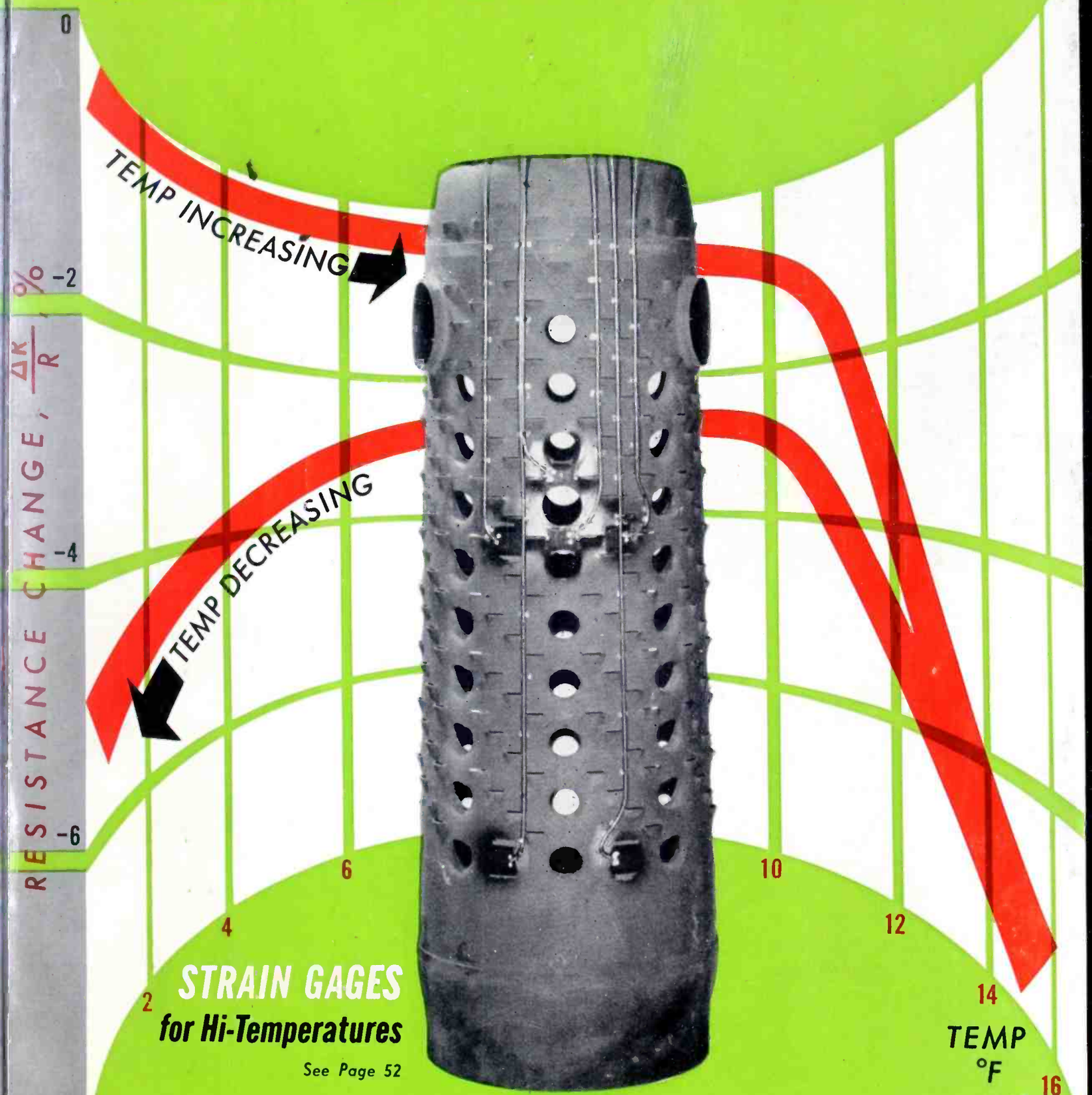
ELECTRONIC INDUSTRIES



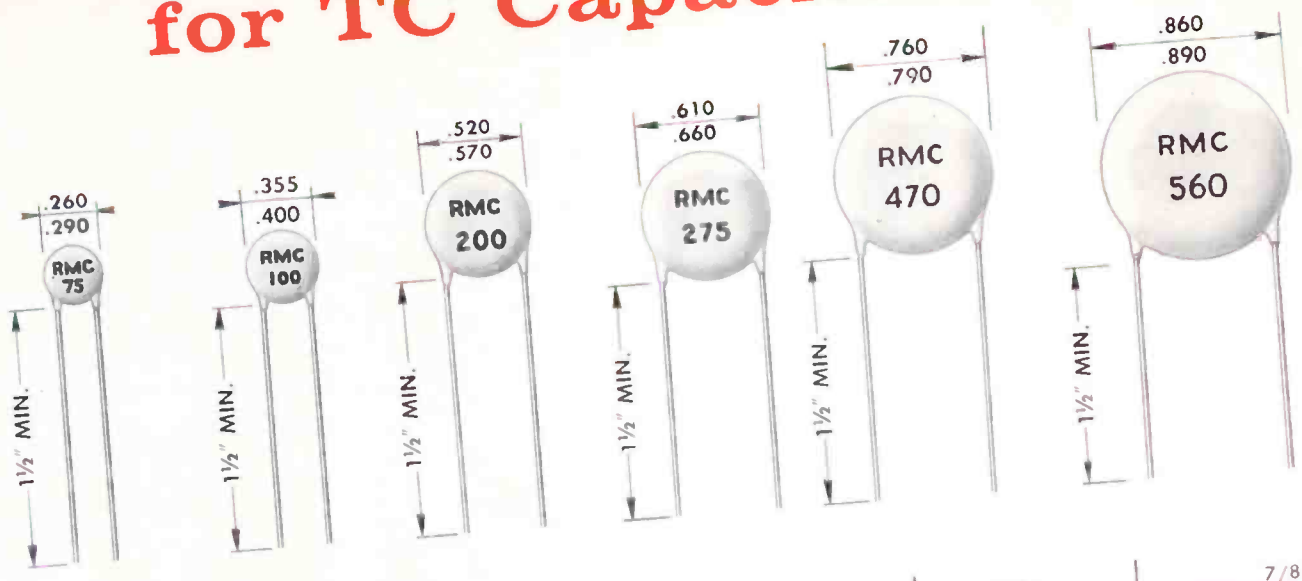
STRAIN GAGES for Hi-Temperatures

See Page 52

May • 1958
A Chilton Publication

RELY ON RMC

for TC Capacitors



TC	1/4 Dia.	5/16 Dia.	1/2 Dia.	5/8 Dia.	3/4 Dia.	7/8 Dia.
P-100	1- 3 MMF	4- 9 MMF	10- 20 MMF	—	—	—
NPO	2- 13	14- 30	31- 69	70- 85MMF	86-115 MMF	116-150 MMF
N- 33	2- 13	14- 30	31- 56	57- 62	63-100	101-150
N- 75	2- 15	16- 30	31- 56	57- 68	69-125	126-150
N- 150	2- 15	16- 30	31- 67	68- 75	76-140	141-175
N- 220	3- 15	16- 30	31- 75	76-100	101-140	141-175
N- 330	3- 15	16- 30	31- 75	76-100	101-150	151-190
N- 470	3- 20	21- 51	52- 80	81-120	121-200	201-240
N- 750	5- 30	31- 68	69-150	151-220	221-300	301-375
N-1500	10- 51	52-120	121-200	201-270	271-470	471-560
N-2200	20- 75	76-150	151-200	201-300	301-680	—

TYPE C DISCAPS meet all specifications of the EIA standard RS-198. These temperature compensating DISCAPS are rated at 1000 V.D.C. to provide a higher safety factor than other standard or mica capacitors.

Constant production checks assure that all specifications on temperature characteristics are met. Another phase of RMC quality control consists of a 100% test for capacities.

Over the years leading manufacturers have relied on RMC for quality of product and maintenance of delivery schedules. Write today on your company letterhead for information.

SPECIFICATIONS

LIFE TEST: As per EIA-RS-198
POWER FACTOR: Over 10 MMF less than .1% at 1 megacycle. Under 10 MMF less than .2% at 1 megacycle
WORKING VOLTAGE: 1000 V.D.C.
TEST VOLTAGE (FLASH): 2000 V.D.C.
CODING: Capacity, tolerance and TC stamped on dis
INSULATION: Durez phenolic-vacuum waxed
INITIAL LEAKAGE RESISTANCE: Guaranteed higher tha 7500 megohms
AFTER HUMIDITY LEAKAGE RESISTANCE: Guarantee higher than 1000 megohms
LEADS: No. 22 tinned copper (.026 dia.)
TOLERANCES: ±5% ±10% ±20%
These capacitors conform to the E.I.A. specification f Class 1 ceramic capacitors.
The capacity of these capacitors will not chan under voltage.

DISCAP CERAMIC CAPACITORS

RMC

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

Circle 1 on Inquiry Card, page 99

ELECTRONIC INDUSTRIES

Vol. 17, No. 5 May, 1958

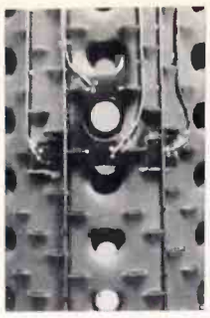
MONTHLY NEWS ROUND-UP

NEW PRODUCTS & TECH DATA

DEPARTMENTS

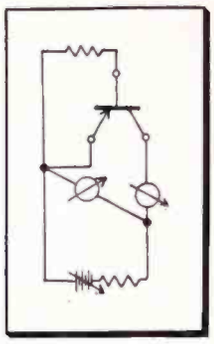
BPA NBP

Strain Gage Testing 52



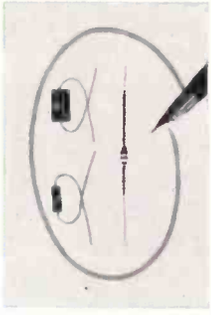
New bonding materials and techniques make it possible to test turbojet engines at rated conditions with the strain gages mounted right on the turbine blades.

Transistor Test Set 58



This unique equipment makes possible accurate knowledge of dc current transfer ratio of power transistors not usually available from manufacturers' data sheets.

Solid State Capacitor! 69



Another great stride toward miniaturization is achieved by the new electronically variable, solid state capacitor — "Varicap" — which handles a wide range of tuning problems.

New Deflection Amp 76

"Framelok" grid construction significantly reduces failures of TV horizontal deflection amplifiers due to short circuits, intermittent arcing between elements, and screen emission.

ELECTRONICS INDUSTRIES, May, 1958, Vol. 17, No. 5. 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 year. $7.00; 2 yrs. $11.00. All other countries 1 yr. $18.00, 2 yrs. $30.00.

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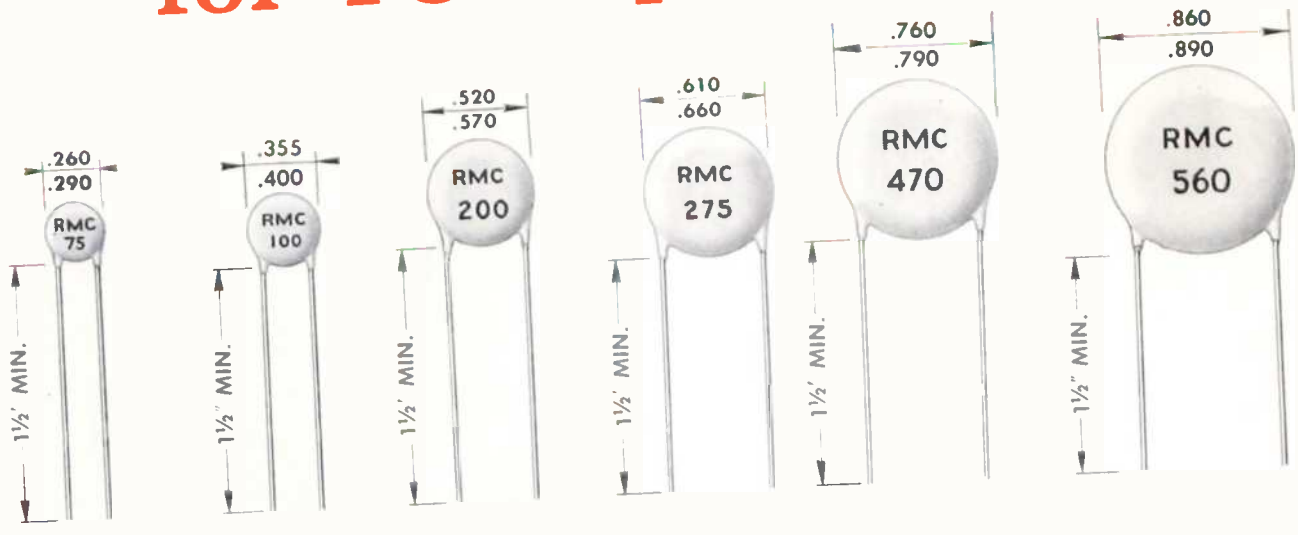

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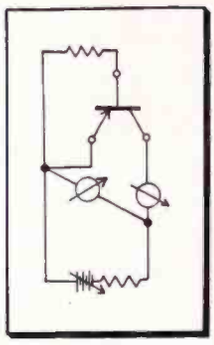

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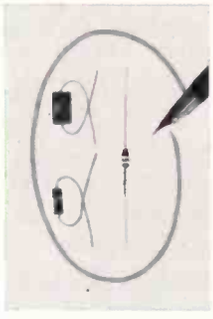

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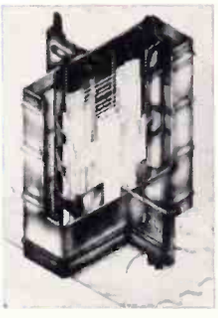

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RADARSCOPE

"FREEZING" RADAR IMAGE

DuMont Scientist Marshall P. Wilder presses button on instrumentation panel to freeze a radar image for more than five minutes on the screen of a 15 in. direct-view cathode-ray storage tube.

GLASS TRANSISTOR HOUSINGS were introduced by both Corning Glass and GE at the IRE Show. Savings, according to transistor people, will approximate 10¢ per transistor—a significant step towards making transistors competitive, pricewise, with tubes.

THE FCC dismissed a complaint by 13 AM and TV Broadcast Stations against 288 community antenna TV systems in 36 states. The complaint said that the commission should exercise jurisdiction over community antenna TV systems as common carriers. But the commission pointed out that these systems operate by means of wire lines and when properly operated involved no radio transmission.

DEFENSE ELECTRONICS SPENDING will probably exceed $4 billion in fiscal year 1959—equal to 25% of the planned $15.8 billion spending by the Defense Department. It will be an all time record figure, topping 1958's $3.6 billion and 1957's $3.5 billion expenditure for electronics.

AUTOMATIC CHECK OUT is currently the pet project in defense electronic circles. Missiles are providing the impetus. Striking example is the decision to fully automate a final countdown of the THOR IRBM. Human operators cannot be depended upon to perform the countdown functions manually.

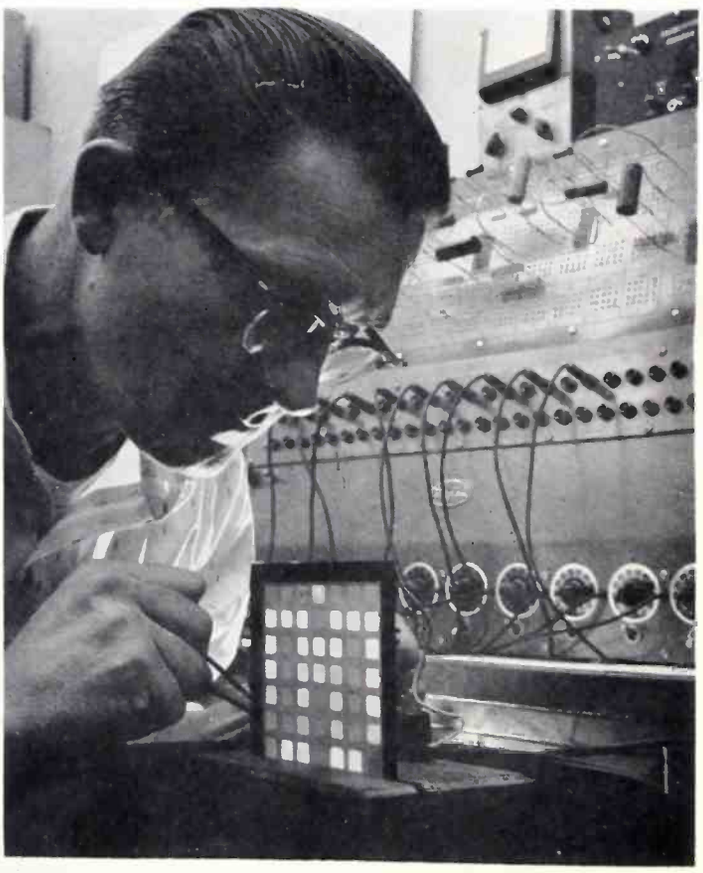
THE STEREO DISC picture last month took a turn toward complete confusion. Ignoring what had seemed to be a unanimous desire for "compatibility" with monaural records Columbia Records announced that they will market this fall stereophonic records that can be played only on special stereo phonos. RCA Victor is expected to follow with a similar announcement.

CO-CHANNEL TV interference and adjacent channel interference may be reduced by having alternately spaced stations transmit with vertical and horizontal polarizations. The FCC is now considering the possibility in a report entitled "polarization discrimination in TV broadcasting" available from the Technical Research Div., FCC, Room 7506, New Post Office Bldg., Washington 25, D. C.

FEDERAL TRADE COMMISSION deserves a big bouquet for the very fine job they are doing cleaning up the tube counterfeiting racket which has plagued the receiving tube industry for some 10 years. Steps are now being taken so that advertising will properly

TOWARD TV-ON-THE-WALL

Checkerboard "Elf" screen, combining an electroluminiscent panel with a ferroelectric control device is a significant step toward TV-on-the-wall. Developed by Westinghouse Research Labs, screen shows contrasts of 200:1, is ¼-in. thick and 3 times brighter than TV tubes. Bits of light can be a few thousandths of an inch square.



indicate whether tubes are actually brand new, seconds, rejects, or "reprocessed" tubes.

MICRO-MODULE PROGRAM, for which RCA last month received a $5 million dollar production engineering contract from the Signal Corps, will significantly affect the entire field of military electronics, including tactical communications and missile guidance and control. It will provide the Army a radically new production capability within industry for microminiature construction of electronic equipment. The general goal is a 90% reduction in size and weight of present military electronic equipment.

RADIO AND TV PRICE CUTS announced last month as an anti-recession measure by Admiral caught the industry napping. In chopping $40 from their $169.95 17-inch table model and $3 off their $15.95 table model radio, Admiral announced their goal "of increased production of consumer items at a price the buyer can afford to buy." Within six weeks of cutting the price on their radio, the firm was back-ordered on the item almost sixty days. GE too, announced $4 reductions on their portable TV receivers but no other radio or TV manufacturer admits that price cuts are being considered.

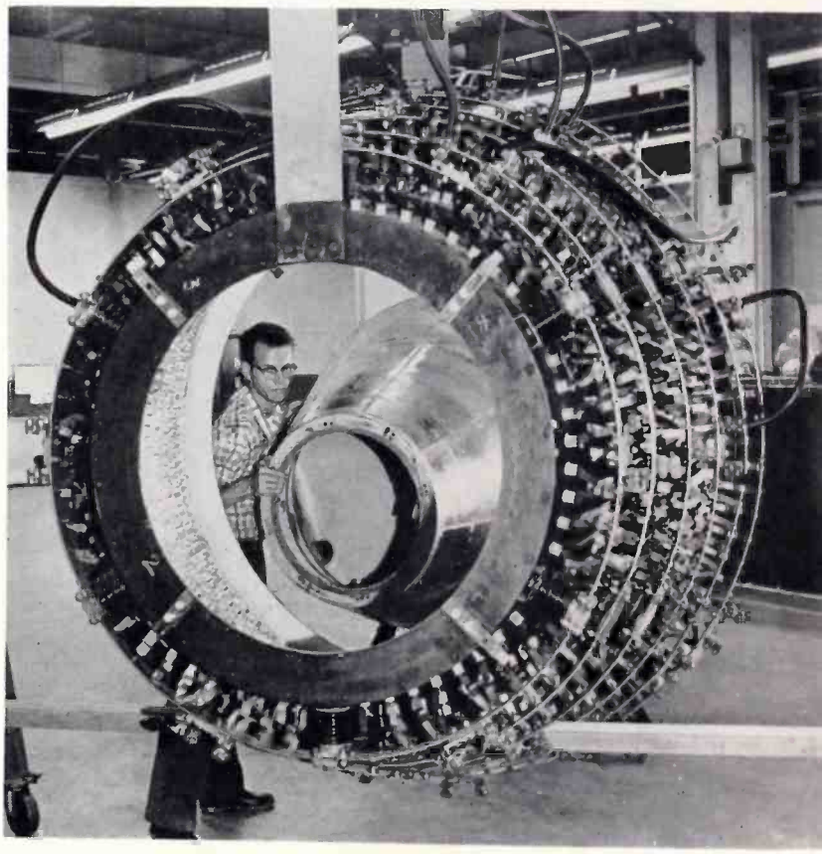
PAY-TV may be finding strong opposition from Washington legislators and John Q. Public but sports promoters and the entertainment world in general are going right ahead with their plans for closed - circuit telecasts of a wide range of spectator events. Paid TV proponents have done a particularly fine selling job on the sports world. Sports promotors are convinced that it is only a question of time before all major sports events will be seen exclusively on subscription TV, and the profits, of course, to be made with this arrangement are beyond imagination. It seems unlikely that pay TVwill get the green light within the next few years, but with the constant pressure from the sports and entertainment world, it is hard to imagine that it will be suppressed indefinitely.

MISSILE PRODUCTION figures supplied by the Association of Missile and Rocket industries (AMRI) lists over 2000 U. S. companies either directly in missile work or qualified and in pursuit of contracts. Many areas of activity are along the East Coast, in the Midwest, and in California in that order. The West Coast air frame workers and their subcontractors control a large share of the dollar volume. As other areas of business shrink, the multibillion dollar missile field becomes increasingly attractive with even state and local governments and Chambers of Commerce throwing their weight into contracts award picture. AMRI is arranging state wide missile conferences to bring together manufacturers and government procedure men. First of the series, the Ohio Missile Conference, was held on March 26th in Cleveland.

RADIO COMEBACK is emphasized by reports from at least two of the major networks that their financial nose dive seems over, that the losses are now diminishing monthly and that a break-even point is visualized in the near future. The figures for 1957 are the first optimistic upturn since radio broadcasting took its nose dive starting in 1949. While the AM broadcasting industry as a whole has staged a remarkable comeback and particularly at a local level, the networks have found it very difficult to provide fare that could compete successfully with television. Just last month the ABC Radio Network announced they would drop all of their weekday entertainment type programs except one to concentrate on news broadcasts. These steps were being adopted to reduce losses that have amounted to more than $2 million annually. Broadcasting magazine estimates that the four major networks collectively had an 9.8% increase in "net time sales" in 1957.

