short a period as possible. When power is applied to ordinary low watt resistors, the power should remain on only long enough for the SWR meter needle to come to rest on the scale. For repeated measurements, the terminating resistor should be replaced or allowed to cool completely before reapplying r-f power. Where the transmitter power is low anyway, or the terminating resistor is capable of handling the power, such precautions are naturally less demanding.

During each measurement a close watch should be kept on power input to the final r-f stage, if it is supplying power to the line. During the entire measurement, no change should be necessary. If the final stage has to be returned for resonance, the antenna might not be operating at the resonant frequency or a mismatch might be existing although undetected. In this matching system, so far as the transmitter and the r-f line are concerned, they cannot distinguish between a resistive dummy load and a resistive antenna load.

Finally, the usual precautions against stray couplings and stray capacitances must be observed. Then, too, the higher the frequency, the more critical the measurements become. Despite the simplicity of this measuring setup an infinite amount of patience is required in making final adjustments.

Values for Voltage Curves of Fig. 1.

| At receiving end | | λ/8 back from receiving end | | λ/4 back from receiving end | |
|---|---|---|---|---|---|
| 2.85 | Infinity | 2.0 | Infinity | 0 | Infinity |
| 2.8 | $3R_o$ | 2.3 | $3R_o$ | 1.45 | $3R_o$ |
| 1.95 | $R_o$ | 1.95 | $R_o$ | 1.95 | $R_o$ |
| 1.35 | $\frac{1}{3}R_o$ | 2.25 | $\frac{1}{3}R_o$ | 2.8 | $\frac{1}{3}R_o$ |
| 0 | $0R_o$ | 2.05 | $0R_o$ | 2.85 | $0R_o$ |

| 3λ/8 back from receiving end | | λ/2 back from receiving end | | Slightly greater than λ/8 back from receiving end* | |
|---|---|---|---|---|---|
| 2.1 | Infinity | 2.85 | Infinity | 1.95 | Infinity |
| 2.3 | $3R_o$ | 2.8 | $3R_o$ | 2.2 | $3R_o$ |
| 1.95 | $R_o$ | 1.95 | $R_o$ | 1.95 | $R_o$ |
| 2.25 | $\frac{1}{3}R_o$ | 1.35 | $\frac{1}{3}R_o$ | 2.4 | $\frac{1}{3}R_o$ |
| 1.85 | $0R_o$ | 0 | $0R_o$ | 2.2 | $0R_o$ |

* Illustrating two anomalous points along with flat line condition. Not used in graphs.

Values for Current Curves of Fig. 1.

| At receiving end | | λ/8 back from receiving end | | λ/4 back from receiving end | |
|---|---|---|---|---|---|
| 0 | Infinity | 1.40 | Infinity | 1.95 | Infinity |
| 1.05 | $3R_o$ | 1.6 | $3R_o$ | 2.0 | $3R_o$ |
| 1.40 | $R_o$ | 1.4 | $R_o$ | 1.4 | $R_o$ |
| 2.05 | $\frac{1}{3}R_o$ | 1.6 | $\frac{1}{3}R_o$ | 1.0 | $\frac{1}{3}R_o$ |
| 1.95 | $0R_o$ | 1.4 | $0R_o$ | 0 | $0R_o$ |

| 3λ/8 back from receiving end | | λ/2 back from receiving end | |
|---|---|---|---|
| 1.4 | Infinity | 0 | Infinity |
| 1.55 | $3R_o$ | 1.05 | $3R_o$ |
| 1.4 | $R_o$ | 1.4 | $R_o$ |
| 1.6 | $\frac{1}{3}R_o$ | 2.05 | $\frac{1}{3}R_o$ |
| 1.4 | $0R_o$ | 1.95 | $0R_o$ |

Values for Apparent Power Curves of Fig. 1.

| At receiving end | | λ/8 back from receiving end | | λ/4 back from receiving end | |
|---|---|---|---|---|---|
| 0 | Infinity | 2.9 | Infinity | 0 | Infinity |
| 2.95 | $3R_o$ | 3.6 | $3R_o$ | 2.9 | $3R_o$ |
| 2.75 | $R_o$ | 2.73 | $R_o$ | 2.73 | $R_o$ |
| 2.76 | $\frac{1}{3}R_o$ | 3.5 | $\frac{1}{3}R_o$ | 2.8 | $\frac{1}{3}R_o$ |
| 0 | $0R_o$ | 2.77 | $0R_o$ | 0 | $0R_o$ |

| 3λ/8 back from receiving end | | λ/2 back from receiving end | |
|---|---|---|---|
| 2.84 | Infinity | 0 | Infinity |
| 3.6 | $3R_o$ | 2.94 | $3R_o$ |
| 2.74 | $R_o$ | 2.73 | $R_o$ |
| 3.5 | $\frac{1}{3}R_o$ | 2.77 | $\frac{1}{3}R_o$ |
| 2.6 | $0R_o$ | 0 | $0R_o$ |

# A new standard of performance for color television systems... The **RCA TM-21** Color Monitor

This new color control monitor is a reference standard for evaluating the quality of color television pictures from any source. Providing the most precise and brilliant color picture available . . . this new monitor accurately reproduces the scene *as the camera sees it*.

**QUALITY CONTROL OF COLOR PROGRAMMING**—The TM-21 is used in Color Camera Chains, Switching Systems, Master Control and Transmitting Control for monitoring color picture quality. It is the basic instrument for checking registration, shading and deflection linearity . . . color fidelity of the entire TV system . . . chroma to monochrome ratio . . . color phase or hue adjustments.

**BEST POSSIBLE COLOR**—When used to display color pictures in clients' rooms and executive offices, the TM-21 lets the station put its "best color foot forward." Clients will be impressed by the bright, high definition picture.

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**SIMPLIFIED MONITOR ALIGNMENT**—Initial adjustment is extremely simple. Built-in test switch reduces set-up time to minutes. Screen grid selector switch provides quick viewing of primary colors.

**LONG-TIME STABILITY**—Once set up, monitor adjustments "hold." Extra stability has been designed into brightness, contrast, decoder, convergence, and linearity circuits.

Get maximum return from your color TV investment! Ask your RCA Broadcast and Television representative for further information on the new TM-21 Color Monitor. In Canada: Write RCA VICTOR Company Limited, Montreal.


# Check these additional technical features:

- Feedback techniques and precision components provide long-term stability.
- Automatic brightness tracking for color balance.
- Convergence circuits designed for rapid setup.
- DC restoration at black level, stabilized by feedback.
- Stabilized diode demodulators.
- All components and tubes easily accessible.
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Circle 74 on Inquiry Card, page 103

# CUES for Broadcasters

## Volume Indicators

*STEPHEN J. STANLEY*
*WTRI, Albany, N. Y.*

Owners of the GE Limiting Amplifier, Type BA-5-A and other similar equipment incorporating built-in volume indicators, should be able to use or adapt an idea that I used.

In the limiting amplifier, S-13 is a double pole double throw toggle switch mounted on the front panel and marked 1 and 2. Position one switches the volume indicator across the output of the preamplifier section, while position two switches it across the output of the limiting amplifier unit.

This dpdt switch was removed and replaced with a two pole-three position rotary switch. Positions one and two were wired to the proper outputs to correspond with the original wiring. Position three was wired to a spare jack in the audio jack panel. I would suggest at this point, to wire two or three jacks in multiple with this jack if, of course, they are available.

It becomes quite apparent that when the new switch is in position three, the volume indicator can then be used for any desired external audio level measurements.

This system could be incorporated in equipment having a built-in volume indicator, but no switching facilities, by adding a dpdt switch and having position one normal and position two external.

## Testing Tape Speed

*BYRON G. PARRISH*
*WHAW, Weston, W. Va.*

Are you faced having to "play back" a tape-recording on the same recorder to obtain good fidelity? If so, one or more of your recorders is running slightly slow (or fast), due to capstan wear or a faulty motor.

Consequently, you're confronted with the task of determining which one is the "culprit." There's no need to purchase costly test equipment; it's very easy and inexpensive to make your own tape-recording "standard" for all speeds.

First, make a tape of a C.W. tone (500 to 1000 cps is satisfactory). Cut a 1½ in. strip from this tape. Next, you'll need a 36 in. length of "clean" tape. Be very careful in measuring these lengths of tape; your accuracy determines the accuracy of your "standard" tape.

Splicing these 2 strips together forms a 37½ in. loop. When this loop is played back, you will hear a series of "beeps," the P.R.F. (Pulse Repetition Frequency) depending upon the tape speed of the recorder.

| *Tape Speed (ips)* | *"Beep" Separation (sec.)* |
|---|---|
| 15 | 2½* |
| 7½ | 5 |
| 3¾ | 10 |
| 1⅞ | 20 |

* Every other "beep" giving 5 sec. check points.

## Remote Communication Control

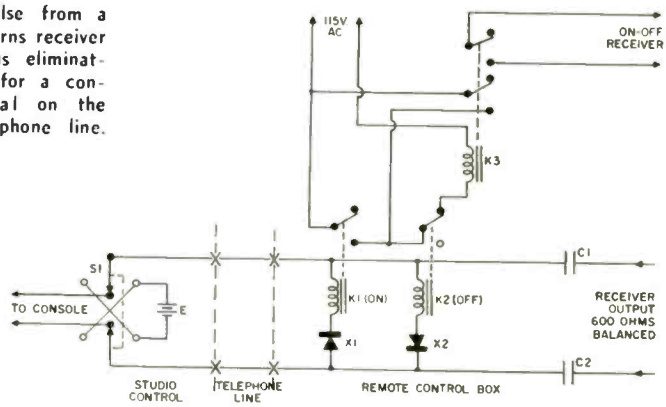
*TERRANCE O'ROURKE,*
*Ch. Engr.*
*WBUD, Trenton, N. J.*

To increase the range and quality of our two-way communication system for our news department, we installed an additional receiver on top of a high building in downtown Trenton. This receiver feeds a permanent telephone line to our studios located 6 miles away.

In order to keep the cost down on telephone rental charges, we employed only one telephone line for audio transmission and on-off control of the receiver. The circuit also has the advantage of only requiring a brief dc pulse from a small battery to either turn the receiver on, or off, without having to keep a constant potential on the line.

Relay K3 is wired for self-locking and provides, through its additional contacts, the on-off switch for the receiver. This relay action is controlled by polarity sensitive relays K1 and K2. (Latching relays were not used due to their low resistance and high current requirements.)

A brief dc pulse from a small battery turns receiver on or off, thus eliminating the need for a constant potential on the permanent telephone line.




K1 and K2 are of the plate current type with a coil resistance of 5000 Ω each. The miniature selenium rectifiers inserted in series with each coil but in opposite directions, permit only one relay to energize at a time, depending on the polarity of the applied voltage pulse.

Over 20 db was applied across these controlling relays but no chatter was observed. All the remote components were mounted inside an aluminum box to prevent dust from impairing its operation.

Parts List: *K3*—1 ea 115 V. ac Relay DPDT.

*K1 & K2*—2 ea P&B plate current relay LM5-SPDT-5000 Ω.

*X1 & X2*—2 ea 65 ma. Selenium Rectifiers.

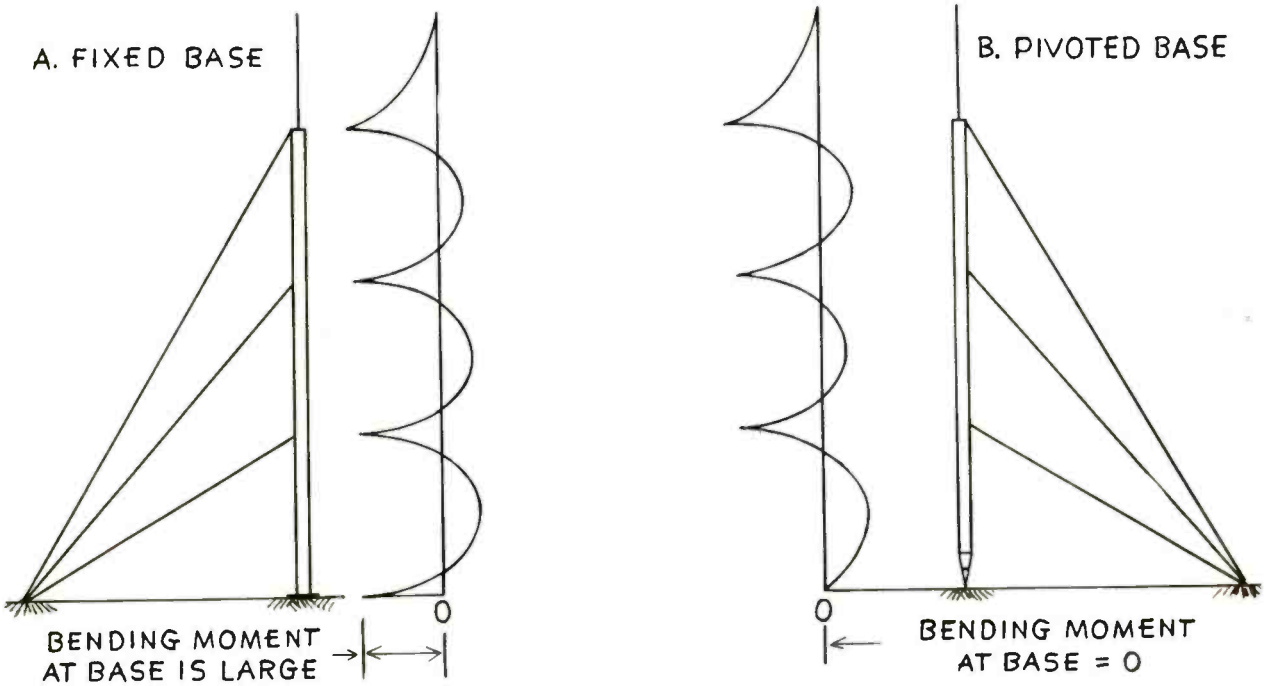
*S1*—1 ea Centralab Lever Action Switch. 2 Pol.-3 Pos.-Spring Return-Non-Short. No. 1455.

*C1 & C2*—2 ea 1 μf ceramic condenser.

*E*—1 ea 22.5 V. or 45 V. battery depending on distance of remote unit.

# TOWER TIPS

**Straight Base Versus Pivot on a Guyed Tower**




A guyed tower may be designed to come straight down at the base pier or to a pivot. Either method is satisfactory providing the conditions encountered are properly resolved and engineered.

The advantage of a pivoted base is that the pivot relieves a large bending moment at the pivot. This is graphically illustrated in the figure. Compare the moment curves of the two types of towers. The pivot saves steel, and it takes bending off the base insulator, in case there is an insulator. The load on a pier is pure down-load and the pier is a little easier to design.

The advantage of a straight fixed-base is ease in fabrication. The erector can start erecting without using temporary guys. However, the bending moment tends to increase weight. The insulators are a problem because each insulator must carry tension as well as compression. The base pier must be designed for the bending moment plus column load, thus making a larger concrete block.

WALTER L. GUZEWICZ

# Cues for Broadcasters

(*Continued from page* 010)

### Warning Tags

*DONALD M. WHEATLEY, Ch. Engr.*
*WJOY, Burlington, Vt.*

In order to avoid lost air time when things are not normal, we use tags made from red vinyl transcriptions.

These tabs are hung on the console switches when the unit is patched out of circuit for transcribing, etc. They serve as a reminder that some thing isn't set for normal operation on the circuit tagged.

### More on Echoes

*JESS PETERS, Ch. Engr.*
*WJOB, Hammond, Ind.*

For those stations who own, or have access to a Magnecord 3D Tape-Recorder—creating an echo effect is quick and easy.

Simply record the portion wanted with the echo effect, in 3D. When this is played back on a full track tape machine, the result is quite satisfactory.

The degree of delay can be controlled somewhat by the tape speed. We find 15 inches per second is best in most cases.

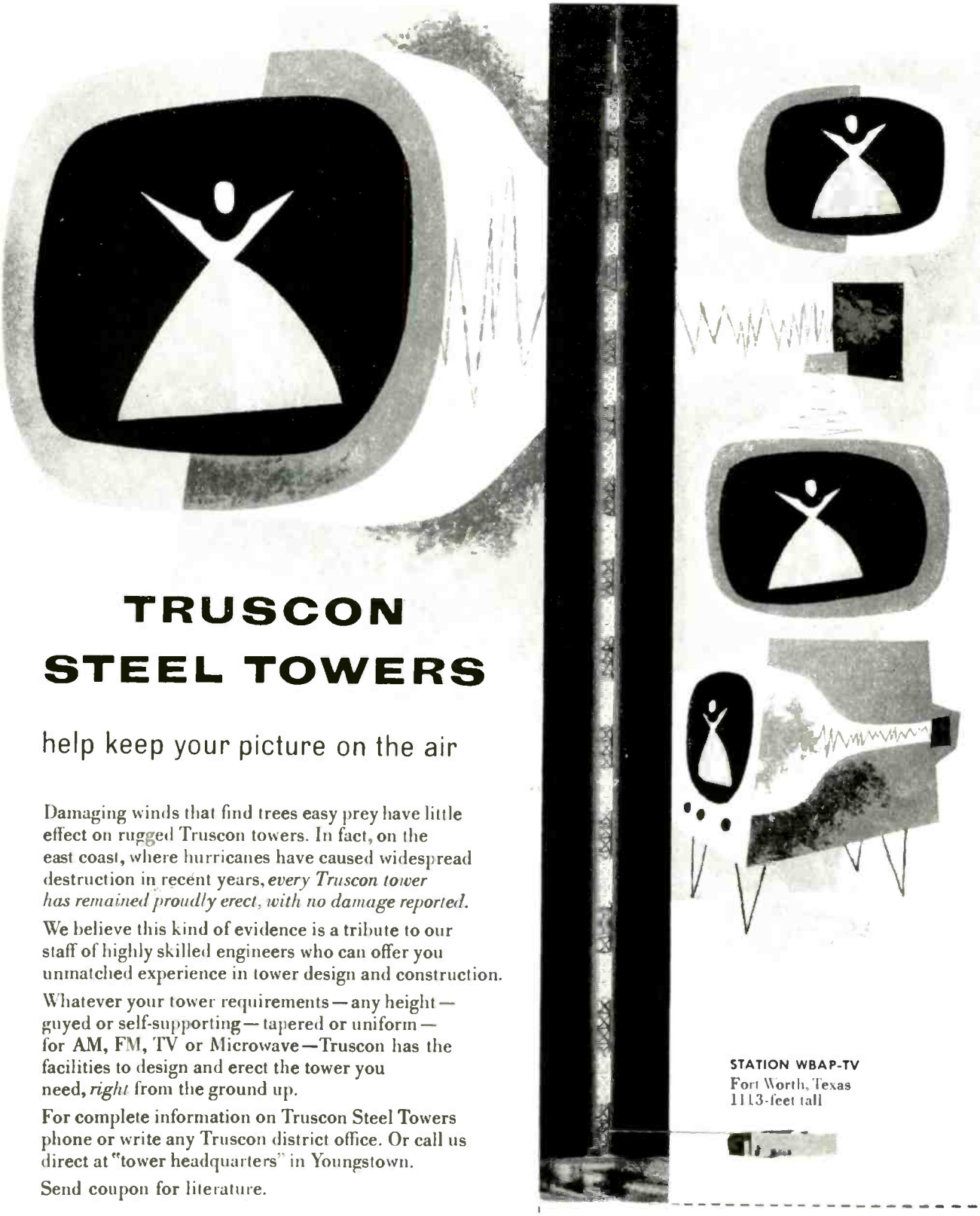
## Survey to Forecast Crop of Scientists

The U. S. Office of Education has launched a nationwide survey—the first of its kind—to determine the future crop of scientists and mathematicians.

About 1,100 colleges and universities have been invited to participate in a tally of college juniors majoring in science and mathematics. More than 600 of these institutions have assisted in pretesting the survey questionnaire, which has been developed during the past year.

Lawrence G. Derthick, U. S. Commissioner of Education, said in announcing the study, "It will give us a two-year lead in our knowledge of the potential supply of scientists and mathematicians. Such knowledge is urgently needed by educators and others in planning the Nation's educational programs."

The questionnaire covers such physical sciences as physical science, general; astronomy, chemistry, metallurgy, meteorology, physics, geology, geophysics, oceanography, and other earth sciences and physical sciences.



# TRUSCON STEEL TOWERS

## help keep your picture on the air

Damaging winds that find trees easy prey have little effect on rugged Truscon towers. In fact, on the east coast, where hurricanes have caused widespread destruction in recent years, *every Truscon tower has remained proudly erect, with no damage reported.*

We believe this kind of evidence is a tribute to our staff of highly skilled engineers who can offer you unmatched experience in tower design and construction.

Whatever your tower requirements — any height — guyed or self-supporting — tapered or uniform — for AM, FM, TV or Microwave — Truscon has the facilities to design and erect the tower you need, *right* from the ground up.

For complete information on Truscon Steel Towers phone or write any Truscon district office. Or call us direct at "tower headquarters" in Youngstown.

Send coupon for literature.

**STATION WBAP-TV**
Fort Worth, Texas
1113-feet tall

TRUSCON®

**TRUSCON STEEL DIVISION**
**REPUBLIC STEEL**
**YOUNGSTOWN 1, OHIO**
Export Dept.: Chrysler Bldg., New York 17, N. Y.

A NAME YOU CAN BUILD ON

**TRUSCON STEEL DIVISION**
**REPUBLIC STEEL CORPORATION**
**1092 Albert Street, Youngstown 1, Ohio**

Please send me latest catalog showing specifications and other details of Truscon Steel Towers.

Name_____ Title_____

Company _____

Address _____

City_____ Zone___ State_____

C-2912-R



Circle 77 on Inquiry Card, page 103

## *10,000 Miles of Wire In WBBM-TV, Chicago*

WBBM-TV, that new CBS station in Chicago, billed as the "largest TV-radio-recording station in the world," has about 10,000 miles of wiring. Another 10,000 miles of wire will be needed when color broadcasts are started.

In order to protect this vital complex of control cables, telephone wires, audio and video lines, paging circuits,

Control room for Studio One at the new CBS radio-TV-recording station in Chicago. The studio can be seen in the background.

etc., CBS engineers used nearly a mile of cable trough and ladders. Standard trough and ladder sections made by the T. J. Cope Div. of the Rome Cable Corporation were used. Changes and servicing are simplified by the system.

## *Push SSB for Mobile Services*

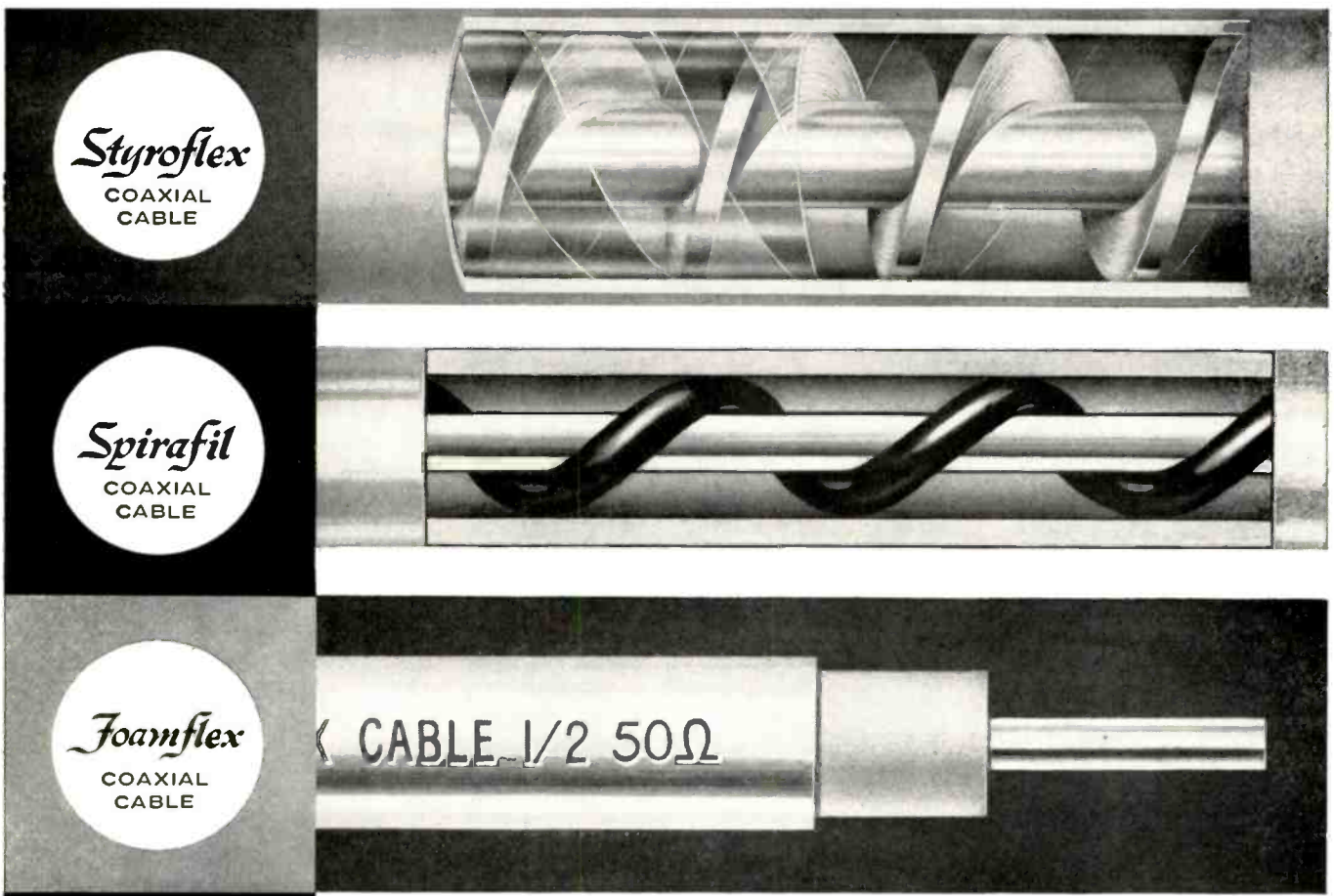
SSB has received a new boost from tests at Motorola's Applied Research Department. The tests indicate that the "synchronous sideband system is well suited for mobile service and VHF frequencies, and will provide more channels at the expense of somewhat more equipment complexity," according to Motorola's Dr. William L. Firestone.

Motorola ran tests with comparable FM and SSB equipment operating side-by-side in a mobile installation. Tests were run in residential and industrial areas of Chicago. Significant results are reported: "As the signal became weaker, ignition disturbances from the test vehicle and from nearby vehicles were heard on both equipments, but although the FM reception was somewhat easier to read, good communication was obtained from both equipments. . . . audio quality . . . was much the same at this point. As the test progressed into the fringe area, the two equipments went out of range at the same point." Dr. Firestone reports further that the two systems were comparable in other significant factors as well.

- No radiation
- Low attenuation
- Excellent frequency response
- Uniform electrical properties over wide temperature variations
- Unlimited operating life
- Continuous 1000′ lengths

## These are the Features of the

# FINEST LINE OF HIGH FREQUENCY CABLES IN THE COMMUNICATIONS FIELD!




PHELPS DODGE COPPER PRODUCTS CORPORATION

300 PARK AVENUE, NEW YORK 22, N. Y.

# New Products . . . for Communications

## POWER SPEAKER

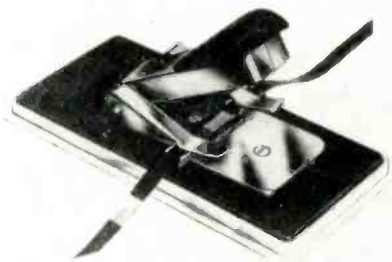
A new transistorized "Big Voice" power speaker increases the effectiveness of two-way mobile radios by extending the listening range hundreds to thousands of feet, insuring that the

driver will hear all messages even when working away from his parked vehicle. And by turning a control, speaker is converted into a powerful public address system with a half a mile or more range. Speaker provides up to 15 watts power output at 12 volts. Motorola Inc., 4501 W. Augusta Blvd., Chicago 51, Ill.