MISSILE "SUPER TOASTER"

This ingenious circular oven was devised by Chrysler engineers to duplicate the severe temperature conditions encountered when a ballistic missile re-enters the atmosphere. Nose of Redstone missile is shown being readied to undergo the severe heat test.



3, 5, 10 watt axial lead Blue Jackets now available in values down to one ohm for increased usefulness in transistor circuits

Blue Jacket®

MINIATURE AXIAL LEAD RESISTORS

Meet the need for closer tolerance power wirewound resistors with these thoroughly reliable, low cost Sprague Blue Jackets—available in a full wattage range from 3 to 218 watts. The miniaturized axial lead units shown here are now available in resistance tolerances to 1% and 2% as well as standard 5%. Blue Jackets are designed for utmost stability under extreme conditions. Leads are anchored securely to *resistor body* without danger of disturbing connection of lead and fine resistance wire when lead is flexed during installation. You can depend upon Blue Jackets for *simplified, safe* production and top performance characteristics.

SPRAGUE TYPE NO.	WATTAGE RATING	DIMENSIONS L (inches)	D	MAXIMUM RESISTANCE ± 1% TOL.	MAXIMUM RESISTANCE ± 5% TOL.
151E	3	1 1/32	13/64	1,000 Ω	10,000 Ω
27E	5	1 1/16	3/16	5,500 Ω	30,000 Ω
28E	10	1 3/16	3/16	12,000 Ω	50,000 Ω

WRITE FOR BULLETIN NO. 7400 • SPRAGUE ELECTRIC COMPANY
233 MARSHALL STREET • NORTH ADAMS, MASSACHUSETTS

SPRAGUE®
THE MARK OF RELIABILITY

SPRAGUE COMPONENTS: RESISTORS • CAPACITORS • MAGNETIC COMPONENTS • TRANSISTORS
INTERFERENCE FILTERS • PULSE NETWORKS • HIGH TEMPERATURE MAGNET WIRE • PRINTED CIRCUITS

As We Go To Press...

Dot-information (r) is recorded as film is shot, then translated by ground equipment into the numerical information below.

Aerial Photos Coded, Labelled by New Device

Federal Telecommunication Labs has delivered to the USAF an automatic caption writer that translates information from the photo recon plane instrument panel onto the photos being taken.

Information from the instruments is displayed on a small 1-in. cathode ray tube which is in the camera's field of view. The information is in the form of dots which are translated by ground-based equipment into numerals that will indicate altitude, location and other facts important to the military.

Among other commercial applications foreseen for the device are library cataloguing and industrial automation.

WEATHER RADAR

High-accuracy radar indicator supplied to the U. S. Weather Bureau by DuMont Labs for weather forecasting has a tested azimuth accuracy of ±.25 degree. It will supply accurate long-distance information on storms.

High Resolution TV Tube for Satellite

Transmission of high quality photographic information from the first camera-carrying satellite with no loss in detail—an accomplishment thought to be years away by military and industry scientists—may be just around the corner as a result of a new form of TV picture tube developed by CBS-Hytron.

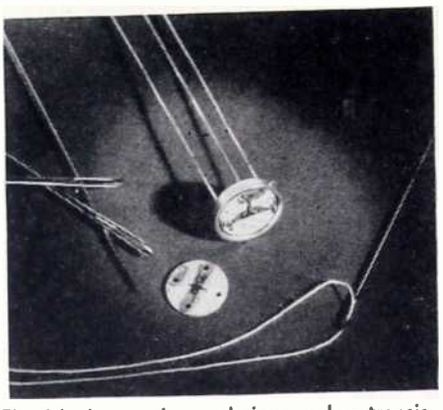
According to Norman F. Fyler, who supervised development of the new tube for CBS-Hytron, this is how the new TV eye will work. A satellite travelling in orbit will photograph its subject: a section of the earth, another planet, or perhaps even our own moon. The exposed film will be "scanned" by the

CBS-Hytron's N. F. Fyler displays new ultra-high resolution CRT that transmits photo information of microscopic detail.

TV eye in the satellite at the proper time, for example, as the satellite passes over our own country. The picture will then be sent to earth where a companion eye will permanently reproduce the picture on film with all the detail of the original.

The new TV eye, termed an ultra-high-resolution cathode-ray tube, provides a microscopically small electron beam which makes it possible to transmit and display images of such fine detail that they far exceed the capabilities of the unaided human eye.

Transmitting and receiving versions of the new CBS tube have been developed. They are already in use in experimental advanced radar and critical photographic transmission systems.



Fixed bed mounting technique makes transistors that easily pass most rigid AF tests.

Ruggedized Transistor Developed by G. E. Co.

Transistors rugged enough to still work after being shot from a 12-gauge shotgun into a telephone book have been developed by the General Electric Co.

The new technique involves the method of mounting the tiny bar of germanium or silicon.

Instead of suspending the minute piece of germanium or silicon between two upright posts within the transistor, as has been common practice, G. E. mounts it on a flat, circular ceramic wafer. The ceramic wafer in turn rests solidly on the "floor" of the transistor housing.

The fixed-bed mounting technique provides protection against three major causes of transistor failure: the expansion and contraction of metal parts caused by hot and cold temperatures; direct impact, and vibration.

G. E. is now building unijunction transistors with the fixed-bed mounting and plans to extend its use to other industrial and military transistors in the near future.

NEC Calls For Papers

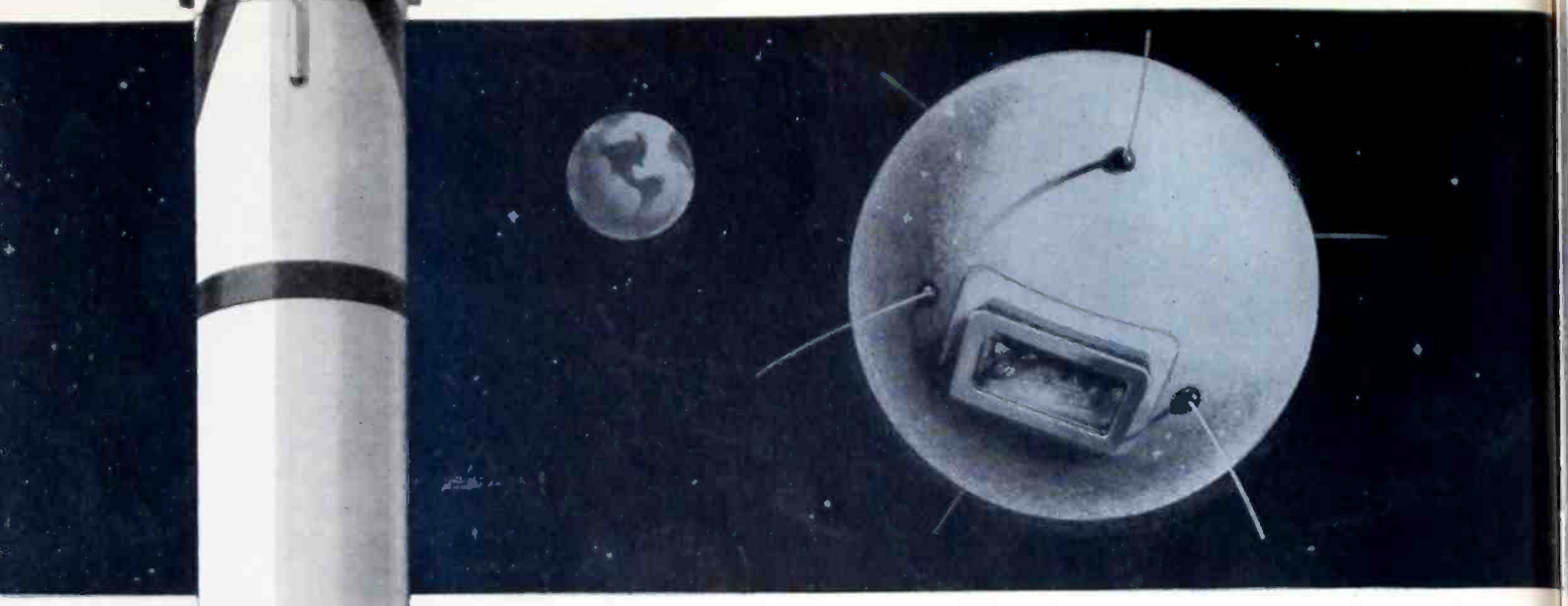
Engineers and scientists in electronics and related fields are invited to submit papers for presentation at the 14th annual National Electronics Conference to be held October 13-15 at the Hotel Sherman in Chicago.

Papers must be previously unpublished and pertain to the results of research and development.

Contact Program Committee Chairman, Mr. L. W. Von Tersch, Electrical Engineering Department, Michigan State Univ., East Lansing, Michigan.

More News on Page 10

New Product Announcement



STEMCO TYPE MX* THERMOSTATS

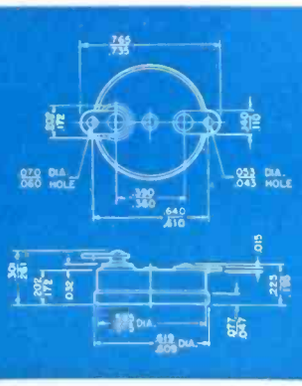
especially designed for missile, avionic and electronic applications

New Stemco Type MX Thermostats are miniature snap-acting units designed to *open* on a temperature rise. Being compact, lightweight units able to withstand high G's under wide ambient temperature ranges, Type MX thermostats are ideal for missile, avionic and other electronic applications where close temperature control is mandatory.

Basic design flexibility of the Stemco Type MX Series means the units can be supplied from regular production runs in a wide variety of models, both semi-enclosed or hermetically sealed. Ceramic or metal bases for semi-enclosed units, round enclosures or CR-7 crystal cans for hermetically sealed units. Several types of terminal arrangements, mounting provisions, brackets, etc., are available.

Stemco Type MX thermostats give you performance . . . small cubage . . . rugged reliability . . . *at a production price.*

* 2° to 6°F differentials available



TYPE MX *Hermetically Sealed* — Electrically independent bimetal disc. Rated at 2 amps at 115 VAC and 28 VDC, based on 250,000 operations.

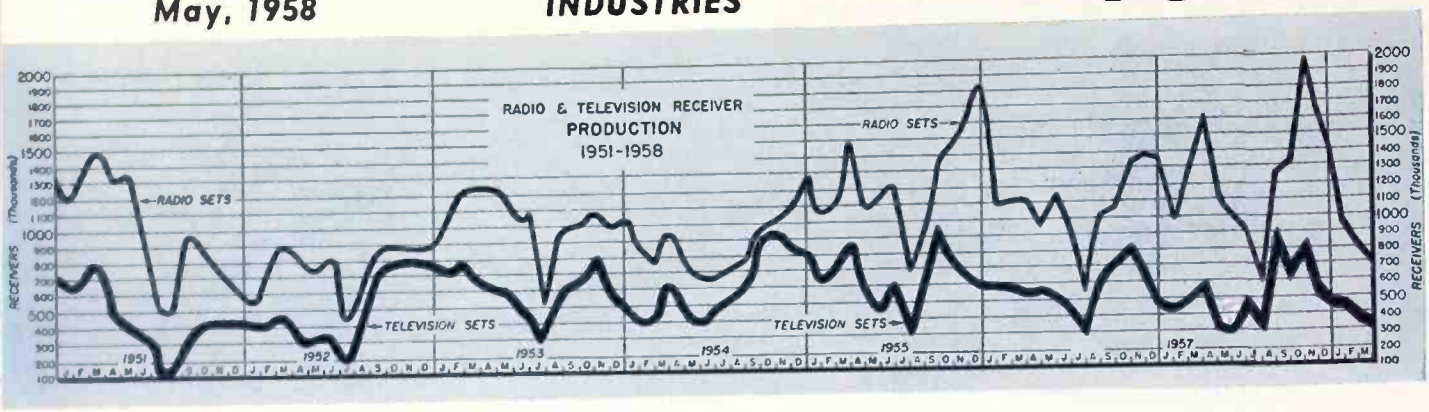
TYPE MX *Semi-Enclosed* — Metal base shown; also ceramic base types. Bulletin 6100 for data on hermetically sealed and semi-enclosed types.

AA-7285

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

STEMCO® THERMOSTATS

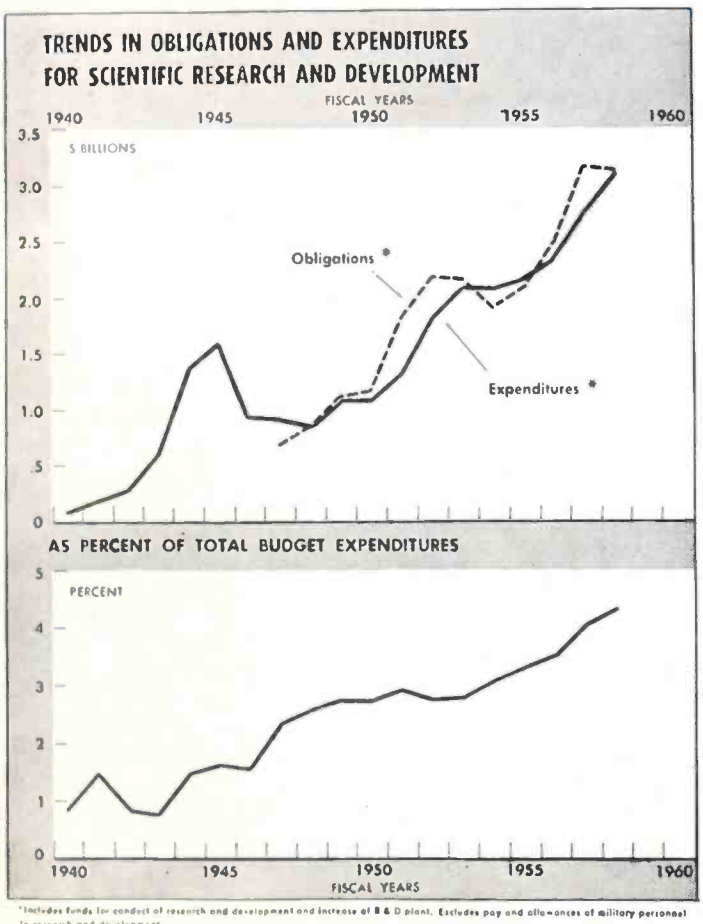
Circle 3 on Inquiry Card, page 93



GOVERNMENT ELECTRONIC CONTRACT AWARDS

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

Amplifiers	78,589
Amplifiers, magnetic	31,358
Amplifiers, synchro	32,500
Analyzers	55,506
Analyzers, spectrum	138,200
Antennas & accessories	2,040,375
Attenuators	28,500
Batteries, dry	1,551,563
Batteries, storage	135,024
Beacon equipment, radio	454,041
Cable assemblies	149,978
Capacitors	30,480
Computers & accessories	256,703
Computers, airborne	224,528
Connectors	36,635
Couplers	33,071
Crystal units	64,333
Frequency standards	41,693
Generators, signal	249,328
Gyroscopes	5,036,746
Indicators	58,354
Loudspeakers	26,470
Meters, frequency-power	54,118
Meters, volt	100,137
Monitors, voltage	39,452
Multimeters	239,311
Oscillographs	29,261
Oscilloscopes	1,142,622
Power supplies	271,359
Power supplies, dynamotor	302,600
Radio receivers	77,499
Radio set control	98,387
Radio sets	51,685
Radio transmitters	140,491
Radiosonde equipment	48,773
Recorders & accessories	184,581
Relay assemblies	119,901
Relays	119,824
Semiconductor diodes	70,360
Stroboscopes	29,310
Tape, recording	27,750
Teletype equipment	742,296
Testers	1,848,857
Test sets, radar	262,176
Testers, tube	183,677
Transformers	29,354
Transistors	25,600
Transponder sets	214,149
Tubes, electron	6,445,830
Waveguide & accessories	26,916
Wire & cable	1,647,152



*Includes funds for conduct of research and development and increase of R & D plant. Excludes pay and allowances of military personnel in research and development.

Sources: Bureau of the Budget and National Science Foundation.

—*National Science Foundation*

ESTIMATED MILITARY ELECTRONIC SPENDING

(in millions)

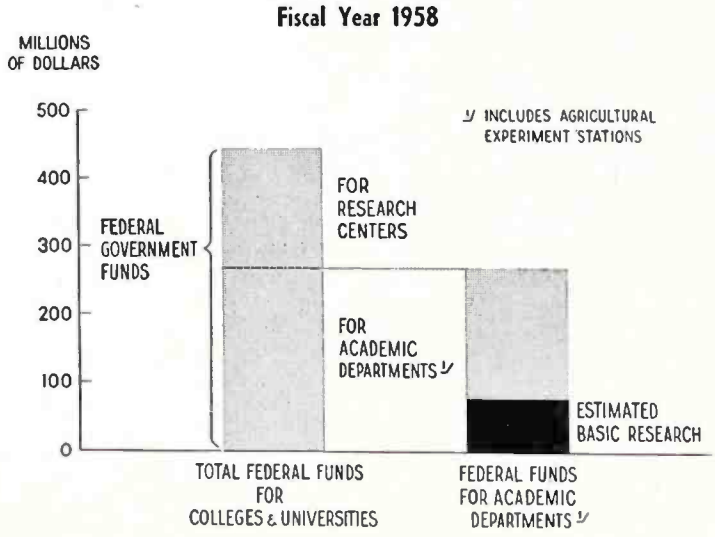
F Y	Electronics Expenditures*	Total Expenditures*	Percent
1954	$2,663	$17,343	15
1955	2,453	14,388	17
1956	2,825	13,673	21
1957	3,506	15,335	23
1958 (est.)	3,600	15,638	23
1959 (est.)	4,000	15,828	25
TOTAL	$24,765	$128,116	19

* For Major Procurement and Production plus Research and Development by all Services. Military Functions only: Excludes Military Assistance.

—*Electronic Industries Association*

ESTIMATED FEDERAL GOVERNMENT FUNDS FOR RESEARCH AND DEVELOPMENT AT COLLEGES AND UNIVERSITIES

Fiscal Year 1958



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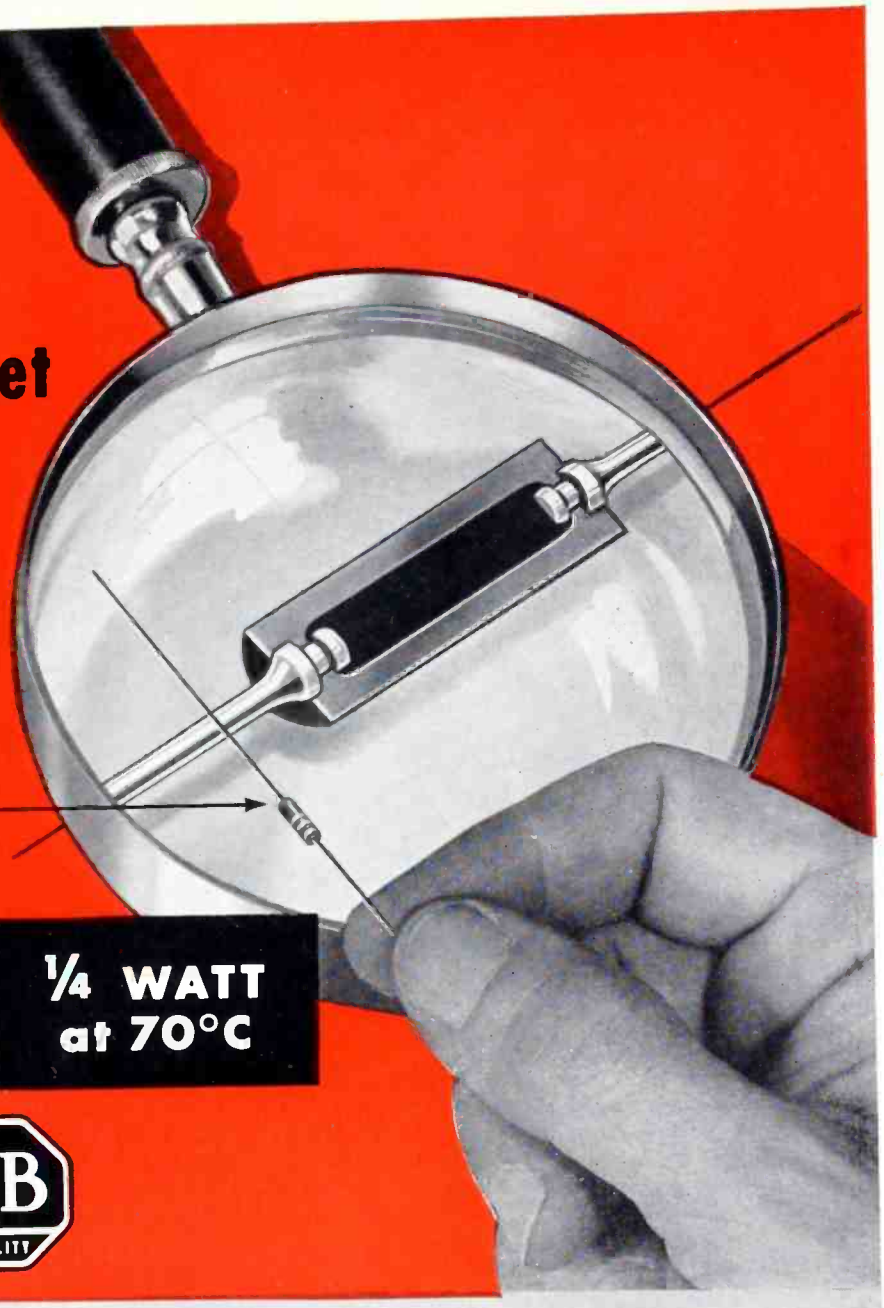
The same hot-molded insulating jacket as larger Allen-Bradley resistors

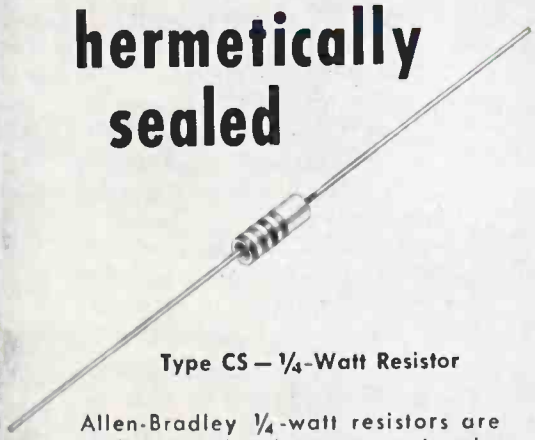
yet it's only ¼ inch long!



TYPE CB | **¼ WATT at 70°C**

AB QUALITY

Also hermetically sealed



Type CS — ¼-Watt Resistor

Allen-Bradley ¼-watt resistors are available enclosed in a ceramic tube with high temperature end seals, making them impervious to humidity and moisture. Derated linearly from +70°C rating to 0 at +150°C. Available in 2% and 5% tolerances, and in resistance values from 47 ohms to 22 megohms.

These ¼-watt composition resistors—ONLY ONE QUARTER OF AN INCH LONG—have the same hot-molded insulating jacket . . . the same reliability . . . the same physical uniformity . . . that have made the larger Allen-Bradley resistors the quality standard of the electronics industry for so many years!

Although exceptionally small, Allen-Bradley Type CB resistors are rated for continuous operation at 70°C ambient temperatures. The hot-molded insulating jacket of these resistors makes impregnation unnecessary . . . yet it provides the most reliable protection against extended periods of high humidity, as encountered in actual service. Available in all EIA resistance values from 47 ohms to 22 megohms. Tolerances: 5%, 10%, and 20%.

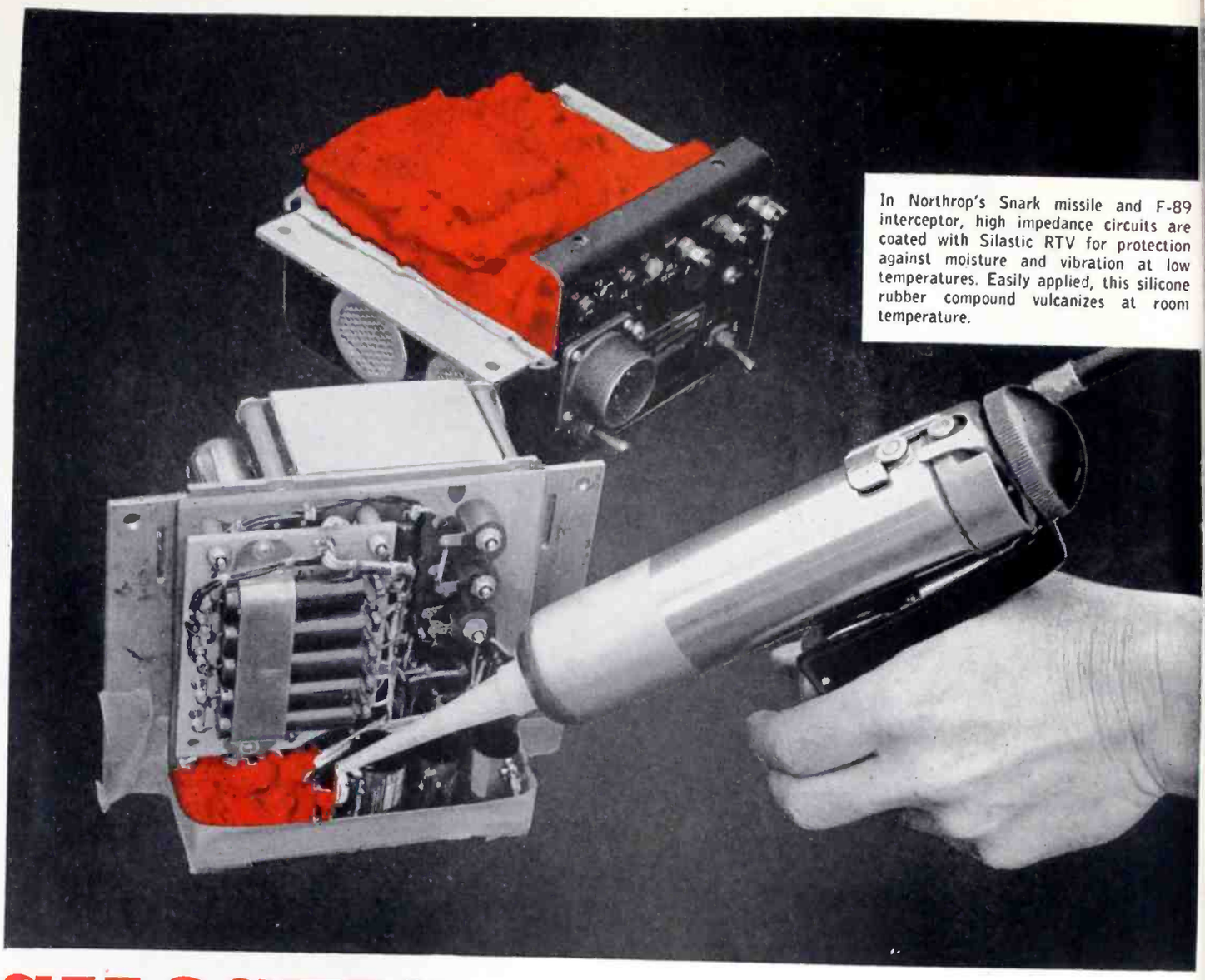
You can save space—with no sacrifice in performance or reliability—when you specify Allen-Bradley Type CB resistors. Write today for complete specifications.

Allen-Bradley Co., 1315 S. First St., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

ALLEN-BRADLEY
QUALITY

HOT-MOLDED COMPOSITION RESISTORS

Circle 5 on Inquiry Card, page 99



In Northrop's Snark missile and F-89 interceptor, high impedance circuits are coated with Silastic RTV for protection against moisture and vibration at low temperatures. Easily applied, this silicone rubber compound vulcanizes at room temperature.

SILASTIC
SILICONE RUBBER
RTV seals, cushions delicate circuits

Sensitive electronic components can be both cushioned and sealed against moisture by encapsulating with Silastic RTV*, Dow Corning's silicone rubber that vulcanizes at room temperature. A single coating provides protection, and in addition improves electrical properties of the unit, especially surface resistivity. Silastic RTV cures in 24 hours, and remains resilient from —100 F to 350 F. Write for complete data.

Get latest data on Silastic

Mail coupon today

Dow Corning Corporation, Dept. 165
Midland, Michigan

Please send me latest data on Silastic

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COMPANY _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

*T.M.REG.U.S.PAT.OFF.

Typical Properties of Silastic for Encapsulating and Potting

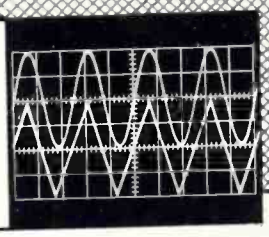
• Temperature range, °F	—100 to 350 F
• Dielectric strength, volts/mil	300 to 500
• Surface resistivity at 50% relative humidity, ohms	2.8×10^{15}
• Dielectric constant, 10^2 cycles per second	2.95 to 3.05
• Dissipation factor, 10^2 cycles per second	0.01
• Moisture absorption after 7 days at room temperature, %	+3 to +5

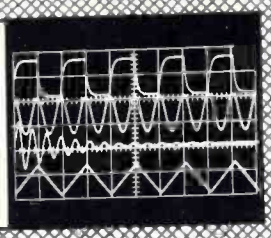
If you consider ALL the properties of a silicone rubber, you'll specify SILASTIC.

first in silicones — DOW CORNING SILICONES

DOW CORNING CORPORATION • MIDLAND, MICHIGAN

Two Beams Four Traces





DC-to-25 MC

TYPE 551

When the job requires it, you can double up and display four different waveforms at once with this dual-beam oscilloscope. Type 53/54C Dual-Trace Plug-In Units in both channels make possible the four-trace display.

Less spectacular but more frequent uses of this versatile fast-rise oscilloscope include waveform comparison measurements on a dual-beam display in the dc-to-25 mc range, and all the usual and unusual applications of a high-performance laboratory oscilloscope.

TYPE 551 SPECIAL FEATURES

WIDE-BAND VERTICAL AMPLIFIERS
Main-unit risetimes—12 mμsec.
Passbands and risetimes with Type 53/54K units—dc-to-25 mc, 0.014 μsec.

SIGNAL-HANDLING VERSATILITY
All Type 53/54 Plug-In Units can be used in both channels.

0.2 μsec DELAY NETWORKS

WIDE SWEEP RANGE
0.02 μsec/cm to 12 sec/cm.

SINGLE SWEEPS
Lockout-reset circuitry.

COMPLETE TRIGGERING
Fully-automatic or amplitude-level selection with preset or manual stability control.

10-kv ACCELERATING POTENTIAL
Brighter display for fast sweeps and low repetition rates.

PRICE

without plug-in units	$1725
Type 500/53A Scope-Mobile	$108
Type 53/54K Fast-Rise Plug-In Preamplifiers, each	$125
Type 53/54C Dual-Trace Plug-In Preamplifiers, each	$275

Prices f.o.b. factory.

Please call your Tektronix Field Engineer or Representative for complete specifications and, if desired, to arrange for a demonstration at your convenience.

ENGINEERS—interested in furthering the advancement of the oscilloscope? We have openings for men with creative design ability. Please write Richard Ropiequet, Vice President, Engineering.

Tektronix, Inc.

P. O. Box 831 • Portland 7, Oregon

Phone CYpress 2-2611 • TWX-PD 311 • Cable: TEKTRONIX

Circle 84 on Inquiry Card, page 99

Coming Events

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

May 1-8: ASTE Industrial Exposition & Annual Mtg., American Society of Tool Eng.; at Phila., Pa.

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

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

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

May 6-8: 12th Annual Frequency Control Symp., by U.S.A. Signal Eng'g Labs.; at Berkeley-Carteret Hotel, Asbury Park, N. J.

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

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

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

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

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

May 12-14: 8th Annual Research Equipment Exhibit & Instrumentation Symp., by National Institute of Health; at Bethesda, Md.

May 13-15: Spring Assembly Mtg., by Radio Technical Commission for Marine Services; at Benjamin Franklin Hotel, Philadelphia., Pa.

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

May 19-22: 45th Annual Electroplaters Society Conv.; at Sheraton-Gibson Hotel, Cincinnati, Ohio.

May 21-23: EIA Annual Conv.; at Sheraton Hotel, Chicago, Ill.

May 22: 1st Annual Distribution Congress, by Magnetic Recording Industry; at Conrad Hilton Hotel, Chicago.

May 25-29: International Conv. on Transistors, by Institution of Electrical Engineers; at Savoy Place, London, W.C. 2, England.

May 26-28: American Society for Quality Control's 12th Annual Conv.; at Hotel Statler, Boston, Mass.

May 27-28: Maintainability of Electronic Equipment by EIA; at Univ. of Penna., Phila., Pa.

June 1-4: Institute of Appliance Manufacturers Conv. & Exh.; at Cincinnati, Ohio.

June 2-4: National Telemetering Conf., by IAS, AIEE & ARS; at Lord Baltimore Hotel, Baltimore, Md.

June 4-6: Annual Conv. & Exh., by Armed Forces Communications & Electronics Assoc.; at Sheraton-Park Hotel, Washington, D. C.

June 5-6: 2nd National Symp. on Production Techniques, by IRE; at Hotel New Yorker, New York City.

June 6-8: High Fidelity Show, by S. W. High Fidelity Distributors Assoc.; at Shamrock Hilton Hotel, Houston, Tex.

June 8-12: 50th Anniversary Conv., by National Assoc. of Electrical Distributors, at San Francisco, Calif.

June 9-13: 4th International Automation Exposition, at the New York Coliseum, New York City.

June 9-13: 6th Annual Technical Writers Institute, at Rensselaer Polytechnic Inst., Troy, N. Y.

June 10-11: 7th Annual Conv. of National Community TB Ass'n; at Mayflower Hotel, Washington, D. C.

June 11-13: 13th National Mtg. of Assoc. for Computing Machinery, at Univ. of Ill., Urbana. Ill.

June 11-14: Annual Mtg. of the National Society of Professional Engineers; at Chase Hotel, St. Louis, Mo.

June 16-18: 2nd National Conv. on Military Electronics, by IRE; at Sheraton-Park Hotel, Washington, D. C.

June 20-26: Radio Components Exh. by the French EIA; at Parc des Expositions, Porte de Versailles, Paris, France.

June 22-27: 61st Annual Mtg. & Apparatus Exh., American Society for Testing Materials; at the Hotel Statler, Boston, Mass.

June 22-27: Summer Mtg. of the AIEE; at Buffalo, N. Y.

Abbreviations:

ACM: Association for Computing Machinery
AIEE: American Inst. of Electrical Engrs.
ARS: American Rocket Society
EIA: Electronic Industries Assoc.
IAS: Inst. of Aeronautical Sciences
IRE: Institute of Radio Engineers
ISA: Instrument Society of America

As We Go To Press (cont.)

Solar Converters Power Satellite

To supply power for one of the radio transmitters in the small sphere in the Vanguard test vehicle the high intensity sunlight of outer space is being converted to electricity by 108 solar converters group in six clusters placed symetrically around the sphere's surface.

At its planned altitude, the satellite will be in direct sunlight at least 60 of each 100 minutes required for a complete trip around the world.

The sun-powered minitrack radio will be in operation a minimum of 60% of the time, more than enough for tracking and location purposes.

The silicon solar cells are soldered together in banks of nine.

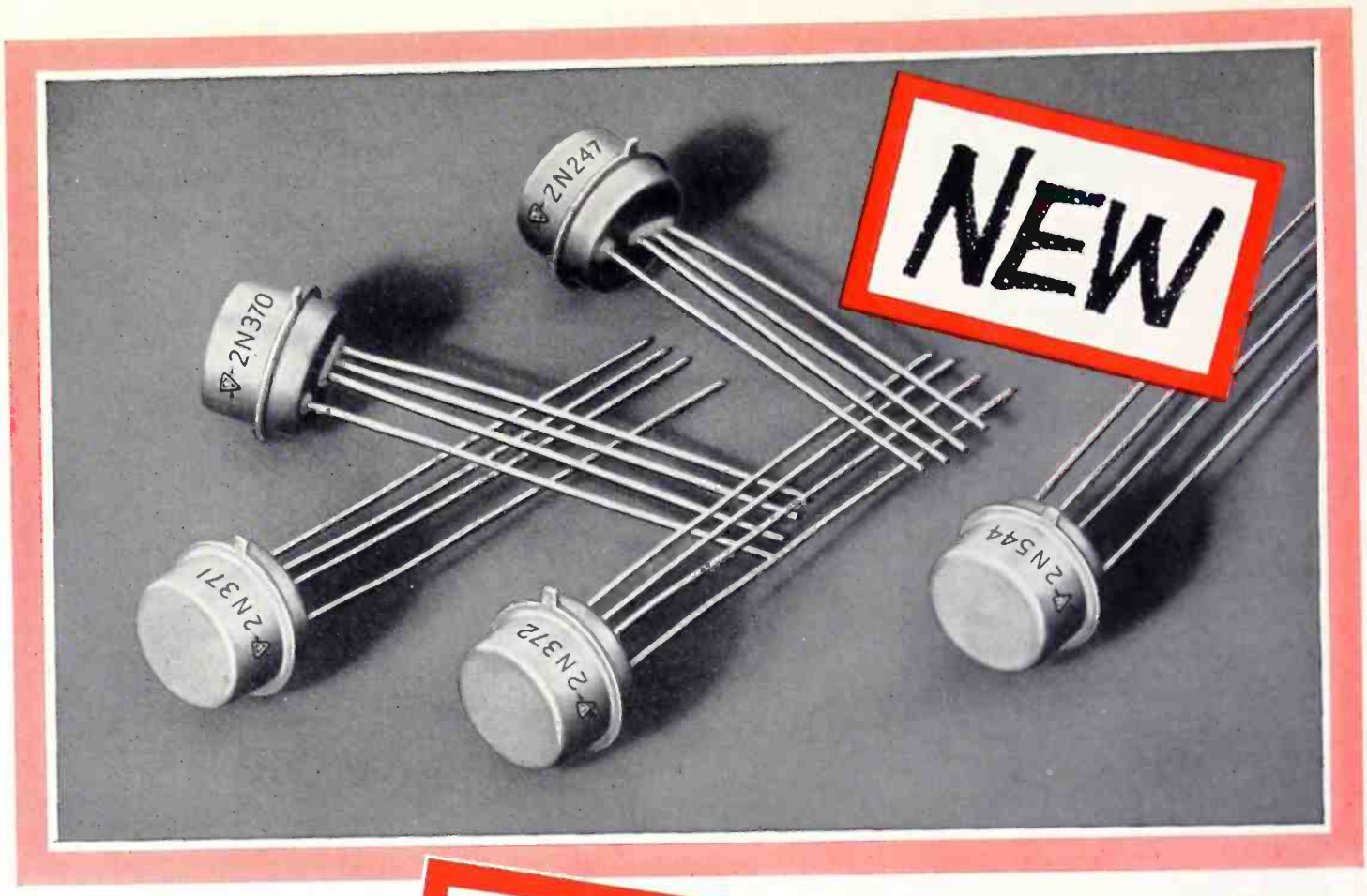
Each group of 18 cells is embedded in an air-drying ceramic cement, cushioned by a silicone rubber gasket and encased in an aluminum housing stamped to fit the sphere exactly. The cells are covered by fused silica, similar to ordinary window glass. Unlike ordinary glass it will not discolor under the intense bombardment of gamma, beta, cosmic, and other rays high above the earth.

The housings themselves are approximately 1⅞ x 2¼ in. and stand out about .25 in. from the sphere's skin.

The individual cells were purchased from Hoffman Electronics Corp., Los Angeles, California and the fused silica from Corning Glass Works.

"TINIEST" DIODE

No larger than a household pin is this new hermetically sealed diode developed by Pacific Semiconductors Inc. and shown alongside conventional diode and 6AL5.



Sylvania RF-IF Transistors

Five new PNP Drift transistors, types 2N247, 2N370, 2N371, 2N372 and 2N544, for radio frequency amplifier service

Sylvania's new PNP Germanium Drift transistors feature high output resistance for increased gain at 1.5 mc to 20 mc, low feedback capacitance and high alpha cutoff frequency.

Designed for RF-IF circuits, they open the door to more transistorized electronic equipment operating from the broadcast band to the higher frequencies.

The new Sylvania drift transistors incorporate a diffused base on an intrinsic germanium layer for improved control over base thickness, more uniform base region, lower base resistance and reduced collector capacitance. The end result is superior performance at higher frequencies.

The new PNP drift transistors feature Sylvania welded hermetic seal construction for maximum protection in rugged environments. They are encased in a modified JETEC class 30 case with four flexible in-line leads. The additional center lead is connected to the metal case providing a complete unit shield and interlead shield. Coupling to adjacent circuit components is reduced to a minimum.

Call your Sylvania Sales Representative or write direct for information on new Sylvania PNP drift transistors, types 2N247, 2N370, 2N371, 2N372 and 2N544.

ELECTRICAL CHARACTERISTICS (25°C)

	2N247	2N370	2N371	2N372	2N544	Unit
Power Gain, Pg						db
V_{CE}= -8, I_E=1 ma. Freq.=20.0 mc						
Minimum	24	10	12	10	30.5	
Typical	27	—	—	—	—	
Maximum	31.5 (V_{CE}= -9 Freq.= 1.5 mc)	17	17	17	37.5 (V_{CC}= -9) (Freq.= 1.5 mc) (R_L =750 ohms) (Neutralized)	
Reverse Biased Collector Voltage, V_{CB}						V
V_{EB}= -0.5, I_c=50 ua						
Minimum	-40	-20	-20	-20	-20	
Typical	—	—	—	—	—	
Maximum	—	—	— (I_c =.050 ma)	—	—	
Collector Base Capacitance, Cob						uuf
V_{CB}= -12, I_E -0, Freq. =1.5 mc						
Minimum	—	—	—	—	—	
Typical	1.5	—	—	—	—	
Maximum	2.5 (V_{CB}= -9)	2.5	2.5	2.5	2.5	

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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Electronic Industries' News Briefs

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

EAST

NATIONAL CO. has received a $4.2-million contract from the GE Heavy Military Electronics Equipment Dept. for design, development, and production of complex electronic systems for the Atlas Missile.

AIRCRAFT RADIO CORP. received national honors for its success in design and production of an automatic direction finder which is approximately 1/5 the size and 1/3 the weight of previous equipment used as a standard.

FEDERAL TELECOMMUNICATION LABORATORIES has entered into the field of single-sideband research with the successful field-testing of a radio transmitter-receiver.

BENDIX RADIO DIV. has received an order from National Airlines for communications-navigation equipment installations in National's new Lockheed Electra fleet.

RATHEON MANUFACTURING CO. supplied many of the electronic devices being used in the Vanguard satellite to study soft x-ray radiations in outer space. These x-rays are believed a key to the behavior of solar storms disrupting long distance communications and other electronic systems.

WARD LEONARD ELECTRIC CO. has moved its New Jersey branch office to 50 Broad St., Bloomfield, N. J. Chester J. Penza is manager of the office.

SYLVANIA ELECTRONIC SYSTEMS has established a new laboratory to handle date processing systems. It will be located at the division's Waltham Laboratories, Mass.

GULTON INDUSTRIES, INC., has established the Glennite Instrumentation Div. for the development and production of high accuracy sensing devices, data handling systems and computers.

SPERRY GYROSCOPE CO. has been awarded three Navy contracts for $63-million for the production of major components of the Talos and Terrier guided missile systems.

NARDA ULTRASONICS CORP. has introduced mass-produced low cost ultrasonic cleaners. These include high capacity, production-size units.

G-V CONTROLS, INC., now makes available from stock, through selected local distributors, thermal time delay relays.

FAIRCHILD CONTROLS CORP.'s Components Div. has been awarded a contract for the production refinement of high temperature potentiometers by the Wright Air Development Command.

SUPERIOR ELECTRIC CO., Bristol, Conn., provided the light-conditioning for the new Dupont Tarleton Hotel in Miami through its Luxtrol light control units. The system permits guests to select desired degree of lighting.

MOTOROLA INC. supplied and will maintain the flood forecasting radio communications system for the Pennsylvania Dept. of Forests and Waters.

INTERNATIONAL TELEPHONE AND TELEGRAPH CORP. is building a new plant on a 15-acre site near Roanoke, Va. The plant will occupy 45,000 sq. ft. and employ about 250 persons.

RCA SEMICONDUCTOR AND MATERIALS DIV. has been established for the engineering, manufacturing, and marketing of semiconductors and materials, as well as basic components fabricated from them. Dr. Alan M. Glover will be General Manager of the new Division.

GE's HEAVY MILITARY ELECTRONIC EQUIPMENT DEPT. has been awarded a subcontract, expected to exceed $100-million, to design, develop, produce, test, and place in operation the world's largest known radar system. System is to detect ICBM's as they rise over the horizon, several thousands miles distance.

MID-WEST

COLLINS RADIO CO. has awarded its $2.5-million Manufacturing Building project contract to the H. C. Beck Co. of Dallas, Tex., as contractors for general construction. The facility will occupy 230,000 sq. ft.

STROMBERG-CARLSON is building the largest piece of "Pagemaster" selective radio signaling system gear for Western Electric Co. Called a signaling control terminal the 11 ft tall rack will permit city-wide personal signaling on the same frequency as mobile telephone service. The device will be used in Columbus, Ohio.

NATIONAL VULCANIZED FIBRE CO. has moved its mid-west headquarters to a newly constructed plant in the Broadview section of suburban Chicago. The building incorporates fabricating facilities, sales office, and a warehouse.

MINNEAPOLIS-HONEYWELL REGULATOR CO. will supply nuclear simulators having the "feel" of costly research reactors to four U. S. universities. University of West Virginia, University of Minnesota, University of Oklahoma and Wayne State University (Detroit) will use them to train prospective nuclear engineers.

GE's LAMINATED PRODUCTS Textolite sales office in Boston will be located at 145 N. Beacon St. The new office will be staffed by R. L. Wright and R. M. Baril. Telephone Algonquin 4-5316.

HOFFMAN ELECTRONICS SEMICONDUCTOR DIV. supplied the solar cells which the Navy's successful Vanguard satellite is using as a radio transmitter power source.

MINNESOTA MINING & MFG. CO. supplied the magnetic tape used in the IGY projects to record the vast quantities of scientific data received by radio from the various satellites.