Circle 241 on Inquiry Card, page 103

## TAPE SPLICER

A professional splicer for magnetic recording tape has been added to the line of IRISH brand products. The splicer is designed for fast, precise tape editing and repairing. It is easy



to handle and will make a neat professional splice in seconds. Splicer may be removed from its base and mounted directly on any tape recorder. It cuts 2 rounded indentations in the tape splice, giving splice a narrow waist. This leaves edges of tape free of adhesive. ORRadio Industries, Inc., Shamrock Circle, Opelika, Ala.

Circle 242 on Inquiry Card, page 103

## FIELD STRENGTH METER

The battery operated FSM-1 tunes continuously from 54 to 216 MC. The bands covered are VHF television, FM, aircraft, mobile, amateur and other special services. Addition of a B-T

UHF converter expands signal readings to the complete UHF television range. Exact signal strengths can be read from 10 μv. to 3 v. It includes a phone jack, front panel attenuator switches, pilot light, handle & carrying strap, db and percentage AM modulation scales. Blonder-Tongue Labs., Inc., 9-25 Alling St., Newark 2, N. J.

Circle 243 on Inquiry Card, page 103

# New Tech Data for Engineers

### Volt-Ohm-Frequency Meter

A 2-color bulletin issued by Lycoming Div. of Avco Mfg. Corp., Stratford, Conn. describes a combination of volt-ohm-frequency meter Model B. Brochure is complete with photographs, electrical and mechanical specifications.

Circle 160 on Inquiry Card, page 103

### Loudspeakers

A 12-page illustrated catalog covers a complete line of loudspeakers and speaker components for high fidelity and commercial-industrial use. Complete information and description is given. University Loudspeakers, Inc., 80 So. Kensico Ave., White Plains, N. Y.

Circle 161 on Inquiry Card, page 103

### Carbon Film Resistors

A 2-color brochure issued by Texas Instruments, Inc., P. O. Box 312, Dallas, Tex. describes their new line of deposited carbon film resistors. Brochure is complete with tables, graphs, and photographs along with all required specifications.

Circle 162 on Inquiry Card, page 103

### Combination Test Set

A 2-color, 4-page brochure issued by Microwave Electronics Div., Sperry Gyroscope Co., Great Neck, N. Y. describes their new combination test set for measuring all X-band, radar parameters. Brochure contains photographs, and complete electrical and mechanical specifications.

Circle 163 on Inquiry Card, page 103

### Microwave Components

Sylvania Electric Products Inc., 500 Evelyn Ave., Mountain View, Calif. has just issued an 8-page, 2-color brochure giving technical information on traveling wave tubes, ferrite devices, and klystrons. Brochure is complete with photographs, tables, and outline drawings.

Circle 164 on Inquiry Card, page 103

### Communication Towers

Complete new communications tower catalog is now available from Rohn Mfg. Co., 116 Limestone, Bellevue, Peoria, Ill. Catalog features full information on their line of heavy-duty communications and amateur towers. Complete information, including installation, is contained in this catalog.

Circle 165 on Inquiry Card, page 103

### Laminated Plastics

Synthane Corp., Oaks, Pa. has just published a new 6-page folder describing the six most widely used grades of metal-clad laminates for printed circuitry. The 2-color brochure is fully illustrated and contains detailed tables giving the various properties of the laminates.

Circle 166 on Inquiry Card, page 103

### Metal Foils

A 4-page bulletin issued by Modern Adhesives and Electronics, Inc., 402 Garden Blvd., Garden City So., Long Island, N. Y. describes fully their complete line of aluminum, copper and lead foils. Bulletin is complete with tables, electrical and mechanical specifications.

Circle 167 on Inquiry Card, page 103

### Ultrasonic Cleaner

The Narda Ultrasonics Corp., 160 Herricks Rd., Mineola, N. Y. has issued a bulletin describing their new SonBlaster ultrasonic cleaner. Bulletin is complete with specifications, photographs and prices.

Circle 168 on Inquiry Card, page 103

### Binder Catalog

An all new 116-page loose-leaf and sales presentation catalog is being offered by the Elbe File & Binder Co., Inc., Fall River, Mass. It lists over 2500 stock items and special price schedules for hundreds of made-to-order binders. Complete information is given along with photographs and illustrations.

Circle 169 on Inquiry Card, page 103

### Manufacturing Transistors

The General Transistor Corp., 91-27 138th Place, Jamaica, 35, N. Y. has just issued an 8-page, 2-color brochure describing, with photographs, step-by-step procedures followed in manufacturing germanium alloyed junction transistor.

Circle 170 on Inquiry Card, page 103

### Ultrasonic Generator

The ultrasonic generator for industrial processing and laboratory research is described in a new 2-color brochure issued by The General Ultrasonics Co., 67 Mulberry St., Hartford 3, Conn. Brochure contains complete information on transducers and electronic generator. An ultrasonic spectrum chart is included.

Circle 171 on Inquiry Card, page 103

### Precision Resistors

Chicago Telephone Supply Corp., Elkhart, Ind. has just issued a 2-color brochure that describes their latest line of resistors. The new precision wire fixed resistor with a "floating" element is described completely with photographs, electrical and mechanical specifications.

Circle 172 on Inquiry Card, page 103

### Computer Operations

A new aid to help top management investigate the electronic computer, its capabilities, operation and applications has been published by Remington Rand Univac Div. of Sperry Rand Corp., 315 Fourth Ave., New York 10, N. Y. in a 196-page manual, titled "A Study for Management —The Univac II Data Automation System." Written entirely from the management point of view, the illustrated manual is a good starting point for thorough exploration of electronic data processing.

Circle 173 on Inquiry Card, page 103

### Germanium Rectifiers

Bulletin GEA-5773C, 6 pages, tells how to select and apply fan-cooled and blower-cooled germanium rectifiers. Tables, charts, line drawings, and photographs are included to tell the story. General Electric Co., Schenectady, N. Y.

Circle 174 on Inquiry Card, page 103

### AF Amplifiers

Cinema Engineering, Div. Aerovox, Burbank, Calif. has issued a catalog on its audio frequency amplifiers. A dozen pages contain illustrations, charts and diagrams. Catalog No. 16-C describes pre-amplifiers, line amplifiers, oscillators, equalizer-amplifiers, plug-in chassis in kit form, mounting frames and power supplies.

Circle 175 on Inquiry Card, page 103

### Oscillographic Recording

A new 16-page catalog contains descriptions, specifications and prices of all Sanborn Co., 175 Wyman St., Waltham 54, Mass. line of "150" oscillographic recording systems and full line of "150" accessories and unit instruments.

Circle 176 on Inquiry Card, page 103

### Test Instruments

A bulletin issued by California Technical Industries, Belmont, Calif., describes their complete line of test instruments for radome and antenna testing, microwave measurements, dynamic flight, simulation, and production test equipment.

Circle 177 on Inquiry Card, page 103

# Does specialized business publication advertising pay?

**No one is in a better position to give a hard-boiled, practical answer to this question than the men who spend their working lives on the sales front ... the men the ads are supposed to help ... the men who sell.**

**Here are the statements of salesmen who know what advertising does for them when it appears in the industrial, trade or professional publications that serve the specialized markets to which they sell:**

Bill Kramer
Monsanto Chemical Co.
**sells to industry**

## says Mr. Kramer:

"We make many different chemicals, mostly standardized products that don't have trade names. Many of our chemicals are purchased in small quantities direct and through distributors. So you might think that all I have to sell is price. That's not true. Thanks to our advertising in business papers the name '*Monsanto*' is known to stand for quality products and service.

"We have so many small customers I can't call on all of them, so advertising must carry a large part of the load for the small orders we get from such people which add up to a great deal of tonnage. Advertising also gets across the fact that we warehouse standard chemicals right here in the city and can give prompt service.

"We have such a long list of chemicals that I wouldn't do much of a sales job if I just read the list of chemicals we make on each sales call. So again our company uses advertising to let the people know all the different chemicals we are prepared to deliver. Then we salesmen can concentrate on the individual prospect's immediate requirement.

"Of course you don't always know exactly what chemicals are required by a particular prospect because a company can go into a new product, or a variant of an old one, almost overnight and come up with a need for a chemical he'd never used before. So it's pretty important for our advertising to remind all buyers just what lines we have.

"Although many of our chemicals don't have trade names, we have one silica product that has become known to the trade as '*Santocel*'. Very few people in the trade call this by its proper chemical name – they refer to it as '*Santocel*'. Advertising in the trade papers has created this new name and made it stick. These are just some of the ways I know advertising is working for me – calling on people I can't get to see and calling more often than I can possibly do in person, and suggesting new uses for our products."

Harold Robus
Shuron Optical Company
**sells to wholesalers**

## says Mr. Robus:

"My direct customers are wholesalers—distributors with optical laboratories who sell to and fill prescriptions for optometrists, ophthalmologists and opticians. These men in turn are my secondary, though nonetheless important, customers. I do a lot of so-called missionary work with them, and I also write a lot of orders that are billed, of course, through the wholesaler of their choice.

"My company's trade advertising in professional journals is directed to these men who examine eyes and dispense eyewear. It has several purposes. First, it sells the company and its policies. Then we use it to introduce new products and all important specifications such as styles, colors, sizes and availability. Another aim of our advertising is to keep the 'retailer' sold on products that he has ordered from me or from his wholesaler.

"I know our advertising does a job when I hear constant references to 'the SHURON ad I saw recently' or 'that new frame I saw in your ad.'

"It has been my experience that all three types of advertising are important, but that keeping the 'retailer' sold on SHURON products is the most vital. It helps bolster his confidence in his own judgment and cuts down my competitors' chances of selling him between my calls.

"Yes, I list advertising as No. 2 in importance in selling our products. When I put it in second position I put it ahead of salesmen. Here's the way I see it. Number one — you have to have a good product. Number two — you have to have a good advertising campaign. Number three — you have to have good men to follow up the advertising.

"That's my opinion."

Glen Chase
Yarnall-Waring Company
**sells to industry**

## says Mr. Chase:

"I have been selling *Yarway* products for over seven years, and I'll have to admit that I've taken the trade paper advertising for granted. But when I stop to think I realize it's out there working for me all the time.

"For instance, I never have to tell my prospects who YARNALL-WARING is, or what they make. Often I don't even have to tell them why they should see me and find out what I've got to offer. The advertising has done much of the *who, what,* and *why* of selling before I make my contact.

"Here's an example: I recently had a phone call from a potential customer that I'd never even called on. He was having trouble with a competitive product. He'd seen our ads and wanted to try my product. That's one time when my sale consisted merely of writing the order. Advertising really made the sale.

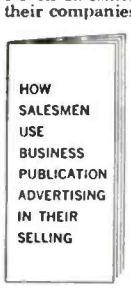
"The advertising has given people a good impression of our company, too. This is surprising, when you stop to think about it, because we are a relatively small organization.

"Our company name is YARNALL-WARING but a great many people say '*Yarway*'. I believe this use of our trade-mark may be due to the wide use of the company trade-mark in our trade paper advertisements, on our product name plates, shipping cartons and stationery."

**Ask your own salesmen** what your company's business publication advertising does for them. If their answers are generally favorable, you can be sure that your business publication advertising is really helping them sell. If too many answers are negative, it could well pay you to review your advertising objectives — and to make sure the publications that carry your advertising are read by the men who must be sold.

**How salesmen use their companies' advertising to get more business**

Here's a useful and effective package of ideas for the sales manager, advertising manager or agency man who would like to get more horsepower out of his advertising. Send for a free copy of the pocket size booklet entitled, "How Salesmen Use Business Publication Advertising in Their Selling," which reports the successful methods employed by eleven salesmen who tell how they get more value out of their companies' advertising.




You'll find represented many interesting variations in how they do this. Some are very ingenious; all are effective. You can be sure that more of your salesmen will use your advertising after they read how others get business through these simple methods.

The coupon is for your convenience in sending for your free copy. Then, if you decide you want to provide your salesmen with additional copies, they are available from NBP Headquarters in Washington, at twenty-five cents each. Or if you choose you can reprint the material yourself and distribute it as widely as you please. But first, send for your free copy.

**NATIONAL BUSINESS PUBLICATIONS, INC.**

NBP

...each of which serves a specialized market in a specific industry, trade or profession.

NATIONAL BUSINESS PUBLICATIONS, INC.
Department 5A
1413 K Street, N. W.
Washington 5, D. C. STerling 3-7533

Please send me a free copy of the NBP booklet "How Salesmen Use Business Publication Advertising in Their Selling."

Name

Title

Company

Street Address

City Zone State

# New Tech Data for Engineers

(*Continued from page* 123)

### Solderless Connectors

The "Hyfen," a solderless multi-lead plug-and-receptacle connector, is described in a 2-colored brochure issued by the Omaton Div. of Burndy Corp., Norwalk, Conn. Brochure is complete with photographs, specifications, and information on working with these solderless connectors.

Circle 178 on Inquiry Card, page 103

### Electronic Equipment

Meter calibrators, voltage regulators, digital readout meters, dc power supplies and other electronic equipment for either laboratory or production use is described in a new 8-page catalog just released by Davenport Mfg. Co., Dept. TTN, 1713 N. Ashland Ave., Chicago 22, Ill. The booklet gives complete information and operating data for all models.

Circle 179 on Inquiry Card, page 103

### Pulse Transformers

General catalog TR-57, issued by Triad Transformer Corp., 4055 Redwood Ave., Venice, Calif. describes their complete line of pulse transformers. Catalog contains complete information and specifications.

Circle 180 on Inquiry Card, page 103

### Transistor Inverters

A 10-page, 2-color brochure issued by Varo Mfg. Co., Inc., 2201 Walnut St., Garland, Tex. describes their complete line of transistor inverters for conversion of dc to 400 cps ac. Brochure contains photographs, electrical and mechanical specifications, block diagrams, schematics, and tables covering transistor inverters.

Circle 181 on Inquiry Card, page 103

### Magnetic Storage Drums

A 2-color brochure issued by Bryant Gage & Spindle Div., Bryant Chucking Grinder Co., P. O. Box 620, Springfield, Vt. describes their line of magnetic storage drums. Brochure contains photographs, line drawings and other information.

Circle 182 on Inquiry Card, page 103

### Copper Foil

An 8-page illustrated booklet suggesting commercial applications of copper foil has just been released by The American Brass Co., Ansonia Div., 75 Liberty St., Ansonia, Conn. Publication D-8 describes such applications as electrostatic shielding, printed circuitry and other uses.

Circle 183 on Inquiry Card, page 103

### Electronics in General

"The New World of Electronics" has been published by the Amphenol Electronics Corp. of Chicago, 1830 S. 54th Ave., Chicago 50, Ill. Designed to examine the various factors which affect electronic development, the colorful booklet describes the importance of research, engineering, facilities, quality control and reliability in electronic components and in any electronics product. Described as being of interest to everyone associated with the electronics industry.

Circle 184 on Inquiry Card, page 103

### Shielding Materials

The Metal Textile Corp., Roselle, N. J., has issued a filing cabinet type folder including data sheets and booklets describing radiation interference shielding products. It contains photographs and complete information.

Circle 185 on Inquiry Card, page 103

### Transmitter Tubes

Penta Laboratories, Inc., 213 N. Nopal St., Santa Barbara, Calif., offers a 9-page bulletin "Transmitting Tubes for Linear Amplifier Service." The bulletin details special problems of linearity in output and efficiency, and transmitter tube geometry in linear amplifiers for single-sideband operation. Comparative data on triodes, tetrodes and pentodes, including oscilloscope patterns, and tube loading characteristic curves are presented. Design principles of new tubes are discussed and the results of electron-path studies are illustrated.

Circle 186 on Inquiry Card, page 103

### Scientific Instruments

A new short form catalog has been issued by Eldorado Electronics Co., 2821 10th St., Berkeley, Calif. Instruments included are the accelerator current integrator, Universal photomultiplier, photometer, milli-microsecond time-to-pulse height converter, and multi-channel pulse-height analyzer.

Circle 187 on Inquiry Card, page 103

### Thermostat Metals

TRU-6, a 4-page technical bulletin entitled "Corrosion-Resistant Thermostat Metals," summarizes the test results on various thermostat metals exposed to corrosive environments such as highly humid atmospheres, hot water, salt spray, etc., and describes the material as observed in actual application. Charts, graphs and photographs are included. Metals & Controls Corp., Attleboro, Mass.

Circle 188 on Inquiry Card, page 103

### Chassis Latches

Bulletin No. 27L issued by the Camloc Fastener Corp., 22 Spring Valley Rd., Paramus, N. J., describes in detail their electronic chassis latches for electronic chassis and airborne equipment fastening.

Circle 189 on Inquiry Card, page 103

### Stainless Fasteners

Allmetal Screw Products Co., Inc., 821 Stewart Ave., Garden City, L. I., N. Y., has just issued a new 2-color, 52-page stainless fastener stock list and data book. The first part includes illustrations, thread and design specifications, and availability in a variety of corrosion-resistant metals of 40 basic fastening devices. The second part consists of engineering data relating to the composition, properties, applications, and weights of these fasteners.

Circle 190 on Inquiry Card, page 103

### Fasteners

A 2-color brochure issued by Standard Pressed Steel Co., Box 899, Jenkintown, Pa., covers a complete line of standard industrial fasteners, socket screw products, self-locking nuts, spring pins and steel collars. Brochure is complete with photographs and specifications.

Circle 191 on Inquiry Card, page 103

### X-ray Instrumentation

A new 12-page booklet giving engineering data on the newest X-ray instruments for element analysis and structure determinations is available from the Instrument Div., Philips Electronics, Inc., 750 S. Fulton Ave., Mt. Vernon, N. Y. Text covers basic diffraction equipment including cameras, the X-ray diffractometer and the X-ray spectograph. A special section is devoted to the electronic circuit panel which is employed with diffractometer and spectograph installations.

Circle 192 on Inquiry Card, page 103

### Motorized Devices

An 8-page catalog describing instrument panel vibrators, DC generators, planetary gear reductions, clutches, rate gyros, actuators, timers, and power positioners is available from Globe Industries, Inc., 1784 Stanley Ave., Dayton 4, Ohio. The devices described meet various MIL specifications, and also have application in industrial control equipment.

Circle 193 on Inquiry Card, page 103

# Procurement Information on Guided Missile Programs

The Office of the Secretary of Defense has assembled the following information to guide firms and individuals desiring to participate in the guided missile programs of the military departments.

### THE DEPT. OF THE ARMY

Companies interested in the Department of the Army Guided Missile Program as a prime or subcontractor may utilize U. S. Army Ordnance Corps District Offices as readily accessible points of contact, or to discuss current procurements on a prime contract basis and possible potential subcontracting sources:

Birmingham Ordnance District
2120 North Seventh Avenue
Birmingham, Alabama

Boston Ordance District
Boston Army Base
Boston 10, Massachusetts

Chicago Ordnance District
209 West Jackson Boulevard
Chicago 6, Illinois

Cincinnati Ordnance District
Swift Building
230 E. Ninth Street
Cincinnati 2, Ohio

Cleveland Ordnance District
Lincoln Building
1367 E. Sixth Street
Cleveland 14, Ohio

Detroit Ordnance District
574 East Woodbridge
Detroit 31, Michigan

Los Angeles Ordnance District
55 South Grand Avenue
Pasadena, California

New York Ordnance District
180 Varick Street
New York 14, New York

Philadelphia Ordnance District
128 North Broad Street
Philadelphia 2, Pennsylvania

Pittsburgh Ordnance District
200 4th Avenue
Pittsburgh 22, Pennsylvania

Rochester Ordnance District
Sibley Tower Building
25 North Street
Rochester, New York

St. Louis Ordnance District
1016 Olive Street
St. Louis 1, Missouri

San Francisco Ordnance District
1515 Clay Street, P.O. Box 1829
Oakland 12, California

Springfield Ordnance District
Springfield Armory
Springfield 1, Massachusetts

The Army presently has prime contracts with the following companies which utilize innumerable companies and organizations for subcontract work:

Western Electric Co., N. Y., N. Y., or Burlington, N. C.
Douglas Aircraft Co., Santa Monica, Calif.
Raytheon Manufacturing Co., Andover, Mass.
Firestone Tire and Rubber Co., Los Angeles, Calif.
Gilfillan Brothers, Inc., Los Angeles, Calif.
Chrysler Corp., Warren, Mich.
The Martin Co., Orlando, Fla.
Utica-Bend Corp., Utica, Mich.
Emerson Electric Co., St. Louis, Mo.

### THE DEPT. OF THE NAVY

For information on requirements of the Department of the Navy regarding missiles, write the following Small Business Specialists who will provide more specific information as to how further to proceed:

Small Business Specialist
Bureau of Aeronautics
Department of the Navy
20th and Constitution Avenue, N.W.
Washington 25, D. C.

Small Business Specialist
Bureau of Ordnance
Department of the Navy
18th and Constitution Avenue, N.W.
Washington 25, D. C.

Work on Navy missile requirements may also be done for prime contractors having current contracts with the Navy Department. For information on such prime contractors consult "Selling to Navy Prime Contractors," which may be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.—Price 30¢. Among current Navy prime contractors in missile work are the following:

Bendix Aviation Co., Mishawaka, South Bend, Ind.
Convair, Division of General Dynamics, Pomona, Calif.
Chance-Vought Aircraft, Inc., Dallas, Tex.
Douglas Aircraft Co., Inc., Santa Monica, Calif.
General Electric Co., Schenectady, N. Y.
Lockheed Aircraft Corp., Sunnyvale, Calif.
Philco Corp., Phila., Pa.
Raytheon Mfg. Co., Waltham, Mass.

### THE DEPT. OF THE AIR FORCE

Individuals or companies desiring procurement information relative to missiles should contact the Small Business Specialist at the Air Procurement District Offices nearest their place of business, and listed as follows:

Boston Air Procurement District
Middletown Air Materiel Area
Boston Army Base
Boston, Massachusetts

Newark Air Procurement District
Middletown Air Materiel Area
218 Market Street
Newark, New Jersey

New York Air Procurement District
Middletown Air Materiel Area
111 East 16th Street
New York 3, New York

Philadelphia Air Procurement District
Middletown Air Materiel Area
1411 Walnut Street
Philadelphia 2, Pennsylvania

Rochester Air Procurement District
Middletown Air Materiel Area
20 Symington Place
Rochester 3, New York

Chicago Air Procurement District
Oklahoma City Air Materiel Area
5555 South Archer Avenue
Chicago 38, Illinois

Milwaukee Air Procurement District
Oklahoma City Air Materiel Area
770 N. Plankinton Avenue
Milwaukee, Wisconsin

St. Louis Air Procurement District
Oklahoma City Air Materiel Area
1114 Market Street
St. Louis, Missouri

Dayton Air Procurement District
Mobile Air Materiel Area
Bldg. 70, Area "C"
Wright-Patterson Air Force Base
Dayton, Ohio

Dallas Air Procurement District
San Antonio Air Material Area
912 S. Ervay
Dallas 1, Texas

Cleveland Air Procurement District
Mobile Air Materiel Area
1279 W. Third Street
Cleveland 13, Ohio

Detroit Air Procurement District
Mobile Air Materiel Area
W. Warren Ave. & Lonyo Blvd.
Detroit 32, Michigan

Indianapolis Air Procurement District
Mobile Air Materiel Area
54 Monument Circle
Indianapolis 6, Indiana

Arizona Air Procurement District
San Bernardino Air Materiel Area
P.O. Box 5555, Helen Street Annex
Tucson, Arizona

Los Angeles Air Procurement District
San Bernardino Air Materiel Area
1206 Maple Avenue
Los Angeles 15, California

San Diego Air Procurement District
San Bernardino Air Materiel Area
4325 Pacific Highway
San Diego 10, California

Atlanta Air Procurement District
Warner Robins Air Materiel Area
41 Exchange Place, S.E.
Atlanta, Georgia

San Francisco Air Procurement District
Sacramento Air Materiel Area
Bldg. 1, Oakland Army Terminal
W. Grand Ave. & Maritime
Oakland 14, California

# Industry News

**William F. Kamsler** will now serve in the position of Product Line Sales Supervisor, Systems Div., Beckman Instruments, Inc. Mr. Kamsler was formerly with Fischer & Porter, and prior to that Leeds & Northrup.

**Joseph D. Zasa** is now a Sales Engineer in the Apparatus Div. of Texas Instruments, Inc., for the northeastern region of the U. S. with headquarters in New York City. Mr. Zasa was formerly with General Electric and Leetronics, Inc., as sales manager.

**Emil Nichols**, Manager of Test Equipment Sales, **A. R. Walthers**, Manager Tachometer Sales, and **Paul M. Heilman**, Distributor Sales Manager, are the latest appointments at Weston Electrical Instrument Corp.

**Roland L. Van Allen** has accepted an appointment as Head of the Circuit Research section at Control, a division of Magnetics, Inc.

**Gerald E. Potter** is now Director of Field Applications for Filtors, Inc. Mr. Potter was formerly Sales Manager of components for Rocklar Corp. and sales supervisor of Potter and Brumfield, Inc.

**Richard J. Meyer** has recently been promoted to the rank of Brigadier General. General Meyer is Chief of the R D Div., Office of the Chief Signal Officer.

**Donald M. Miller** has been elected Executive Vice President of Airborne Instruments Laboratory.

D. M. Miller

R. M. Fritz

**Robert M. Fritz** is now Manager—Marketing for GE's Missile & Ordnance Systems Dept.

**Arthur L. Mayer** and **William F. Sheehan** have been appointed, respectively, Sales Manager and Engineering Department Head for missile systems for Sperry Gyroscope Company's Sunnyvale Development Center.

**Robert Burns** is the new Sales Manager of the cataloged products division of Chicago Standard Transformer Corp. Mr. Burns was formerly Sales Manager of Gramer-Halldorson Transformer Co. and a District Manager of the Distributor Div. of Belden Mfg. Co.

**T. M. Fitzgerald** has been named General Sales Manager of the Electronic Div. P. R. Mallory & Co. Inc.

T. M. Fitzgerald

R. Ives

**Raymond Ives** has been appointed Mid-Western Regional Sales Manager for the Alpha Wire Corp. Mr. Ives was previously associated with Reeves Sound-Craft.

**Dr. William J. McBride, Jr.**, will head Varian Associates' newly organized Systems Group.

**Seymour Winuk** has been promoted to Assistant Sales Manager for selenium rectifiers, Semiconductor division of the Radio Receptor Co.

**Henry M. Taylor** has joined Stromberg-Carlson—San Diego, as Manager of Marketing. Mr. Taylor was formerly Manager of Customer Relations for the Electronics Systems Div. of Sylvania Electric Products, Inc.

**Rudolph Sachs** has joined General Transistor Corp. as Vice President in charge of the new Diode Div. **Max Fialkov** becomes Head of Transistor Manufacturing; **Allan Easton** heads the Marketing Div.; **Frank Pennucci** heads the General Services Div.; **Bernard Cohen** heads the engineering Div.; and **Bernard Jacobs** is in charge of the Research Div.