AMPHENOL ELECTRONICS CORP. has formed a new Cable and Wire Division that will operate as a separate unit of the company. General Manager of the Division is James E. Sullivan. The new division will concentrate sales and production responsibilities for the purposes of marketing new products, increasing sales volume, and providing better service.

WEST

PACIFIC DIV., BENDIX AVIATION CORP. has opened an analog computing facility in the Systems Analysis Branch. Heart of the facility is a Reeves Instrument Corp., REAC Model 400 Analog Computer. The division is located in N. Hollywood, Calif. Other news: a jet starter facility will be added to the Anelope Valley installation.

CONSOLIDATED ELECTRODYNAMICS CORP. and **HITEMP WIRES, INC.**, Westbury, N. Y., have signed a non-exclusive licensing agreement giving Hitemp the right to manufacture and market ceramic-coated wire. Under the license, Hitemp, gains the right to produce and sell Ceramicite-coated wire for a 10-year period on a royalty basis.

GE's COMPUTER DEPT. will construct a permanent plant in Deer Valley Park, near Phoenix, Ariz. The initial structure will cover 104,000 sq. ft. Occupancy is scheduled for January 1959.

AMPEX CORP., INSTRUMENTATION DIV. has made available a new color motion-picture film which contains unusual sequences of high-speed photography, enabling the viewer to see a new tape recorder start, stop and reverse its motion more than 100 times a second. Film is available for showings to interested groups in business, science, education and industry. The Ampex videotape recorder will be displayed at the Milan (Italy) Fair. President Gronchi of Italy will be the star of the first European demonstration.

BJ ELECTRONICS, BORG-WARNER CORP., through its Environmental Test Laboratory, has received a new contract for pilot run evaluation and testing of electronic instrumentation for USAF, WADC. Tests will be upon electronic communication, navigation and IFF equipment, test equipment, and components.

BECKMAN INSTRUMENTS, INC., has received contracts totaling more than $170,000 from the Ford Instrument Co. Div. of Sperry Rand Corp. for a series of high-precision components to equip a Navy shipboard fire control system.

FOREIGN

INTERNATIONAL RECTIFIER CORP. will open a branch office in Geneva, Switzerland, to strengthen its export services. A well-trained engineering staff will also be organized there.

NARDA MICROWAVE CORP. has appointed Handelsfirmaet-Ditz-Schweitzer, Copenhagen, as sales and service representative for Denmark.

F-R MACHINE WORKS INC., Woodside 77, N. Y., has engaged Radionics, Ltd., 8230 Mayrand St., Montreal 9, Canada, to sell its "FXR" line of microwave and electronic test equipment and high power modulators in Canada.

ALLEN B. DU MONT LABORATORIES, INC., has contracted with H. M. T. Barkhordar of Teheran to distribute Du Mont TV receivers, hi-fi phonographs, and radios in Iran.

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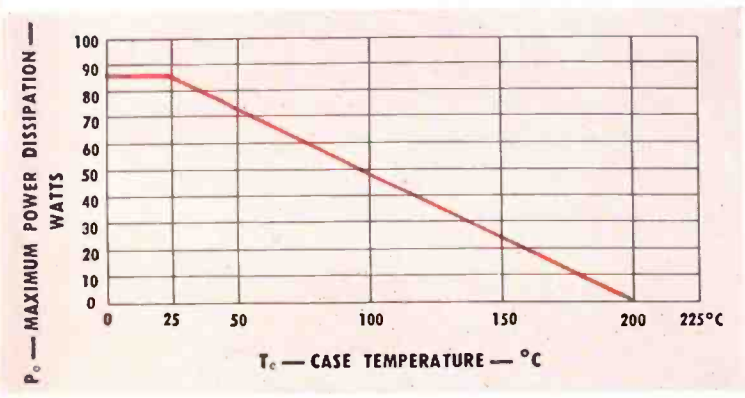
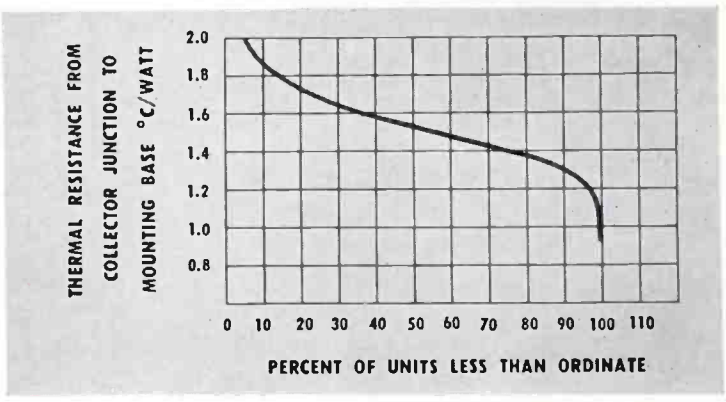
TRANSISTORS

45 WATTS at 100°C . . . OPERATION TO 200°C





For your audio servo applications . . . for your circuits that demand *high* power at *high* temperatures, specify TI 2N389 and 2N424 high power silicon transistors. Obtain optimum performance from −65°C to +200°C.
Both units are derated from 85 watts at 25°C to 200°C and combine the additional advantages of low distortion . . . stability . . . high reliability.

	Test Conditions	2N389 min	2N389 max	2N424 min	2N424 max	units
BV_{CEX}	I_C = 10mA, R_{EB} = 33 ohms	60	—	80	—	volts
BV_{EBO}	I_B = 10 mA	−10	—	−10	—	volts
R_{CS}	I_C = 1A, I_B = .2A	—	5	—	10	ohms
V_{BE}	V_{CE} = 10V, I_C = 1.5A	—	8	—	—	volts
V_{BE}	V_{CE} = 10V, I_C = .75A	—	—	—	8	volts
h_{FE}	I_C = 1A, V_{CE} = 10V	10	60	—	—	
h_{FE}	I_C = 1A, V_{CE} = 15V	—	—	10	60	
P_C	T_C = 25°C	—	85	—	85	watts
P_C	T_C = 100°C	—	45	—	45	watts
	Storage Temperature	−65°C to +200°C				

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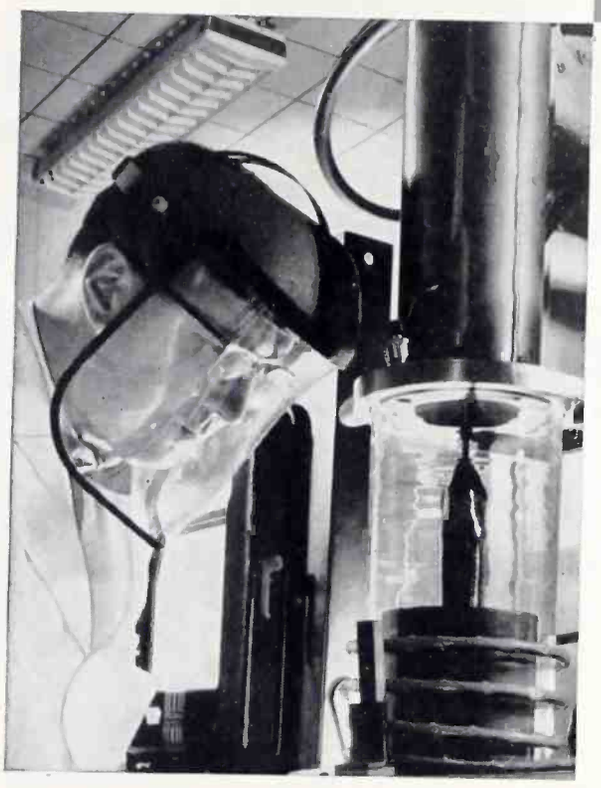
Circle 9 on Inquiry Card, page 99

DELCO HIGH POWER TRANSISTORS are made from



In the center of the quartz housing, a germanium crystal is being grown. A "perfect crystal lattice," it will be cut into wafers 3/10ths of an inch square and less than 1/100th of an inch thick to become the heart of Delco High Power transistors.

GERMANIUM

because it alone combines these 5 advantages:

Lower saturation resistance—Germanium gives Delco High Power transistors a typical saturation resistance of only *3/100ths* of an ohm. No other present material offers this characteristic, which permits efficient high-power switching and amplification from a 12- or 24-volt power supply.

Higher current gain—Gain with germanium is not only higher but is more linear with current.

Lower distortion—In many applications, distortion requirements can be satisfied only with germanium transistors.

Lower thermal gradient—As far as deliverable power of present devices is concerned, germanium meets the need and, in addition, provides a thermal gradient of only 1.2° C/watt.

Greater economy—More power per dollar.

DELCO RADIO

Division of General Motors, Kokomo, Indiana

BRANCH OFFICES

Newark, New Jersey
1180 Raymond Boulevard
Tel.: Mitchell 2-6165

Santa Monica, California
726 Santa Monica Boulevard
Tel.: Exbrook 3-1465

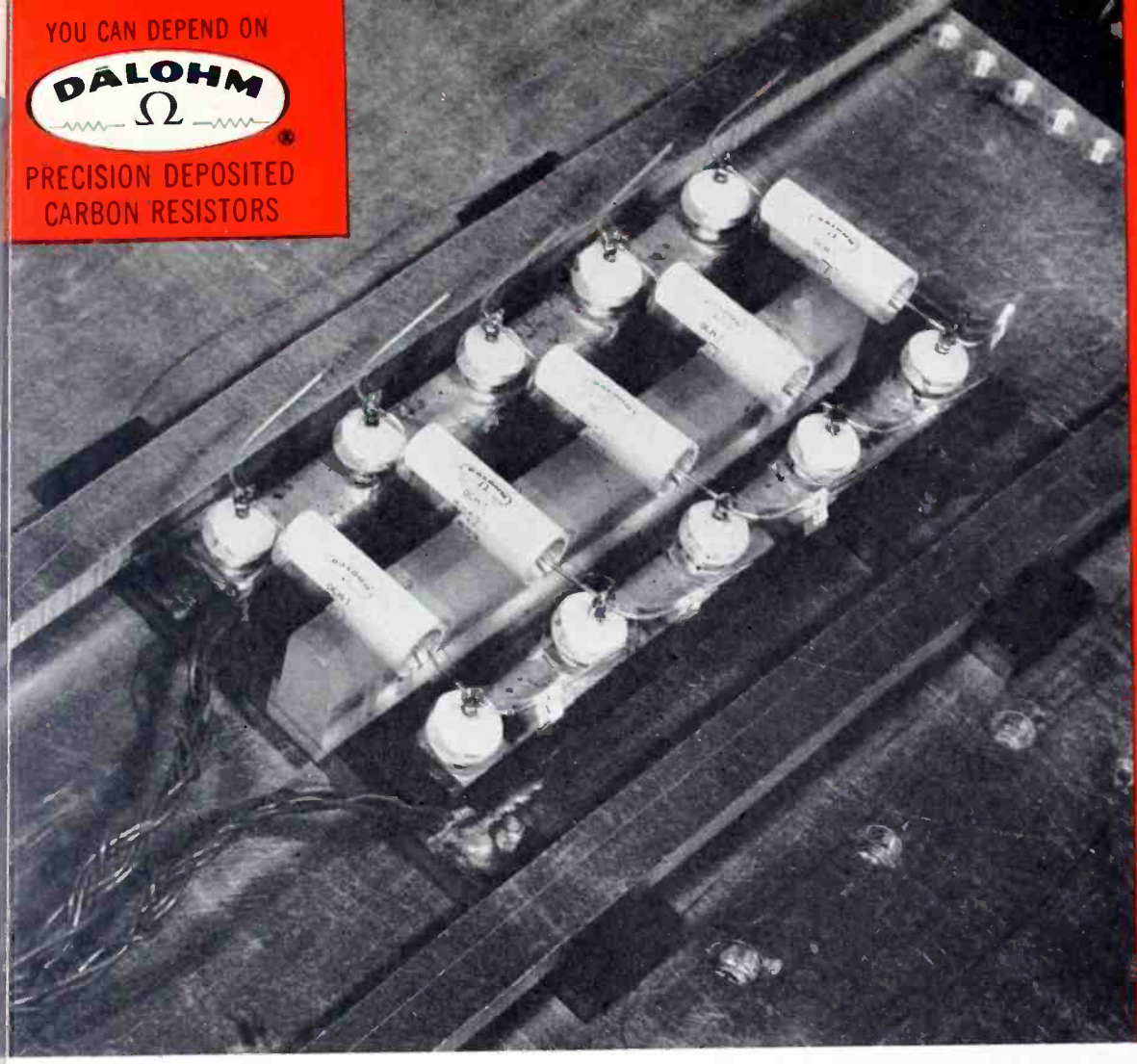
Examine Delco High Power germanium transistors and see how practical it is to go ahead with your plans now. For high current applications there is no better material than germanium, or Delco Radio would be using it. All Delco High Power transistors are produced in volume; all are normalized to retain their fine performance and uniformity regardless of age. Write for engineering data and/or application assistance.

Circle 10 on Inquiry Card, page 99

YOU CAN DEPEND ON

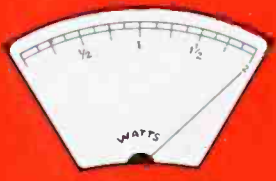
DALOHM Ω

PRECISION DEPOSITED CARBON RESISTORS

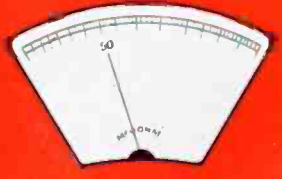


HI-TEMPERATURE
−55° C. to +150° C.

HI-PRECISION
±1%



HI-WATTAGE
¼ to 2 Watts



HI-RESISTANCE
1 Ohm to 50 Megohms

DCH Resistors take VIBRATION up to 2500 cps...yet retain 100% reliability!

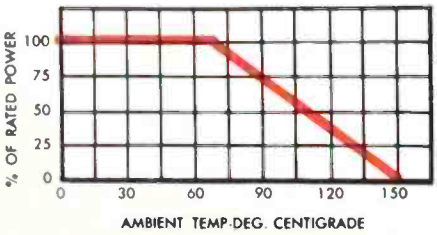
Severe vibration is only one of many tough parameters that DALOHM DCH Deposited Carbon Resistors meet with 100% reliability.

All DALOHM Deposited Carbon Resistors surpass the extremes of resistor requirements for their respective types, at the same time providing a wide margin in precision, miniaturization and reliability.

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

- Precision tolerance: 1%
- Powered at ⅛, ¼, ½, 1 and 2 watts.
- Resistance range from 1 ohm to 50 megohms.
- Surpass requirements of MIL-R-10509B.
- Temperature coefficient: 140 ppm/degree C. to 500 ppm/degree C.
- Voltage coefficient: 0.002% or less per volt.

TYPICAL DCH DERATING CURVE



A TYPE FOR EVERY APPLICATION

DCH TYPE

Completely sealed in newly developed, non-hydroscopic ceramic; gives absolute protection from humidity, salt spray, shock, vibration and other adverse environmental conditions; 8 sizes from 9/32 x .155 to 2¼ x .400; power, resistance and tolerance as listed at left.

Request Bulletin R-27

DC TYPE

Silicone sealed providing maximum protection from abrasion, moisture, salt spray and other environmental conditions; 8 sizes from 9/32 x 3/32 to 2-1/16 x 5/16; power, resistance and tolerance as listed at left.

Request Bulletin R-24

MC TYPE

Latest development in deposited carbon; molded in plastic for complete protection from moisture; salt spray, shock, vibration and all environmental conditions; 3 sizes from ¾ x ¼ to 2¼ x ⅜; powered at ½, 1 and 2 watts; resistance and tolerance as listed at left.

Request Bulletin MC

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 8 on Inquiry Card, page 99

Readin', 'Ritin', and Reliability

Synthane plastic laminated bushings and breaker arms for automotive ignition.

Dependable operation of a school bus, a truck, or your own car involves the functioning of many parts. One breakdown can wipe out the memory of ten thousand trouble-free miles.

Some of these parts are made of laminated plastics. They're usually unseen, unsung, small in size yet efficiently performing their job.

Their cost is relatively insignificant when compared with the cost of equipment in which they work, but it should be sufficient to insure dependability.

Actually, what you pay for Synthane laminated plastics is little or no more than you'd pay for any other plastic laminate. But the Synthane price includes top quality materials, product control, excellent facilities and workmanship, an assurance of continuous supply, and a long reputation for fair dealing.

If you are interested in a reliable source of laminated plastics—sheets, rods, tubes, or completely fabricated parts, write for an interesting catalog or call our representative nearest you.

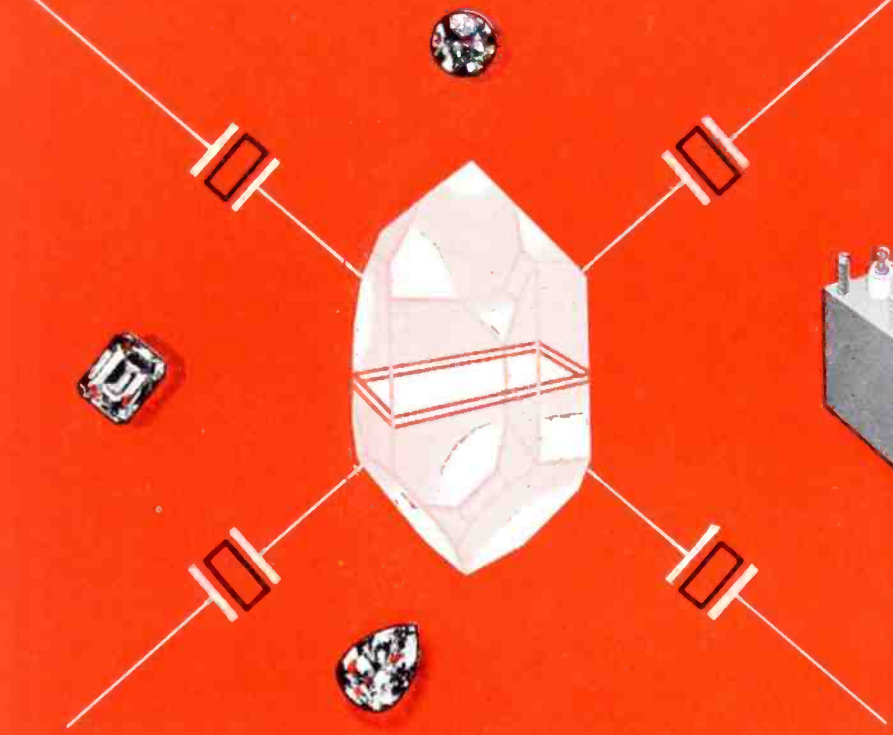
SYNTHANE

SYNTHANE CORPORATION, 11 RIVER RD., OAKS, PA.

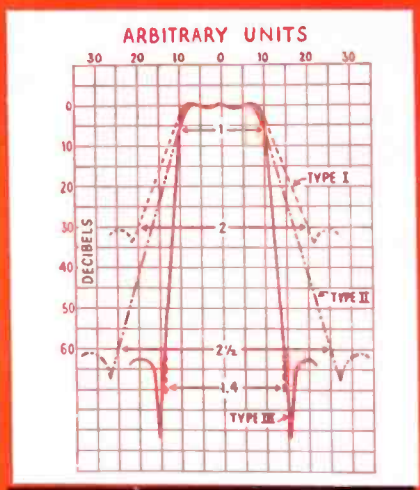
Circle 12 on Inquiry Card, page 99

Crystal filters

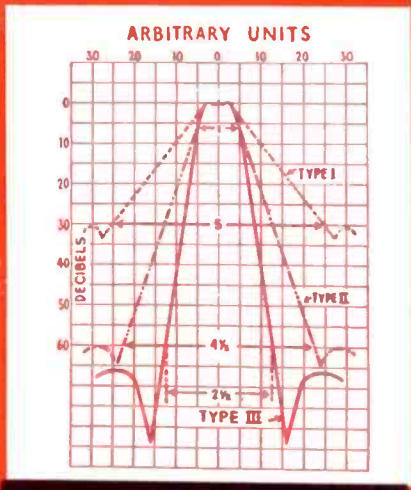
by BURNELL & CO., INC.



TYPICAL RESPONSE CURVES INDICATING THE VARIOUS SHAPE FACTORS AVAILABLE IN STANDARDIZED BURNELL CRYSTAL FILTERS



WIDE BAND CRYSTAL FILTER



NARROW BAND CRYSTAL FILTER

Burnell & Company is pleased to announce that it has expanded, in its new plant, the facilities of its *crystal division* for the production of crystal filters.

Like fine jewels, crystal filters are synonymous with stability, permanence and reliability. With the development of advanced production techniques and circuitry by Burnell & Co., they offer vast potential in electronic communications, telemetry, and remote control applications.

Depending on band width and frequency, they may be composed entirely of crystals, or in complex networks, combine quartz crystal elements with stabilized toroidal coils to produce the desired band width and shape factor. Frequency has been extended from low range to the megacycle spectrum so that Burnell Crystal Filters now provide the solution to myriad problems formerly insoluble with even the best of toroidal components.

Economical, standardized complex designs of lattice networks and their three terminal network derivatives preclude high developmental costs. Packaging encompasses a wide range in standard, miniature and sub-miniature sizes with considerable latitude in permissive impedance range from required transistor usage to pentode operation. Whether your crystal filter is of standard design or calls for custom specifications, our facilities are at your disposal. Write for new Burnell Crystal Filter Bulletin, XT-455.

Burnell & Co., Inc.

first in toroids, filters and related networks

Dept. I-5

EASTERN DIVISION
10 PELHAM PARKWAY
PELHAM MANOR, N.Y.
PELHAM 8-5000

PACIFIC DIVISION
720 MISSION ST.
SOUTH PASADENA, CAL.
RYAN 1-2843

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Tele-Tips

AMATEUR ROCKETEERS are being warned that all proposed launchings should be discussed with Civil Aeronautics Administration safety inspectors.

WEAPONS PROGRESS is pointed up by the newest gag making the rounds of the Pentagon. "If it works, it's obsolescent." The missile excitement generated another version that goes, "If it goes up and comes back down, it's obsolescent, but if it goes up and stays up, we want it."

CLOSED-CIRCUIT TV is being installed in a county jail in Dallas to keep watch on cell blocks as a shortcut to efficiency. Jail officials say, "The fact that prisoners know they are being watched is more valuable than anything."

STANDARD AMPERE was double-checked by the National Bureau of Standards and found to have drifted only a few parts per million since its original evaluation in 1942. Standard ampere must be checked by applying Ohm's Law to the standard volt and standard ohm maintained at the labs. In this latest test the ampere was determined by two methods. One method found the ampere equal to 1.000008 absolute amperes; the other found it equal to 1.000013 absolute amperes. The weighted mean then is 1.000010 absolute amperes.

PAY-TV—Newsletter & Digest is name of new publication to be distributed every two weeks. As the name implies, it will seek to present all the news on toll TV. Edward Cory is the publisher; Don Rico is the Editor. Offices are at 25 California Street, San Francisco 11, Calif.

U.S AND U.K are trying to settle a difference—of one part in a billion in their measurement standards. The discrepancy exists in the radio comparison between "atomic clocks" based on the un-

Tele-Tips

varying vibrations of cesium atoms. The U. S. Army Signal Engineering Laboratories at Ft. Monmouth, N. J., has shipped two cesium beam standards to Britain for comparison.

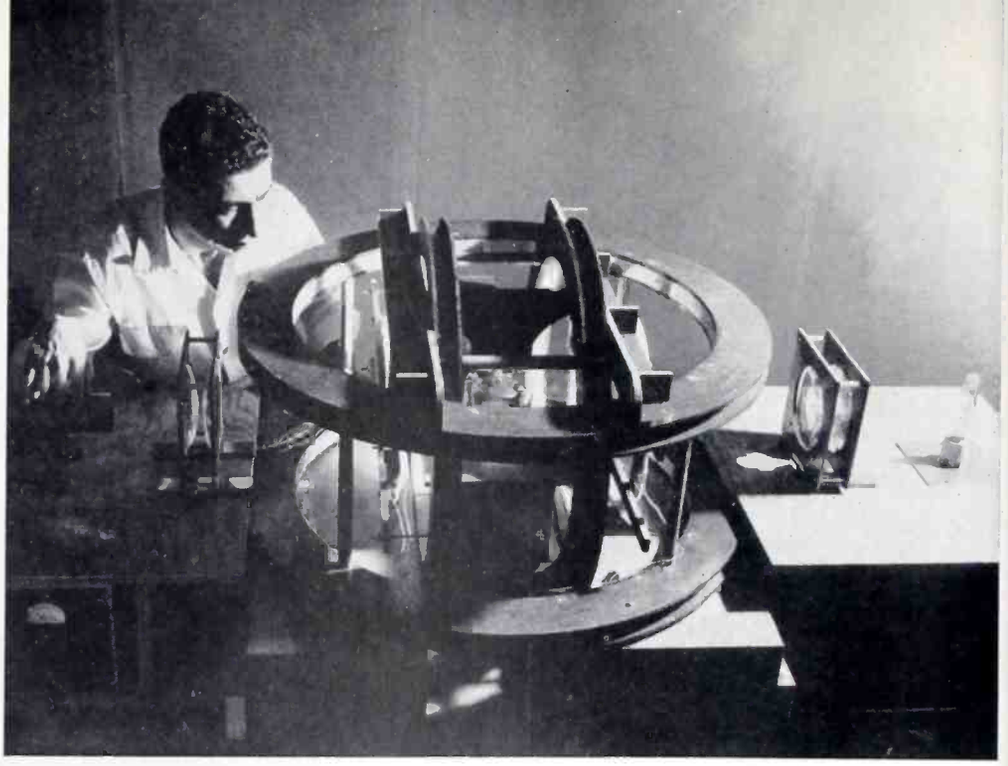
IF MICRO - MINIATURIZATION goes much further a jeweler's loupe will be standard equipment for electronic technicians.

SPACE FLIGHT is not for the happy-go-lucky dare-devils of past years. The space adventurer is a scientifically trained, serious man who understands exactly what the problems are that he is facing. Scott Crossfield, who will fly the X-15 space rocket plane, holds engineering degrees, as does Capt. Ivan Kincheloe, who holds the high altitude record for piloted aircraft.

THE ELECTRONIC COMPUTER will now try its hand at beating the stock market. A Massachusetts investment house, Danforth-Epply Corp., is using the computer to arrive at the favorite stocks of the mutual funds, calculating the amount being spent to acquire the stocks, and the chances of growth.

ROCKET SHIP PERSONNEL will probably eat the containers that their food comes in. Industrial packaging people say that instead of a metal can, packages in which food and other supplies will be packed for space travel will probably be made of vitamin-loaded chemical films.

SATELLITE "MAILMAN." An ingenious plan has been devised to use an earth satellite as a relay station for international mail. Images of the letter would be facsimile-recorded on the satellite's instrumentation as it crossed over one area and then the "picture" would be retransmitted to the ground when the sphere was over the letter's destination. Total time to go half-way around the world would be an hour.

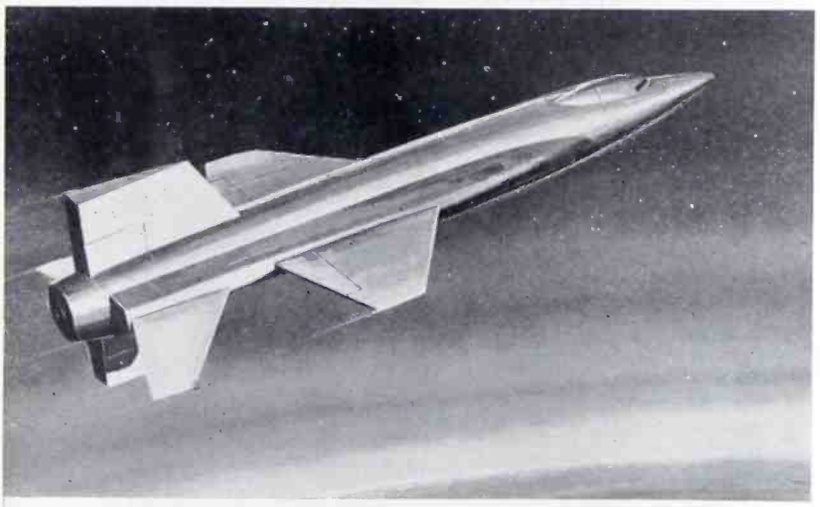


ATOMIC CLOCK

Herbert Ohlstein, senior technician at Federal Telecommunication Labs, Nutley, N. J., demonstrates atomic gas cell surrounded by magnetic shielding used by engineers of IT&T in developing a light weight "atomic clock" time standard.

SPACE PLANE

The X-15 rocket-powered airplane under development at the Los Angeles Div. of North American Aviation Inc. for the Army, Navy and NACA is designed to be the first plane to penetrate space.



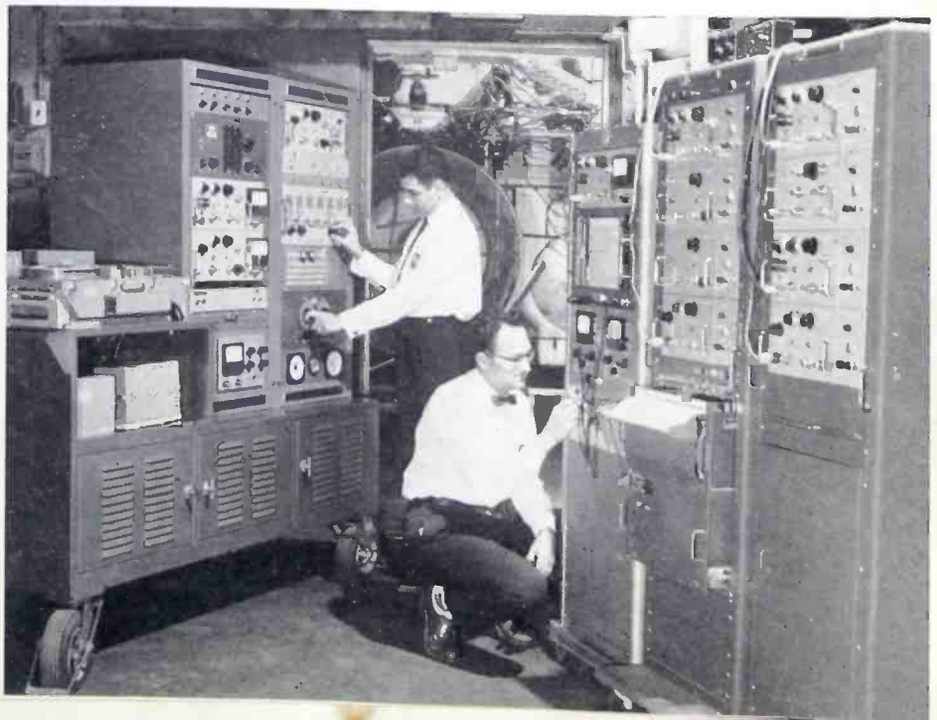
Snapshots . . . . .

MOUNTAIN MICROWAVE

Unique high altitude pipeline microwave system (below) installed by GE across N. Mexico and California has 3 hops over 100 mi. in length. Helicopter airlifted equipment to remote mountain top locations.

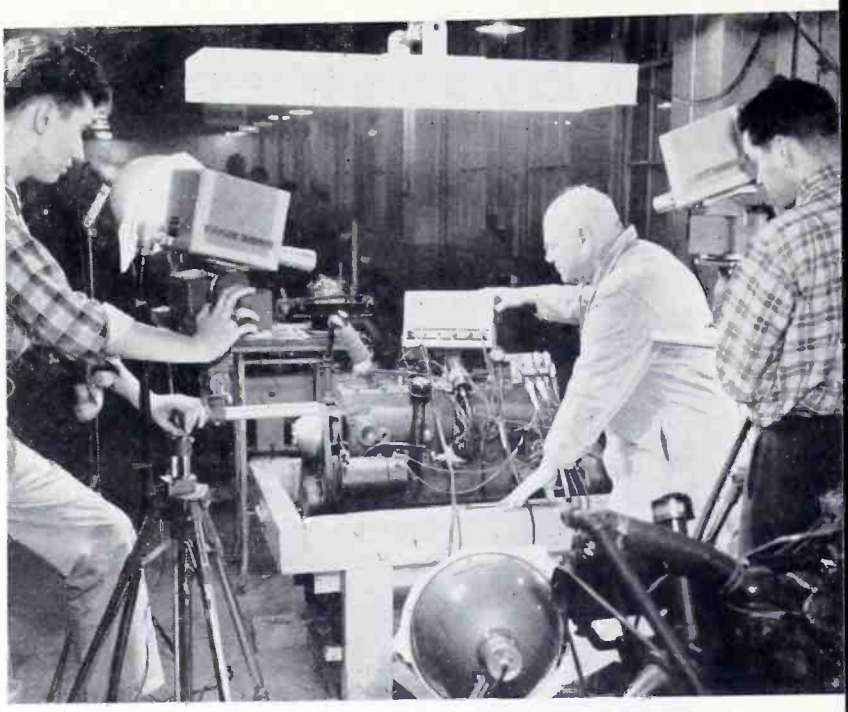
CHECKING ENGINES

GE's Small Aircraft Engine Dept. (below) has invested $500,000 in portable instruments that instantaneously measure and record the performance of gas turbine engines.



RAMJET MISSILE

Burned to a black waffle pattern by searing air friction heat, the Lockheed X-7 missile has set a new speed and altitude mark. It is recovered by parachute and nose spike.



CLOSED-CIRCUIT TV

In a "practice-what-we-preach" move the Television Dept. of the New York Trade School set up a closed-circuit TV system within the school to facilitate the teaching of TV and other trades.

of the Electronic Industries

NEW C-C TV CAMERA

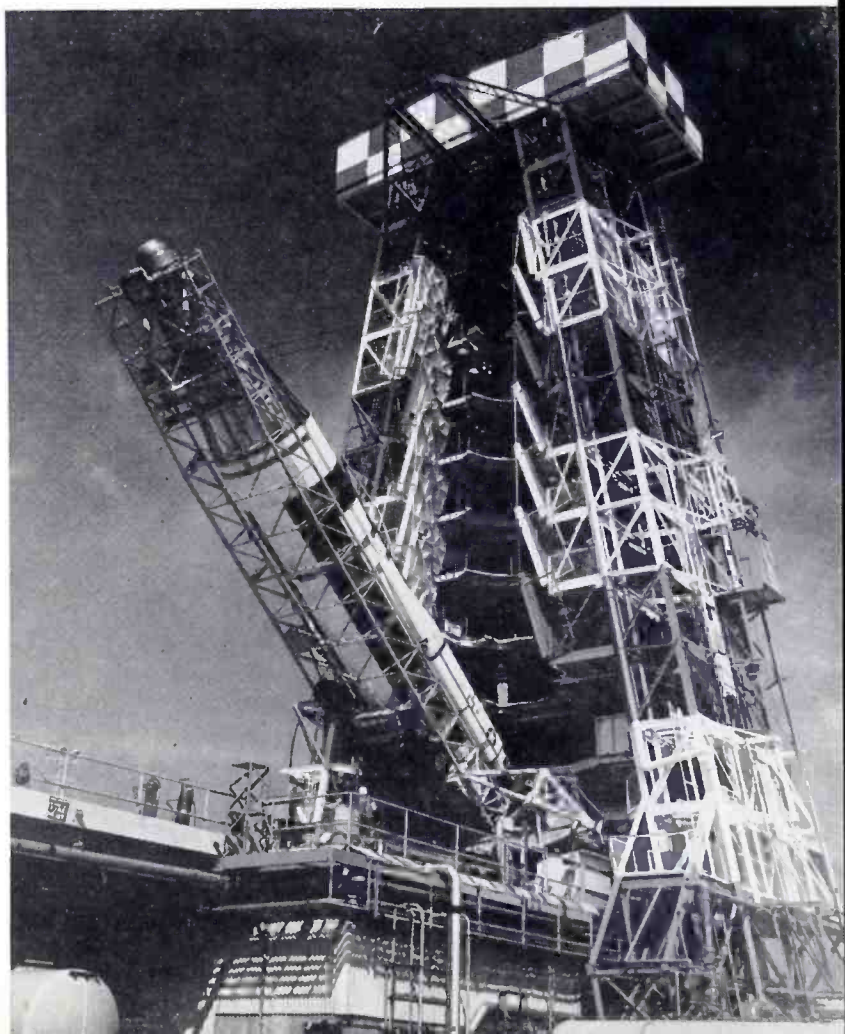
GE's new TE-6-A closed - circuit TV camera (left) functions without separate control, power units or bulky cable connections. Cost —$1200.

"GAS LIGHT"

Combining hydrogen and oxygen gases (left) to produce electricity was one of the marvels demonstrated last month at the Brussels World's Fair by National Carbon Co.

"ATLAS"

Still resting on the trailer (right) that brought it across the country from Convair, San Diego, the AF ATLAS missile is raised into launching position at Cape Canaveral, Fla.



Books

Scientific Encyclopedia, 3rd Edition

Published 1958 by D. Van Nostrand Co., Inc., 12 Alexander St., Princeton, N. J. 1845 pages. Price $30.00.

Covering areas that extend over all of physical science, engineering and medicine, including many related subjects, this vast fund of scientific knowledge has been prepared by leading scientists on every subject, each an authority in his field.

Entries provide a broad, comprehensive treatment of basic principles, laws, and relationships of the detailed facts upon which these laws are based, and of their applications throughout our entire civilization.

New developments in all phases of science and engineering considered in this book sharply detail a broad picture of the advances made during recent years. Each topic is first explained as simply as possible and then expanded to include more detailed and more advanced information.

Calculus for Electronics

By A. E. Richmond. Published 1958 by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36. 415 pages. Price $6.00.

Here is a complete text for students in the field of electronics who require a knowledge of calculus in their work. It presents simultaneously the processes of calculus and their application to problems in electrical and electronic circuits. This combination gives the student a firm grasp of the basic science of his applied field and motivates him to go on to more advanced work.

Application of calculus methods to television, radar, loran, and transistors are also included in the text.

Solid State Physics, Volume V

Edited by Frederick Seitz and David Turnbull. Published 1957 by Academic Press, Inc., Publishers, 111 Fifth Ave., New York 3. 470 pages. Price $11.00.

This volume contains a balance between experimental and theoretical material, an admixture of both introductory and advanced topics. Five subjects by different authors compose this volume. The subjects are: Galvanomagnetic and Thermomagnetic Effects in Metals, Luminescence in Solids, Space Groups and their Representations, Shallow Impurities States in Silicon and Germanium, Quadrupole Effects in Nuclear Magnetic Resonance Studies of Solids.

Television in Science and Industry

By V. K. Zworykin, E. G. Ramberg, and L. E. Flory. Published 1958 by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16. 312 pages. Price $10.00.

In this book the authors seek to explore the function of television as an extension of human sight—variously called closed circuit or industrial television to distinguish it from

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Another Example of Electronics Progress at Hoffman

Light as a Feather

Type IN1530

Hoffman
Zener Reference Elements
Designed Specifically for
PRINTED CIRCUITS

ELECTRICAL CHARACTERISTICS

EIA No.	Operating Voltage @ 10mA and 25°C	Maximum Change in operating voltage −55 to + 100°C	Maximum Dynamic Impedance @ 10mA
	(Volts)	(Volts)	(Ohms)
IN1530	8.4 ± 5%	.014	15
IN1530A	8.4 ± 5%	.007	15

Operating and Storage Temperature Range: −65°C to + 150°C

Lightweight and rugged for airborne applications

Hoffman . . . leader in silicon semiconductor devices . . . now offers this new line of sub-miniature ZENER REFERENCE ELEMENTS, specifically designed to maintain a constant DC voltage level under extreme *Temperature, Shock* and *Vibration* conditions. This new light weight . . . 8 grams . . . "Circuit commander" is ideal for use in applications demanding a stable and reliable voltage reference . . . in a case designed for miniaturized and printed circuit mounting.

Types IN1530 and IN1530A are available from stock to specifications per the chart above.

Write for complete information, Technical Bulletin T1B 28-58.

Hoffman Electronics CORPORATION

SEMICONDUCTOR DIVISION
930 Pitner Avenue • Evanston, Ill.
UNiversity 9-9850

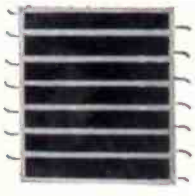
LEADER IN DIFFUSED JUNCTION SILICON SEMICONDUCTORS

Silicon Zener Power Regulators

Silicon Junction Diodes

Silicon Medium Power Rectifiers

Silicon Micro-Miniature (Glass) Diodes



Silicon Photo-Voltaic Cell Assembli--

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Books

(*Continued from page 26*)

the broadcast function—and to d scribe the tools which have been d veloped to realize it.

Analyzing both equipment and a plications, the authors discuss clos circuit color television and the ir provements achieved by transistoriz tion. Also described are stereo tel vision, specialized television metho in research, television microscop etc. The principal field of applicatio of television in industry, researcl medicine, education, commerce, mil tary affairs, home and farm are ou lined.

The Ultra High Frequency Performance of Receiving Tubes

By W. E. Benham and I. A. Harris. Published 19 by McGraw Hill Book Co., Inc., 330 W. 42n St., New York 36. 169 Pages. Price $6.50.

This book offers a simple, detaile account of the behavior of radio re ceiving tubes at ultra-high frequen cies. It describes those tubes (chiefl triodes) which show promise of out standing performance as low nois amplifiers, as oscillators, and to lesser extent, as mixers.

A special feature is the new analy sis of the effect of elastically reflecte electrons from the anode of a triod on a signal and noise characteristics The book closes with chapters on th limited knowledge of large signa transitune theory and the calculation of noise factor.

Networks Synthesis, Volume I

By David F. Tuttle, Jr. Volume I. Published 1956 by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16. 1190 pages. Price $23.50.

This initial volume in a two volume work presents the principles of synthesis of electrical networks in which steady state behavior as a function of frequency is all important. This volume covers networks with two terminals.

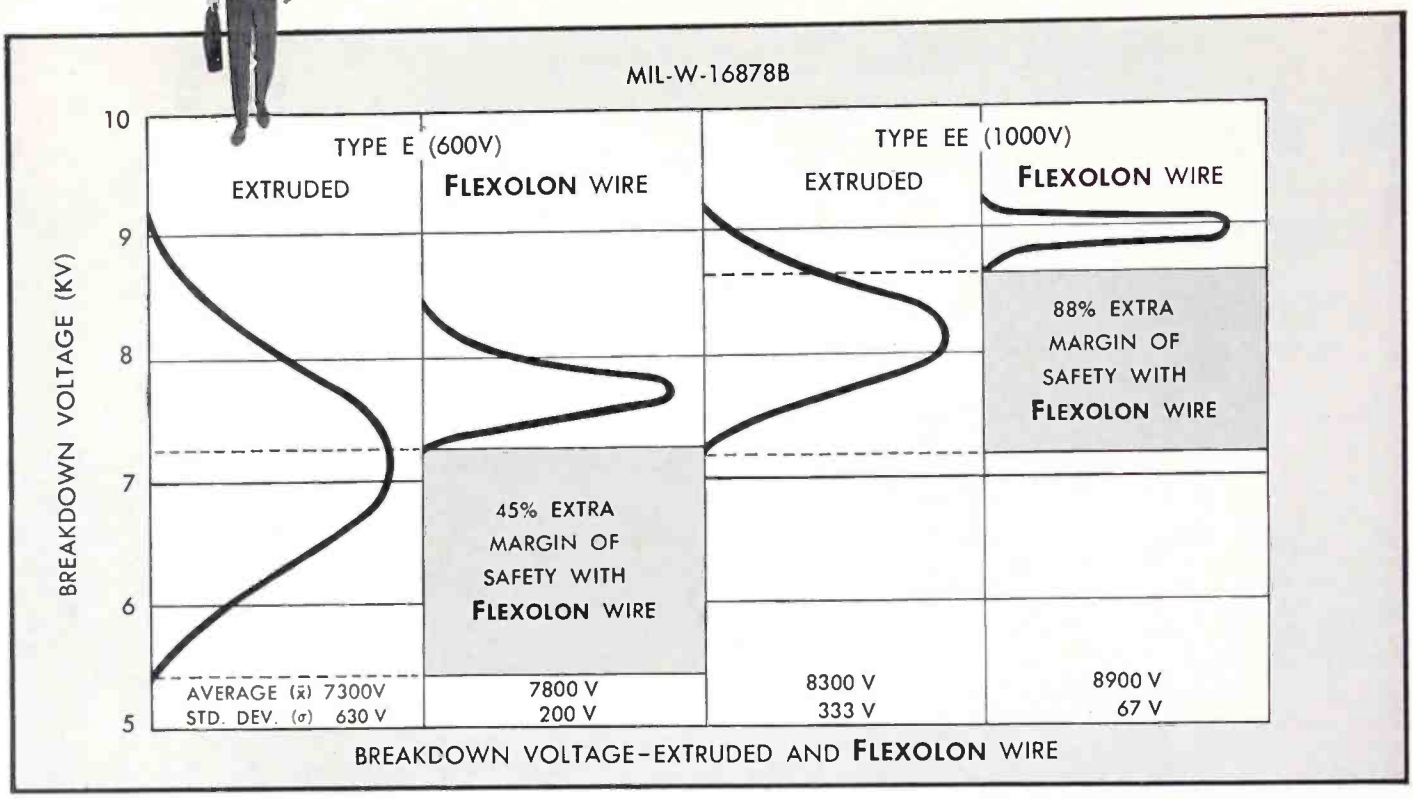
The author gathers together the important advances in network synthesis of the past 20 years and adds this to the classical material. The result is a coherent, intelligible treatment of what network synthesis can accomplish. Nearly all subjects discussed are supported by demonstrations or proofs.

Introduction to Heat Transfer, 3rd Edition

By Aubrey I. Brown and Salvatore M. Marco. Published 1958 by McGraw-Hill Co., Inc., 330 W. 42nd St., New York 36. 332 pages. Price $6.75.

This book presents the fundamentals of heat transfer in a manner readily understood by 3rd and 4th year engineering students. The authors provide a clear understanding of the principles of the subject with a working knowledge of the application of these principles to a variety of engineering problems, and with a good foundation for advanced and more specialized studies in this field.