**Christian J. Goodman, Jr.**, is now Product Sales Manager in the Semiconductor Products Dept., General Electric Co. **K. O. W. Sandberg** becomes Manager of Manufacturing for the Plastics Dept.

**Robert D. Browning** has joined Research and Engineering Staff of ORRadio Industries, Inc. Mr. Browning was formerly a Recording Engineer for RCA Victor.

**Dr. Jobe Jenkins** will now serve as Manager of the Communications Dept. for a Weapon System Technical Div. of Lockheed's Missile Systems Div.

**Dean R. McKay** has been appointed Director of Communications at International Business Machines Corp.

**John B. Graef** has been promoted to the position of Manager of Aviation Industry Sales at Westinghouse Electric Corp.

**Robert W. Olson** has been advanced to the position of Vice President-Research and Engineering and **E. O. Vetter** appointed General Manager of Industrial Instrumentation Div. at Texas Instruments, Inc.

**Perry L. Toback** has been named as head of Application Engineering, Hoffman Semi-conductor Div. Mr. Toback was formerly with Panellit Corp. and Armour Research Foundation.

P. L. Toback

S. Krinsky

**S. Krinsky** has been appointed Director of the newly opened Western Engineering Div. of Telechrome Mfg. Corp. Mr. Krinsky was formerly Chief Engineer of Chromatic Television Labs.

**Gerald L. Moran** is now General Manager of the Chemical and Metallurgical Div. of Sylvania Electric Products Inc.

**J. Burton Henry** has become Sales Manager, New Products Div. at International Resistance Co. **Louis F. Norris** is now a Sales Engineer.

**Lawrence LeKashman** has rejoined Electro-Voice as Sales Vice President. Mr. LeKashman was formerly with David Bogen Co. and Presto Recording Corp.

# Books For Electronic Engineers

### *Closed Circuit TV System Planning*

*By Morris A. Mayers and Rodney D. Chipp. Published 1957 by John F. Rider, Publisher, Inc., 116 W. 14th St., New York 11. 250 pages, xii pages. Price $10.00.*

This book is a complete and authoritative advisory source for all who are contemplating the use of closed circuit television. An excellent guide for those who are faced with the responsibility of planning and evaluating closed circuit TV systems, it answers all questions related to the organization of closed circuit television systems, such as space requirements, cost of equipment and its installation, types of equipment available and manpower needed to operate and maintain the equipment.

The advantages, disadvantages, capabilities and limitations are plainly stated. There are extensive descriptions and photographs of where and how closed circuit TV is already used, that is, sales meetings, merchandising, production control, and supervision, remote handling of hazardous operations, school and industrial education, plant protection, and other uses where remote observation is most efficient. These actual instances are not only interesting reading, but illuminating and thought-provoking discussions which may lead the reader to adaptations suitable to his own purposes.

### *Handbook of Semiconductor Electronics*

*Edited by Lloyd P. Hunter. Published 1956 by McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36. 832 pages. Price $12.00.*

This book gives a brief description of transistor action, and a discussion of the basic principles of electrical conduction in solids. The principle needed to understand the mechanism of transistor and diode action are highlighted. The principles of operation of diodes, photo cells and transistors are given with a minimum of formal development.

### *Pulse and Digital Circuits*

*By Jacob Millan, Ph. D. and Herbert Taub, Ph. D. Published 1956 by McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36. 687 pages. Price $12.50.*

The basic non-linearities of tubes and semiconductor devices are described and then the effects of these non-linearities on waveform transmission are studied. Waveform generating circuits are analyzed in detail. Other fundamental circuits or components are carefully considered. Finally, the basic building blocks, with which the reader is now familiar, are assembled into pulse digital systems such as radar, television, and digital computers.

### *Elements of Magnetic Tape Recording*

*By N. M. Haynes. Published 1957 by Prentice-Hall Co., Inc., Publishers, 70 Fifth Ave., New York 11, 392 pages, xii pages. Price $7.95.*

This work carries an authority, and has a thoroughness and scope unequalled by any other book of its kind. It is the only volume that combines the basic information about magnetic sound recording with all the latest, newest developments in this field.

Regardless of the nature of the reader's own scientific background, one will get from this carefully organized, readable volume a solid understanding of the subject that can lead to a profitable hobby or career in sound recording. One will also become thoroughly familiar with the requirements of a superior tape recording system, know what to look for when buying or building a tape recorder.

This book falls into three logical sections. The introduction contains chapters in magnetic fundamentals, electroacoustic fundamentals, magnetic tape nomenclature, recording medium.

In the second part, the reader gets to the heart of the actual magnetic tape process.

The third part deals with the apparatus of tape recording, including flutter, tape handling elements and mechanisms, battery operated recorders, and basic maintenance and repair.

## Books Received

### *Wave Propagation*

*By Alexander Schure, Ph. D., Ed. D. Published 1957 by John F. Rider, Publisher, Inc., 116 W. 14th St., New York 11. 64 pages, paper bound. Price $1.25.*

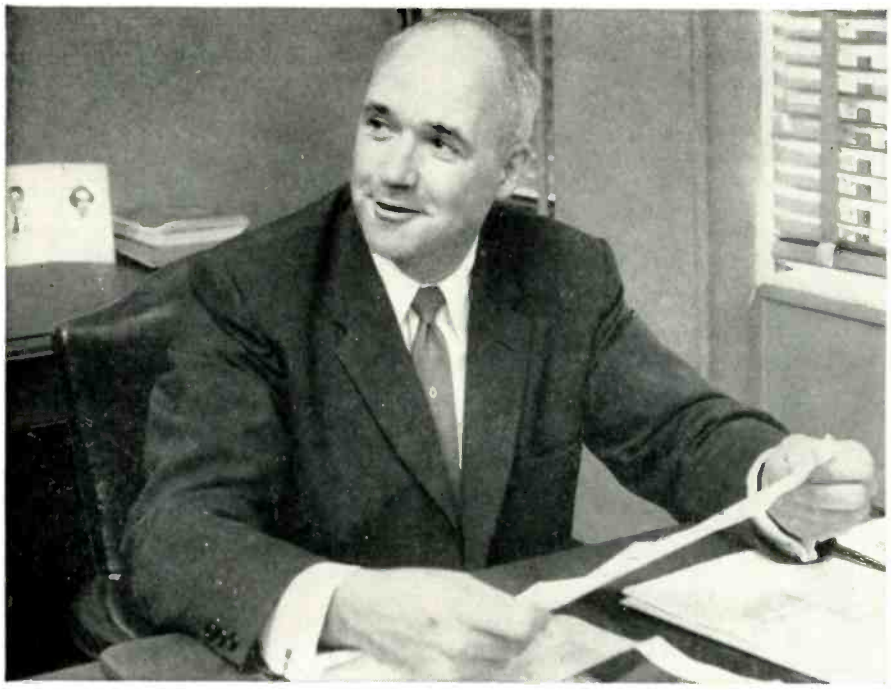
### *Antennas*

*By Alexander Schure, Ph. D., Ed. D. Published 1957 by John F. Rider, Publisher, Inc., 116 W. 14th St., New York 11. 88 pages, paper bound. Price $1.50.*

### *Energy*

*3y Sir Oliver Lodge, F.R.S. Published 1957 by John F. Rider, Publisher, Inc., 116 W. 14th St., New York 11. 64 pages, paper bound. Price $1.25.*

# "People depend on business



With time out for duty with the Army Air Force during World War II, Eugene Raven spent the first 10 years of his business career with newspapers, including the Omaha *World Herald* and the Des Moines *Register and Tribune*. Late in 1944 he joined United Air Lines as Assistant Advertising Manager. Today he is Director of Advertising. When Mr. Raven recently agreed to discuss business publications with us, we promptly flew (via United Air Lines) to his Chicago office. Here are the highlights of the discussion which followed.

**Q What is the early history of United Air Lines?**

**A** United is actually the outgrowth of four different companies. The first, Varney Air Lines, was started in April 1926. Close on its heels came Pacific Air Transport, National Air Transport, and Boeing. All four were merged to form United Air Lines in 1931. Our company, as presently organized, was incorporated in 1934.

**Q At what point did advertising enter the picture?**

**A** Very early in the game. Offhand, as early as 1928.

**Q What has been your basic advertising philosophy?**

**A** We have always been a firm believer in the value of advertising, and we have operated on the basis that we are willing to spend an advertising dollar if it attracts more dollars to the business. That was our policy even in our early years, when other airlines considered advertising a questionable expense.

**Q What was the general purpose of your early advertising?**

**A** In those days the big job was to convince people that it was safe and economical to fly. We had both fear and fare to overcome. You must remember that in the late 20s a passenger was a fellow who sat on the mailbags if there was room enough for him. Airplanes were designed to carry mail, not passengers.

**Q What accounted for the change in attitude about passenger traffic and the development of passenger planes?**

**A** Despite the early fears of flying and the $400 fare coast-to-coast, hardy individuals demanded the speed of air travel in emergencies. Quite a contrast when you figure 36 million people will fly this year and coast-to-coast fares are as low as $80.

**Q Were your first advertising activities of a localized nature?**

**A** Yes. Our first advertising was in newspapers.

**Q When did United first enter into business paper advertising?**

**A** We first started using business publications in 1939.

**Q What is the objective of your business publication advertising today?**

**A** It is twofold. A large portion of our business paper advertising is directed toward freight sales, the rest toward passenger sales. On the freight side, we use both horizontal and vertical publications to reach our customers and prospects. We do, however, try to concentrate our efforts to reach those specific industry groups which account for the major part of the freight we carry. Machinery parts and tools, for example, are two of the major sources of our freight revenue. The story we have to tell is a big and important one. We must make known to those readers the services of United available to industry—new and improved equipment, more and faster schedules, special facilities for handling various types of freight, and the like.

**Q To whom are your freight messages addressed?**

**A** Basically to manufacturers and shippers—but in addition to those people, we are interested in reaching purchasing agents, for they also dictate the method of shipment to a very large extent.

**Q And how about the passenger side of your business paper advertising?**

**A** On the passenger side the job we have to do, in simplest of terms, is to sell seats. To do this we not only talk directly to prospective passengers through national magazines, but also to some 2000 travel agents through their own trade publications. It is the responsibility of the Advertising Department to keep these agents, who are a very real part of our sales force, fully informed about the things we have to sell the traveling public—such things as new types of equipment, new nonstop schedules, and holiday tours. We have found from experience that the best way to get this information across is through the use of various business publications.

# publications to keep informed..."

**Q** You of course supplement such advertising?

**A** Oh yes. We use direct mail and make numerous personal calls, but business publications carry the bulk of the load.

**Q** What do you consider to be the highlight of United's advertising history?

**A** Well, the first thing that comes to my mind is the advertising campaign which announced the introduction of stewardess service, which incidentally was in itself an industry "first." Another is the fact that United was the first airline ever to use magazine advertising.

**Q** Just when was that?

**A** About 27 years ago. And we have advertised in magazines constantly ever since then; even during the war years, when the only thing we had to talk about was what we thought would be the airplane and the airport of the future.

**Q** How many business publications do you use at the present time?

**A** My answer depends on just what your definition of a business publication is, but if you include any magazine edited to appeal to the men and women within a certain industry or horizontal industrial group, the number is approximately 50.

**Q** How do you determine your advertising appropriation?

**A** We first determine the job to be done and relate the cost of doing that job to anticipated growth and volume. Naturally, there must be a sound relation between the amount we spend and the amount we take in; but we do not believe in appropriating a set percent of gross and then trying to figure out how to spend it.

**Q** Do you believe that advertisements in themselves are important to the reader of a business publication?

**A** I definitely believe they are. An advertisement properly prepared will give the reader additional information to that found on the editorial pages.

**Q** Do you believe that business publications are increasing in their importance to the advertiser?

**A** Yes I do, and my reason for believing so is that business publications are becoming increasingly important to the reader. People depend on business

publications to keep informed of developments and trends within their business or industry, and because the reader has high interest in the publication, an advertiser has an opportunity to talk to him about new and improved products or methods, or new and improved tools or materials, at a time when he is actually seeking such information.

**Q** Do you feel that business publications are meeting their responsibilities to the industries they represent?

**A** I think they are. Not only are they doing an excellent job, but they are increasing their value through editorial research. From their vantage point within an industry, editors are able to take a broad, impersonal view of trends and developments. They can dig, probe and compare; then interpret and report their findings in a way that is both interesting and, more importantly, useful to the reader. In this way business publications are making major contributions to industry.

**Q** What are your views on the subject of frequency?

**A** We firmly believe in consistent advertising. We believe we must come back month after month with a continuing story about the services we have to offer, the various uses that can be made of those services, and their advantages. We never know just when a customer or prospect will be ready to use our service, but through consistent advertising we can hope that once he is ready he will remember that United Air Lines is an organization well qualified in every way to meet his needs.

---

Through the use of business publications you are able to communicate with your customers and prospective customers in an atmosphere that is natural to them and most productive for you. In this respect, today's responsible business publications serve a purpose unduplicated by any other selling force.

Chilton publications cover their chosen fields with an editorial excellence and a strict control of circulation that assure confidence on the part of readers and advertisers.

Chilton
COMPANY

*Chestnut and 56th Streets • Philadelphia 39, Pennsylvania*

CHILTON PUBLICATIONS: Department Store Economist • Hardware Age • The Iron Age • Jewelers' Circular–Keystone • Distribution Age • Motor Age • Automotive Industries • Optical Journal and Review of Optometry • Spectator • Commercial Car Journal • Boot and Shoe Recorder • Hardware World • Gas • Electronic Industries • Butane-Propane News • Book Division

# Coaxial Cables

(*Continued from page* 85)

tivity value dropped 24% at 15 KMC, but still remained somewhat higher than it was prior to corrosion, even after polishing.

Resistivity is also a function of temperature. For example, at 250°C, the resistance of copper is approximately 1.5 times its resistance at 850°C.[3]

Mineral insulated (MI) cables have been satisfactorily nickel plated to prevent oxidation and/or corrosion and are rated for 760°C continuous operation.[35]

### *Silver*

For high temperature coaxial cables, silver could be used as a protective coating for a copper surface and for reduction of losses. Several investigations have reported on the effect of aging a silver plated waveguide.[32, 36, 37, 38] The results obtained are consistent with corrosion results reported, the surface resistivity of silver tending to increase with age and frequency.[32]

The rate of diffusion of the base metal into the silver and vice versa would be the primary loss limitation for gas filled cables. "The solubility of nickel in silver and of silver in nickel is not very large but it is higher than iron, which is essentially zero."[39] Using these materials, reasonable life could be expected at 500°C.

Kittel[34] irradiated clad plates of silver containing 25% cadmium for periods up to one year. "Densities and dimensions showed negligible change."[34]

The conditions under which silver migration constitutes a contaminating influence on dielectrics have been studied by the Stanford Research Institute of Menlo Park, California.[40] It was found that silver migration was promoted by high humidities and high voltages. It can be prevented by cadmium plating, or by electroplating gold on silver. Surface treatment with a silicone emulsion has reduced silver migration. Migration was not detected on silver mica capacitors or on materials where silver was in chemical combination with another metal.

### *Platinum*

Platinum is subject to the same limitations as to diffusion and does have a higher resistivity than silver, gold or rhodium.[39] The resistivity of platinum is close to that of carbon steel.

The authors gratefully acknowledge the assistance and helpful suggestions of F. B. Coker, H. A. McGee, P. S. Klasky and E. Stowell in preparing this report.

A REPRINT of this article can be obtained by writing on company letter head to Editor Electronic Industries, Chestnut & 56th Sts., Phila. 39, Pa.

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## New Products

### XENON THYRATRON

A new three-electrode, forced-air cooled xenon thyratron, designed primarily for use in applications in which high peak currents are required, such as welding and X-ray

tube operation, is available. The RCA-7086 can also be used for grid-controlled rectifier or inverter service. Capable of withstanding a maximum peak forward and inverse voltage of 650 v. at a maximum peak anode current of 400 ampere in intermittent service, or 160 ampere in continuous service. Radio Corporation of America, Harrison, N. J.

Circle 213 on Inquiry Card, page 103

### NULL DETECTOR

Battery operated portable Model 2050 all transistor null detector is available. Instrument is particularly suited for bridge measurements in any location. Specifications include: Sensitivity (with 400 or 1000 cps filter); in "Linear" positions—200 $\mu$v for full-scale, 80 $\mu$v for 30% deflection; in "Null" position—2000 $\mu$v for full-scale, 100 $\mu$v for 30% deflection.

Input Impedence: Approximately 1 Megohm (resistive) at 1000 cycles. Frequency Range: 40 cycles to 20 kc ±1 db. Freed Transformer Co., Inc., 1726 Weirfield St., Brooklyn 27, N. Y.

Circle 214 on Inquiry Card, page 103





Circle 89 on Inquiry Card, page 103

# New Products . . . for the Electronic Industries

## COUPLERS

Two new series of high directivity couplers, of 3 db. and 6 db. values, with six models in each category, covering the range from 2.60 to 18.0 KMC are available. They supplement

existing series of 10 db., and 40 db. couplers, thus providing a complete line of couplers in 5 values, all covering the same range. The new units are multi-holed and consist of a primary and secondary line with the coupling holes contained in a common wall. Standard cover flanges terminate both ends of the primary line. The Narda Microwave Corp., Mineola, N. Y.

Circle 231 on Inquiry Card, page 103

## COUNTERS

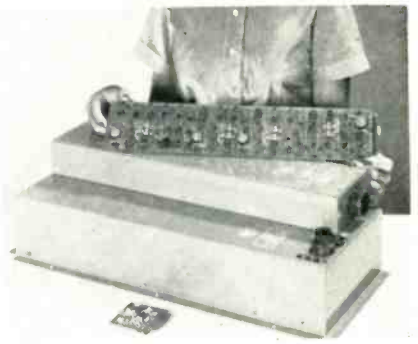
A series of small, cylindrical-case none-reset counters are available. Case diameter is 0.790 in. with mounting flanges at the figure window or at the bottom as required. The


counters are available in a range of 3-6 figures. The driveshaft is ⅛ in. diameter and can project from the left or the right hand end of the case. When additional actuation is necessary as count is registered, the driveshaft can project from both ends of the case. Revolutions may be counted at a maximum of 1000 per minute. Technicraft, 6221 Ridge Ave., Philadelphia 28, Pa.

Circle 232 on Inquiry Card, page 103

## TIME CODE GENERATOR

An airborne time code generator, employing transistor-driven, magnetic cores, is being produced. Unit is designed for missile and aircraft instrumentation. The 1½ cu. ft. unit



supplies a 16-bit, 24-hour binary code to hours, minutes and seconds. Signals generated by the equipment are suitable for recording timing marks or time codes on magnetic tape, oscillographs or to energize neon lights for indicating time code on the edge of motion pictures film in optical instrumentation equipment. Electronic Eng. Co. of Calif., 1601 E. Chestnut Ave., Santa Ana, Calif.

Circle 233 on Inquiry Card, page 103

Circle 92 on Inquiry Card, page 103



Circle 93 on Inquiry Card, page 103

# New Products . . . for the Electronic Industries

## SUB-CARRIER OSCILLATORS

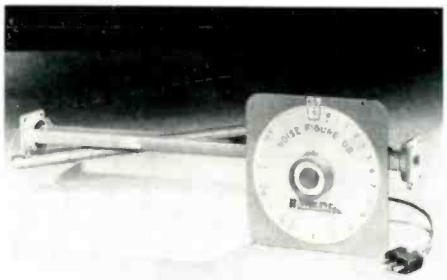
A new line of transistorized sub-carrier oscillators for application in FM/FM telemetering systems is available. Two of the oscillator types are voltage controlled, with the

Model TOE-100 employing silicon transistors for high temperature ranges, and Model TOE-101 utilizing germanium transistors for very low temperature applications. A third type, TOR-100, is a silicon transistor resistance bridge sub-carrier oscillator. Bendix Aviation Corp., 11600 Sherman Way, N. Hollywood, Calif.

Circle 234 on Inquiry Card, page 103

## NOISE GENERATOR MOUNTS

A series of 7 direct reading noise tube mounts and attenuators, covering the frequency range from 2.60 to 26.5 KMC/sec is available. Each unit, in combination with the Type 2200



power supply, provides a noise generator designed for direct reading noise figure measurements which facilitates laboratory and production testing. These tube mounts utilize Argon gas tubes to provide a 16.0 db level of noise which is controlled by a precision attenuator section. Waveline, Inc., Caldwell, N. J.

Circle 235 on Inquiry Card, page 103

## DIELECTRIC TEST SET

Industrial insulation breakdown tester is designed to furnish the potentials required for dielectric tests conducted under MIL-C-13294A. Console type unit is completely self-con-

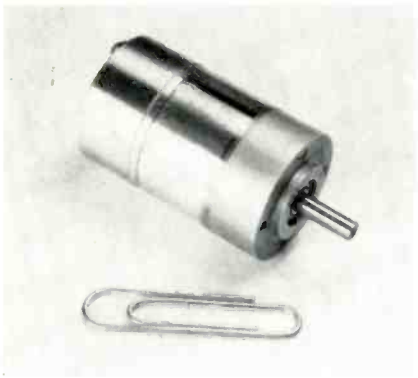
tained. Output is 5 kw at 1000 or 5000 v rms. Operates from 220 v rms, 60 cps, single phase line. Output voltage is continuously adjustable. Has instantaneous trip type circuit breaker rated to trip at 25 amps. Voltage and current are simultaneously metered. Industrial Transformer Corp., Gouldsboro, Pa.

Circle 236 on Inquiry Card, page 103

# New Products

## ENCLOSED MOTOR

A new miniature 24 v dc explosion proof, totally enclosed motor measures only ⅞ in. diameter by less than 1½ inch in length. There are two models: Model 6A5 which is

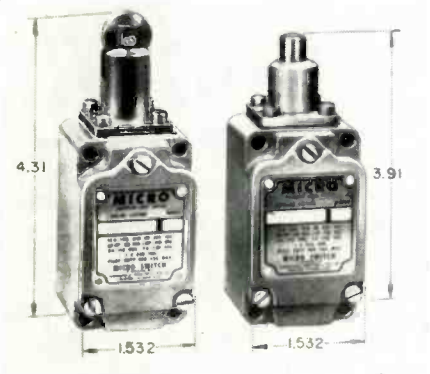


rated at 0.01 hp at 12,000 RPM, and Model 6A2 rated at 0.001 hp at 4,000 RPM. Model 6A2 is designed for continuous duty and requires a 0.22 amperes maximum current, while Model 6A5 is for intermittent service and requires 0.9 amperes maximum current. Western Gear Corp., P. O. Box 182, Lynwood, California.

Circle 244 on Inquiry Card, page 103

## LIMIT SWITCHES

A pair of 2-circuit limit switches that are compact in size and have high electrical capacities are now available. The roller-plunger switch (5LSI) is for cam or slide operations. The plunger actuated switch (2LSI) offers a full ¼ in. of overtravel. Both are completely sealed and resistant to abuse and wear. The con-




tact arrangements are double-throw 2-circuit, single-pole double-break. The electrical rating is: 10 a., 120, 240 or 480 volts ac; 0.8 a., 115 vdc. Micro Switch, Freeport, Ill.

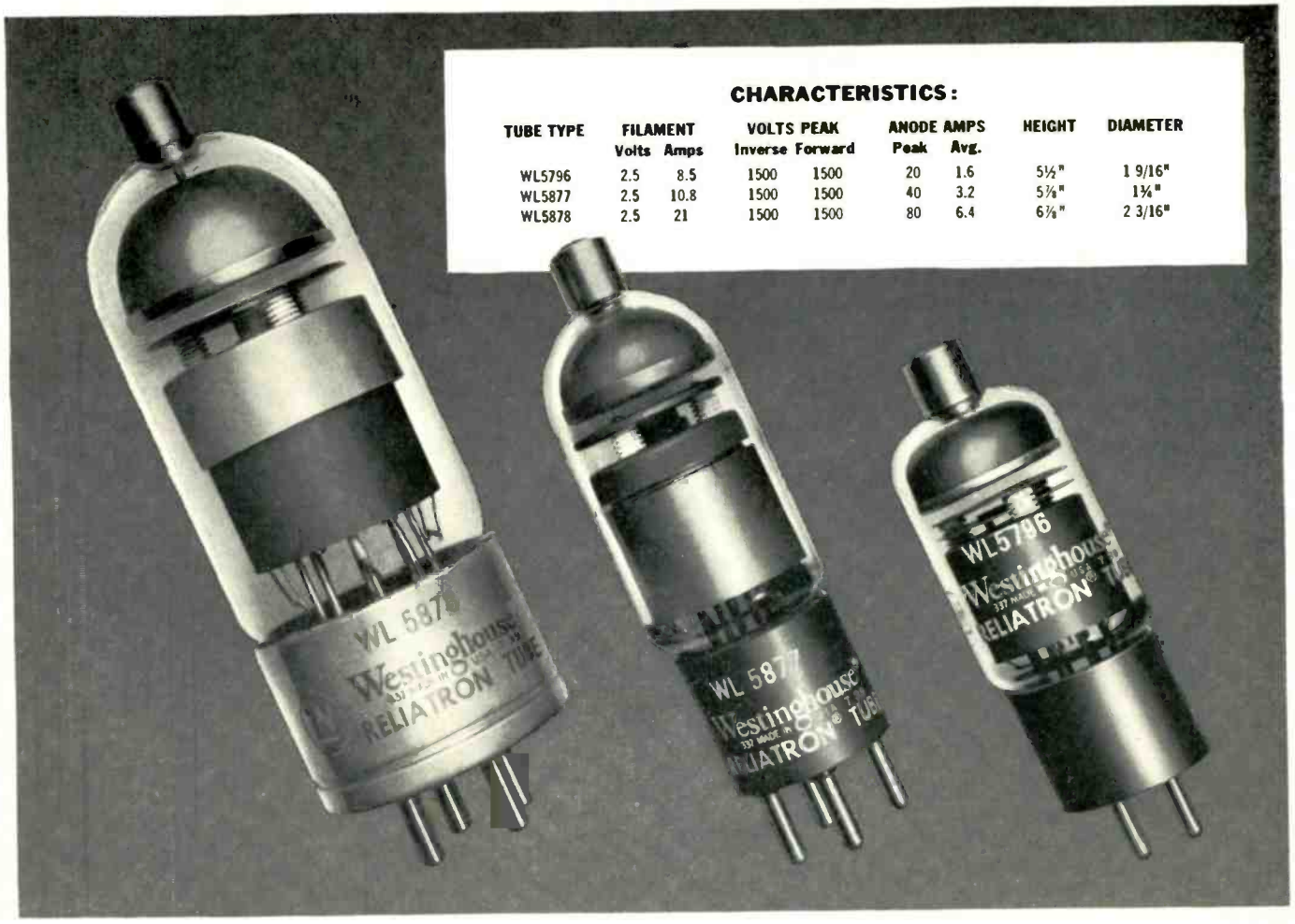
Circle 245 on Inquiry Card, page 103





Circle 86 on Inquiry Card, page 103

# New Xenon-filled Westinghouse THYRATRON TUBES fit 90% of new equipment needs!




**CHARACTERISTICS:**

| TUBE TYPE | FILAMENT Volts | FILAMENT Amps | VOLTS PEAK Inverse | VOLTS PEAK Forward | ANODE AMPS Peak | ANODE AMPS Avg. | HEIGHT | DIAMETER |
|---|---|---|---|---|---|---|---|---|
| WL5796 | 2.5 | 8.5 | 1500 | 1500 | 20 | 1.6 | 5½" | 1 9/16" |
| WL5877 | 2.5 | 10.8 | 1500 | 1500 | 40 | 3.2 | 5⅞" | 1¾" |
| WL5878 | 2.5 | 21 | 1500 | 1500 | 80 | 6.4 | 6⅛" | 2 3/16" |

## Compact new design saves space, gives superior performance and uniform quality!

For motor controls, firing ignitrons, inverter service or any other new industrial or military equipment need—you'll find new Westinghouse Thyratrons the most advanced you can use. They meet NEMA and EIA specifications for control applications and have the following characteristics:

- 12 to 1 peak to average anode current rating.
- 1,500 volt forward and inverse voltage rating.
- 15 second averaging time.
- Operate in broad ambient temperature limits (—55° to 70°C)
- Fast cathode heating time.
- Small compact construction.

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To see how Westinghouse Thyratrons can fill your design requirements, write today for detailed data. Westinghouse engineers will be glad to consult with you, if you wish. Sample orders available for immediate shipment.

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WESTINGHOUSE ELECTRIC CORP. Elmira, N. Y.

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—WL5877 —WL5878 —WL5796

NAME_____

TITLE_____

COMPANY_____

ADDRESS_____

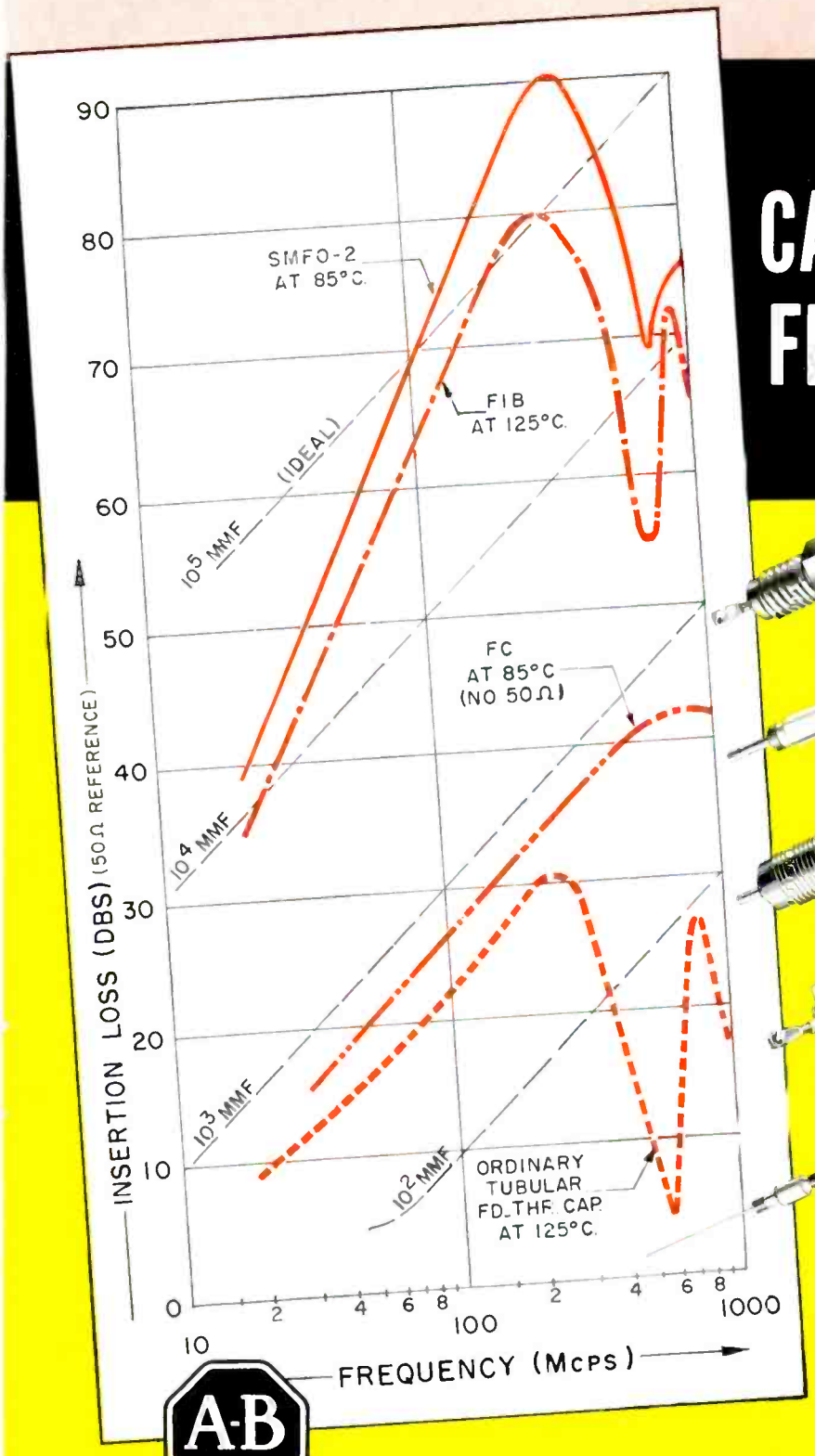


Circle 104 on Inquiry Card, page 103

Circle 120 on Inquiry Card, page 103 ⟶

# a new idea

## in the elimination of high frequency radiation




A-B QUALITY

# ALLEN-BRADLEY

# CASCADED CERAMIC FEED-THRU FILTERS

(PATENT PENDING)

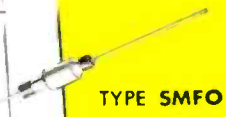


TYPE **FIB**

TYPE **FIS**

TYPE **FCD**

TYPE **FC**



TYPE **SMFO**
(FULL SIZE)

NOW . . . out of the Allen-Bradley research laboratories comes a completely new and far more effective line of high frequency filter elements . . . especially designed to eliminate radiation from low power circuits operating in the frequency range from 50 mcs to 5000 mcs.

Employing an entirely different concept, these new filter elements have a phenomenal filtering efficiency . . . that actually *increases* tremendously with frequency, as illustrated in the graph at left.

These filter elements display none of the detrimental internal resonance characteristics of standard tubular capacitors . . . and cascading elements permit an increase in effective capacity far beyond that practical even with discoidal design.

Filters are available in voltage ratings up to 500 v, DC at temperatures up to 125°C. Max. RF current is 0.25 amp, and max. DC or low frequency current is 5 amp.

Technical information available upon request.

**ALLEN-BRADLEY**
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1-58-E

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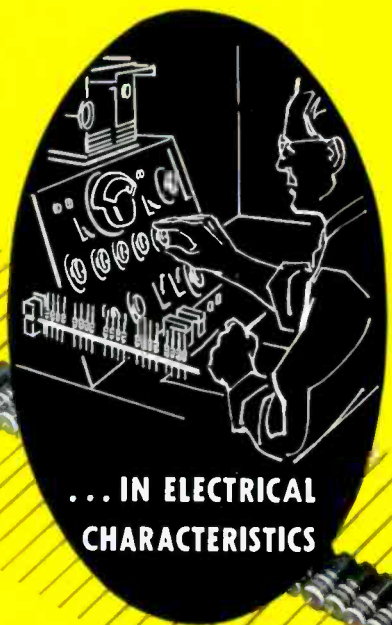
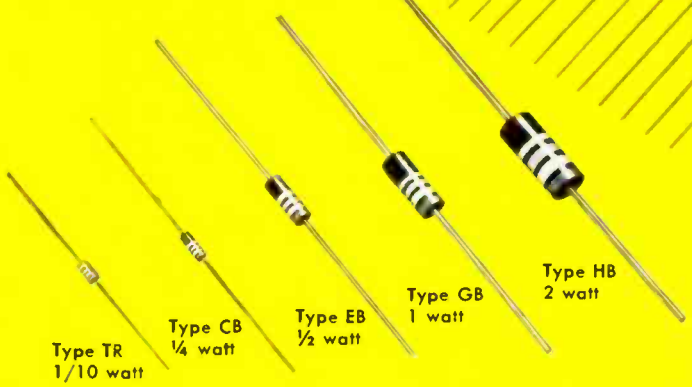
## Allen-Bradley Hot Molded Composition Resistors—

# INCREDIBLY UNIFORM!






Among electronic engineers, Allen-Bradley *hot* molded resistors have won a reputation for unequalled uniformity. That's why they are the "industry standard" wherever component uniformity . . . electrical and mechanical . . . is especially critical. Through continuous sampling and testing, consistent quality—Allen-Bradley *quality*—is maintained. Conservative ratings and stable properties assure reliable performance at *all* times. A-B resistors are free from catastrophic failure. When you buy Allen-Bradley quality components—fixed and variable composition resistors, ceramic capacitors, and ferrite parts, you assure yourself of fewer "rejections" on final test. These Allen-Bradley components are not always the lowest priced, but—they are *always* the best! Write for technical information, today.

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# *International*
# ELECTRONIC SOURCES

ELECTRONIC INDUSTRIES' exclusive monthy digest of the world's top electronic engineering articles

## ANTENNAS, PROPAGATION

*By Controlling Radiation, Suppressor Improves Pattern, M. W. Scheldorf. "El. Ind." Jan. 1958. 3 pp. A new type element, properly applied on a long conductor at half wavelength intervals, "shielding" portions normally causing cancellation, has been evolved. Its effectiveness offers opportunities for wide application in systems with extensive conducting elements.

**Circular Waveguides for Long Distance Transmission of Centimeter and Millimeter Waves,** G. Comte, et. al. "Cab. & Tran." October 1957. 14 pp. The first part of the paper describes methods used to determine attenuation of the $TE_{01}$ wave in circular guides at frequencies of 24,000, 35,000, and 48,000 Mc/s. Its second part relates to circular guides with isotropic conductivity; measurement results are given for a number of experimental lines and factors are studied which cause increased attenuation of the $TE_{01}$ wave. Bends can be passed through by this wave without perturbation, with the aid of different methods, some of which have been experimented.

**Radiation from Slots on Dielectric-Clad and Corrugated Cylinder,** James R. Wait and Alyce M. Conda. "NBS J." November 1957. 10 pp. An approximate formula is derived for the radiation pattern of an axially slotted cylinder with a thin dielectric coating. The accuracy of the formula is shown to be sufficient for practical purposes. Using a similar method, the pattern function for a slot on a corrugated cylinder is derived. Extensive numerical results are presented for both dielectric and corrugated cylinders.

**Designing Tapered Waveguide Transitions,** B. J. Migliaro. "El." November 1, 1957. 3 pp.

**Examination of an Omnidirectional Aerial with Horizontal Polarization,** Wolfgang Krank. "Rundfunk." Oct. 1957. The paper deals with examinations made of a horizontally polarized omnidirectional aerial for television and VHF sound, the principle of which was indicated by Alford and Kandoian. The extent to which the horizontal diagram departed from a circle was measured; when the frequency is varied by ± 24% of the nominal frequency, it is required that the non-circularity should remain below ± 8%.

**A New Wide-Band Balun,** Willmar K. Roberts. "Proc. IRE." December, 1957. 4 pp. This paper describes a form of balun which is useful for matching a balanced circuit to an unbalanced circuit of nearly the same impedance over a wide frequency range.

* Those articles marked with an asterisk are available as reprints to EI readers. Requests should be sent, on company letterhead, to Sources Editors, Electronic Industries, Chestnut & 56th Sts., Philadelphia 39, Pa.

**A Combined Broadcast and Television Transmission Aerial for the NDR Station (North German Broadcast) at Flensburg,** E. Mohr. "Rundfunk," Vol. 1, No. 4. August 1957. 14 pp. A 205 m antenna mast planned for NDR will be the transmitting antenna for television and VHF/FM, as well as for broadcast transmission. By means of an insulator inserted at a height of 110 m, the antenna mast will be divided into two sections. Thus, it will be possible to obtain a vertical radiation pattern, suitable for serving the region on medium waves at any frequency in the range from 500 to 1,600 kc.

**Current Distribution of Vertical Reflectors with Cylindrical Cross-Section,** G. Ziehm. "Freq.," Vol. 11, No. 8. August 1957. 11 pp. Problems exist when a directional receiving antenna system is mounted on a mast, which electrical length is close to a quarter wave length of the system. The danger exists of a feedback onto the directional antenna. The article considers the amount and distribution of the vertical current for cases normally encountered (1.5 to 25 mc).

**Radiation from a Radial Dipole Through a Thin Dielectric Spherical Shell,** M. G. Andreasen. "IRE Trans. PGAP." October 1957. 6 pp.

**The Current Distribution and Input Impedance of Cylindrical Antennas,** E. V. Bohn. "IRE Trans. PGAP." October 1957. 6 pp.

**Scanning Lens Design for Minimum Mean-Square Phase Error,** E. K. Proctor and M. H. Rees. "IRE Trans. PGAP." October 1957. 8 pp.

**Second-Order Beams of Two-Dimensional Slot Arrays,** L. A. Kurtz and J. S. Yee. "IRE Trans. PGAP." October 1957. 7 pp.

**20-70 MC Monopole Antennas on Ground-Based Vehicles,** R. E. Webster. "IRE Trans. PGAP." October 1957. 6 pp.

**New Method of Antenna Array Synthesis Applied to Generation of Double-Step Patterns,** C. J. Sletten, et. al. "IRE Trans. PGAP." October 1957. 5 pp.

**Convergent Representations for the Radiation Fields from Slots in Large Circular Cylinders,** L. L. Bailin and R. J. Spellmire. "IRE Trans. PGAP." October 1957. 10 pp.

**Some Observations on Scattering by Turbulent Inhomogeneitles,** Martin Balser. "IRE Trans. PGAP." October 1957. 8 pp.

**Scanning Characteristics of Microwave Aplanatic Lenses,** G. G. Cloutier and G. Bekefi. "IRE Trans. PGAP." October 1957. 6 pp.

**Dielectric Films in Aluminum and Tantalum Electrolytic and Solid Tantalum Capacitors,** John Burnham. "IRE Trans. PGAP." September 1957. 10 pp.

**Transformer Design for Zero Phase Shift,** Nathan R. Grossner. "IRE Trans. PGAP." September 1957. 4 pp.

## REGULARLY REVIEWED

AEG Prog. AEG Progress
Aero. Eng. Rev. Aeronautical Engineering Review
Ann. de Radio. Annales de Radioelectricite
Arc. El Uber. Archiv der elektrischen Uebertragung
ASTM Bul. ASTM Bulletin
Auto. Con. Automatic Control
Auto. El. The Automatic Electric Technical Journal
Avto. i Tel. Avtomatika i Telemakhanika
AWA Tech. Rev. AWA Technical Review
BBC Mono. BBC Engineering Monographs
Bell Rec. Bell Laboratories Record
Bell J. Bell System Technical Journal
Bul. Fr. El. Bulletin de la Societe Francaise des Electriciens
Cab. & Trans. Cables & Transmission
Comp. Rend. Comptes Rendus Hebdomadaires des Seances
Comp. Computers and Automation
Con. Eng. Control Engineering
E. & R. Eng. Electronic & Radio Engineer
Elek. Elektrichestvo
El. Electronics
El. & Comm. Electronics and Communications
El. Des. Electronic Design
El. Energy. Electrical Energy
El. Eng. Electronic Engineering
El. Eq. Electronic Equipment
El. Ind. ELECTRONIC INDUSTRIES & Tele-Tech
El. Mfg. Electrical Manufacturing
El. Rund. Electronische Rundschau
Eric. Rev. Ericsson Review
Freq. Frequenz
GE Rev. General Electric Review
Hochfreq. Hochfrequenz-technik und Electroakustik
IBM J. IBM Journal
Insul. Insulation
IRE Trans. IRE Transactions of Prof. Groups
Iz. Akad. Izvestia Akademii Nauk SSSR
J. BIRE. Journal of the British Institution of Radio Engineers
J. ITE. Journal of The Institution of Telecommunication Engineers
J. IT&T. Electrical Communication
J. UIT. Journal of the International Telecommunication Union
Nach. Z. Nachrichtentechnische Zeitschrift
NBS Bull. NBS Technical News Bulletin
NBS J. Journal of Research of the NBS
NRL. Report of NRL Progress
Onde. L'Onde Electrique
Phil. Tech. Philips Technical Review
Proc. AIRE. Proceedings of the Institution of Radio Engineers
Proc. BIEE. Proceedings of the Institution of Electrical Engineers
Proc. IRE. Proceedings of the Institute of Radio Engineers
Radiotek. Radiotekhnika
Radio Rev. La Radio Revue
RCA. RCA Review
Rev. Sci. Review of Scientific Instruments
Rev. Tech. Revue Technique
Syl. Tech. The Sylvania Technologist
Tech. Haus. Technische Hausmitteilungen
Tech. Rev. Western Union Technical Review
Telonde. Telonde
Toute R. Toute la Radio
Vak. Tech. Vakuum-Technik
Vide. Le Vide
Vestnik. Vestnik Svyazy
Wire. Wld. Wireless World

For more information, contact the respective publishers directly. Names and addresses of publishers may be obtained upon request by writing to "Electronic Sources" Editors, ELECTRONIC INDUSTRIES & Tele-Tech, Chestnut & 56th Sts., Philadelphia 39, Pa.

# *International* **ELECTRONIC SOURCES**

## CIRCUITS

***Three Output Immittance Theorems,** Dr. H. Stockman. "El. Ind." Jan. 1958. 5 pp. Formulated here are theorems designed to assist the engineer in treating linear networks in transistor circuitry. Their validity is not disturbed by variations in the power supply.

**Transistor Circuits and Applications,** A. G. Milnes. "Proc. BIEE." November 1957. 16 pp. Junction-transistor circuits are reviewed, and new concepts and trends in design are discussed. Improvements in transistor ratings are described, but special transistor types such as tetrodes, p-n p-n and unipolar devices are not considered.

**R-F Power Supply for Infrared Viewers,** T. Fujii and H. Kojima. "El." November 1, 1957. 1 p. Substitution of r-f power supply for conventional vibrator power supply in sniperscopes or snooperscopes results in noise-free operation and avoids magnetic effects of low-frequency transformer flux leakage.

**Filter Technique Development In France During The Last Ten Years,** J. E. Conlin. "Cab. & Tran." October 1957. 12 pp. In filter technique the decennial period 1947-1957 is first and foremost characterized by the assimilation of former mathematical theories. Codification and simplification work has created, among others, a new branch of theory: transformation of four-terminal networks leading to ladder-filters structures no more formed of groups of elementary structures according to Zobel's method, but constituting an indivisible unit.

**The Frequency-Lock A.F.C. Circuit,** R. Leek. "Proc. BIEE." November 1957. 11 pp. A frequency-lock a.f.c. loop was used to and track a weak c.w. signal of changing frequency in the presence of high levels of noise. The noise-free operation of the loop as a tracking system is discussed qualitatively from first principles, and this is followed by a theoretical analysis.

**Electrical Integration,** W. Holle. "El. Rund." November 1957. 2 pp. Derivation of conventional integrators is shown by simple circuit considerations and transposition. A circuit involving slight outlay for the indication of a definite integral is given.

**A Design of a Circuit of Alternating Current of a Magnetic Amplifier,** N. A. Kaluzhnikov. "Avto i Tel." September, 1957. 5 pp. The article suggests a method for designing a circuit of alternating current of magnetic amplifiers with cores of iron-nickel alloy, based on the theory of an "ideal" magnetic amplifier. The performance is examined of a choke-coupled magnetic amplifier with a complex (inductive-active) load and alternating current; also analyzed are the peculiarities of performance of a two-cycle circuit with an inductive load.

**Zener-Diode Voltage Regulators Reduce Volume Requirements 98%,** J. L. Feistman. "El. Eq." November 1957. 5 pp.

**Low Plate Voltage Tube Circuit Design,** David Fidelman. "El. Des." November 1957. 5 pp.

**Concerning the Estimate of Electronic Integrating Devices,** B. Ya. Kogan. "Avto i Tel." September 1957. 3 pp. Three main types of electronic integrators are compared for the value of each as regards the minimum possible frequency for integrating the sinusoidal input signal and the maximum possible time for integrating the step-signal.

**Review: Extremum Regulation,** Yu. I. Ostrovsky. "Avto i Tel." September, 1957. 3 pp. The basic circuits of extremum-regulators, described in Soviet and foreign literature, are classified and presented.

**A Method for Calculating Linear Circuits,** W. Klein. "Arc. El. Uber." Vol. 11, No. 8, August 1957. 7 pp. The paper gives a method of calculating linear circuits which can also be applied to tubes, transistors, and transformers. The method consists of setting up a list of the circuit components in the form of multi-pole admittance matrix followed by a calculation of five determinants.

**Transmitter Cost-Trimmed by Series Gate Modulator,** Ralph H. Baer. "El." November 1, 1957. 3 pp.

**A Filter with Properties Approaching Those of an Ideal Low-Pass Filter,** J. Remer. "Rundfunk." Vol. 1, No. 4, August 1957. 8 pp. The article describes the calculation and construction of a filter which approaches ideal conditions. The amplitude variations of this low-pass filter up to the cut-off frequency of about 5.5 kc are less than $\pm 5\%$. At 5.5 kc, the amplitude drops to only 9% of the maximum value. The variations of the group propagation time are less than .025 ms, and do not increase in the immediate vicinity of the cut-off frequency. The transient effects were found to agree with the calculations.

**Direction of Rotation and Curvature of the Impedance Locus of an Actual, as well as Ideal, Two-Terminal Network,** H. Wolter. "Arc. El. Uber." Vol. 11, No. 9. September 1957. 7 pp. Usually, the impedance locus of a two-terminal network follows a closed curve that revolves at least once in a clockwise direction, with the frequency changing from $-\infty$ to $+\infty$. A method is given for synthesizing two-terminal networks that have impedance loci which are curved counterclockwise at places.

**Comparison between Negative Resistance, Transistors, and Feed-Back Circuits,** T. Scheler and H. W. Becke. "Freq." Vol. 11, No. 8, August 1957. 10 pp. The article outlines the various problems associated with feed-back circuits when transistors are used. Highlighted are the relations between transistor characteristics and selected circuitry, and the mathematical treaties are given. Comparison with actual operating conditions is provided, and finally the calculation of complicated four-terminal networks for open and short-circuited terminals is provided by matrices.

**Optimum Design for Tunable Frequency Multiplier for Frequency Modulation Transmitters,** H. Schonfelder. "Freq." Vol. 11, No. 8, August 1957. 6 pp. A multiplier for frequency modulation should only consist of simple one and two resonance circuits in the frequency multiplier stages in order to permit greatest ease in tuning. When band width and number of stages are given, optimum conditions for the minimum amount of non-linear distortions is achieved. When the band width of the individual filters is chosen the multiplier generated harmonic distortions meet the requirements of the channel width. The article describes a method which permits optimum design with all stages in class C operation. The rejection of frequencies outside the channel is 70 db, and the non-linear distortion factor is less than .3%, as long as the frequency multiplication is less than 1 to 5. The oscillator frequency must not be less than 1 mc.

## COMMUNICATIONS

***A Simple Antenna Matching Indicator,** J. Zelle. "El. Ind. Op. Sect." Jan. 1958. 3 pp. An inexpensive breadboard jig simplifies coupling for SWR indicators and provides a quick method of measuring mismatch.

**A 100-Line Private Electronic Exchange,** L. J. Allen and R. L. Hobbs. "ATE J." October 1957. 22 pp. This article describes a 100-line exchange which is entirely electronic, and does not depend for its operation on any electromechanical device. The design is based on the use of the XC18 cold-cathode triode for switching purposes and the UD309 speech cold-cathode triode for the speech circuits.

**The High-Band Country Set,** N. A. Lockley "ATE J." October 1957. 7 pp. This article describes a subscriber's duplex battery-operated v.h.f. radiotelephone equipment operating in the band 156 to 184 Mc/s, for use in undeveloped areas and places where mains supplies are not available. It has all normal telephone facilities, and can be used for subscribers on automatic, c.b., and magneto exchanges.

**Thyratrons Improve Mobile Phone Operation,** W. Ornstein. "El." November 1, 1957. 6 pp.

**The Remote and Automatic Control of Semi-Attended Broadcasting Transmitters,** R. T. B. Wynn and F. A. Peachey. "Proc. BIEE." November 1957. 11 pp. In the Chairman's Address to the Radio Section in October, 1949, a description was given of the steps which the B.B.C. was taking to extend its sound-broadcasting service without a proportional increase in the number of its technical staff. This was being achieved by a process which now might be termed 'automation,' but which at that time meant broadcasting from unstaffed transmitters remote from the studios supplying the program material. The paper reviews this technique and may be regarded as confirmation that these steps were justified.

**The Design of High- and Low-Power Medium-Frequency Broadcasting Transmitters for Automatic and Semi-Attended Operation,** W. J. Morcom and D. F. Bowers. "Proc. BIEE." November 1957. 10 pp. The paper describes two medium-frequency broadcasting transmitters, rated at 660 watts and 100 kW respectively, and their associated combining circuits. Three of the smaller units are used in parallel to give a 2kW station with fully automatic control, while two 100 kW sets make up the semi-attended station at Daventry; however, to conform with international limitations, the V.V.C. operate them at 75 kW each, giving 150 kW carrier power from the two units in parallel.

**"Frena," A System of Speech Transmission at High Noise Levels,** F. de Jager, and J. A. Greefkes. "Phil. Tech." October 9, 1957. 11 pp. By transmitting the frequency component and amplitude component of speech in two separate channels—the former in a single-sideband channel of 3,000 c/s bandwidth and the latter in a channel say 100 c/s wide—it is possible to receive the speech in fairly intelligible form at very low signal-to-noise ratios.

**Radio Frequency Problems,** Gunnar Pedersen. "J. UIT." October 1957. 6 pp.

**Use of Ferrites in Telecommunications and Electronics,** G. Delyon. "Cab. & Tran." October 1957. 21 pp. Owing to the rapid development of research on ferrites and of their industrial manufacture, numerous problems concerning the use of these materials have been solved. They are frequently used in the low frequency field (bading coils, filters, transformers, magnetic amplifiers) as well as in that of short waves (wave guides, magnetic recording) or of electronics in general (harmonic generators, permanent magnets, gyrators, particle accelerators).

**Series of Papers on Meteor-Burst Communication.** "Proc. IRE." December, 1957. 92 pp. By utilizing successive meteor trails, an intermittent type of communication system has recently been developed in which pre-recorded

messages are transmitted at a very high rate of speed in brief bursts corresponding to the durations of the individual meteor trails.

**Development of Terminal Equipments for Long and Medium Distance Carrier Current Systems,** J. L. Hurault. "Cab. & Tran." October 1957. 23 pp. The paper begins with a brief but complete historical outline of carrier current terminal equipments technique. Special points of this technique are then examined with more detail: filtering methods, carrier current generation, amplitude modulation methods, vacuum tube amplification.

**Two New Sound Mobile Units,** L. V. Tuerkheim. "Rundfunk." Vol. 1, No. 4, August 1957. 6 pp. Two large identical mobile units were recently put into service by the Bavarian Broadcast. Each vehicle contains a spacious air conditioned and acoustically-treated operations room. Gas generators provide the necessary electric power. Precautions were taken to avoid electrical, mechanical, or audio interferences. The article describes the installation in detail.

**Phase Displacement Caused by Refraction in Tropospheric Layers,** E. Berg. "Arc. El. Uber," Vol. 11, No. 9, September 1957. 13 pp. The solution of the phase equation for troposphere with overcritical refraction is given for a magnetic dipole with the aid of the Whittacker function. The solution for a homogeneous atmosphere is found as a special case by equating certain constances to zero. The obtained series expansion of Green's function is converted with the aid of Watson's transformation. An approximation shows the dependence on the index of refraction, and the height of the tropospheric dust. The phase surfaces and their displacement at the ground are compared with conditions in the homogeneous atmosphere.