How the man  *from Tensolite can widen your safety margins on 250° C. hook-up wire*



:EXOLON hook-up wire with Raybestos-Manhattan R/M "eflon" tape proves highest in dielectric strength

Tensolite's new* FLEXOLON *high temperature wire, insulated with R/M "Teflon" tape, exceeds the requirements of MIL-W-16878B, Types E and EE

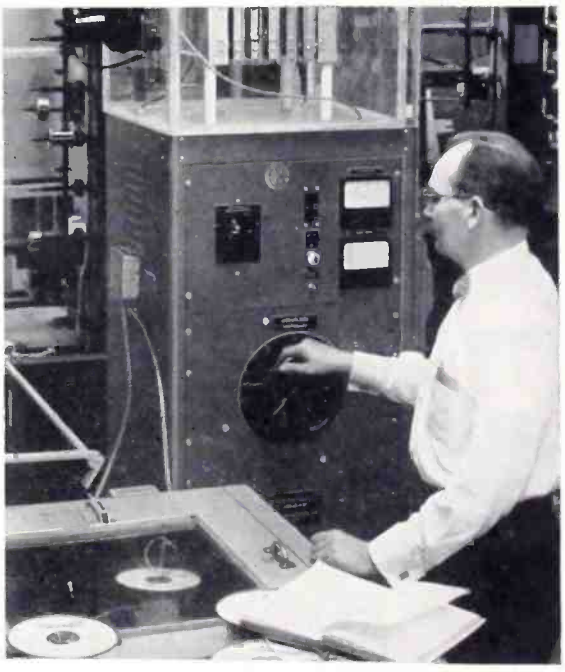
If you want to widen the safety margins in your product or merely maintain the present margins with smaller wire, Tensolite's new FLEXOLON high-temperature hook-up wire can solve your problem.

Rugged tests – In a series of extensive tests, FLEXOLON wire's dielectric strength was charted against the strength of extruded wire. Ten-foot samples, selected at random, were immersed in a water bath containing a suitable wetting agent for 4 hours. Each piece was then subjected to a high-potential test with voltage increasing from 0 at the rate of 3 kv per 10-second interval until breakdown was observed.

Results conclusive – In the type E category, extruded wire fell 45 per cent below FLEXOLON wire's minimum dielectric strength. In the type EE category, the extruded samples were 88 per cent lower than the minimum dielectric strength of FLEXOLON wire.

Extra advantages – Tensolite's unique process which permits application of 2½ times more layers of Raybestos-Manhattan R/M "Teflon" tape to FLEXOLON wire assures full insulation protection and far superior performance. The new technique also gives FLEXOLON wire perfect concentricity which provides easier stripping, faster and cleaner cuts, and added protection against strand damage.

Complete information – Ask the man from Tensolite for full details on the many advantages of FLEXOLON high-temperature hook-up wire. Or write to Tensolite for informative FLEXOLON wire bulletin.



88 per cent extra margin of safety – This high potential test proved that Type EE extruded wire fell 88 per cent below FLEXOLON *wire's minimum dielectric strength.*

Tensolite INSULATED WIRE CO., INC.

West Main Street, Tarrytown, N. Y. • Pacific Division: 1516 N. Gardner St., Los Angeles, Calif.

"FLEXOLON" is a trademark of Tensolite Insulated Wire Co., Inc.

"TEFLON" is a registered trademark of the DuPont Company

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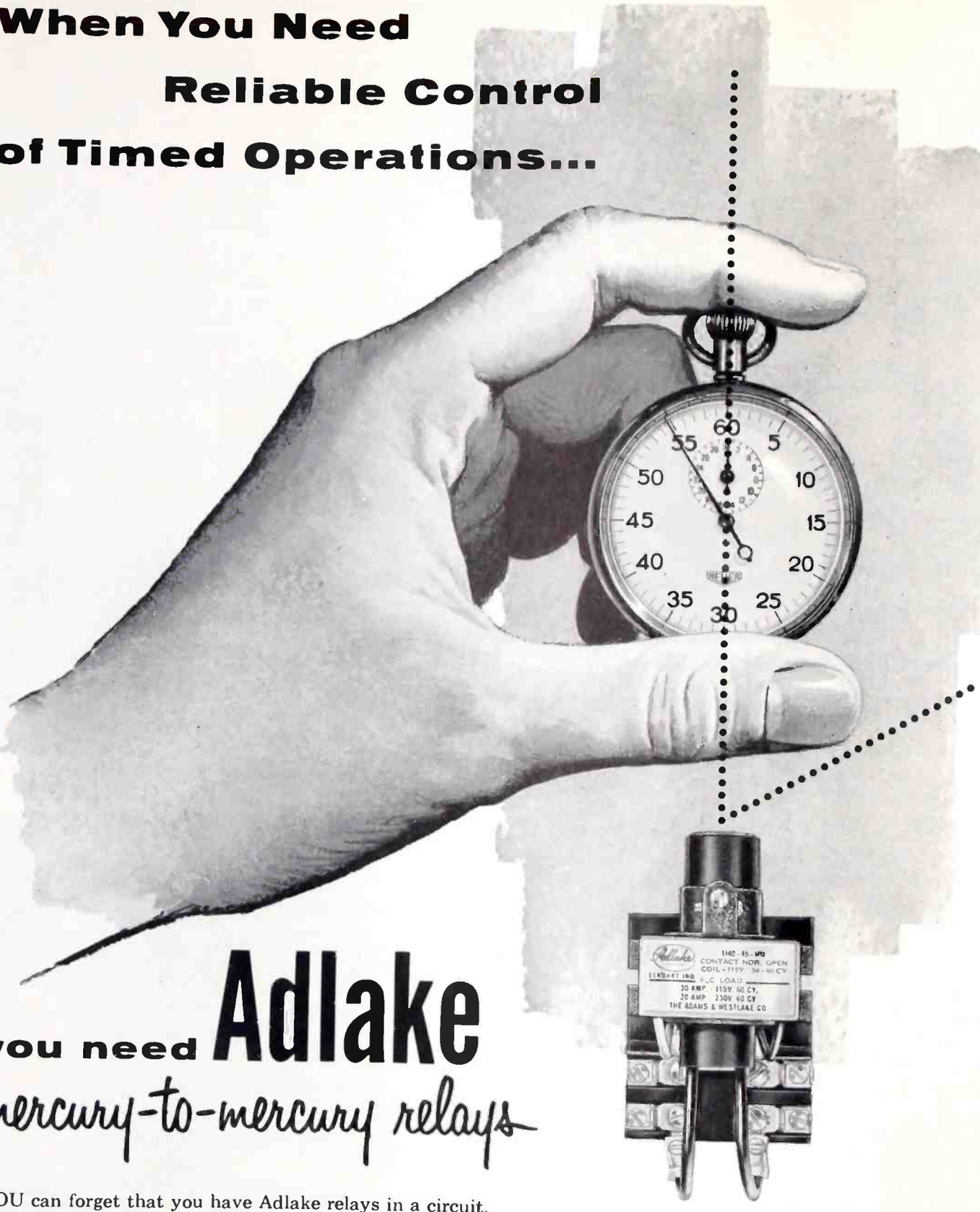
When You Need Reliable Control of Timed Operations...



you need Adlake mercury-to-mercury relays

YOU can forget that you have Adlake relays in a circuit, but the Adlake relays won't. Here are four reasons why you can forget, and they won't...

- **Perfect snap-action. No pitting, burning or sticking.**
- **No intrusion of dirt, dust or moisture—hermetically sealed at the factory.**
- **Time delay characteristics fixed and non-adjustable.**
- **Quiet. Chatterless. Requires no maintenance whatever.**

Our engineers will gladly help you with your control problems. No obligation. Just write the-original and largest maker of plunger-type relays—THE ADAMS & WESTLAKE COMPANY, 1182 N. Michigan, Elkhart, Ind. • New York • Chicago

Adlake
THE ADAMS & WESTLAKE CO.

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maintain and control reliability

with new

PRE-PROGRAMMED INSTRUMENTATION

NEW ROBOTESTER — IMMEDIATE AID TO IMPROVE MAINTAINABILITY OF EQUIPMENT RELIABILITY

A bold imaginative concept has evolved from Lavoie Labs in the form of a Programmed Instrumentation Approach with Failure Prediction. Designed for the **active control** of maintainability and reliability of electronic equipment in aircraft, missile and weapon systems.

The universal-tape programmed performance checking Robotester is versatile and flexible and is the basis of this forward-thinking Lavoie program.

The Robotester itself expands checkout capabilities and slashes 80% of final test time. Operational testing and production line check out is accomplished through continuous, high-speed sampling and comparison . . . split-second recognition, isolation and identification of abnormal functions.

Nominal circuit values and specified tolerances are tape-punched in minutes to accommodate voltages (AC and DC) from 0.5 to 500 volts; Hi Pot to 500 volts; resistances from 1 ohm to 9.99 megohms; and tolerances of 1%, 5%, 10% and 20% of nominal. A total in excess of 60000 tests possible . . the Robotester will check any two circuit points at rates up to 100 tests per minute.

Write today for complete technical information and specifications on the New Robotester.

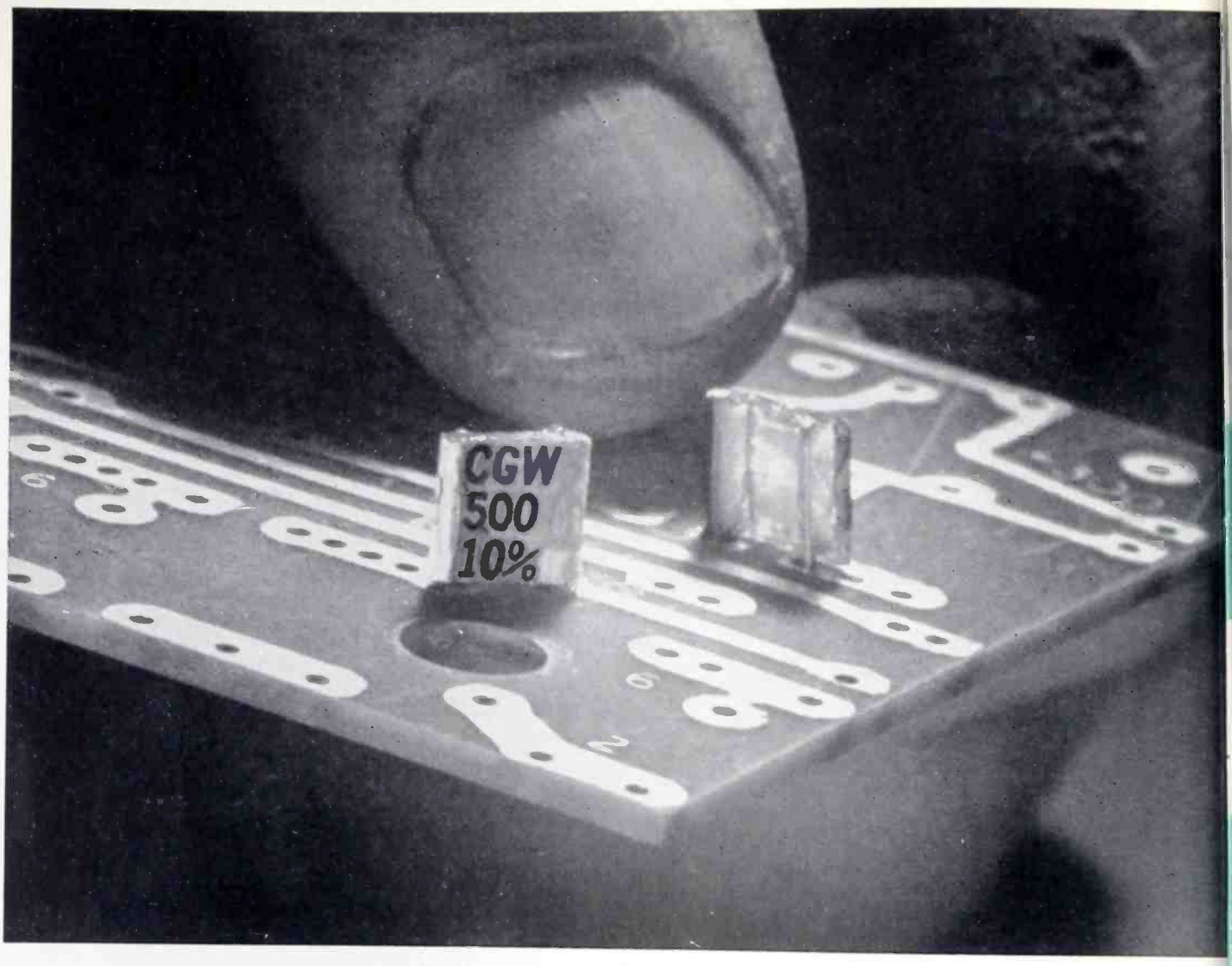
Write on company letterhead for "Lavoie Programmed Instrumentation" . . please specify application.

Lavoie Laboratories, Inc.

MORGANVILLE, NEW JERSEY

DESIGNERS AND MANUFACTURERS OF ELECTRONIC EQUIPMENT

Circle 21 on Inquiry Card, page 99



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

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

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

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

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

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

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

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

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

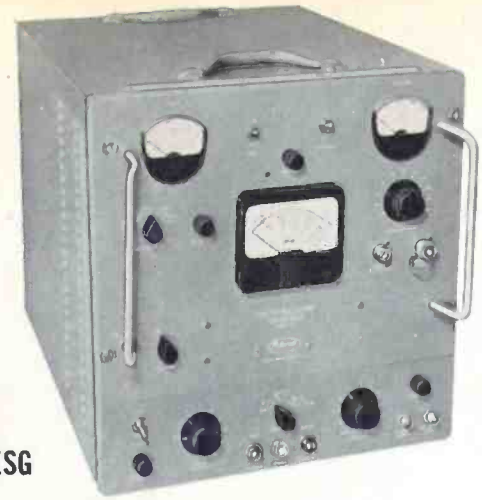
FEATURES

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

Corning means research in Glass

CORNING GLASS WORKS, 95-5 Crystal St., Corning, N. Y.
Electronic Components Department

Engineers: Tear out for your notebook



odel ESG

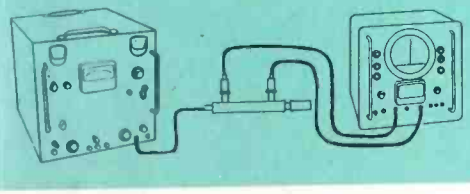
All Electronic

MICROWAVE SWEEP GENERATOR

POLARAD
PROVEN RELIABILITY

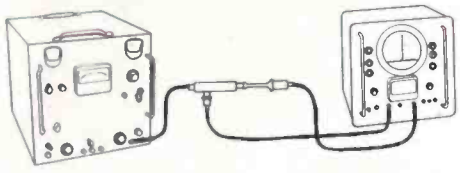
- Dynamic Measurements, Rapidly
- High Power Source

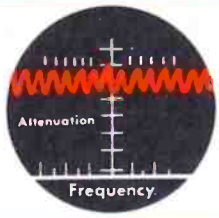
1,000 to 15,000 mc



MEASUREMENT OF VSWR OR PERCENT POWER REFLECTION

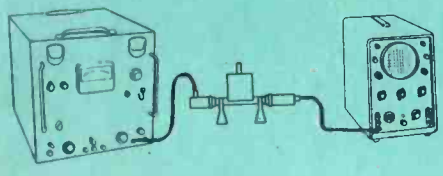
By employing an ESG along with a Rapid Scan Ratio-Scope (Model VS-2) in a reflectometer system set-up, accuracies equivalent to those obtained with the use of a slotted line can be achieved, by an untrained technician, in a fraction of the time formerly required. A two-to-one frequency range is provided. 7 interchangeable microwave oscillator units enable measurements to be made at microwave frequencies of 1000 to 15,000 mc.

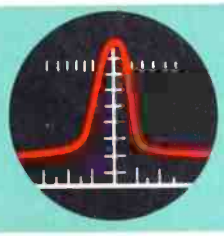




ATTENUATION MEASUREMENT

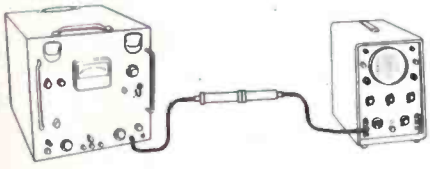
Broadband attenuation measurements are easily made with an ESG and Rapid Scan Ratio-Scope (Model VS-2) Attenuation of the unit under test is read directly on the ratio-scope indicator. Attenuation measurements can be made either at single frequency or over a band of frequencies (ESG sweeps its full frequency range).

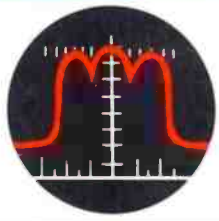




MEASUREMENTS OF Q

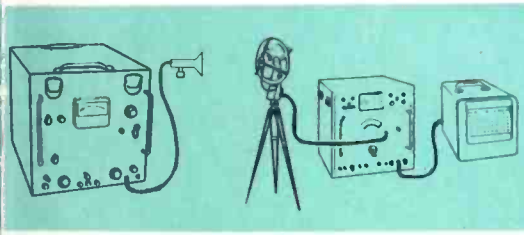
The use of a Model ESG enables rapid visual instantaneous measurement of high and low Q. This cuts down engineering man hours when compared with laborious point-to-point Q measurements. The diagram shows a typical set-up utilizing a standard oscilloscope.

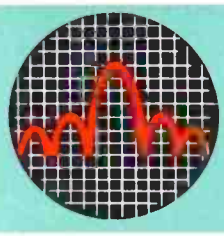




FILTER ALIGNMENT AND BANDPASS MEASUREMENTS

Because of the ESG's rapid sweep, the complete characteristics of a filter can be observed and measured instantaneously, utilizing a standard oscilloscope. The ESG's high power output enables determination of the filter's offband response. Dynamic measurements across the entire frequency range of the filters are possible because the stable backward wave oscillator in the ESG sweeps the full frequency range of the filter.





ANTENNA PATTERN MEASUREMENTS

By using an ESG to feed an antenna under test, accurate pattern measurements can be obtained over long distances and over a wide frequency range. This because of the ESG's high stable power output from 10 milliwatts to 1 watt. Provision is made in the instrument for amplitude modulation from external source and internal 1000 cps and 456 kc square wave modulation is provided.

FREE LIFETIME SERVICE ON ALL POLARAD INSTRUMENTS

Polarad Model ESG Microwave Sweep Generator utilizes stable backward wave oscillators to make possible rapid dynamic tests of broadband and narrowband microwave systems and components. This instrument covers the frequency range from 1000 to 15,000 mc by use of 7 interchangeable microwave oscillator units, each of which can be purchased separately. The ESG can be externally modulated, providing a pulse rise time less than 0.15 microsecond.

Contact Polarad or your nearest Polarad representative for complete details.

Polarad Model VS-2 Rapid Scan Ratio-Scope is available to provide visual presentation of VSWR and attenuation.

SPECIFICATIONS: Basic Unit: Model E-B

INTERCHANGEABLE PLUG-IN UNITS

MODEL	FREQUENCY RANGE	POWER OUTPUT	MODEL	FREQUENCY RANGE	POWER OUTPUT
Model E-L1	1,000 to 2,000 mc	80 to 1,000 mw	Model E-C2	4,800 to 9,600 mc	20 to 150 mw
Model E-L2	1,600 to 3,200 mc	80 to 1,000 mw	Model E-X1	6,500 to 11,000 mc	20 to 100 mw
Model E-S1	2,000 to 4,000 mc	80 to 800 mw	Model E-X2	7,500 to 15,000 mc	15 to 40 mw
Model E-C1	3,600 to 7,200 mc	25 to 400 mw			

POLARAD ELECTRONICS CORPORATION

43-20 34 Street, Long Island City 1, N. Y.
Representatives in principal cities. See your Yellow Pages.

CODE MODULATED MULTIPLE-PULSE MICROWAVE SIGNAL GENERATOR

950-10,750 mc

An integrated mobile instrument. Generates multi-pulse modulated carrier for missiles, beacons, radar, DME, Tacan, Loran... provides 5 independently adjustable pulse channels. Variable pulse width, delay and repetition rate; and pulse time modulation.

SPECIFICATIONS:

Frequency Range:
- Band 1: 950 to 2400 mc.
- Band 2: 2150 to 4600 mc.
- Band 3: 4450 to 8000 mc
- Band 4: 7850 to 10,750 mc

Frequency Accuracy: ±1%

RF Power Output: 1 milliwatt (0 DBM)

Attenuator:
- Output Range: 0 to —127 DBM
- Output Accuracy: ±2 db
- Output Impedance: 50 ohms nominal

RF Pulse Characteristics:
- a. Rise Time: Better than 0.1 microsecond as measured between 10 and 90% of maximum amplitude of the initial rise.
- b. Decay Time: Less than 0.1 microsecond as measured between 10 and 90% of maximum amplitude of the final decay.
- c. Overshoot: Less than 10% of maximum amplitude of the initial rise.

Internal Pulse Modulation:
- No. of Channels: 1 to 5 independently on or off
- Repetition Rate: 10-10,000 cps
- Pulse Width: 0.2 to 2.0 microseconds
- Pulse Delay: 0 to 30 microseconds
- Accuracy of Pulse Setting: 0.1 microsecond
- Minimum Pulse Separation: 0.3 microsecond
- Initial Channel Delay: 2 microseconds from sync. pulse
- Internal Square Wave: 10-10,000 pps (separate output)

Pulse Time Modulation:
- Frequency: 40-400 cps any or all channels
- Required Ext. Mod.: 1 volt rms min.
- Maximum deviation: ±0.5 microsecond

Power Input (built-in power supply) 105/125 v. 60 cps 1200 watts.

Model B

FOUR INTERCHANGEABLE MICROWAVE OSCILLATOR UNITS — all stored in the instrument . . . each with UNI-DIAL control . . . precision power monitor circuit to maintain 1 mw power output reference level . . . keying circuit to assure rapid rise time of modulated r-f output . . . non-contacting chokes.

PRECISION OSCILLOSCOPE WITH BUILT-IN WIDE BAND RF DETECTOR for viewing the modulation envelope and accurately calibrating the r-f pulse width, delay, and group repetition rate. Equipped with built-in calibration markers.

FIVE INDEPENDENTLY ADJUSTABLE PULSE CHANNELS — each channel features variable pulse width and delay; has provisions for external pulse-time modulation. Repetition rate for each group of pulses can be varied.

SELF-CONTAINED POWER SUPPLIES — Model B operates directly from an AC line through an internal voltage regulator. The coded multipulse generator is equipped with an electronically regulated low voltage DC supply. Klystron power unit adjusts to proper voltage automatically for each interchangeable tuning unit.

FREE LIFETIME SERVICE ON ALL POLARAD INSTRUMENTS

POLARAD — PROVEN RELIABILITY *IN ACTION*

POLARAD ELECTRONICS CORPORATION

43-20 34 Street, Long Island City 1, N. Y.
Representatives in principal cities. See your Yellow Pages.

New – SEND TEST SIGNALS DURING PROGRAMMING

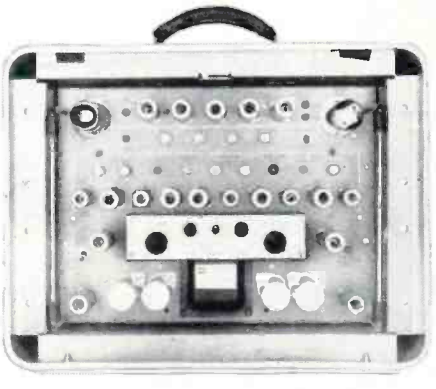
TELECHROME MFG. CORP.