## COMPONENTS

**•New Technique for Winding Subminiature Coils,** W. F. Kallensee. "El. Ind." Jan. 1958. 2 pp. Coils for subminiature transformers create a manufacturing problem because conventional winding forms can not be used. This new method uses modification of an established process and adhesive-coated wire to make self-supporting coils.

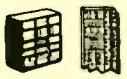
**The Special Features of Designing Multistage Magnetic Amplifiers,** N. P. Vasil'eva, M. A. Boiarchenkov. "Avto. i Tel." July 1957. 9 pp. Certain special features of designing low-power magnetic amplifiers are discussed. Concepts are developed with regard to the selection of circuits, the number of stages and the determination of the design parameters of multistage amplifiers on the basis of the ideas governing the achievement of a specified speed of response.

**Bounds for Thermistor Compensation of Resistance and Conductance,** A. B. Soble. "IRE Trans. PGCP." September 1957. 6 pp.

**Modern Batteries,** Walter J. Hamer. "IRE Trans. PGCP." September 1957. 11 pp.

**Simplified Pulse Transformer Design,** J. H. Smith. "El. Eng." November 1957. 5 pp. A brief outline is given, for the non-specialist, of the design technique of pulse transformers. The discussion includes design of low-power pulse transformers and materials used, high power types and the relevant parameters, the Multiar transformer with a circuit description. Finally, a parameter for core selection in video or audio power transformers is derived.

**Wide Band Balanced and Screened Transformers in the range 0.1—200 Mc/s,** M. M. Maddox and J. D. Storer. "El. Eng." November 1957. 8 pp. A method for the design and construction of wide band transformers is described in which the physical characteristics of the transformer are determined so that it appears as an ideal transformer together with a symmetrical low-pass filter with the appropriate iterative impedance. The winding, which may be encapsulated, is screened and has a form which achieves a high degree of balance.



## COMPUTERS

**Difference Counters,** A. F. Fischmann. "El. Eng." November 1957. 5 pp. The difference counter is a device counting the difference in number between two sequences of pulses inserted at two different input terminals. Some applications are discussed, and two practical examples are given, each being designed for a different speed. Finally, the design of a decimal difference counter is outlined.

**A Digital Single Line Indicator,** V. Gundelach. "El. Rund." November 1957. 3 pp. The reading of electronic counters with glow discharge lamp lighted number columns still suffers from the poor brightness and different position level of the digits composing an indicated number. A device is described which is designed as a supplement to an electronic counter displaying the counting result in one line composed of appr. 5 cm high digits.

**Synthesis of Lumped Parameter Precision Delay Line,** E. S. Kuh. "Proc. IRE." December, 1957. 11 pp. A technique is presented for designing delay lines for precision time domain applications, such as arise, for example, in analog to digital conversion.

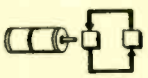
**Demonstration Model of a Simple Repeating Analogue Computor for Linear Calculation Operations,** M. Kalthoff. "El. Rund." November 1957. 5 pp. After an introduction into the addition and integration of voltage values an electronic analogue equations with constant coefficients displaying its solution functions as screen images on a conventional cathode ray tube.

**Symbolic Designations for Electrical Connections,** A. Weinberger and H. Loberman. "J. Assoc. for Computing Machinery." October 1957. 8 pp.

**Five Ways to Apply An Analogue Computer in Control System Design,** E. C. Goggio. "Auto. Con." October 1957. 7 pp.

**Satellites and Computers — and Psychology,** Edmund C. Berkeley. "Comp." November 1957. 3 pp.

**Binary-Decimal Counter Operates at 10 Mc,** D. E. Cottrell. "El." November 1, 1957. 4 pp.



## CONTROLS

**Automatic Liquid-Level Control by the Phase Method Using Ultrasonic Waves,** V. B. Brodsky. "Avto. i Tel." July 1957. 13 pp. The theory of the method is given, and it is shown that the utilization of conversion transformers and dielectric fillers in the metering line makes it possible to measure liquid level over a range which is considerably greater (or less) than the range over which the standing-wave minimum is shifted. The errors of the method are examined and the limits of its applicability are evaluated.

**Modulation of Radioactive Radiation in Automatic Control Units,** D. I. Ageikin, L. V. Meltzer, N. N. Shumilovsky. "Avto. i Tel." July 1957. 3 pp. Various methods of modulating radioactive radiation are examined for the purposes of application in automatic control units. Mechanical and field modulation are analyzed in some detail.

**A Miniature Unit for Controlling the Duration of Radioactivity Measurements,** M. C. B. Russell and J. C. Boag. "El. Eng." November 1957. 4 pp. A unit is described which may be associated with scaling circuits to control the duration of radio-activity measurements. The duration of the count is measured with a maximum error of 20 msec in units of time which are displayed on a register. A count is automatically terminated by preset count or time limits, but its duration is always made equal to a whole number of time periods.

**Counters for Electronic Control,** J. R. Cunningham. "Auto. Con." October 1957. 4 pp.

**An Analysis of the Movement of a Loaded Hydraulic Servomotor with Feedback,** V. A. Khokhlov. "Avto i Tel." September, 1957. 4 pp. An analysis is given of the motion of a loaded hydraulic servomotor with a rigid feedback while its piston is effected by constant position and inertia loads. It is shown that the equation of an uninterrupted liquid flow, which determines the movement of the piston, is correct only if the inert mass of the load is not higher than the critical one. The equation for calculating critical mass is given.

**A Relay Position System of Automatic Control with a Compound Servomotor,** V. V. Gorsky. "Avto i Tel." September, 1957. 6 pp. A relay position system of automatic control is analyzed in which the servomotor has a compound system of excitation. Formulas are deduced for the determination of the rotation speed and angle of the output shaft system. The transient regimes of the machine are analyzed with an account of the results of saturating it with a magnetic circuit. The article determines the type of nonlinear speed feedback during which the minimum insensitive zone and absence of overshooting is reached. A description of a device for the functional transformation of the voltage speed feedback and its circuit diagram are given. This relay system, in the author's opinion, is close to the optimum one.

**The Use of Radioactive Radiation in the Installations of Automatic Control,** Yu. V. Gushchin, L. W. Meltzer, M. I. Tolokonnikov, M. N. Schumilovsky. "Avto i Tel." September, 1957. 13 pp. The basic methods and trends of using radioactive radiation in automatic control devices are considered. The article gives brief characteristics of the sources and receivers of radiation used in such devices. Examples of practical application.

**How To Design a High-Speed Magnetic Switch,** Donald R. Erb. "El. Eq." November 1957. 5 pp.

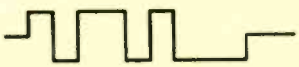
## INDUSTRIAL ELECTRONICS

**An Automatic Fog Warning Instrument,** J. W. Nichols and M. H. Westbrook. "El. Eng." November 1957. 5 pp. In this article an instrument which will give automatic warning of a decrease in visibility, through fog, is described. The instrument works on the scattered light from a projected beam. The backscatter is measured by a photocell, amplifier and RC integrator. The electronic features of the design are dealt with in detail.

**Electronics Controls Gas Chromatograph,** Walt Donner. "El." November 1, 1957.

# *International* ELECTRONIC SOURCES

**Wind Tunnel Instrumentation,** A. Tiffany. "El. Eng." November 1957. 5 pp. The design and operation of modern wind tunnels centers increasingly upon the instrumentation techniques available for collecting and processing the experimental data. Interest is growing in the application of digital methods in many fields of testing and control and this article outlines the development of a data handling system matched to the needs of a particular problem.



## INFORMATION

**Information Theory and Communications,** Pierre Mertz. "Wire & Radio Communications." November 1957. 3 pp. Here some of the ideas of information theory are presented in elementary fashion. A notion is given of how quantity of information is measured, and pitfalls are noted which show why this is not always precise. The idens are applied to appraise the performance of conventional telegraph and telephone channels.

## MATERIALS

**The Function of Additives in Tungsten for Filaments,** J. L. Meijering and G. D. Rieck. "Phil. Tech." October 16, 1957. 9 pp. In the production of tungsten for incandescent filaments certain suhstances (dope) are added with a view to obtaining filaments which do not undergo deformation on incandescence. In such wires long boundaries are found between the crystals after recrystallization. With the aid of paper models a plausible explanation is given of the way in which the formation of the long boundaries is promoted by the presence of strands or tubular systems of foreign atoms, which arise in the wire during the drawing process.

**The Sylvatron: A New Application of Electroluminescence,** K. H. Butler and Frederic Koury. "Syl. Tech." October 1957. 4 pp.

**The Magnetic Relay on Ferrites,** G. D. Kozlov. "Avto i Tel." September 1957. 2 pp. The article considers the magnetic amplifier performing in relay regime—magnetic relay, designed for use on ferrite cores, is examined for multiple variations of current in load relay (100-200). The method of devising such a magnetic relay.

**Fused Silica—New Delay Line Materials,** Henry S. Craumer. "El. Eq." November 1957. 4 pp.

**Changes in Luminescence of ZnS After Excitation by $H_2$ + ions** — W. Berthold. Vak. Vol. 6, No. 56, August 1957. 9 pp. each. This is the second and third part of a previous article.

## MEASURING & TEST

***A Prospectus on Medical Electronics, Part 1,** R. G. Stranix. "El. Ind." Jan. 1958. 4 pp. This article presents a quick survey of recent developments, a calculated guess of what's anticipated, and information on how the interested engineer or manufacturer can break into this field. Also, a few tips on selling to the medical profession.

**System Reliability Through Reliable Design,** K. A. Pullen. "Auto. Con." September 1957. 4 pp. The author enumerates some of the more important principles for achieving system reliability and analyzes some typical examples of questionable design in terms of them.

**Automatic Evaluation of Printed Circuit Receptacles,** E. C. Bean. "NRL." October 1957. 4 pp. A machine that automatically collects life test data on printed circuit receptacles has heen designed and developed. Up to 4,000 cycles of test data can be recorded during one test run.

**Characteristics of Some Ferrous and Non-Ferrous Waveguides at 27Gc/s,** J. Allison, et. al. "Proc. BIEE." November 1957. 4 pp. Measurements of the attenuations produced by air-filled, rectangular waveguides of brass, copper, aluminum, nickel-silver, nickel, mild-steel, Radiometal, Rhometal and Mumetal have been made at a frequency of 27Gc/s, and the effective permeabilitics of the ferrous materials at this frequency have been estimated from the results.

**Thermal Design—11,** Harry M. Passman. "El. Des." November 1, 1957. 4 pp. Second part of a two-part article deals with design improvements. Though the scope of the article is limited to airborne electronic equipment the information provided should prove helpful to design engineers coping with thermal problems.

**All-Transistor Circuits for Portable Detectors,** G. G. Eichholz, et. al. "Nucleonics." November 1957. 4 pp. Prospectors need small instruments. Canada's Department of Mines has developed 4 prototypes for search and assay that can be carried by hand or in the pocket. They are cheap and reliable.

**Tones Monitor Heart's Electrical Action,** A. J. Morris and J. P. Swanson. "El." November 1, 1957. 3 pp. Frequency of neon-tube oscillator is controlled by amplitude of heart's electrical signal. Resulting tone series gives surgical team a constant check on heart.

**Development of Transmission Measuring Apparatus for Carrier Currents During The Last Ten Years,** J. A. Ville. "Cab. & Tran." October 1957. 5 pp. The general characteristics of transmission equipment which appeared or developed during the last decennial period are increase of channel number, widening of the transmitted band, and extension of television transmission and radio links.

**High Precision Transmission of Measurement Parameters,** E. Munk. "El. Rund." November 1957. 3 pp. An examination is carried out as to how the simultaneous transmission of time-varying parameters can best be carried out to satisfy the requirement of high accuracy. As example an equipment is described operating on the binary P.C.M. basis and intended for mobile use. Particular attention was paid to simplicity.

**Screen Image Photography,** R. Falker and E. E. Hucking. "El. Rund." November 1957. 4 pp. Practical hints for the photograph of oscillograph and tv receiver screen images using conventional equipment are given. Methods for definite brightness adjustment and points of view for equipment selection, also some questions concerning the handling of positives are considered.

**Errors in the Measurements of the Frequency Spectra of Pulses by a System of Staggered-Tuned Resonant Circuits,** G. Seeger and H. G. Stablein. "Arc. El. Uber." Vol. 11, No. 8, August 1957. 6 pp. The method of directly measuring the frequency spectra of pulses by a system of staggered-tuned resonant circuits gains in importance. The dissipation factors of the circuits used cause errors. The kind and magnitude of errors are discussed in this paper. The investigations are carried out for two cases: circuits of equal absolute band width, and circuits of equal relative band width.

**Navy Missile Measurements—Moment of Inertia,** Samuel E. Dorsey. "El. Eq." November 1957. 4 pp.

**Photoelectric Target for Missile Tests,** Samuel E. Dorsey. "El." November 1, 1957. 3 pp.

**Design of a Dual Pulse Code Train Generator,** A. M. Leuck and T. I. Humphreys. "El. Eq." November 1957. 4 pp.

**Operational Test Equipment Must Be Tailored to Missile and Its Crew,** George A. Harter. "Aviation Age." November 1957. 4 pp.

**Gamma-Ray Monitor Has High Reliability,** J. M. Jackson and J. J. Suran. "El." November 1, 1957. 5 pp.

## RADAR & NAVIGATION

**Designing Flight Control Systems for Ballistic Missiles,** Joseph A. Miller. "Aviation Age." November 1957. 4 pp.

**Aids to Inertial Navigation,** F. Stevens and F. W. Lynch. "Aero. Eng. Rev." November 1957. 5 pp. The mechanical and natural limitations of inertial systems, methods to overcome these limitations, the problem of inertial platform misalignment, and methods for platform stabilization are discussed.

**Weather Avoidance With Airborne Radar,** P. L. Stride. "El. & Comm." October 1957. 6 pp.

**Three Approaches to Inertial System Design,** James Holahan. "Aviation Age." November 1957. 5 pp.

## SEMICONDUCTORS

**The Junction Transistor As A Charge-Controlled Device,** R. Beaufoy and J. J. Sparkes. "ATE J." October 1957. 18 pp. The operations of the junction transistor is described in terms of the charge in the base region when a current flows from emitter to collector. This leads to the specification of new parameters of transistor performance which take the form of time constants, normally expressed in picocoulombs per microamp.

**The Junction Transistor As A Network Element At Low Frequencies, II,** J. P. Beijersbergen, et al. "Phil. Tech." October 9, 1957. Second article from a series of three on the properties of the junction transistor as a network element. Many equivalent circuits are possible for the transistor. To get an idea of how the transistor behaves in a proposed circuit, an equivalent circuit suited to this circuit is chosen. Mention is made of the types most commonly used for this purpose.

**IRE Standards on Graphical Symbols for Semiconductor Devices, 1957,** "Proc. IRE." December, 1957. 6 pp.

**Designing Transistor Circuits Small-Signal Parameters and Equivalent Circuits,** Richard B. Hurly. "El. Eq." November 1957. 5 pp.

**Transistor Noise in the Low Frequency Band,** J. Schubert. "Arc. El. Uber." Vol. 11, No. 8. 10 pp. No. 9, 7 pp. August and September 1957. Measurements of the noise behavior of transistors over a wide range of frequencies gives evidence of the validity of a simple equivalent circuit in the region of white noise that indicates the analogy to noise of vacuum triode. The optimum operating conditions for

the minimum noise figure are given for the grounded emitter, for the grounded base, and grounded collector circuits.

**Experimental Determination of the Base and Emitter Lead Impedances of Junction Transistors by Applying Low Frequency Measurement Techniques,** W. Guggenbuhl and W. Wunderlin. "Arc. El. Uber." Vol. 11, No. 9, September 1957. 4 pp. Starting from the basic equation of the one-dimensional theory of junction transistors, formulas are derived for the calculation of the lead resistances from the low frequency parameters. The results are compared with values found by other methods. Good agreements confirm the validity of this approach of this method.

**Theoretical Analysis and Theoretical Test of Distortions in Four Poles which Contain Low Frequency Junction Transistors,** G. A. Spescha and M. J. O. Strutt. "Arc. El. Uber." Vol. 11, No. 8. August 1957. 14 pp. The theoretical part of the article treats the non-linear distortions on the basis of equations of a non-linear four-pole in the hybrid form. The quasi-hybrid linear parameters of the four-pole are extended by the addition of distortion expressions which may be calculated by differentiation of the quasi-linear parameters. The distortion parameters are determined experimentally. In the second part, the theory is applied to junction transistor four-poles operating in the grounded base, grounded emitter, and grounded collector connections. Methods of measuring the distortions are described fully. Finally, conclusions as to the application to amplifier stages are stated.

**Semiconductor Compounds Open New Horizons,** Abraham Coblenz. "El." November 1, 1957. 6 pp. Comprehensive survey of semiconducting compounds.

**Transistor Conversion Nomograph,** C. W. Young. "El. Eq." November 1957. 3 pp.

**Cooling of Power Transistors,** Melvin Mark. "El. Des." November 1, 1957. 2 pp.

**Thermal Turnover in Germanium P-N Junctions,** A. W. Matz. "Proc. BIEE." November 1957. 10 pp. The static reverse characteristics of an alloyed germanium p-n junction are analyzed, taking into account an avalance multiplication factor. The condition for thermal stability is examined, the onset of the existence of a negative-resistance region is predicted.

## TELEVISION

**Testing Methods for Image Orthicon Camera Tubes,** F. Pilz. "Rundfunk." Vol. 1, No. 4. August 1957. 14 pp. In addition to the usual measurements of resolution, frequency response and geometry, the article describes methods which permit measurements of the following characteristics pertaining to image orthicons: secondary emission factor, gain of the multiplier, capacitance of the signal plates, and the memory, as well as modulation depth of the return beam. Finally, the article describes the construction of a test device for image orthicon tubes.

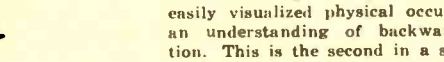
**Use of an Industrial Television Link in Sound Broadcasting,** K. Mandl. "Rundfunk." Vol. 1, No. 4. August 1957. 2 pp. The Bavarian broadcast uses ITV to support sound broadcasts in cases where the events being broadcasted cannot be seen directly from the control room. Two sets of equipment are in use; one with a mobile unit, the other permanently installed in the Congress Hall of the German Museum. The article highlights the technical problems.

**The BBC's New Television Studios in London,** N. Thomas. "Rundfunk." Oct. 1957. The paper begins with a description of the two additional television studios which the BBC acquired with the purchase of the Riverside Film Studio in Hammersmith, and which are to supplement the Line Grove Studios. The studios are equipped with image-orthicon cameras, with a separate vision and sound control room for each studio. The paper goes on to describe the lay-out of the studios and their video equipment, as well as the lighting and air-conditioning installation and the power supply.

**The Colour Sub-Carrier Frequency In A 625-Line Version of the NTSC System,** Erich Schwartz. "Rundfunk." Oct. 1957. The article begins with a list of the different color sub-carrier frequencies which have been proposed for adaptations of the NTSC system to the European 625-line standards. A direct transpostation without modification leads to a frequency of 4.7 ± 0.04 Mc/s for the color sub-carrier. The nearest frequencies which could be chosen are 4,2109375 and 4,1015625 Mc/s.

**Fundamentals of Colour Television,** F. W. de Vrijer. "Phil Tech." Octoher 9, 1957. 12 pp. This introductory article on color television begins by recapitulating some colorimetric concepts, such as additive color mixing and the chromaticity diagram (color triangle). The principle of color television is then explained with reference to a system containing three camera tubes and three picture tubes, considered at this stage with separate transmission channels for the three primary colors (red, green and blue).

**The RAI's New Television Studios in Rome,** Luigi Sponzilli. "Rundfunk." Oct. 1957. The RAI's television studios in Rome consist of four inter-connected buildings. They are situated not very far from the town center and are connected with the Italian television network by means of decimetric-wave radio links.



## THEORY

**On the Nature of the Electron,** J. L. Salpeter. "Proc. IRE." December, 1957. 11 pp. In this paper the concept of the electron as a fundamental particle of modern physics is discussed in relation to Pauli's exclusion principle, wave mechanics, the uncertainty principle, and relativity.

**Chladnl's Figures on the Vibrating Capacitor of a Synchrocyclotron,** B. Bollee. "Phil. Tech." October 9, 1957. 2 pp. The frequency modulation of the new 600 MeV synchrocyclotron now being built by the CERN at Geneva is effected by a vibrating capacitor in the form of a 2 meters wide aluminum tuning fork. Initially, trouble was caused by the occurrence of an undesirable resonance at a frequency equal to twice the fundamental frequency at which the vibrator was excited (55 c/s). To eliminate this and similar resonances, the overtones of the vibrator were subjected to an investigation, in which the various vibration modes are strikingly revealed as Chladni's figures.

**Masers and Related Quantum-Mechanical Devices, Part 1,** G. E. Weibel. "Syl. Tech." October 1957. 8 pp. The basic principles of maser devices are reviewed. Considering first the quantum-mechanical behavior of single atoms or molecules, here called microsystems, transitions resulting in the absorption or emission of radiation are then described. Energy storage and frequency conversion in media containing large numbers of microsystems are considered and the analogy to frequency conversion in non-linear networks is pointed out. The analog network is shown to predict the possibility of signal amplification and of self-sustained oscillation.

## TRANSMISSION

***Raising the Limits for Coaxial Cables,** E. T. Pfund et al. "El. Ind." Jan. 1958. 5 pp. This progress report reviews present knowledge and practical experience with coaxial cables at very high temperatures. The need for improvement is great, and several likely approaches are under investigation.

**The Structure of Remote-Control Lines for Dispersed Objects,** V. A. Il'in. "Avto. i Tel." July 1957. 7 pp. The paper examines the structural reliability and the relative length of the transmission lines. On the basis of the analysis recommendations are made with regard to the selection of transmission lines for dispersed objects.

**Cross-Talk in Cables During Pulse Transmission, H. Kaden.** "Arc. El. Uber." Vol. 11, No. 9. September 1957. 6 pp. A pulse traveling over a line generates in the neighboring line near-end as well as far-end voltages which differ from each other. While the near-end cross-talk is present for twice the propagation time of the line, the far-end cross-talk is present only for the pulse duration. The method for calculating the cross-talk is given in detail.

## TUBES

***Understanding the Backward Wave Oscillator,** Dr. D. A. Dunn. "El. Ind." Jan. 1958. 5 pp. A series of logical steps, each representing an easily visualized physical occurrence, leads to an understanding of backward-wave oscillation. This is the second in a series of articles on the basic principles and recent developments in microwave tubes.

**Improved Vacuum Tube Reliability Through Maintenance,** G. B. Woodman. "Tech. Rev." October, 1957. 4 pp.

**A Transmitting Triode for Frequencies Up To 900 Mc/s,** P. J. Papenhuijzen. "Phil. Tech." October 16, 1957. 11 pp. The TBL 2/300 tube is a disc-seal triode designed for use with coaxial systems. The directly heated cathode is practically an equipotential surface even up to as high as 900 Mc/s. For the grid a new material is used, which has low-emission properties.

**Welding Techniques for High Vacuum Tubes,** W. Espe. "Vak." Vol. 6, No. 5. August 1957. 11 pp.—Part I. Vak Tech., Vol. 6, No. 6, September 1957. 6 pp.—Part II. The article is a thorough treaty of welding methods used for high vacuum systems. Methods and apparatus are described.

**The Selection and Application of Traveling Wave Tubes—1,** N. Hansen and A. Nielsen. "El. Des." November 1957. 4 pp. Part 1 of a two part series which studies the traveling wave tube from the viewpoint of the user. It describes the procedure in selecting the proper operating performance and circuit design most suited for a particular application, and the practical problems associated with designing and packaging a traveling wave amplifier.

**New Type of Cold Cathode Trigger Tube, Part 2,** G. O. Crowther and K. F. Gimson. "El. Eng." November 1957. 10 pp.

# *International* ELECTRONIC SOURCES

**The Breakdown of Cathode Coatings,** B. Wolk. "Syl. Tech." October 1957. 5 pp.

**TV Picture Tubes Employing 110-Degree Deflection,** W. A. Dickinson. "Syl. Tech." October 1957. 4 pp.

**Tube Developments for Guided Missile Applications,** R. W. Slinkman. "Syl. Tech." October 1957. 4 pp.

## U. S. GOVERNMENT

Research reports designated (LC) after the PB number are available from the Library of Congress. They are photostat (ph) or microfilm (mi), as indicated by the notation preceding the price. Prepayment is required. Use complete title and PB number of each report ordered. Make check or money order payable to "Chief, Photoduplication Service, Library of Congress," and address to Library of Congress, Photoduplication Service, Publications Board Service, Washington 25, D. C.

Orders for reports designated (OTS) should be addressed to Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. Make check or money order payable to "OTS, Department of Commerce." OTS reports may also be ordered through Department of Commerce field offices.

**Radar Simulator for Use in Air Traffic Control Studies,** W. C. Hixson, G. A. Harter and C. E. Warren, Ohio State University. January 1954. 29 pp. Mi $2.70, ph $4.80. (PB 123088, LC). The radar simulator described in this report will be capable of simulating thirty moving aircraft targets on a plan-position type radar indicator. Control of target heading, velocity, position, and turn rate will be available at each aircraft target operating station. The following additional features will be available: 1. Simulation of wind drift effect. 2. Distinctive coding symbol on each target. 3. Automatic variation of aircraft airspeed as a function of altitude. 4. Continuous display of targets on the CRT indicator or alternative simulation of the standard PPI scan.

**Survey Study on Antennas for Forward Ionospheric Scatter Transmission,** Pickard and Burns, Inc. February 1956. 59 pp. Mi $3.60, Ph $9.30. (PB 122372, LC). The material presented covers first a study and survey of propagational effects associated with ionospheric forward scatter transmission, then an examination of various antenna types having possible use, and finally a comparison of the advantages and disadvantages of the various antennas.

**Electrostatic Machines, Influence Type,** I. Kessler, U. S. Army. April 1955. 49 pp. $1.25. (PB 121122, OTS). Covers the development and engineering tests of four electrostatic machines: a 20-kv, electric-motor-driven machine, a 6-kv, electric-motor-driven machine, a 20-kv spring-motor-driven machine, and a 6-kv, spring-motor-driven machine.

**Remote Control Wide-Band Multichannel Telemeter,** E. E. Bissell, Jr. and M. W. Oleson, U. S. Naval Research Laboratory. July 1956. 27 pp. 75 cents. (PB 121246, OTS). The remote control telemeter, as finally produced after three years of evaluation and development, is capable of simultaneous transmission of 8 channels of data information, varying in frequency from dc to 10 KC, on a common radio-frequency carrier. Basically the telemeter system breaks down into two main parts: the telemeter transmitting electronics and the telemeter receiving electronics.

**Typical Overload Behavior of Low-Power Traveling-Wave-Tube Amplifiers,** G. P. Ohman and F. A. Kittredge, U. S. Naval Research Laboratory. July 1956. 16 pp. 50 cents. (PB 121039, OTS). The RCA Type A-4395 TWT, selected as a typical low-power traveling-wave-tube amplifier, was subjected to input overloads of various kinds and degrees, and the output in most cases was recorded photographically. In the overload region, this tube can be an extremely nonlinear device. When the overload is a single pulse, much distortion of pulse shape and length may occur.

**Evaluation of the Quality and Uniformity of the Titanium Mill Products Received by the Aircraft Industry During 1956,** F. J. Gillig and L. W. Smith, Cornell Aero. Lab., Inc. Mar. 1957. 75 pages. $2. (PB 121625, OTS) Twenty consumers in the aircraft industry were asked about their principal difficulties with titanium procured in 1956. The survey indicates there has been a shift in emphasis on the nonuniformity aspects. The problem prevalent three years ago regarding nonuniformity of mechanical properties has decreased, although it has not disappeared entirely. This is due in part to an improvement in the quality of the material and in part to more elaborate forming techniques. The major nonuniformity problem is thickness variation. This is especially true in alloys having higher elevated-temperature strength and can be expected to become more pronounced as even stronger alloys are developed. Two other problems frequently mentioned were hydrogen contamination and poor surface finish. All three conditions point to the need for better production control and specialized processing equipment.

**An Evaluation of Bend Testing of Titanium Sheet,** W. P. Achbach and E. G. Bodine, Battelle Memorial Institute. Apr. 1957. 27 pages. 75 cents. (PB 121626, OTS) This report contains recommendations for a uniform procedure for conducting the bent test on titanium alloys developed in the Department of Defense titanium sheet-rolling program. The procedure parallels as closely as possible the typical bend test used by the aircraft industry. The authors state that insofar as practical, since numerous different procedures exist throughout the industry, the recommended procedure retains the desirable features of the majority of tests and reduces to a minimum the uncontrollable items found in some procedures. The recommended procedure is not intended as a specification requirement.

**Notch Sensitivity of Titanium and Titanium Alloys,** F. C. Holden, Battelle Memorial Institute. Apr. 1957. 91 pages. $2.50. (PB 121627, OTS) Most notch-testing is of the short-range acceptance or quality-control type. Because of the nature of these tests, the results usually are not suitable for providing fundamental data. To simulate unfavorable service conditions, a test specimen with a sharp notch usually is used, and the notch sensitivity is evaluated from the notch-unnotch strength ratio. The more basic type of research program utilizes tests having a wider range of variables, such as notch geometry and test temperature. A useful objective of this type of program in the future would be an acceptable standard procedure for determining notch sensitivity. A longer range objective would be the establishment of a basis for predicting failure under the complex system of stresses that exists in a notched section. The report recommends a test procedure.

**Ferroelectric Devices,** E. Wainer, Horizons, Inc. Dec. 1956. 143 pages. $3.75. (PB 121974, OTS) This study of the characteristics and applications of ferroelectrics resulted in development of two utilitarian devices, both based on a second-harmonic dielectric amplifier. The first was a voltage squarer with an accuracy of about 4 percent, a substantially better reading than that given by vacuum tube circuits. The device appeared to have use where an output voltage proportional to the square of some other voltage is desired. The second development was an electrometer amplifier which enables conversion of signals of the order of 1 volt into a.c. measurement or amplification where input resistance is of the order of $10^9$ to $10^{10}$ ohms. A solid state voltage regulator was also constructed which, although not based on ferroelectric principles, showed promise for regulation of d.c. voltage in control circuits where a.c. noise is not a disturbance. The three devices offer the advantages of simplicity, compactness, and potential elimination of vacuum tube circuits. Their development grew out of construction and evaluation of a ferroelectric low-level d.c. modulator. A number of other novel devices were suggested by the research.

**Determining the Usefulness of Barium Titanate Material for Memory Devices in Large Scale Digital Calculators,** C. F. Pulvari, Catholic Univ. of America. Apr. 1956. 86 pages. $2.25. (PB 121384, OTS) This research not only confirmed the high promise of ferroelectric information storage devices, but also is the basis for a prediction of the possibility of small-size, large-capacity, lightweight memories. The study covered the production of ferroelectric materials and their properties, with emphasis on condensers of barium titanate and their use as information storage media. Among the results was determination of the proper size and thickness for condensers. Switching time and method of imprinting electric charge were studied theoretically and experimentally. Hysteresis loop investigations resulted in values for switching energy. Methods and modes were developed for reading stored information based on research, a ferroelectric memory matrix with a storage capacity of 100 binary digits was built which proved the feasibility of such devices. Another basic study concerned the use of ferroelectrics in recording tape. Growth of perfect c-domain single crystals with vastly improved properties also was accomplished.

**Loaded Dielectric Foams,** G. E. Niles, Emerson and Cuming, Inc. Dec. 1956. 51 pages. $1.50. (PB 121897, OTS) The development reported in this paper filled a need for a lightweight material of high dielectric constant for use in sandwich radome construction. The material was based on foaming resin systems loaded with aluminum microflake to achieve the necessary dielectric constant and at the same time retain much of the low bulk density of the foamed resin. Isocyanate resinous foams loaded with aluminum microflake were successfully made. They compared favorably electrically with other radome core materials. Processes for loaded dielectric foams were developed which allow good process control resulting in a material of predictable properties. Development of a method of construction and submission of a radome demonstrated the practical application of loaded dielectric foams as the core in sandwich-type half-wavelength radomes. Flaked aluminum applied as a paste was found better than silver and nickel for loading foams and increasing the dielectric constant.

**Phase Retardation Design Curves for Solid Lossless Dielectric Panels,** E. J. Luoma, Wright Air Development Center. Feb. 1956. 27 pages. 75 cents. (PB 121783, OTS) This report presents data on radome design in a manner which provides the designer with a clearer perspective of design parameter variations in terms of overall performance. There was a need in the variety of design curves available for solid walls for a presentation of radome design data in which the thickness-to-wavelength is plotted as a function of incidence angle with the phase retardation remaining constant. The graphs in this volume provide some of that data for the solid lossless case. A conclusion of the data processing recommends that for more complex radome walls, the explicit transcendental equation for phase retardation should be solved before obtaining the constant phase retardation data by graphical cross plotting.

## PATENTS

Complete copies of the selected patents described below may be obtained for $.25 each from the Commissioner of Patents, Washington 25, D. C.

**Fabrication of Semiconductor Devices, #2,794,846.** Inv. C. S. Fuller. Assigned Bell Telephone Laboratories, Inc. Issued June 4, 1957. The conductivity of a semiconductor is changed by fusing a glass-forming composition containing impurity to the surface of the semiconductor; fusing is accomplished by firing the semiconductor at an elevated temperature. Thus significant impurities diffuse into the surface of the semiconductor wherever the glass-forming composition has been applied thereto.

**Transistorized Keying and Mark-Hold Unit, #2,794,856.** Inv. F. T. Turner. Assigned The Western Union Telegraph Co. Issued June 4, 1957. The bistable circuit for keying a teleprinter comprises two transistors, their emitters connected to opposite terminals of an input transformer secondary and their bases connected to a center tap over individual resistors. Positive marking pulses and negative spacing pulses alternately cause conduction of these transistors. A selector magnet is connected into the collector circuit of the transistor conducting in response to the marking pulses, while the other collector circuit contains an impedance approximately equal to the selector magnet impedance and connected thereto.

**Semiconductor Translating Device and Circuit, #2,794,863.** Inv. W. W. van Roosbroeck. Assigned Bell Telephone Labs., Inc. Issued June 4, 1957. The major portion of a filament adjacent the emitter and extending toward the collector is of substantially intrinsic material in which the difference between the number of free holes and the number of free electrons present is less than the number of free hole-electron pairs.

**Phase-Sensitive Synchronizing Circuit, #2,795,644.** Inv. S. A. Proctor. Issued June 11, 1957. Large-amplitude pulses to be controlled are applied between cathode and plate of a tube and low-amplitude control pulses between grid and cathode of the same tube. The tube is biased in such a manner that the integral of the current carried by this tube each time it conducts is a function of the relative phase of the two pulse voltages. The integrated output is used to control the phase of the large-amplitude pulses.

**Dielectric Amplifier Employing Ferroelectric Materials, #2,795,468.** Inv. W. P. Mason. Assigned Bell Telephone Laboratories, Inc. Issued June 11, 1957. A flexible bimorph ferroelectric capacitor is included in a bridge circuit. The carrier is applied to the bridge to be modulated by a mechanical signal which flexes the bimorph capacitor. Demodulation is accomplished in a bridge circuit to which the carrier as well as the modulated carrier are supplied.

**Vacuum Tube Voltmeter Amplifier, #2,795,653.** Inv. R. D. McCoy. Assigned Reeves Instrument Corp. Issued June 11, 1957 A first feedback path couples the loaded cathode of the second tube to an intermediate point on the plate load impedance of the first tube. A second negative feedback path couples the same cathode to the screen grid of the first tube, stabilizing the gain of the first tube.

**Sync Separator, #2,797,258.** Inv. B. E. Denton. Assigned Radio Corporation of America. Issued June 25, 1957. An amplifier tube grid receives positive synchronizing pulses. A grid leak network, operates at the tips of the synchronizing pulses to establish a bias providing a variable threshold. This threshold is further controlled by an automatic gain control signal, whereby noise immunity in the presence of weak signals is obtained and improved synchronizing pulse separation is provided over a large range of signal variation.

**Radio Communication by Neutral Frequency Deviation, #2,797,313.** Inv. C. Wasmansdorff. Assigned Hoffman Electronics Corp. Issued June 25, 1957. A neutral frequency carrier is generated and its frequency momentarily deviated and returned to the neutral frequency value successively in opposite directions on the frequency scale. Each pair of successive deviations is indicative of intelligence to be transmitted.

**Operating Circuits for Cathode Ray Tubes, especially in Television Receivers, #2,797,358.** Assigned Electric & Musical Industries Ltd. Issued June 25, 1957. A saw tooth wave is applied to a scanning coil. A rectifier in series with a capacitor are connected across the scanning coil, while a focus coil, a resistor, and a focus control potentiometer bridge the capacitor.

**Dot-Arresting, Television Scanning System, #2,798,114.** Inv. K. Schlesinger. Assigned Motorola, Inc. Issued July 2, 1957. The beam is deflected by an in and out-of-phase superposition of a slow and a fast fluctuating wave resulting in alternately slow and fast movement of the beam of the order of twice the beam width. The beam is suppressed during its fast movement, whereby a plurality of substantially stationary discontinous dots is produced which is intensity-modulated by a signal.

**Circuit Arrangement for Producing a Variable High Direct Voltage, #2,798,155.** Inv. J. J. Ph. Valeton. Assigned North American Philips Co., Inc. Issued July 2, 1957. A high step voltage is generated by rectifying the output of an oscillator, the anode voltage of which is cyclically varied as the voltage steps to be produced. The intensity of the rectified voltage then varies cyclically and by steps as prescribed.

**Means for Stabilizing Frequency, #2,798,159.** Inv. B. Parzen. Assigned Olympic Radio & Television Inc. Issued July 2, 1957. An oscillator is locked within the frequency range of a reference oscillation. A signal representative of the phase deviation between the two oscillations is derived and used to control a motor which actuates a phase-correcting capacitor in the oscillator to be stabilized. A fine tuning capacitor in the same circuit is varied in accordance with a beat frequency between the two oscillations.

**Electron Discharge Device for Microstrip Transmission Systems, #2,798,186.** Inv. W. Caithness. Assigned Bomac Laboratories, Inc. Issued July 2, 1957. A dielectric member is joined between a narrow metallic conductor and a flat metal base. A central recessed cavity in the dielectric member faces the base. Two inductive iris members are vertically disposed within the dielectric member in contact with the base, and a conical electrode extends from the undersurface of the narrow conductor into the cavity spaced from the base member to define a discharge gap.

**Carrier Wave Modifying System, #2,798,201.** Inv. S. Woods Moulton and J. S. Bryan. Assigned Philco Corporation. Issued July 2, 1957. A carrier wave of frequency is modulated in amplitude and/or phase and representative of separate intelligence components of varying amplitude and/or phase is converted into a second carrier wave modulated in amplitude and/or phase and representative of separate intelligence components of predeterminably different relative amplitude and phase.

**Slotted Ring Antenna, #2,798,217.** Inv. A. Alford and H. H. Leach. Assigned to Alford. Issued July 2, 1957. A set of substantially flat coaxial rings having an air gap is secured together by parallel spaced conductors. The outer conductor of a coaxial cable is connected to the spaced conductors and the inner conductor of the coaxial cable extends coaxially through the set of rings and is connected to one ring of the set remote from the first ring.

**Wide-Band Amplifier Using Positive Feedback, #2,798,905.** Inv. R. E. Graham. Assigned Bell Telephone Laboratories, Inc. Issued July 9, 1957. Positive feedback is provided from the plate of a cathode follower to a preceding amplifier stage, while negative feedback is provided from the cathode of the cathode follower to the amplifier stage. The positive feedback is adjusted to unity gain when the cathode of the follower stage is connected to zero voltage, whereby a stable gain-frequency characteristic over a broad frequency band is obtained.

**Ultra-High Frequency Tuner of Constant Band-Width, #2,798,945.** Inv. E. M. Hinsdale. Assigned Radio Corporation of America. Issued July 9, 1957. A pair of adjacent cavities have an inductive coupling loop extending through an opening in a common wall. A tunable resonant circuit including a parallel-plate type variable capacitor is placed in each cavity. The inductive loop is moved as the resonant frequency of the tunable circuits is changed.

**Oscillation Generators, #2,798,953.** Inv. Chas. B. Fisher. Issued July 9, 1957. A Wheatstone bridge network constitutes the oscillator feedback path. A first resistor arm is adjacent a second frequency-determining arm; this second arm contains varistors to control the amplitude of the generated oscillations. The two secondary windings of an output transformer constitute the third and fourth bridge arms. The bridge output is fed back to the grid of the oscillator tube.

**Traveling Wave Electron Discharge Devices, #2,798,981.** Inv. J. H. Bryant, H. W. Cole, and A. W. McEwan. Assigned International Telephone and Telegraph Corp. Issued July 9, 1957. A radio frequency coupling unit at the rearward end of the metallic vacuum housing has an input line disposed lengthwise of and within the housing so that the line and the housing present a transmission path. Feedback along this path is suppressed to minimize any tendency to sustain self oscillations.

**Speed Control for Electric Motor, #2,798,998.** Inv. M. L. Marks. Assigned Consolidated Electrodynamics Corp. Issued July 9, 1957. A reference signal is magnetically recorded on a tape to derive a signal representative of the tape speed. This derived signal is alternately sampled with a reference signal to provide a constant frequency control signal, its frequency being determined by the sampling rate, while its phase depends on the relative frequency of the derived and reference signals. The phase of the constant frequency signal is used to control the tape speed.

**Radio Frequency Amplifier, #2,799,736.** Inv. R. J. Hannon. Assigned Standard Coil Products Co., Inc. Issued July 16, 1957. At the operating frequency, the grid of the amplifier tube is effectively grounded through the grid lead inductance. The input is fed to the cathode over a series inductance and a shunt capacitance dimensioned to form with the cathode and grid lead inductance an analog transformer for applying a non-attenuated signal across the inherent input resistance and capacitance of the tube.

**Superregenerative Receiver with Non-Linear Element in Tuned Circuit, #2,799,775.** Inv. R. R. Florac. Issued July 6, 1957. A single semi-conductive crystal is connected in the tuned circuit of a superregenerative receiver. The crystal is connected in parallel with the tuned circuit inductance by means of a series coupling capacitance.

**Deflection Yokes, #2,799,798.** Inv. J. K. Kratz and W. H. Barkow. Assigned Radio Corporation of America. Issued July 16, 1957. The deflection winding for a C.R. tube comprises two coils, each coil consisting of two conductors wound to be substantially continuous along their length. Each conductor has a tap at either end, and the first and second conductors of each coil are connected in parallel.

# *International* ELECTRONIC SOURCES

**Hearing Aid, #2,813,933.** Inv. E. M. Williams. Issued November 19, 1957. A converter for sound into electromagnetic waves is worn by the person who also wears a spectacle frame carrying a receiver for the electromagnetic waves which reconvert them into sound close to the person's ear.

**Regenerative Pulse Translating Circuit, #2,801,345.** Inv. J. P. Eckert and T. H. Bonn. Assigned Sperry Rand Corp. Issued July 30, 1957. A regenerative coil is on a core driven only a short distance up its hysteresis loop, the coil feeding the emitter electrode of a transistor and the collector electrode driving a second coil fed by the collector electrode of the transistor. A rectifier controlling the output signal is connected to a power supply as is the second coil, whereby variations of the threshold bias and the collector bias will be proportional.

**Multi-Electrode Semiconductor Devices, #2,801,347.** Inv. S. W. Dodge. Assigned Radio Corporation of America. Issued July 30, 1957. A plurality of P-N junction input electrodes are in contact with one face of a semiconductive body and a P-N junction output electrode, having a larger area than the input electrodes, is in contact with an opposing surface of the semiconductive body. An ohmic contact base is also mounted on the body.

**Traveling Wave Tube, #2,801,359.** Inv. A. V. Hollenberg. Assigned Bell Telephone Laboratories, Inc. Issued July 30, 1957. The helix consists only in a ribbon conductor formed in a helix, the ribbon width extending parallel to the electron paths and exceeding the gap between successive turns of the helix. The distance around a complete turn of the helix is approximately a plural odd integral number of half wavelengths of the electromagnetic wave propagation.

**Distortionless Audio Amplifier, #2,802,907.** Inv. A. P. G. Peterson and D. B. Sinclair. Assigned General Radio Company. Issued August 13, 1957. A pair of series-connected tubes, the plate of one tube being connected to the cathode of the other tube, supply a balanced output at the common terminal. The power supply is connected across both tubes. The two grids of the tubes are supplied with equal-amplitude opposite-phase signals from the plate and cathode, respectively, of a preceding tube.

**Diode Detector-Transistor Amplifier Circuit for Signal Receivers, #2,802,938.** Inv. G. B. Herzog. Assigned Radio Corporation of America. Issued August 13, 1957. A rectifier is connected in series with the base electrode of a transistor, the base-emitter path of the transistor providing the sole output current path for the diode rectifier which is poled for forward conduction in the same direction as the base current of the transistor.

**Color Television Synchronization, #2,802,045.** Inv. V. D. Landon. Assigned Radio Corporation of America. Issued August 6, 1957. The output of a tunable oscillator and of the color synchronizing burst are applied to the push-pull input and the single-ended input, respectively, of a phase discriminator having two oppositely connected rectifiers. The discriminator output, proportional to the phase difference, is integrated to produce a continuous voltage indicative of the phase difference which is used to tune the oscillator.

**Variable Tone Control Circuit, #2,802,063.** Inv. R. S. Fine. Assigned Radio Corporation of America. Issued August 6, 1957. An audio frequency signal is applied to one end of a grounded resistor and to a potentiometer in parallel to the resistor. A continuously variable tone-controlled signal is derived from a movable contact of the potentiometer. A plurality of spaced taps on the potentiometer each connect to a grounded capacitor, the capacitors having relatively low impedance in the higher audio frequency range and comparatively high impedance in the lower audio frequency range.

**Multistage Amplifier System, #2,802,064.** Inv. D. M. Chauvin. Assigned Westinghouse Electric Corporation. Issued August 6, 1957. A common plate voltage supply serves all stages in a multi-stage amplifier having screen-grid tubes. Screen-grids and anodes are connected to a common resistor leading to the voltage supply. The resistor is so dimensioned that the voltage drop there across constitutes at least one third of the total available voltage drop, whereby the amplifier gain will be substantially independent of the mutual conductance values of the tubes.

**Transistor Receiver with Constant Impedance Manual-Gain Control Between I.F. Amplifier and Detector, #2,802,100.** Inv. V. R. Beck and W. S. Patrick. Assigned Zenith Radio Corp. Issued August 6, 1957. A manual gain control is inserted between a high-impedance transistor amplifier stage and a low-impedance transistor detector. Two fixed terminals of a variable volume control potentiometer are connected across the amplifier output and the variable terminal connected to the detector input. A resistor is connected between one of the fixed terminals and the variable terminal for maintaining substantial impedance matching between the amplifier and the detector at all settings of the variable terminal.

**Valve Chain Circuits, #2,802,104.** Inv. E. L. C. White. Assigned Electric & Musical Industries Ltd. Issued August 6, 1957. A tube chain is connected to each switch the subsequent tube from the conducting to its non-conducting condition vice versa, two subsequent tubes being in opposing condition. A rectifier is connected to the grid of each tube and a series of switching pulses is alternately applied to the no-grid terminals of the rectifiers.

**Stabilized Multivibrator, #2,802,107.** Inv. J. G. Arnold. Assigned Radio Corporation of America. Issued August 6, 1957. A multivibrator, containing at least one frequency determining circuit, comprises a plate load resistor. A gaseous discharge tube is connected directly in parallel with at least one of the load resistors over connections devoid of concentrated impedance. The tubes have a common cathode resistor.

**Squelch System, #2,802,939.** Inv. W. G. Klehfoth. Assigned Collins Radio Company. Issued August 13, 1957. Low-pass and high-pass filters separate different sections of a modulation voltage derived from a detector. The difference of the voltage in these two sections and, if this difference is zero, a control circuit is operated.

**Multivibrator Circuit, #2,802,941.** Inv. J. H. McConnell. Assigned Bell Telephone Laboratories, Inc. Issued August 13, 1957. In a bistable multivibrator, a two-terminal network is connected between the anode of each tube and the control grid of the other tube, each network consisting of a parallel circuit comprising a resistance in one branch and series-connected inductance and capacitance in a second branch, the latter branch being resonant at a frequency high compared to the operating frequency.

**Oscillator-Type Control Circuit, #2,802,945.** Inv. H. T. Seeley. Assigned General Electric Company. Issued August 13, 1957. A dc control voltage subject to variations is applied across the plate-cathode circuit of an oscillator. A signal voltage fed to the grid initiates and sustains oscillations when exceeding a predetermined value. The cathode is maintained at a voltage which is a fraction of the control voltage, whereby the predetermined voltage value is substantially unaffected by the variations in the control voltage.

**Nutating Antenna Supply, #2,803,007.** Inv. A. P. Edelman. Issued August 13, 1957. A wave guide section is resiliently supported on a central axis. A dynamic magnetic field is established around the wave guide section causing one end thereof to nutate about the central axis.

**Signal Delay Tube, #2,806,177.** Inv. A. V. Haeff. Assigned Hughes Aircraft Co. Issued September 10, 1957. Two concentric cylinders are coaxially arranged with resistive layers on opposing surfaces. A conductive edge-wound helix extends radially in the annular chamber formed by the cylinders from which it is insulated. The helical chamber is traversed by a density modulated electron beam and potentials are applied to the two resistive layers and to the helix to direct the beam along this helical path.

**Electronic Oscillator for Producing Frequencies of Musical Tones, #2,806,953.** Inv. S. L. Krauss. Assigned C. G. Conn Ltd. Issued September 17, 1957. The oscillator is adapted to produce frequencies at semitone steps by the combination of a first variable inductor in parallel with a second inductor provided with a plurality of taps, one of which is permanently connected to the cathode of the oscillator tube. A similar tapped capacitor bank is connected to form a tunable resonant circuit, one terminal of which is connected to the grid of the oscillator tube. The oscillation frequency is stepwise variable by the ganged inductor and capacitor tappings.

**Traveling-Wave Tube, #2,806,972.** Inv. S. Sensiper. Assigned Hughes Aircraft Co. Issued September 17, 1957. A wave guide having a periodic relationship with respect to the electron beam path in a traveling wave tube contains at least one ferrite member composed of longitudinal segments parallel to the electron stream. A predetermined longitudinal magnetic field in the wave guide and parallel to the electron beam tends to contain the beam in its path and develops a magnetomotive force in the ferrite segments attenuating at least a portion of the circularly polarized electromagnetic wave.

**Slotted Waveguide Antenna, #2,807,018.** Inv. O. M. Woodward. Assigned Radio Corporation of America. Issued September 17, 1957. A transmission line is surrounded by a plurality of waveguides which are coupled thereto for transfer of radio frequency energy. Each waveguide is adapted to interchange energy with free space, for instance by the provision of suitably arranged and dimensioned slots.

**Matrixing Apparatus for a Color-Signal Translating System, #2,807,661.** Inv. W. C. Espenlaub and B. D. Loughlin. Assigned Hazeltine Research, Inc. Issued September 24, 1957. The matrix apparatus develops from a pair of signals, individually representative of different video-frequency color components and collectively representative of the chromaticity of an image, other signals representative of other different video-frequency color components collectively representative of the chromaticity of the image. A special network containing two impedance sections, one of which includes a phase inverter.

**Electronic Character Selecting and/or Printing Apparatus, #2,807,663.** Assigned Radio Corporation of America. Issued September 24, 1957. The cross-section of each of a plurality of cathode-ray beams in a tube is representative of one indicia. An apertured optical system in front of the CR tube permits the light due to a specially positioned beam to strike a phototube and the phototube output controls the beam intensity of a second registering or printing CR tube. Coded signals control the beam deflection in the first CR tube.

**Antenna Couplings, #2,807,713.** Inv. A. G. Kandoian. Assigned International Telephone and Telegraph Corp. Issued September 24, 1957. A common antenna is coupled to a transmitter and a receiver by an impedance transformer network. This network consists of two symmetrically arranged balanced lumped inductances connected in series, the transmitter and receiver being connected, respectively, at the two ends of the network. The length of this line is one-half wavelength; a space discharge device is connected between the two inductances at the quarter-wavelength point.

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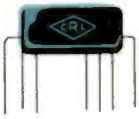
Single-stage


Four-stage

*Continued on next page . . .*

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. . . continued from preceding page

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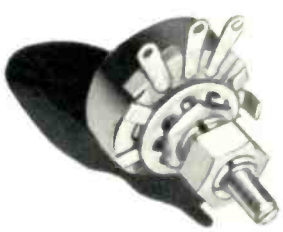

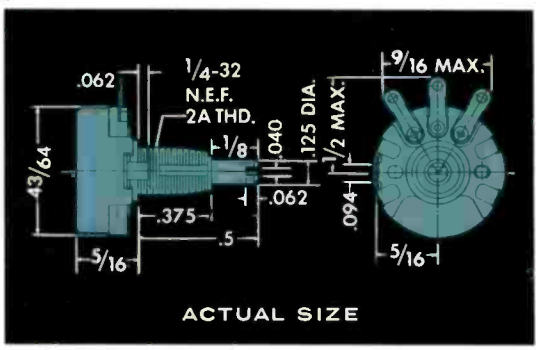


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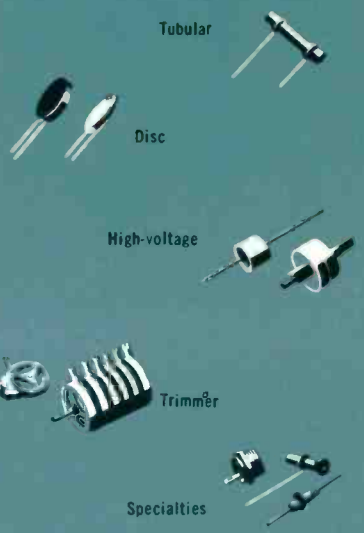
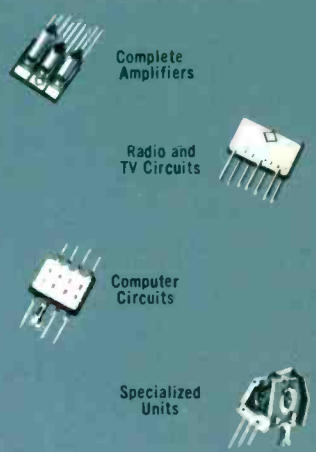
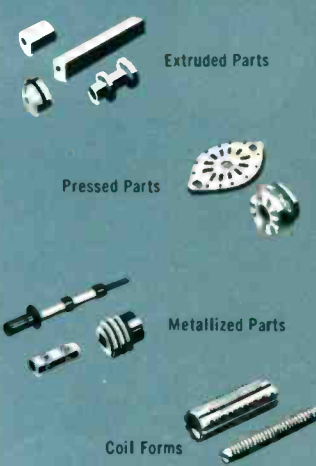
CERAMIC CAPACITORS




PACKAGED ELECTRONIC CIRCUITS




ENGINEERED CERAMICS

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# New Products

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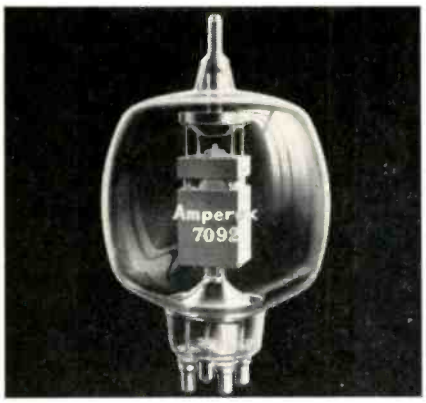


ment. Does not require water cooling. Heavy-duty anode is able to withstand large overloads. Envelope is constructed of extra-thick, hard glass for ruggedness. Used in continuous class C operation, 2 kw. power into industrial loads can be obtained. The thoriated-tungsten filament is rated at 6.3 v. Amperex Electronic Corp., 230 Duffy Ave., Hicksville, L. I., N. Y.