VERTICAL BLANKING INTERVAL TEST SIGNAL KEYER

The Telechrome Model 1008-A Vertical Blanking Interval Keyer is a self-contained portable unit that makes possible transmission of television test and control signals between frames of a TV picture. Any test signal (multiburst, stairstep, color bar, etc.) may be added to the composite program signals. The keyer will operate anywhere in the TV system and operates from composite video, sync, or H & V drive. The test signals are always present for checking transmission conditions without impairing picture quality. The home viewer is not aware of their presence.

These continuous reference signals may be used in connection with various Telechrome devices for automatic correction of video level, frequency response, envelope delay, differential gain and differential phase.

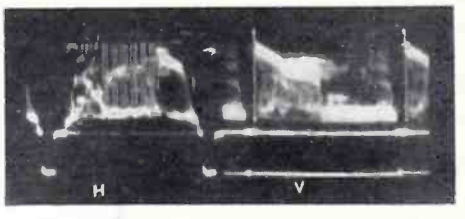
MODEL 1008-A



VERTICAL BLANKING INTERVAL TEST SIGNAL KEYER

Portable or standard rack mounting. Self-contained power supply.

Test signal is thin line between frames. All test signals can be transmitted during vertical blanking portion of program.



Video picture with multiburst test signal inserted, as seen on ordinary wave monitor.

IMPORTANT:

Checking after programming is costly and at best highly inefficient since conditions constantly vary. The Telechrome Vertical Interval Keyer minimizes post-program checking and overtime expenses. It provides instant indication of deteriorating video facilities so that corrective measures can be undertaken immediately—manually or automatically during programming.

Now in use by CBS, NBC, ABC, BBC ITA (Brit.)

1003-C VIDEO TRANSMISSION TEST SIGNAL GENERATOR

Completely self-contained, portable. Produces multi-frequency burst, stairstep, modulated stairstep, white window, composite synch. Variable duty cycle. Regulated power supply. 12¼" standard rack mounting or in carrying case. Integrates with above model 1008-A Test Signal Keyer.

Write for Specifications & Details

TELECHROME MFG. CORP.

The Nation's Leading Supplier of Color TV Equipment

28 RANICK DRIVE
AMITYVILLE, N. Y.
LIncoln 1-3600

Cable Address: COLORTV

Western Engineering Division—13635 Victory Blvd., Van Nuys, Calif., State 2-7479.

Circle 23 on Inquiry Card, page 99

Circle 24 on Inquiry Card, page 99

News of Reps

REPS WANTED

A long-established manufacturer of **fabricated and machined plastic components** for the electronic and radio industries, is seeking reps throughout the United States and Canada. A brochure showing their facilities is available. (R5-1, Editor ELECTRONIC INDUSTRIES.)

A recognized manufacturer of a complete line of **silicon products, wire, sheet, moldings, tubing and self binding** tape desires reps in the Southeastern Territory from Tennessee to Florida. (R5-2, Editor, ELECTRONIC INDUSTRIES.)

The J. G. Penwarden Co., 14734 Arminta St., Van Nuys, Calif., is exclusive rep for Film Capacitors, Inc. in California, Arizona, and Nevada.

Vines & Co. is rep in the states of Utah, Wyoming, and Colorado for Instruments For Industry, Inc.

Harvey Teplitz & Co. is representing Potter Instrument Co. in the Michigan area. Their sales headquarters are at 19942 Inkster Rd., Detroit 19, Mich.

D. R. Bittan Co. is representing the Joseph Pollak Corp. in the Metropolitan New York area.

Norvel Associates of Dallas, reps for Texas, Oklahoma, Arkansas and Louisiana are now carrying Pulse Engineering, Inc. line of miniature pulse transformers, toroids and filters.

R. Edward Stemm, Manufacturers' Engineering rep for a broad line of industrial electronic equipment has announced the appointment of Howard W. Carlson of Minneapolis as Branch Sales Manager for their new office located in the Twin Cities.

Sales Engineering Co. is now rep for Deltine, Inc.'s magnetostrictive delay lines and associated equipment. They will cover the entire New England territory.

The Heimann Co. of Minneapolis has been appointed rep for WEN Products, Inc. Their territory will include Minnesota, North and South Dakota, Iowa, Nebraska, Northern Wisconsin and Upper Michigan peninsula.

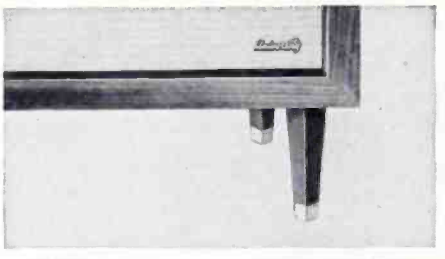
Hollingsworth & Still, 508 Whitehead Bldg., Atlanta, Ga., has been named an authorized industrial sales rep for General Transistor Corp. in the Southeast United States including Alabama, Georgia, Florida, Tennessee, North Carolina and South Carolina.

(*Continued on page* 38)

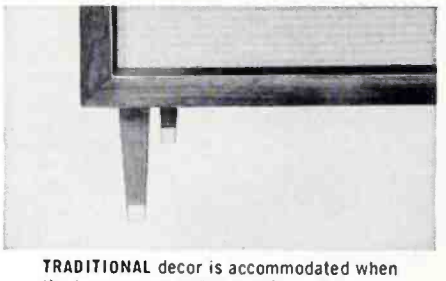
UNIVERSITY INTRODUCES A VERSATILE NEW HIGH FIDELITY LOWBOY...

The Debonaire

The smallest lowboy (only 27⅜" wide, 16" deep, 25⅜" high, including legs) for 2- or 3-way systems using 12" or 15" speakers. Designed to complement both traditional and modern decor.



MODERN decor is accommodated by adjustment of the legs to this triangular position.



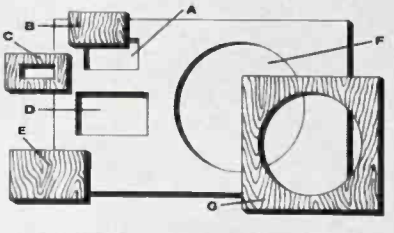
TRADITIONAL decor is accommodated when the legs are set "flat" in this position.

BRILLIANT NEW SYSTEMS AND ENCLOSURE

EN-1215 DEBONAIRE ENCLOSURE Designed for full-range reproduction, the EN-1215 DEBONAIRE enclosure employs the phase inversion principle to augment low frequency response. For versatility, it integrates direct radiation principles to permit using a wide variety of extended range speakers as 2- and 3-way Diffaxials. The versatile baffle board arrangements accommodate the many multi-speaker systems that may be developed with P·S·E—University's Progressive Speaker Expansion plan. P·S·E enables you to start modestly with an extended range speaker for immediate listening satisfaction and build up at your own pace to any one of a number of magnificent sounding speaker systems.

MODEL S-3 DEBONAIRE-12 SYSTEM This system, employing the same 3-way system components so successfully used in the University SENIOR, now makes this highly popular combination available to music lovers in both corner (SENIOR) and lowboy (DEBONAIRE) form. The basic C-12W 12" woofer (less frequency limiter) is ideally suited to the EN-1215 enclosure, reproducing deep bass notes cleanly and efficiently. Mid-range is covered by the new, improved H-600 "reciprocating-flare" horn with T-30 driver; treble range by the UXT-5 Super Tweeter clear out to 17,500 cps. The N-3 Acoustic Baton 3-way network crosses over at 700 cps for mid-range, 5000 cps for treble. PRESENCE and BRILLIANCE balance controls provide optimum adjustment to room acoustics and personal taste.

MODEL S-4 DEBONAIRE-15 SYSTEM An excellent three-element system with a unique approach to mid-range reproduction is achieved in this version of the DEBONAIRE. A 2-way 15" Diffaxial, the Diffusicone-15, is employed together with the new H-600 horn and new Hypersonic T-50 driver. The H-600, with hemispherical diffraction added, complements perfectly the T-50 driver to cover the mid and high ranges from 700 cps crossover to inaudibility. The Diffusicone-15 provides superior bass response to about 1000 cps where its multi-sectional Diffusicone element takes over for mid and high frequency response. With thus both the Diffusicone element *and* the horn/driver combination providing wide-angle response of the mid-range, this three-element system results in an expansion of spatial separation and an exciting blend of reed and woodwind mellowness (from the Diffusicone element) with the brightness of the brass (from the horn/driver). A balance control adjusts the system to room acoustics and personal taste.



EN-1215 BAFFLE BOARD AND ADAPTERS

- **A**—Hole for tweeter Model HF-206 or 4401.
- **B**—Adapter blank to close hole A when tweeter not used.
- **C**—Adapter for Model UXT-5 tweeter.
- **D**—Hole for mid-range (Model H-600 horn).
- **E**—Adapter blank to close hole D when mid-range unit not used.
- **F**—Hole for Diffaxial Models 315-C, 6303, Diffusicone-15; woofer Models C-15W, C-63W.
- **G**—12" adapter (supplied) for Diffaxial Models 312, UXC-123; Coaxial Models 6201, Diffusicone-12, UXC-122 or Model 6200; C-12W woofer.

USER NET PRICES:

Finish	EN-1215	S-3	S-4
Mahogany	$63.00	$196.00	$197.50
Blond	69.00	199.00	200.50
Walnut	69.00	199.00	200.50

LISTEN *University® sounds better* HIGH FIDELITY

See your high fidelity dealer . . . or for FREE LITERATURE on University speakers, complete systems, enclosures and kits, write Desk G-3, University Loudspeakers, Inc., 80 So. Kensico Ave., White Plains, N. Y.

Circle 26 on Inquiry Card, page 99

News of Reps

Instruments For Measuremen 3455 Cahuenga Blvd., Hollywood Calif., is now rep in Southern Ca fornia area for Opad Electric Co.

Arthur K. Elliott Co. of Kans City, Mo., has been appointed sal engineering rep for Kaar Engineeri Corp.

Kittleson Co. is now representi Hubbard Potentiometers, Inc. in se eral western states.

Bertram D. Aaron Co., Los Angele is engineering sales rep in Southe California, Arizona and Colora territories for the Kearfott Co., In Western Div.

J. T. Hill Co., San Gabriel, Cali is now rep for Scientific-Atlanta, In in California, Arizona and Nevada.

Norvell Associates, 3603 Lemm Ave., Dallas 19, Tex., has been a pointed by Electro Tec Corp. as re in Oklahoma, Arkansas, Louisian and Texas areas.

Wright Industrial Products Dallas and Houston, Tex., is now re for Librascope in the states of Texa Louisiana, Arkansas, and Oklahoma.

George M. Hatch has been a pointed Eastern rep for Industri Technological Associates.

Delta Aircraft Equipment Co 1798A Avenue Road, Toronto, Ont has been named to handle Canadia sales for Revere Corp. of America.

Allen Nelson has been appointed b Martin Mann Associates to direct an control distributor sales of this manu facturers' representative organiza tion.

Edward C. Burns has joined th Sales Engineering Co. He will be as sociated with the Chelmsford Massa chusetts office.

The Fascal Co., 1031 Rosecrans St. San Diego, is now sales engineering rep in the greater San Diego area for the Neal Feay Co.

E. V. Roberts & Assoc. are now handling sales for George Rattray & Co. in California, Arizona, Nevada and New Mexico.

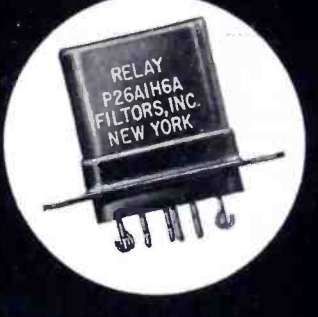
Millard R. Gregg, Dayton, Ohio is now associated with the **John O. Olsen** Co., manufacturers' reps covering Ohio, Western Pennsylvania and West Virginia.

Pacific Electro-Sales, Los Angeles, Calif., are now representing the Hermetic-Pacific Corp. in the San Diego area.

BURTON BROWNE/New York

NEW

FILTORS NEW MICRO-MINIATURE...THE MOST ADVANCED DESIGN



...s, the leading specialists in the development and manu-...e of sub-miniature relays is proud to announce the addition ...l new Powrmite micro-miniature relay to its existing line ...ditionally outstanding relays.

...every field of achievement there is always one leader. In ...ading manufacturers of hermetically sealed micro and sub-miniature relays. relays with highest available reliability the leader is Filtors, Incorporated. All of the experience and know how gained in attaining its position of leadership have gone into making Filtors new Powrmite micro-miniature relay *truly reliable*— again the leader in a field of many.

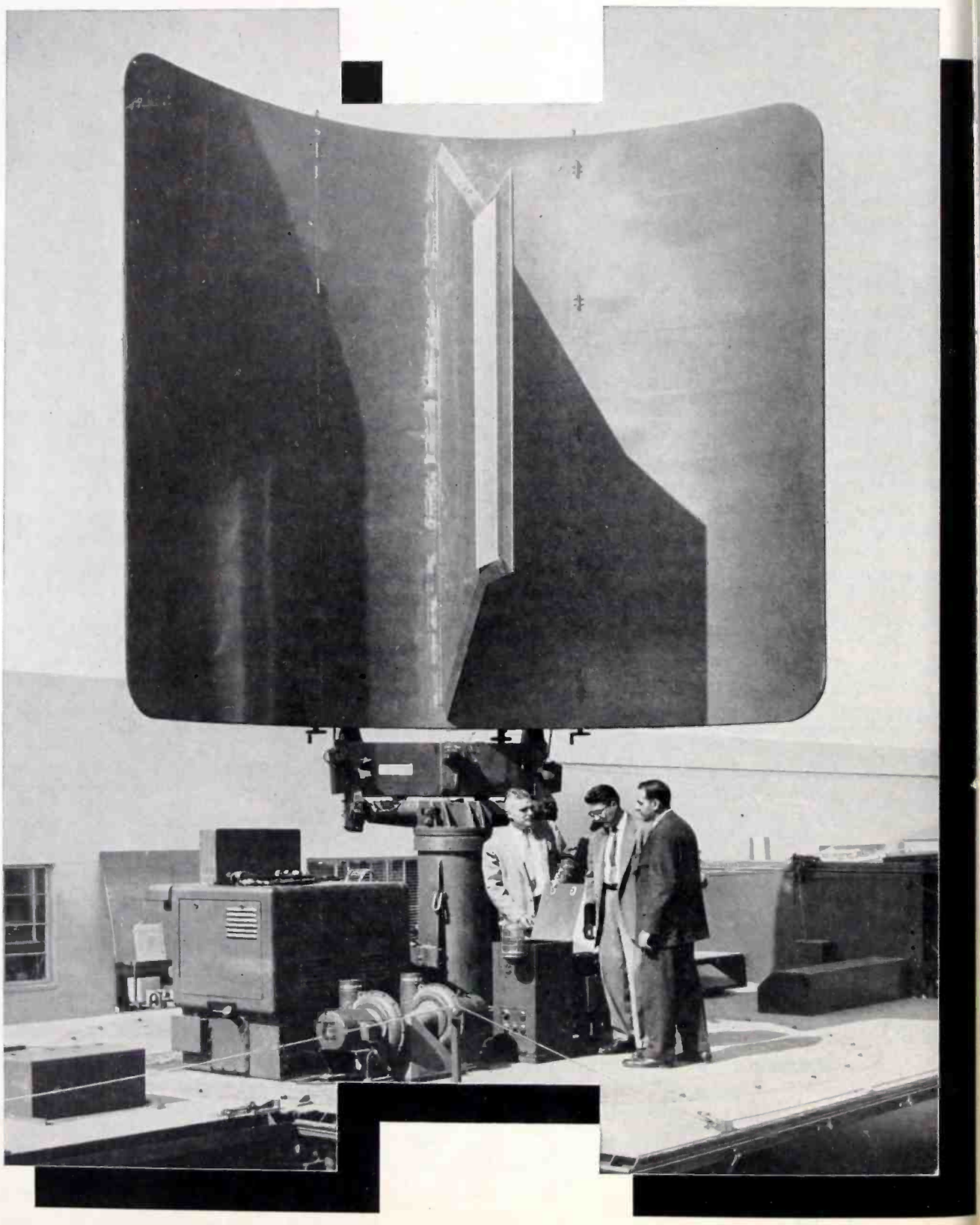
FILTORS, INC.

Main office and plant: Port Washington, N. Y., POrt Washington 7-8220
West coast office: 13273 Ventura Blvd., Studio City, Cal., STanley 3-2770

VIBRATION 20 G'S AT 2000 CPS • 50 G'S SHOCK • 2 AMP OR DRY CIRCUIT • −65°C. TO +125°C.

Circle 28 on Inquiry Card, page 99

HOW TO SEE IN



ALL DIRECTIONS AT ONCE

They add new dimension to defense

Three dimensional radar . . . it is a positioning of radar beams in space by electronic rather than mechanical means. It provides three-dimensional target data from a single antenna, transmitter, and receiving channel. It is a radical new weapon for national defense.

Engineers at the Hughes Ground Systems Division in Fullerton are responsible for pioneering this advancement (see antenna at left). But even more importantly, these same engineers are working on an elaborate radar warning system which will not only provide this complete radar data, but also translate it into meaningful information and relay it to central communications centers.

Other Hughes activities offer similar engineering challenge. The Research and Development Laboratories in Culver City, for example, are probing into the effects of nuclear radiation on electronics equipment, studying advanced microwave theory and applications, examining communications on a global scale, and developing new methods for insuring product reliability.

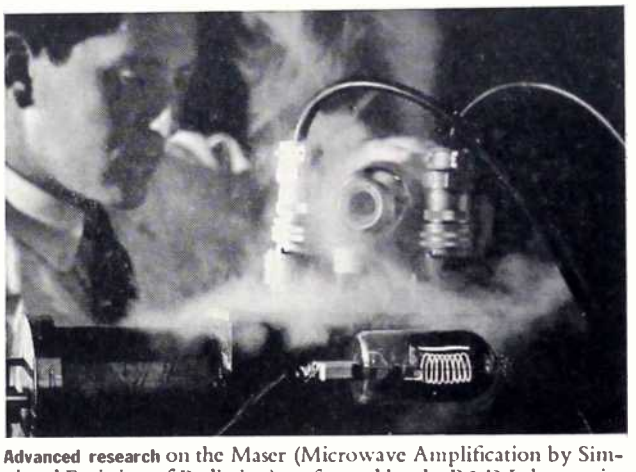
The Hughes Products engineering team makes electronics useful in solving industrial problems. For example, this group has just unveiled an industrial electronics system which will automate a complete and integrated line of machine tools.

The diversity of Hughes activity offers prospective employees opportunity to build a rewarding career in a highly progressive and expanding environment.

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

Communications	Microwaves
Reliability	Crystal Filters
Circuit Design	Computer Engineering
Systems Analysis	Field Engineering
Vacuum Tubes	Semiconductors

Write, briefly outlining your experience, to Mr. Phil N. Scheid, Hughes General Offices, Bldg. 17D-1, Culver City, California.



Advanced research on the Maser (Microwave Amplification by Simulated Emission of Radiation) performed by the R&D Laboratories is directed towards applications of a portable, airborne Maser for missiles and aircraft.

Falcon missiles have been an important factor in establishing Hughes as a leader in advanced airborne electronics. Manufactured in Tucson, Arizona, the Falcon missiles have both infrared and radar guidance systems.

Creating a new world with ELECTRONICS

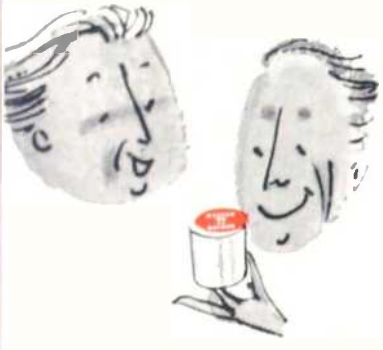
HUGHES

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

"We are sold on Kester '44' Resin-Core Solder, Jim. It's the fastest acting solder we have ever seen."

"Been using Kester Flux-Core Solder for almost half a century, Tom; nothing like it."

"Kester Solder spools are always marked with the exact alloy, Joe; no code markings."



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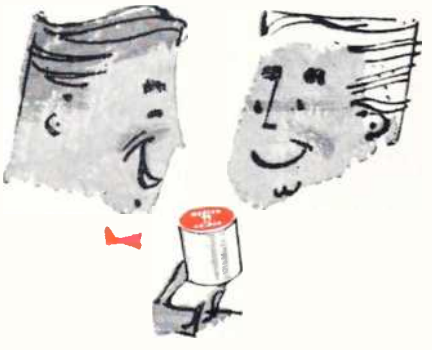

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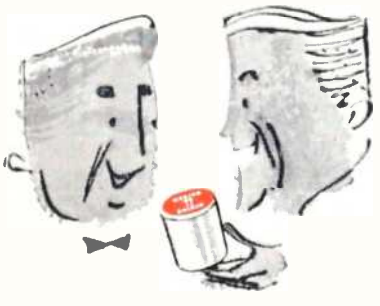

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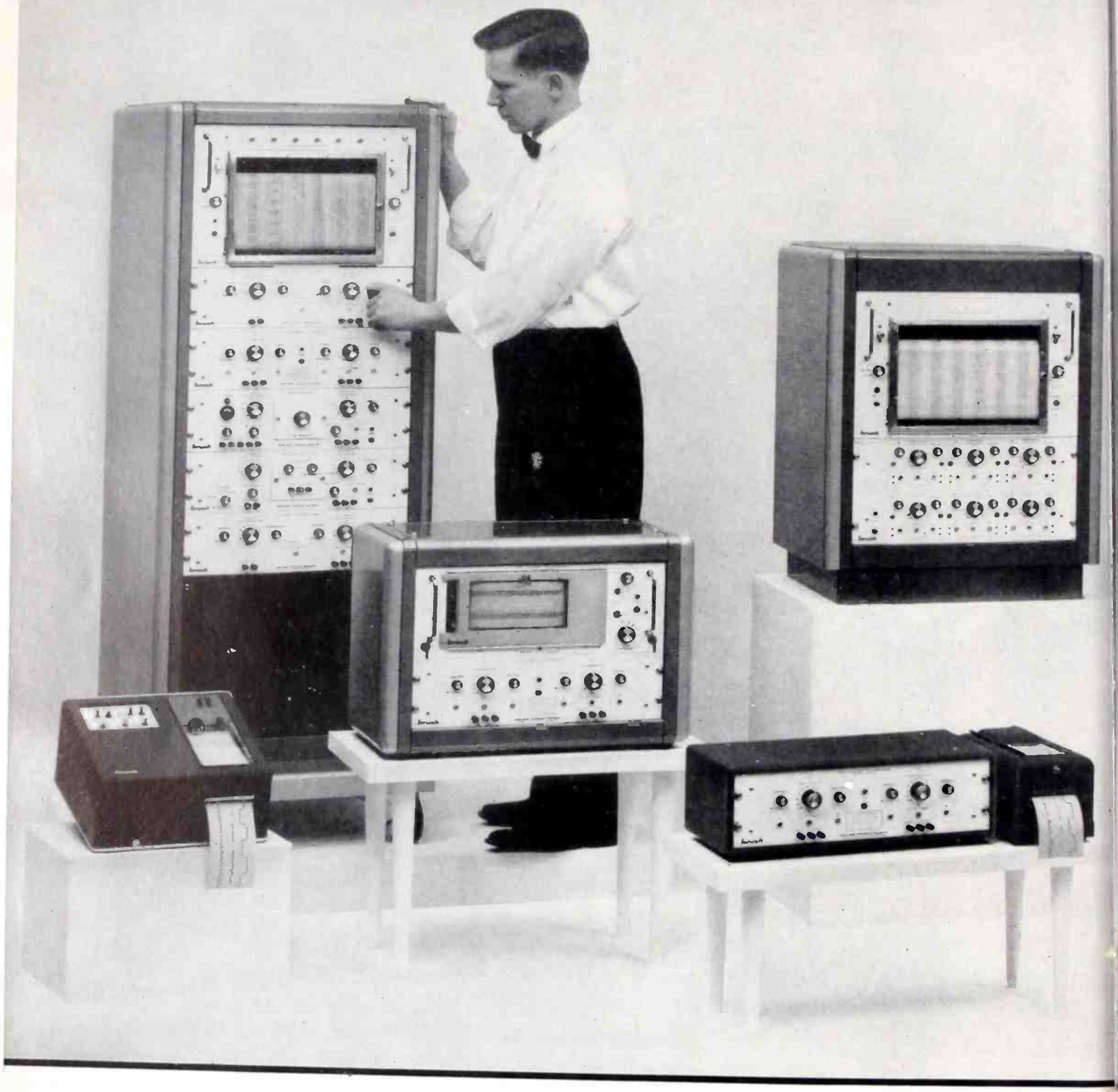

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DIVISION OF

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Circle 31 on Inquiry Card, page 99

Personals

Sydney O. Johnson was nam Manager of Transistor Advance a Design Engineering and **Martin** Clark was promoted to Manager transistor product engineering for t General Electric Co. in Syracuse.