Circle 225 on Inquiry Card, page 103

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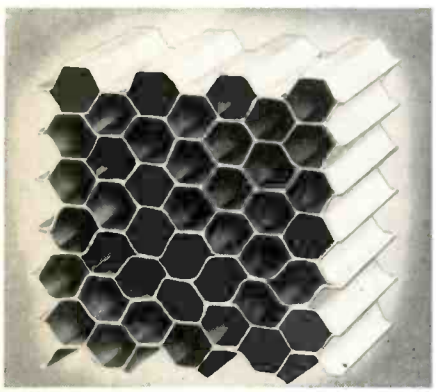

than previously possible. Available in either hot tinned dipped brass or steel, the new air inlets come in a wide variety of sizes. Shielding, Inc., Box 59, Riverton, N. J.

Circle 226 on Inquiry Card, page 103

# News of Manufacturers' Reps

### Reps Wanted

A variety of territories are open for reps to cover a new line of **electromechanical control components.** The components are now being used successfully in high performance servo systems on a line of high production tracer lathes. (R1-1, Editor, ELECTRONIC INDUSTRIES.)

A leading manufacturer of **"Electric Eyes," for automation and production controls,** has openings for qualified reps in Atlanta, Ga., Charlotte, N. C., Chicago, Ill., Dallas, Tex., Denver, Colo., Minneapolis, Minn., and Oklahoma City, Okla. (R1-2, Editor, ELECTRONIC INDUSTRIES.)

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**Stevens-Capell,** 10023 W. Jefferson Blvd., Culver City, Calif. are now West Coast reps covering California, Arizona, and Nevada for the Filtron Co.

**Sheridan Associates** of Cincinnati and Cleveland have been appointed Helipot sales reps in Ohio, Western Pennsylvania and the panhandle of West Virginia for the Helipot Corp.

**Cappels & Associates,** 2004 W. Devon Ave., Chicago, Ill. have been named sales engineers for Federal Instruments, products of Industrial Products Div. of I.T.&T. They are covering the states of Illinois, Indiana, Wisconsin, Iowa and Minnesota.

**R. W. Farris Co.** are now reps in Kansas, Nebraska, Iowa and Western Missouri for the Bud Radio, Inc. Their headquarters are at 406 W. 34th St., Kansas City, Mo.

**Anderson & Associates,** 3825 York Ave. N., Minneapolis, Minn. are now sales reps in Minnesota, Western Wisconsin, North Dakota and South Dakota for the Zero Mfg. Co.

**Professional Communications,** Cedar Ave., R. D. #1, Sayville, L. I., N. Y. are now manufacturer's reps for General Electric Co. on Long Island, N. Y.

**M. P. Odell Co.,** Cleveland, Ohio are now reps for the Vernistat Div., Perkin-Elmer Corp. in Ohio and Eastern Michigan.

**William E. Brice Co.,** 303 Bastrop St., Houston 3, Tex. have been appointed reps for Electro-Span digital supervisory control systems for the Pacific Div. of Bendix Aviation Corp. Their territory is in Texas, Arkansas and Louisiana.

**Robbins Associates,** 114 Villa Ave., Mamaroneck, N. Y. are sales reps in greater New York Metropolitan area for the Coaxial Connector Co., Inc., Mt. Vernon, N. Y.

**J. D. Ryerson Associates, Inc.,** manufacturers' reps in upstate New York have just moved into their own new building in Dewitt, N. Y.

**Wright Industrial Products** has just appointed **N. G. Simpson** as manager of their Houston office. They are engaged in the marketing of control instruments for use in both the aircraft and petro-chemical plants.

**M. J. Howard & Co.,** 132 Crocus Ave., Ottawa have been appointed reps for the entire Canadian market for the Sealectro Corp., manufacturers of teflon insulated terminals.

**Thomas L. Stevens Co., Inc.** have appointed reps in Southern California and Arizona for the Ralph S. Thacker Co.'s line of connectors and electrical components.

**Terwilliger Sales** in Kansas City has just added **Gerald McNeal** as sales engineer. He will work out of St. Louis.

**LeeMark Associates** have been appointed the reps for Alfred Electronics of Palo Alto, Calif. and the Electronic Processes Corp. of San Francisco in the Colorado, Kansas, Missouri region.

**R. L. Pflieger Co.** have been appointed sales engineering reps for Statham Development Corp. and Rheem Mfg. Co., Electronics Div. in the territory of Northern California and Nevada.

**Inland Associates,** 6047 Howe Drive, Mission, Kans. are now sales reps for Clevite power transistors, subminiature gold-bonded diodes, and other semiconductor products in Missouri, Kansas, Nebraska, and part of Iowa.

**Earnest Wilks Co.,** 1212 Camp St., Dallas, Tex., has been appointed factory reps by California Chassis Co., in Texas, Oklahoma, Arkansas and Louisiana.

**Advance Engineering Co., Inc.** recently formed by Robert Hoch and Kenneth G. Boyd have been named reps for the Magnetic Controls Co. of Minneapolis. They will cover the southern and southwestern states.

**Bilray Organization** of Louisville, Ky., has announced a new expansion program directed toward the industrial market in Indiana-Kentucky territories.

**Rodgers Associates** of Chapin Rd., Hampden, Mass., have been appointed New England distributor sales reps for semiconductor products of Radio Receptor Co.

# Three Output Immittance Theorems

(*Continued from page* 63)

generator, we realize that this approach in principle is very similar to the attempt to formulate a transfer function. In both cases the internal function-sources of described type are eliminated, so that the now passivated network obeys simple "three quantity formulas" such as Eqs. a4nd 5.

The act of writing the transfer function automatically removes the function-sources. Again we will use the network in Fig. 2a as an example, assuming $f(U_a) = K I_1$, which is the typical function for the conventional common-base amplifier. The current transfer function, including the effects of the source $E$, now becomes, as an extension of Eq. 5, as derived with the aid of Kirchhoff's laws.

$$A_1(\omega) = \frac{I_2}{I_1} = -\frac{Z_3 + K}{Z_2 + Z_3 + Z_L} = -\frac{Z_r + K}{Z_o + Z_L}, \quad (7)$$

which we equally well may write

$$A'_1(\omega) = \frac{I_2}{\frac{Z_r + K}{Z_o} I_1} = -\frac{Z_o}{Z_o + Z_L} \quad (8)$$

We have now brought the active circuit of Fig. 2a to obey the simple "three quantity" form valid for passive circuits. The equivalent circuit to the left of the output port 2-0 is now the circuit shown in Fig. 4, from which we easily read-off Eq. 8 for checking purpose, using the Current Divider Method. The equivalent cvs-circuit is shown in Fig. 5. With the aid of the Variable Divider Method, we have provided a type of network and a type of equation, which holds for both passive and active networks, and by means of which we may formulate the theorem listed below.

### *Output Immittance Theorem II.*

With reference to the possible use of "three quantity formulas" for both passive and active networks of described type, the formulation of the following theorem becomes possible:

*If the complex transfer function for a linear two-port network is known, and the terminating immittance is known, then, although the network itself may remain unknown, the output immittance may be calculated directly from the transfer function denominator as the sum of all terms, except one—the missing term describing the terminating immittance.*

When the transfer function is known, which is very often the case, the use of this theorem often reduces to a matter of seconds the problem of determining the output immittance.

The proof of the theorem lies in the general existence of the equation-type represented by Eqs. 4 and 5, covering all types of networks, disregarding the type of driving source; within the scope of this article. The theorem, however, does not depend upon the circuit being known. We would obtain the same correct result even if the 2 networks in Fig. 2 were

(*Continued on page* 154)

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unknown. Unknown networks and known transfer functions are experienced in network synthesis approaches.

The transformation to a simple variable-divider network of the general type shown in Figs. 4 and 5 is a powerful one for transistor circuits with arbitrary common electrode.[3] In this way, we can to some extent treat transistors with the aid of conventionally known tube formulas.[4] The circuits are similar to the ones conventionally obtained with the aid of the series and parallel forms of the Equivalent Plate-Circuit Theorem.

### *Maximum Power Considerations*

Even if there are several internal function-sources of described type in transistor and tube circuits, there are certain fundamental relationships that linear circuits will always fulfill when it comes to a power balance with respect to the output port. The Output Immittance Theorem III is based on this power balance, and is formulated as follows:

*In the complex voltage (or current) transfer function of a linear network, which may remain unknown, the output impedance equals the load impedance of the transfer function when this function is set equal to half its value with infinite (respectively zero) load impedance, thus*

$$\left.\begin{matrix} A_V \\ I \end{matrix}\right\}(\omega) \quad \ldots\ldots\ldots\ldots\ldots\ldots Z_L = Z_{out}$$
$$= \frac{1}{2} \begin{matrix} A_V(\omega) \ldots\ldots\ldots\ldots Z_L = \infty \\ I \ldots\ldots\ldots\ldots\ldots Z_L = 0 \end{matrix}$$

*where $A_V(\omega)$ is the complex voltage transfer function and $A_I(\omega)$ is the complex current transfer function.*

This theorem may be proven by the application of the Maximum Power Transfer Theorem. It provides an alternate to Theorem II, is usually less quick, but occasionally quicker. Neither Theorem II nor Theorem III requires a known circuit for its application, and therefore may be of some interest in network synthesis approaches.

### *Theorem Application*

As an example for the application of above theorems, let us consider the transistor amplifier in Fig. 1.[2, 6] The voltage and current directions adopted are those indicated in Fig. 1.[5] Here $h_i$ is the input impedance when the port 2-0 is ac short-circuited. Similarly, $h_o$ is the output admittance when the input port is ac open-circuited. $h_r = \mu_r$ is the reverse voltage transfer (or voltage feedback) ratio; the ratio of the voltage appearing at the ac open-circuited input port to a signal voltage applied to the output port. $h_f = -\alpha_f$ is the forward current transfer ratio; the ratio of the current through the ac short-circuited output port to a signal current applied to the input port.

Our first attempt to determine the output impedance $Z_{out}$ will be to make use of the "applied source voltage-current ratio method" by writing an equation system with $V_2, I_2$ in Fig. 1 temporarily representing the attached source $V_o, I_o$, and with $I_1$ representing the ensuing current $I'_1$. Thus, since the input is short-circuited,

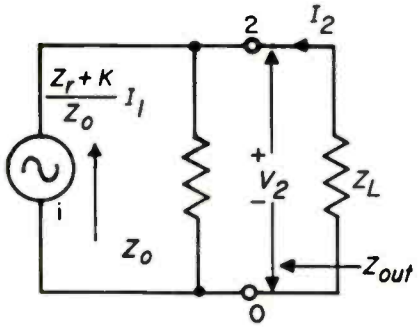


Fig. 4: Automatic elimination of internal function-sources by forming of transfer function representing a Norton generator.

$$\left.\begin{aligned} h_f I_i' + h_o V_o &= I_o, \\ -h_i I_i' &= h_r V_o, \end{aligned}\right\}$$

from which

$$Z_{out} = \frac{V_o}{I_o} = \frac{h_i}{h_i h_o - h_f h_r} = \frac{r}{r g_c + \mu_r \alpha_f + j\omega r C_c}, \quad (9)$$

were we in conventional manner have set $h_i = r$, and assumed zero phase angles for $\mu_r$ and $\alpha_f$.

In carrying out the above calculation, we have not been concerned with the existence or non-existence of the transfer function; as long as we had available the circuit diagram. We will now make the assumption that the circuit diagram has not yet evolved, but that the

transfer function is known. The transfer function is

$$A_V(\omega) = \frac{V_2}{V_1} = \frac{-h_f Z_L}{h_i + Z_L (h_i h_o - h_f h_r)}, \quad (10)$$

In accordance with the Output Immittance Theorem II the output impedance is then

$$Z_{out} = \frac{h_i}{h_i h_o - h_f h_r}, \quad (11)$$

which agrees with previous result, Eq. 9. Alternately, we may apply the Output Immittance Theorem III, in accordance with which

$$\frac{Z_{out}}{\frac{h_i}{h_i h_o - h_f h_r} + Z_{out}} = \frac{1}{2},$$

which also gives the correct result, shown by Eqs. 9 and 10.

As another application example, consider the r-f cascode circuit in Fig. 3, in which the resistor R may or may not be by-passed. The amplifier has the voltage transfer function

$$A_V(\omega) = -\frac{\mu_1 (\mu_2 + 1) Z_L}{r_{p2} + r_{p1} (\mu_2 + 1) + Z_L}. \quad (12)$$

To emphasize the synthesis application of the new theorems, we may consider the given circuit unknown, and only the transfer function known. Thus, we cannot apply the "applied source voltage-current ratio method" since there is no circuit to which to apply it. Nor is the direct application of the Thevenin-Norton theorem possible, not even if the circuit were known, since it contains a function-source (the second tube).

Whatever method we would attempt to use, even with the circuit known, is much longer than the direct application of Theorem II, which yields without calculation

$$R_{out} = r_{p2} + r_{p1} (\mu_2 + 1). \quad (13)$$

To use Theorem III we would write

$$\frac{R_{out}}{r_{p2} + r_{p1} (\mu_2 + 1) + R_{out}} = \frac{1}{2}, \quad (14)$$

from which we also obtain the correct answer, given by Eq. 13.

### *The Third Theorem*

The theorems given above both depend upon the availability of the

(*Continued on page* 156)

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transfer function. One-port networks do not have any conventional transfer function, but may contain internal function sources of the type described. Since a two-port network with removed drive appears as a one-port network, a theorem for one-port networks may also be applied to a passivated two-port network system.

Because of its association with the general field of network theory, this third network theorem has been referred to as Output Immittance Theorem I, and has, for the reason mentioned above, much in common with the other 2 theorems. This additional theorem may be considered a restatement of classical feedback theory, and is formulated as follows:

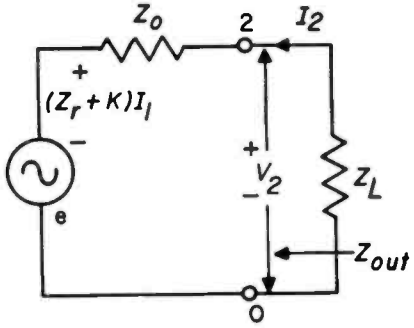


Fig. 5: Automatic elimination of internal function-sources by forming of transfer function representing a Thevenin generator.

*If to the output port AB of a linear two-port feedback network with removed input excitation is applied a signal voltage* $V_{AB}$ *or a signal current* $I_{AB}$, *so that inside the port AB there appears a Thevenin generator with the opposing cvs* $k\ V_{AB}$, *or a Norton generator with the aiding ccs* $k\ I_{AB}$, *then the output immittance equals the Thevenin impedance, respectively the Norton admittance, divided by* $(1 - k)$.

Applying this theorem to the already discussed examples in Figs. 1 and 3, we will find that this theorem also gives the correct results, but is somewhat slow in competition with Theorem II and Theorem III, which are generally very fast. The additional theorem does, however, provide an excellent checking method.

Where the transfer function is unknown, but the circuit known, Theorem I may prove very useful. For the conventional cathode follower, whether we prefer a Thevenin or a Norton generator representation, Theorem I gives the output impedance directly as $r_p / (1 + \mu)$, since (for the Thevenin generator) $k = -\mu$. There is no need to apply Kirchhoff's laws, which would take much longer time, anyhow.

There are additional "cross-breads" between the listed theorems, for example one similar to Theorem III, which may be formulated as follows: The output impedance is the ratio of the complex voltage transfer function with $Z_L = \infty$ and the complex transfer admittance with $Z_L = 0$, thus $Z_{out} = V_2/V_1$ for $Z_L = \infty$, divided by $I_2/V_1$ for $Z_L = 0$.

**References**

1. Stockman, H., "Time-Saving Network Calculations," SER Co., Waltham, Mass., 2nd ed., 1956.

2. "Standards 56 IRE 28.S2," Proc. IRE, vol. 44 nr 11, p. 154, November 1956.

3. Zyskin, G. S., "Simplified Equivalent Circuits for Transistor Amplifiers," Radiotechnika, nr. 2, 1956, reviewed in Electronic Design, vol. 4, nr. 23, p. 96, December 1956.

4. Stockman, H., "Multi-Electrode Transistor-Tube Analogy," Proc. IRE, vol. 42, nr. 6, June 1954. Letter.

5. Stockman, H., "The jw- or Symbolic Method," SER Co., 1st ed., 1956.

6. Shea, R. F., "Transistor Audio Amplifiers," John Wiley and Sons, Inc., 1st ed., 1955.

## *Novel Storage Panels Aid Radar Viewing*

RCA has developed two novel electronic storage display panels that permit prolonged viewing of projected images to which they are exposed for only fractions of a second. The first device employs a new electronic principle to achieve a light amplifier which after a 1/100 sec. exposure to a dim image, stores and displays the image in bright form for several minutes or longer. The other type, employing different principles and more complex structure, has a high resolution storage system combining picture detail with long image persistence.

## *Sea Water Cools Shipboard Gear*

The National Bureau of Standards is experimenting with a method of cooling shipboard electronic equipment that uses sea water as the ultimate heat sink. Heat is transferred from the equipment cabinet through an intermediate coolant. The cooling system removed 72% of the heat produced within a console containing a number of conventional components assembled using standard chassis construction.

## New Products

### TIME-MARK GENERATOR

Type RM181 generates 5 time markers—1, 10, 100, 1000, and 10,000-μsec, and a 10 MC sine wave. Output amplitude is about 2 v.. Outputs are available at a common coaxial connector. The 5 time markers are also available at front-panel binding posts.

The markers and sine wave are derived from a 1 MC crystal-controlled oscillator. Dimensions are: 5¼ high, 19 wide, 9¼ in. rack depth, 11 in. overall depth. Available with a temperature-stabilized crystal oven installed. Tektronix, Inc., P. O. Box 831, Portland 7, Oregon.

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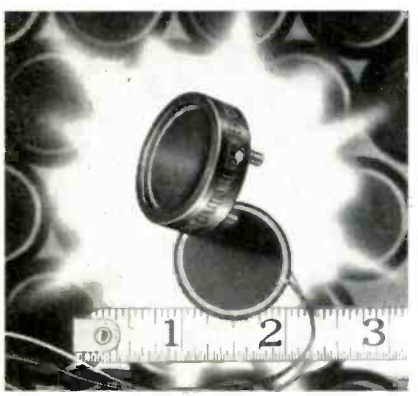
### SOLAR CELLS

Silicon solar cells for the efficient conversion of light and radiant energy into electrical power of useful proportions are available. These p-n junction type cells, when grouped in a series parallel configuration, become a primary power source. Solar batteries of this type provide a practical source of energy to many portable devices and will prove valuable where



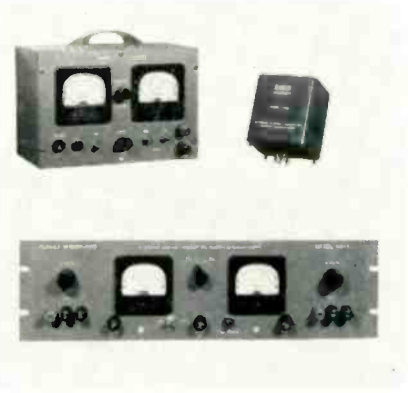

conventional power is not obtainable. Cells are approximately 1 in. in dia. Available in mounted and unmounted types. International Rectifier Corp., 1521 E. Grand Ave., El Segundo, Calif.

Circle 216 on Inquiry Card, page 103

# New Products

## POWER SUPPLIES

A complete line of low voltage units with nominal voltages ranging from 6 to 50 v. and full load current ratings from 50 to 500 ma. are available. Designed for either 60 or 400 cycle op-

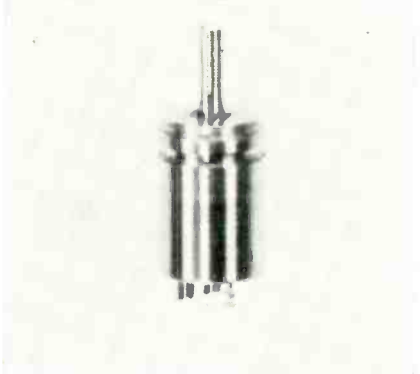


eration, the ripple and regulation factors are better than 0.5%. The temperature ranges from −30 to +65° C. The units have passed rigid shock and vibration tests. "Minisource" is designed for instrumentation, and in special packaging for a variety of industry's needs. Electronic Assembly Co., Inc., 5 Prescott St., Boston 19, Mass.

Circle 237 on Inquiry Card, page 103

## SMALL POTENTIOMETERS

Series 5000 are new ½ in., high-temperature, single-turn Helipot precision potentiometers now in production. The stainless steel potentiometer features a temperature range of −55° to +150°C. Power rating above 5,000 ohms is 2.5 w. at 60°C, derating to 1 w. at 150°C . . . below 5,000 ohms, 1.5 watts at 60°C, derating to zero at 150°C. Standard



resistance range is 500 to 70,000 ohms with a linearity tolerance of ±0.50%. Available in linear and non-linear versions. Beckman/Helipot Corp., Newport Beach, Calif.

Circle 238 on Inquiry Card, page 103

# PROFESSIONAL OPPORTUNITIES

Reporting late developments affecting the employment picture in the Electronic Industries

**Design Engineers • Development Engineers • Administrative Engineers • Engineering Writers**
**Physicists • Mathematicians • Electronic Instructors • Field Engineers • Production Engineers**

## Federal R&D Funds Increase $.5 Billion

In fiscal year 1957, Federal Government expenditures for scientific research and development amounted to around $3 billion, an increase of almost 20% over the 1956 expenditure of $2.5 billion.

More than 60 cents of every dollar for conducting research and development was obligated for development; less than 40 cents for research, both applied and basic. Basic research accounted for only 8 cents.

One of the $964 million obligated for basic and applied research in fiscal year 1957, the physical sciences, including engineering, claimed 67 percent; the life sciences, 29 percent; and the social sciences, 4 percent.

## Begin Union Drive

A drive has been started by the International Association of Machinists to organize workers in the new General Electric Co. computer plant and at Sperry-Phoenix, div. of Sperry Rand, both in Phoenix, Ariz. The union is pointing to contracts with GE throughout the nation and with 14 of Sperry's other plants.

## Patent Examiner Positions

The U. S. Civil Service Commission has announced an examination for filling Patent Examiner positions located principally in the Patent Office, Washington, D. C. The entrance salaries range from $4,480 to $12,900 a year.

Apply to the Board of U. S. Civil Service Examiners, U. S. Patent Office, Washington 25, D. C.

## Urges National Society

Dr. Joseph W. Barker, president of Engineers Joint Council and a member of the President's Committee on Scientists and Engineers, is urging the formation of a national society of engineers similar to the American Bar or Medical Associations.

# *Russian Science Outstripping Us, President's Committee Warns*

President Eisenhower has been advised by his Committee on Scientists and Engineers that "there is ample evidence that the Soviet Union is bending every effort to achieve its goal of world domination by leading the way in the scientific revolution."

The Committee was established by the President on April 3, 1956, to coordinate non-Federal efforts to meet growing needs for scientific manpower. Dr. Howard L. Bevis, Chairman, said in a letter of transmittal accompanying its second interim report last month:

"The rate of Russian progress in most scientific fields is so rapid that, unless we broaden and strengthen our own efforts, there will be little question of Soviet superiority five or ten years from now.

"Your Committee is deeply perturbed lest our major response to this challenge be in total application of our scientific effort to meet purely military needs," the letter continued, "for Russian advances in other technological fields present an equally grave threat to the ultimate security and well-being of our people This lies in the Soviet Union's well-directed and energetic program to achieve and assert scientific pre-eminence in order to gain economic, political and cultural supremacy in the world."

The Committee pointed out in its report that Russia has made "extra-ordinary progress" in scientific and technological development.

"During the 1930's the Committee recalled, "Russia imported American engineers and American machinery for such relatively simple tasks as building dams. Today, Russia has more scientists, engineers and technicians than the United States, and is graduating more than twice as many each year."

Nevertheless, the Report outlines, the country's need for train-

(*Continued on page* 163)

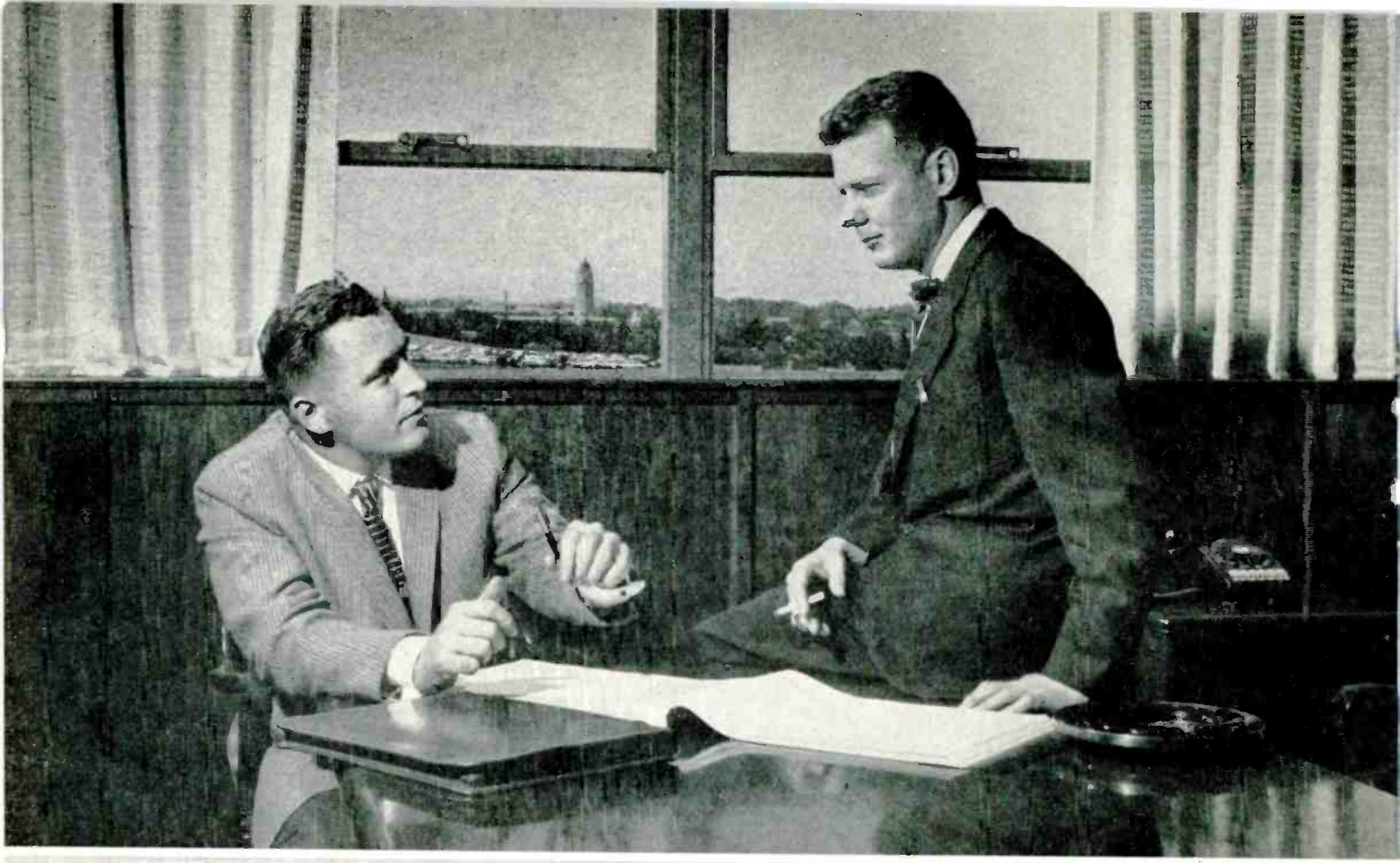
## Government Engineers Get Substantial Raise

As a step toward solving the critical shortages of engineers in Government installations the Civil Service Comm. last month authorized substantial raises in the entrance pay rates for the more than 48,000 government engineers and physical scientists. The total cost to the government will be about $25,500,000, with the Dept. of Defense bearing the burden of the expense.

About 20,000 of the employees are in grades GS-12 and above. Their pay raises will be $1,075 and $1,080 per year.

## "AUTO-SEMBLY" AWARDS


S. F. Danko and M. Abramson, employees at U. S. Army Signal Engineering Laboratories, Fort Monmouth, N. J., receive a record joint cash award of $10,000 for development of the "Auto-Sembly process of automation.



*Here E. V. Stearns (left), Inertial Guidance Department Manager, and G. D. Schott, Flight Controls Department Manager, discuss preliminary design of guidance and control systems.*

## *Lockheed Missile Systems announces...*

# NEW POSITIONS IN INERTIAL GUIDANCE

■ Few areas of science or engineering equal inertial guidance in growth or the need for continuing advances.

It is a field of major effort at Lockheed Missile Systems. Weapon systems management programs include all phases of inertial guidance and navigation.

**Continued expansion in these programs has created a number of new positions, involving:**

Mechanical design of precision instruments such as gyros and accelerometers, giving extreme attention to size, weight, susceptibility to environment and related factors;

electronics circuit design, using miniaturized and solid state techniques;

design of precise computing systems for data handling within the guidance system;

theoretical analysis and study of guidance problems to relate the dynamics of a vehicle in a defined flight path or trajectory to a prescribed mission or objective of the larger weapon system;

theoretical analysis to determine performance of guidance systems and to optimize their design;

analysis and prediction of component performance through application of theory, study and laboratory testing;

design, development and construction of specialized testing equipment in which celestial and terrestrial motions form the basic reference for measurement;

manufacturing development of inertial components such as gyros and accelerometers.

Those possessing a high order of ability and experience are invited to write the Research and Development Staff, Palo Alto 5, California.

*Engineers who lack experience in inertial guidance but wish to participate in its growth are invited to write.*


*Lockheed*

**MISSILE SYSTEMS**

A DIVISION OF

LOCKHEED AIRCRAFT CORPORATION

**PALO ALTO · SUNNYVALE**

**VAN NUYS, CALIFORNIA**

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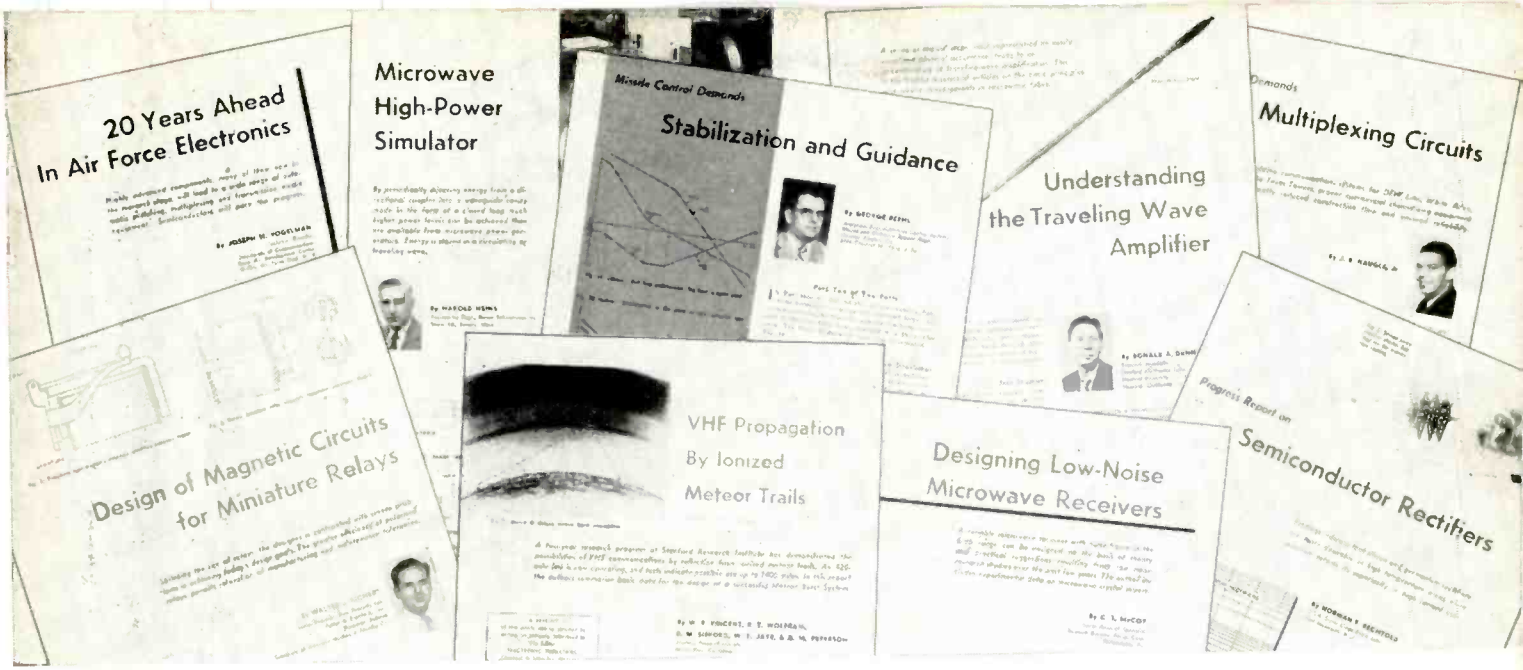



# Engineers Should Write!

*The engineer, with his logical mind and technical training, is the one best person to write engineering articles. A veteran engineer-author gives some practical hints and advice.*

**By W. O. HADLOCK**
*Product Engineering*
*RCA, Camden, N. J.*

YOU are an engineer, by the very nature of your training you have the background to write technical papers of professional value . . . right from the very first one! Your critics may think otherwise whenever there is a scarcity of published articles or an abundance of papers prepared too hastily. This happens when you don't include enough writing time in your plans. Writing takes time—and initiative.

### *Engineers Are Logical*

The engineer is trained to think logically. He has the knack of organizing well. Both of these qualities are just as essential in writing professional papers, as they are in practical engineering. Because the engineer writes with authority, he can analyze to the satisfaction of others the reasons behind a product design. He instills confidence in the reader that his plan is well-conceived.

### *Engineers Benefit*

Writing provides a means of recording your accomplishments; increases your professional prestige; gains acceptance of your idea; gives you broader perspective; helps you to help others; and, perhaps most important of all, provides a logical evaluation of your work.

The rewards of a systematic, written review cannot be over-estimated. You benefit immediately, even as you write. Putting the idea on paper will make you recheck your analysis of the problem and choice of solutions. If the idea is practical, it will withstand

# Engineers Should Write!

*(Concluded)*

the test of being put on paper—and may be further improved by doing so. Conversely, writing down an impractical idea will reveal its shortcomings.

Another pleasant surprise may be the discovery that the technical article is an unusually convenient and flexible method of presentation. Unlike the oral presentation, it can be shaped, re-shaped and changed again and again until perfected.

Once the advantages have been recognized—what is the next move for the prospective engineer writer?

### *First Steps*

The next logical step is to be sure there is a definite need for the article. Then, carefully check the fitness of the topic. To do this, the following questions must be answered satisfactorily: Will the paper contain valuable information? Will it describe a new or novel idea? Will it carry a definite message to the reader? Does the topic have supervisory and policy approval?

By giving these questions sufficient care and attention in the beginning, you will gain better acceptance of your paper—and reduce the time required for final approvals. All these are necessary preliminaries.

### *Think of the Reader*

The reader is the one to satisfy. Quality, style, thoughts, subheads, phrases, captions, illustrations and every element of a paper must be judged with the reader in mind. Whatever the subject, it has to be written to be read. Writing for a journal covering diversified fields will require more thought than one written for a journal tailored for one specific field. Your readers may include engineers in many activities . . . electrical, mechanical, physical and chemical, optical—and many more. All must be considered.

Here are several elements that directly affect the reader.

The title is an important, attention-getting element of your paper. Keep it short, but make sure it tells a story. You will usually change the title and improve it several times before completion.

The introductory part of your paper should gain the favorable attention of the reader. Convince him to continue reading. Write it quickly, then rewrite and strengthen later.

Gain reader interest by writing your paper exactly as you would talk to associates. This will make it equally suitable for oral presentation.

Vary sentence length to provide variety and change of pace.

Well-chosen paragraph subheadings assist the reader. They act as "road-markers" for the reader who "scans."

Include enough illustrations to completely support your paper. It is wise to provide your editor a choice by including too many illustrations, rather than too few. The figure captions are all-important, particularly to the reader who is pressed for time and relies on the captions for the story.

Keep the quality of your writing high. You will gain prestige with your readers. Careful attention to usage arrangement and clarity will result in a minimum of editing. Get the criticism of associates, and help from your company editors.

Be reliable, don't try to fool the reader. Technical articles do not need to be written in a fancy manner. The essential facts should be covered in enough detail to substantiate your conclusions. If there is an element of uncertainty, then the degree of uncertainty should be stated.

Be accurate, every engineer will strive for technical accuracy; however, the "checking" should be done before the paper is submitted for formal approvals. Time will be saved by doing so.

Help the reader summarize what he has read, whether or not you label it as "conclusion," you must leave a definite message for your reader.

There are other elements that help the reader, such as: definitions, glossary of terms, references, acknowledgments and appendices. These vary with the audience and the wishes or style of the journal involved.

The engineer doing the writing is best qualified to know the areas requiring definition or further explanation. However, there is a tendency on the part of the engineer-author to overestimate the readers' knowledge of a specialized subject. The importance of these "readeraids" must not be forgotten during the mechanics of writing.

### *Mechanics of Writing*

Before preparing your paper, it is wise to study the style and format of the journal in which you are interested. In most cases the order will be title, introduction, design problems, body text, detailed description, conclusions, and then the references, acknowledgments and appendices.

Most texts claim that a formal outline is a "must." There's no doubt about the value of an outline in guiding the writer, but it must be subject to change. The most carefully prepared outlines are susceptible to improvement as the writing progresses.

Many engineers will find it possible to write their articles logically and clearly, just as it occurs to them, without the benefit of an outline. Whether or not an outline is prepared, your rough manuscript will require frequent reorganizing, interchanging of paragraphs, and considerable "word-juggling." You may have to "cut and paste" your way through several rough drafts before reaching the final manuscript. You should not be embarrassed at the need for a constant reorganizing and reshuffling of your presentation. This is exactly what an editor might do when writing his own paper or assisting you with yours.

Don't be discouraged if your paper is not accepted by the journal you had in mind. A well-writen, informative technical paper can often be modified to suit the editorial wishes of another magazine.

Certainly, based on the qualifications and abilities of the engineer, the benefits he will gain and the help available to him, there can be but one conclusion. The engineer can and should accept his role as writer—without hesitation!

## Russian Scientists

(*Continued from page* 159)

ed men and women to meet competition from the U.S.S.R. is by no means the only major reason for expansion of our scientific and technological manpower.

"This country's competitive need for a greater supply of highly trained men and women is not the only need—perhaps, in the long run not even the most important reason—for a rapid expansion of our scientific and technological manpower. The dawn of the so-called atomic era is only a phase of the scientific revolution. The world has already moved with giant strides into an age when man is no longer merely adapting nature's raw materials to his use but is actually creating new materials and new methods, releasing new sources of power and setting himself new goals which will radically change civilization. Although the paths along which the scientific revolution will lead cannot be clearly foreseen, the uncertainties of the future in no way hide the fact that this country will need many more highly trained and highly skilled scientists and engineers than we have ever before thought necessary."

## *Hallicrafters Returns To Halligan Family*

The Hallicrafters Co. was repurchased last month by William J. Halligan, Sr., company president, from the Penn-Texas Corp. for $3 million cash. Penn-Texas had acquired the firm in 1956.

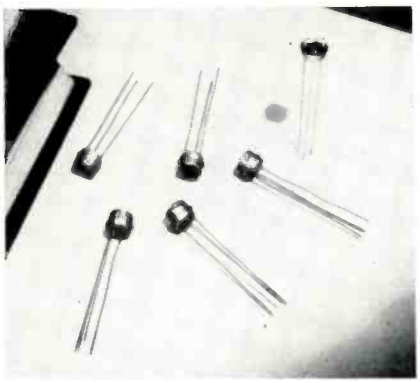
Following the purchase Robert Halligan, vice-president, announced that Hallicrafters was discontinuing television receiver production in January and would expand their activities in electronic research and development for the government, as well as its production of Lowrey electronic organs and short-wave radios.

Television receiver production is being terminated because it lacked "sufficient television volume to support the overhead and other expenses of television." It is expected that most of the television workers will be absorbed in the expansion of the other divisions, but some 5% to 10% will be laid off.

# New Products

## SILICON TRANSISTOR

The silicon Unijunction Transistor is a hermetically sealed 3 terminal device having a stable "N" type negative resistance characteristic over a wide temperature range. A high peak

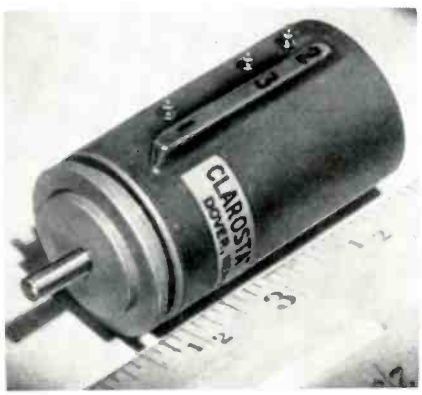


current rating makes this device useful in medium power switching and oscillator applications, where it can serve the purpose of 2 conventional silicon transistors. The 2N489-2N494 are hermetically sealed in a welded case. The case dimensions and lead configuration are suitable for insertion in printed boards by automatic equipment. General Electric Co., Syracuse, N. Y.

Circle 227 on Inquiry Card, page 103

## PRECISION POT

A ⅞ in. dia. multi-turn precision potentiometer providing up to 20% more winding length in a given 10-turn outside diameter, is available. This Series 55 multi-turn pot is designed for close-tolerance military applications and applicable MIL specs. Rated at 3 w., it is available in several resistance values up to 100,000 ohms. Minimum runout and




end resistance with low "noise level." Maximum stability, resolution and reliability. Available in servo and bushing mountings. Clarostat Mfg. Co., Inc., Dover, N. H.

Circle 228 on Inquiry Card, page 103

# ELECTRONIC INDUSTRIES Advertisers—January 1958



* In Operations Edition Only.

While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.

# New Products

## DATA PROCESSING

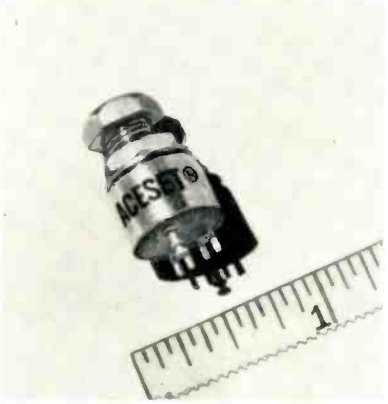
A new system named MADIS, is derived from "Millivolt Analog-Digital Instrumentation System." It follows the building block concept. The basic portion of the system consists

of Commutator, Analog to Digital Converter, Control and Timing Unit, Digital Tape Recorder and a unique built-in Test and Monitoring System. Beyond this point, the system may be expanded, using standard building block components, to fill virtually any data processing system requirement. Custom installations are available. Arnoux Corp., 11924 W. Washington Blvd., Los Angeles, Calif.

Circle 229 on Inquiry Card, page 103

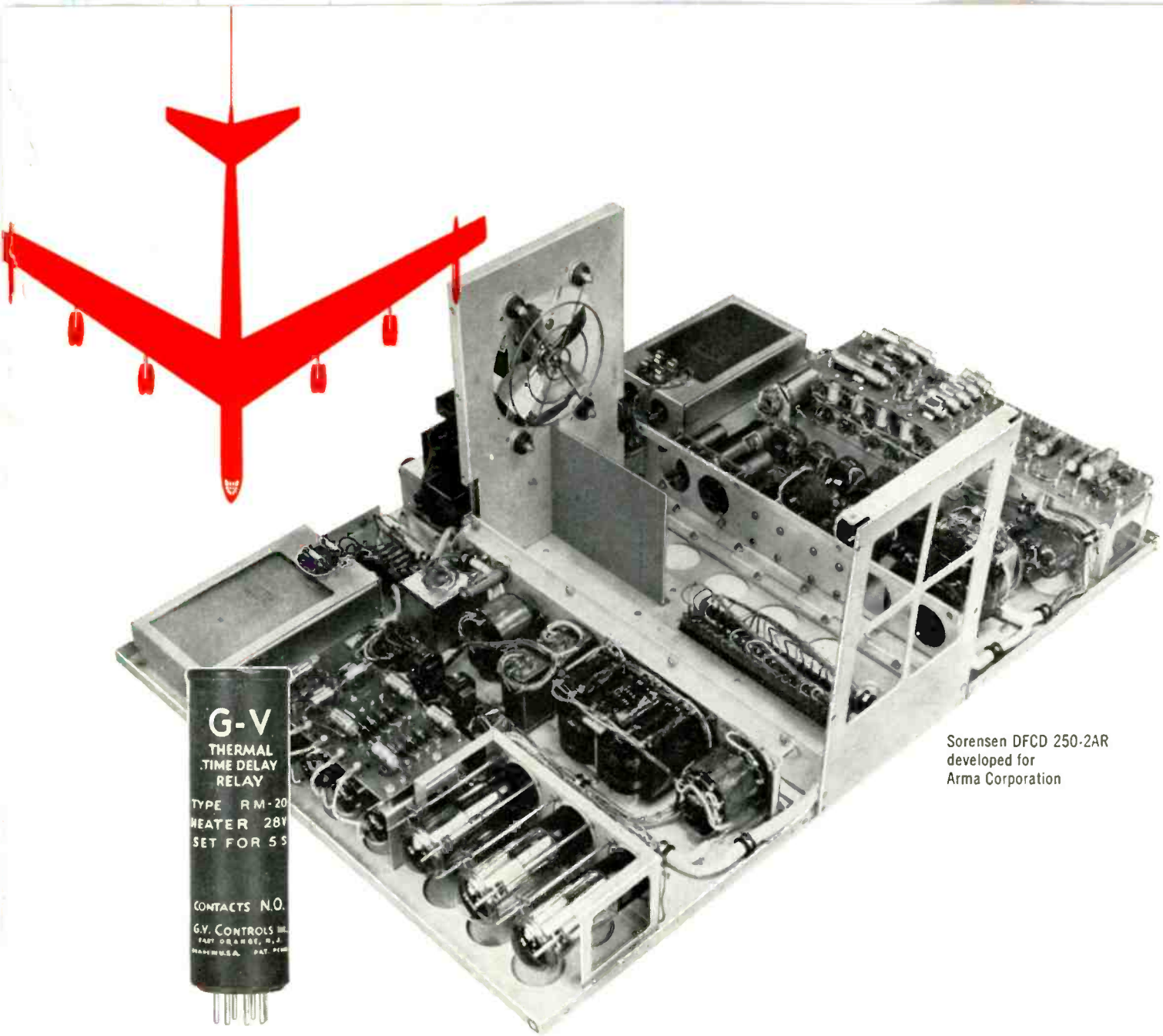
## MINIATURE POTS

A new line of micro-miniature precision wire-wound potentiometers offer stability under temperature cycling. ACESETS are available in 9 values between 100 and 25,000 ohms. Mechanical Specs.: 1 piece machined metal case; stainless steel shaft; self-contained locking device; mechanical rotation, 330° nominal; size, ½ in. dia. x 5/16 in. Electrical Specs.: heat dissipation, 2 w. at 60° C; voltage




breakdown, 1,000 vdc; electrical angle, 325° nominal; resistance tolerance, ±5%. Ace Electronics Associates, Inc., 99 Dover St., Somerville, Mass.

Circle 230 on Inquiry Card, page 103




Sorensen DFCD 250-2AR
developed for
Arma Corporation

# Sorensen Specifies G-V Thermal Time Delay Relays

## "...to enhance reliability..."

In this B-52 power supply control unit, developed by Sorensen & Company, a G-V relay serves as the initial time delay to protect functional thyratron circuitry. Another G-V relay recycles the equipment under overload conditions. Sorensen states that, "These G-V units enhance system reliability and extend life of thyratron tubes and all other circuitry".

In both military and industrial equipment, G-V thermal relays are providing long, dependable, proven service in time delay applications, voltage and current sensing functions and circuit protection.

Write for extensive application data
and catalog material.

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**G-V CONTROLS INC.**
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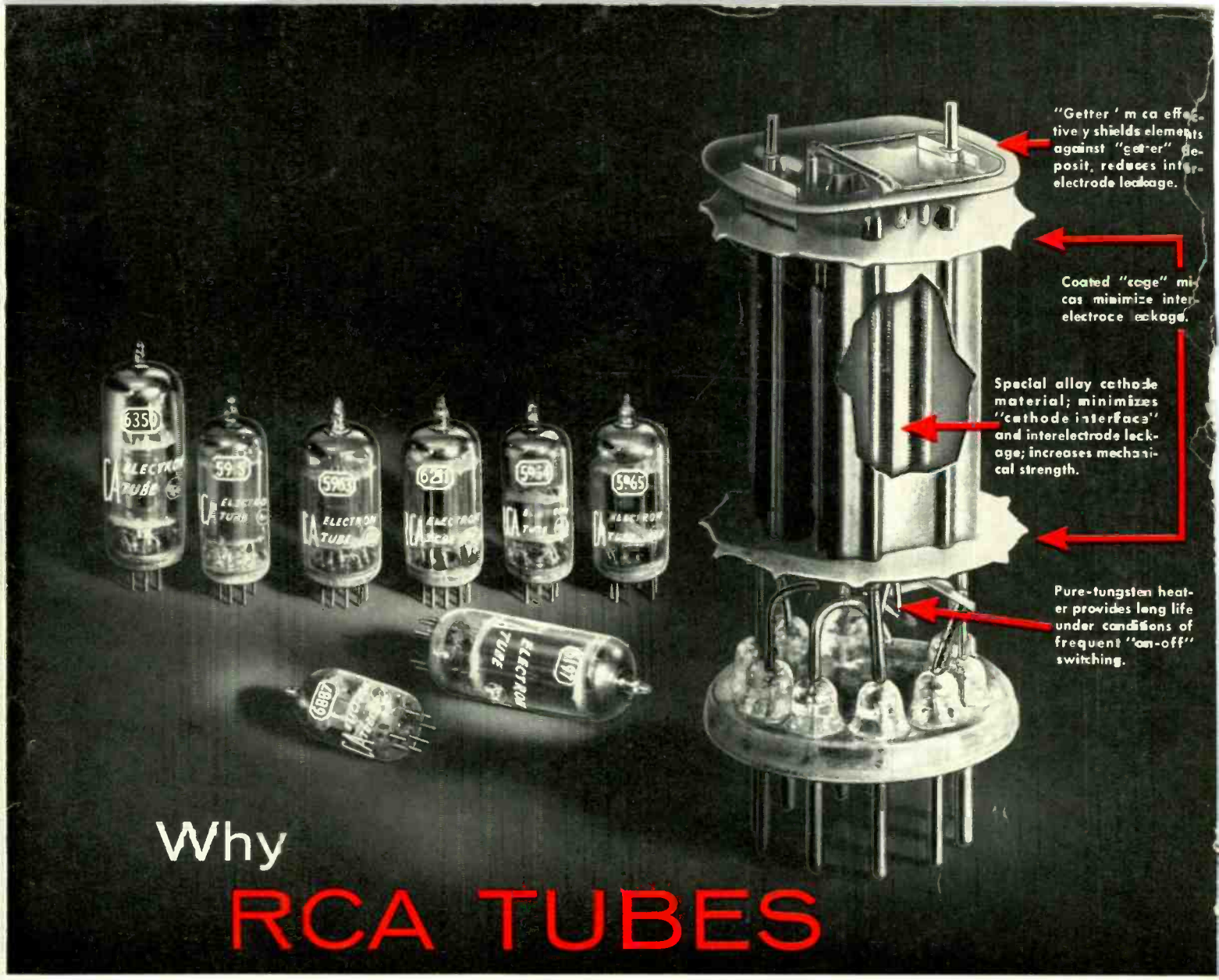


# Why RCA TUBES are specified for COMPUTER DESIGNS

Long-life reliability ...the result of selected materials, rigid quality controls, and exacting inspection and test procedures...makes RCA tubes the right choice for electron computer designs. *Materials* are selected and processed to assure low gas-evolution and to provide relative freedom from "cathode interface". *Quality Control* extends from purity-control of manufacturing areas, through careful selection and training of personnel, to 100% microscopic inspection of tube structures at more than a half-hundred check points. *Sample Testing* of tubes from each production run makes certain that no tubes are released for shipment until long-life test data are complete for the "lot". Super-Sensitive tests for high resistance shorts, 100-hour survival-rate life tests and 5000-hour life tests on a continuous sampling basis weed out potential early-hour failures and provide a "quality monitor" to assure *long-life reliability*.

RCA tubes for computers are ideally suited to applications as gated amplifiers, frequency dividers, pulse amplifiers, cathode followers, "on-off" switching. Illustrated above are medium-mu twin triodes: 5963, 5964, 5965, 6211, 6350; pentagrid amplifier: 5915; power pentode: 6197; twin diode: 6887.

SEND FOR NEW BOOKLET RIB-104A—"Receiving-Type Tubes for Industry and Communications." Includes descriptions and basic data on RCA Computer and other special tube types. Designers of computer equipment are invited to discuss tube requirements with their RCA Field Representative at the nearest RCA Field Office. For your copy, write RCA Commercial Engineering, Section A-50-Q, Harrison, New Jersey.

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