William F. Woodbury has been a pointed to the position of Assista to the Vice President of the Enginee ing & Production Div. of Airbor Instruments Laboratory.

Dr. Franklin E. Lowance has bee appointed Vice President in charge Engineering for Avco's Crosley Di He was formerly Vice President an Director of Research and Engineerin for the Westinghouse Air Brake C He has been in close association wit some of the country's more importan weapons development programs.

Dr. F. E. Lowance

W. Kaufmann

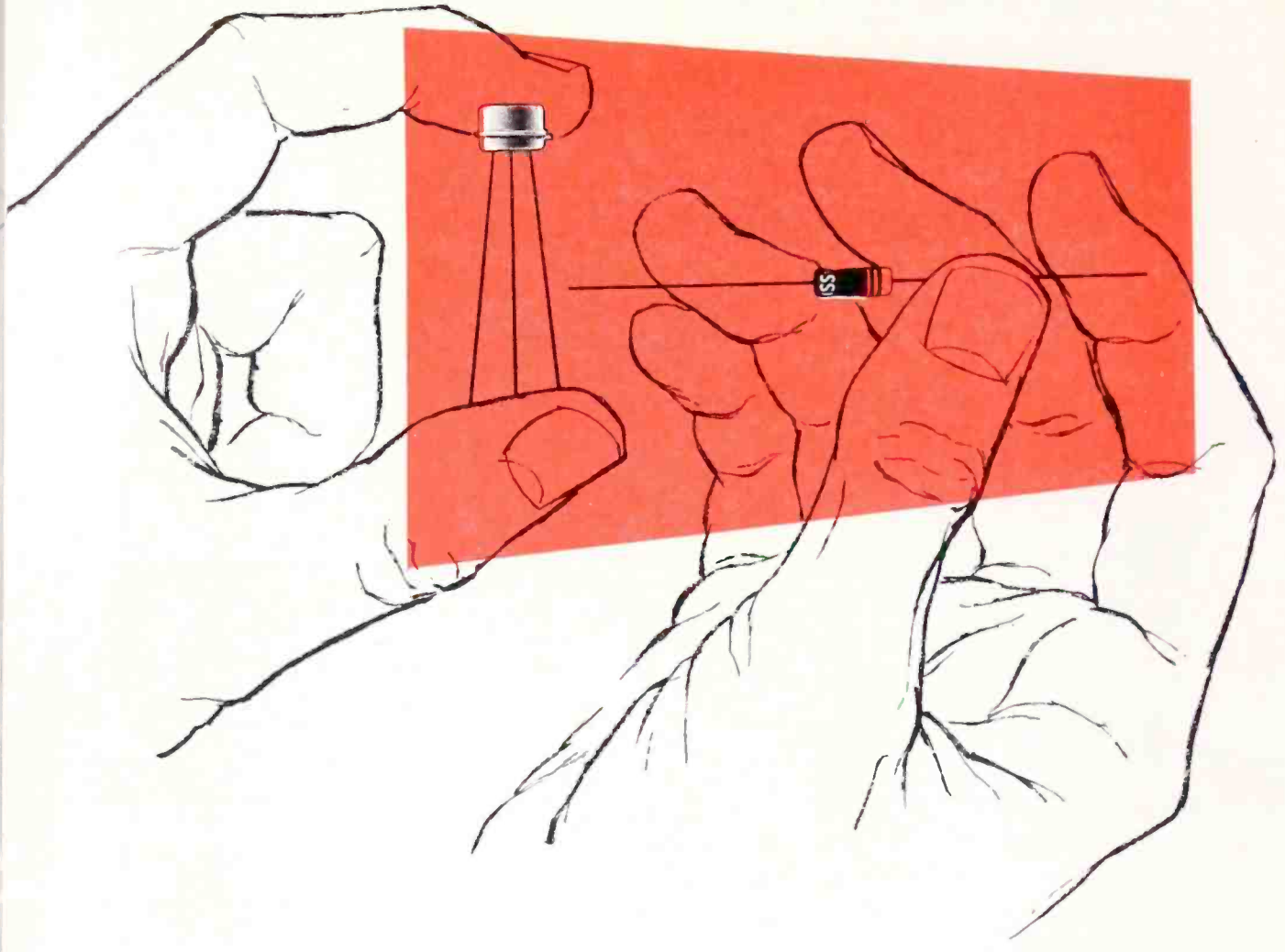
William Kaufmann is now Chie Engineer for product design and de velopment for the Telechrome Mfg Corp. He was formerly Chief Engi neer of Special Design Products Corp He will undertake full responsibilit for the company's advanced designe equipment for color TV broadcasting video transmission test equipment an telemetering equipment for guide missiles.

James M. Evans has been appointe Field Engineering Consultant for th Midwestern United States for Genera Transistor. He will be available a consultant to engineers concerne with the application of transistors t their designing problems.

Roy Christian has joined the Aero nautical and Instrument Div. o Robertshaw-Fulton Controls Co. a Field Engineer in the Cables System Unit.

George W. Chane has been electe to the newly created position of Vic President, Management Engineerin with the Radio Corporation o America.

Robert E. Savold has been ap pointed Field Engineer for the Polara Electronics Corp.



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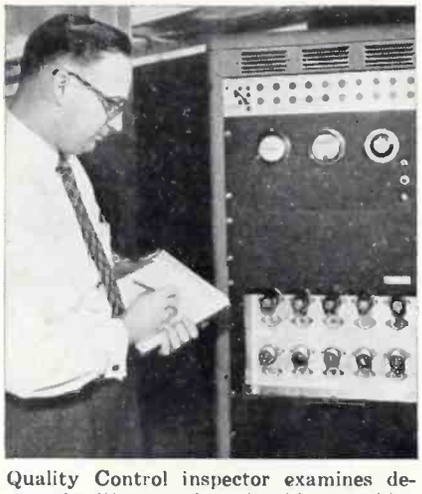
Circle 34 on Inquiry Card, page 99

MICROWAVE AND SPECIAL TUBE NEWS from SYLVANIA

Counter Tubes Set Life Records

Field experience indicates a minimum life expectancy of 10,000 hours and a capability of 20,000 hours for Sylvania counter tubes

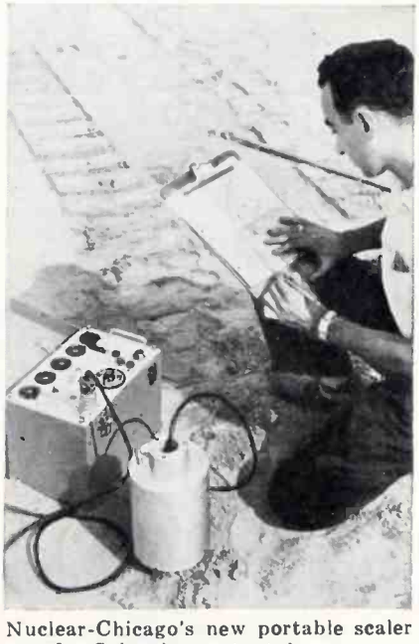


Quality Control inspector examines destructive life test tubes, the oldest of which has been counting continuously since July 2, 1955—a total of over 21,000 hours

UNDER ACTUAL operating conditions in the field, Sylvania counter tubes are achieving new records in reliability and life. Field reports show a life of 10,000 hours in a wide range of applications, while Sylvania life tests indicate a capability for continuous operation in excess of 20,000 hours.

These outstanding records of reliability have been achieved because of qualities inherent in the design of these cold cathode tubes, and extremely close control and testing during manufacture. Some of the in-process steps are: high degree o component treatment at elevate temperatures to remove material im purities and foreign gases; precis control of gas mixture and pressur to assure reliable and repeatable op eration; exacting exhaust and sealin techniques to retain cleanliness o parts and gas; 100% test of al electrical parameters; two 100% ag ing and stand-by tests; and furthe mechanical, electrical and life testin by the Quality Control departmen of Sylvania.

Portable Scaler Uses Counter Tubes



Nuclear-Chicago's new portable scaler uses five Sylvania counter tubes

Nuclear-Chicago's new d/M-Gauge, a completely portable scaler, makes possible fast, accurate density and moisture measurements directly in the field. The new scaler uses five Sylvania counter tubes that can accumulate up to 99,999 counts. It illustrates how Sylvania counter tubes are helping designers achieve maxi mum portability in otherwise bulky counting equipment.

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6802	4 KC	4(0,5,8,9)	Octal	400 V.	0.6 ma
6910	100 KC	10	Duo Decal	400 V.	1.2 ma
6476	4 KC	10	Duo Decal	400 V.	0.6 ma
6879	5 KC	3(0,8,9)	7-pin	320 V.	0.8 ma
7155	100 KC	3(0,8,9)	7-pin	425 V.	1.2 ma

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Armco ORIENTED TS (4 mils) provides exceptionally high permeability in the rolling direction. A super-oriented steel for 400 cycle service.

Design Data Available

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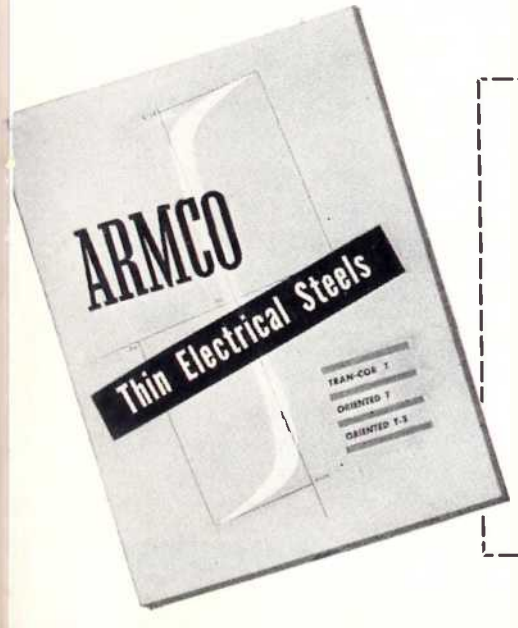
For your copy of this useful design manual on Armco Thin Electrical Steels, just fill out and mail the coupon.



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Circle 36 on Inquiry Card, page 99

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This solid-electrolyte Tantalex Capacitor (shown 1½ times actual size) is rated at 4.7 μF, 10 volts d-c, and is only ⅛" in diameter by ¼" long.

Sprague, the pioneer in the production of solid-electrolyte tantalum electrolytic capacitors, now offers prompt delivery on production quantities of all standard ratings. New expanded facilities end production delays in your assembly of minified transistor circuits.

Typical of these Tantalex Capacitors is the Type 150D shown above. Its tiny sintered anode is impregnated with a solid, non-corrosive, semi-conductor material which cannot leak under any circumstance. It combines true miniaturization with electrical stability previously unobtainable in an electrolytic capacitor of any type.

Thermal coefficient of these capacitors is sufficiently low and linear so that for the first time a circuit designer can think of an electrolytic in terms of parts per million capacitance change. Nominal value is + 500 ppm/ °C. The capacitor may be used without derating over a range from +85°C to as low as −80°C, a temperature at which no other electrolytic has proved useful.

Solid construction permits the Type 150D to withstand the severe shock and vibration encountered in missile and ballistic applications. Hermetic sealing makes it completely immune to humid atmospheric conditions.

Complete performance data covering the wide range of sizes and ratings are in Engineering Bulletin 3520B, available on letterhead request to the Technical Literature Section, Sprague Electric Company, 233 Marshall Street, North Adams, Massachusetts.

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DON'T FORGET! — *Sprague also offers prompt delivery on all other types of tantalum capacitors including tubular foil and sintered anode designs.*

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the mark of reliability

Circle 37 on Inquiry Card, page 99

ELECTRONIC INDUSTRIES

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

Teach Electronic Medicine!

IN a recent news account it was pointed out that leukemia is increasing as a cause of death among general practitioners, internes and pediatricians. The reason for this increase is believed to be due to the continued use of fluoroscope without the stringent safeguards that have been adopted by radiologists. Dr. David Skarloff, writing in the Journal of the Einstein Medical Center, points out that under radiologist-supervised administration the skin dose for a chest examination is less than one-hundredth of that which a patient gets from a fluoroscopic examination in the average doctor's office. Thus a fluoroscopic examination of the chest is equivalent in exposure to potentially harmful rays—to 100 chest surveys.

This report, while interesting in itself, is also extremely significant to us in the electronic industries. The fact is that as of today we know of no course or training program in the medical colleges that is designed to acquaint future doctors-to-be with the versatility, potentiality and with the limitations of medical electronic equipment. For diagnosis, chemical analysis and for case statistical studies, medical electronic equipment now available and the new equipment constantly becoming available, represents the most potent tools for the control and cure of disease that doctors have ever had.

There are some institutions in the United States, such as the National Institutes of Health, Bethesda, Md., that are fairly well equipped with electronic apparatus. In many other institutions, however, equipment is antiquated and obsolete. The lack of basic electronic training is a serious handicap to MDs because they have little or no knowledge reservoir with which to evaluate equipment potentialities. They are thus forced to use established measuring techniques which may or may not be the most efficient and accurate. We hope, and strongly urge, that soon a way will be found to indoctrinate and orient future doctors in the potentialities of electronic medicine. And while we are on the subject of education . . .

Education —In Communism

WE have joined our voice with many others in advocating scientific training of our youth to meet the Russian challenge. We believe many of the thousans of electronic engineers who read this can help as individuals in encouraging the study of science, especially the electronic arts. But it now becomes apparent that an even more important, more fundamental educational requirement faces us—the education of our Youth, and ourselves, in Communism.

This sounds outlandish, but understanding what our cold war enemy is trying to do is the first step in preventing him from destroying our Freedom and life itself. Opposition to Communism must be based on informed public opinion. How many of us (college graduates, scientific thinkers and the like) really understand how and why the Communists are daily trying to undermine our cherished liberties? Very few! Our educators must remedy this situation for us and especially for our children.

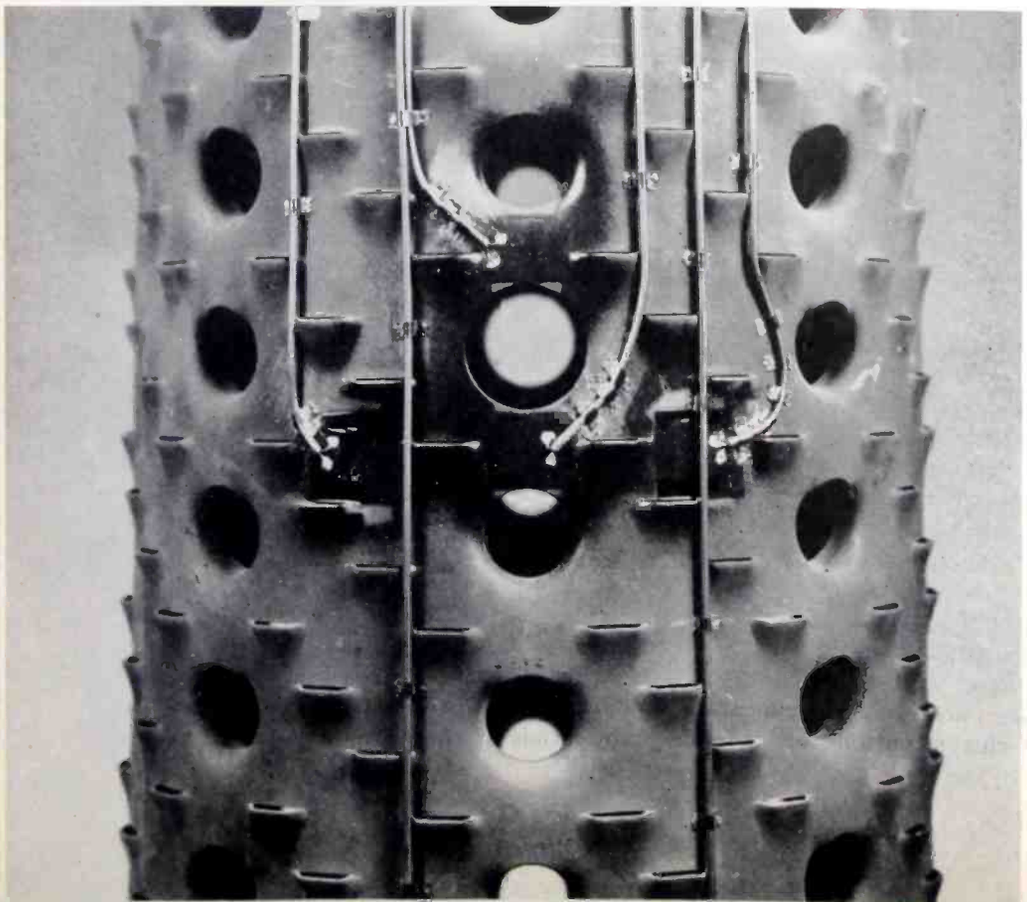
Communism should be taught with MORAL Directive. Taught in the same way that a medical student is taught that cancer is evil and taught what to do to eliminate and defeat it. If taught in any other way, Communism appears as an alternative economic system, possibly even with certain virtues, and the result might be a tendency to recruit to Communism. Teaching with moral directive should reveal the enemy now threatening the destruction of the basic foundations of American civilization; the erroneous beliefs of the Communists which lead to the destruction of our freedom; the methods by which they plan to destroy and what must be done to defeat them. Our educational system, using the moral approach, should reveal that Communism is linked with murder, lying and destruction. Mental and emotional barriers against it should be erected in the minds of the young.

At Lewis Labs they are testing turbojet engine at rated conditions with strain gage mounted on the turbine blades. New bonding materials and techniques make these high temperature operating tests possible.

Strain Gages for

By RICHARD H. KEMP
Lewis Flight Propulsion Laboratory
National Advisory Committee for Aeronautics
Cleveland, Ohio

Fig. 1: A turbojet combustor liner is prepared for tests with high-temp strain gages.



THE physical properties of resistance wire strain gages, when used for static measurements at elevated temperatures, must remain stable and within narrow limits up to the measurement temperature. For example, the wire sensing element should have the following:

(a) a low and stable temperature coefficient of resistance over the temperature range.
(b) a high and stable specific resistivity.
(c) a high resistance to corrosion or surface film changes.
(d) a high degree of metallurgical stability.
(e) a metallurgical condition amenable to fabrication into grids.

The actual values of coefficients and degrees of stabilities that must be attained depend largely on the

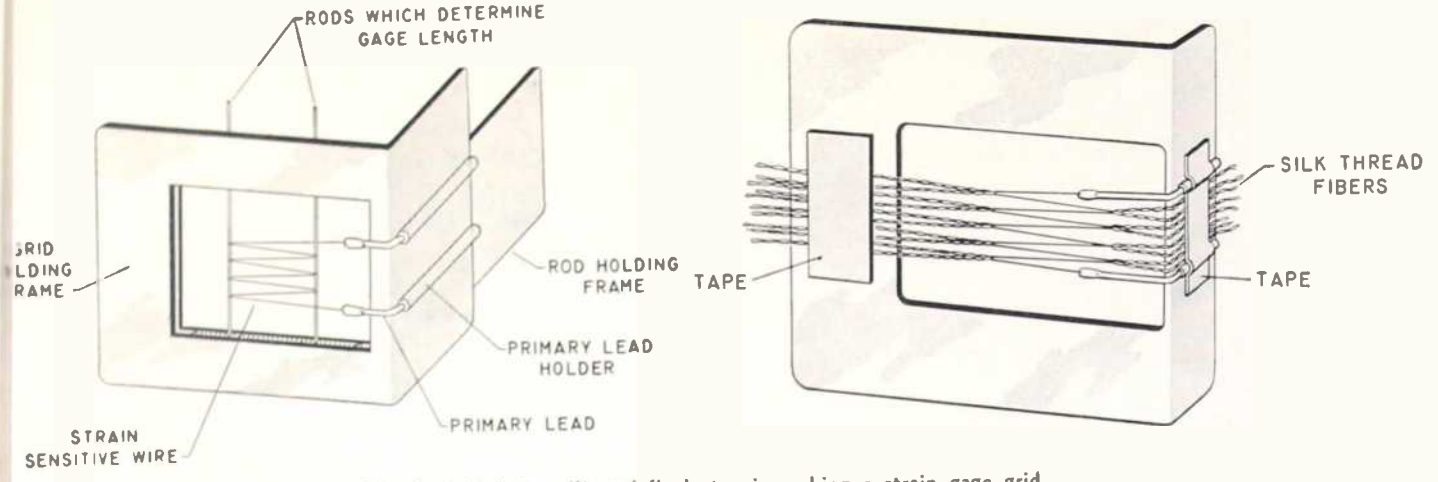


Fig. 2: Initial step (I) and final step in making a strain gage grid.

Jet Engine Research

Using this material to mount gages on turbine blades and combustor liners of turbojet engines has proved highly successful.

ccuracy desired in the strain measurements, the ength of the time period over which the measurements must be taken, and the magnitude and character of the temperature variations that occur at the rage location during the test.

Bonding

In addition, there are requirements that must be met by the material that bonds the wire element to the specimen surface. The adhesion must be sufficient to permit good strain transference from the specimen to the wire at all strains and temperatures encountered; the bonding material must be free of creep at all values of strain, time, and temperature encountered; the bonding material must provide a non-corrosive environment for the wire, have a low electrical conductivity at all temperatures, and be in a form that is amenable to the mounting technique required.

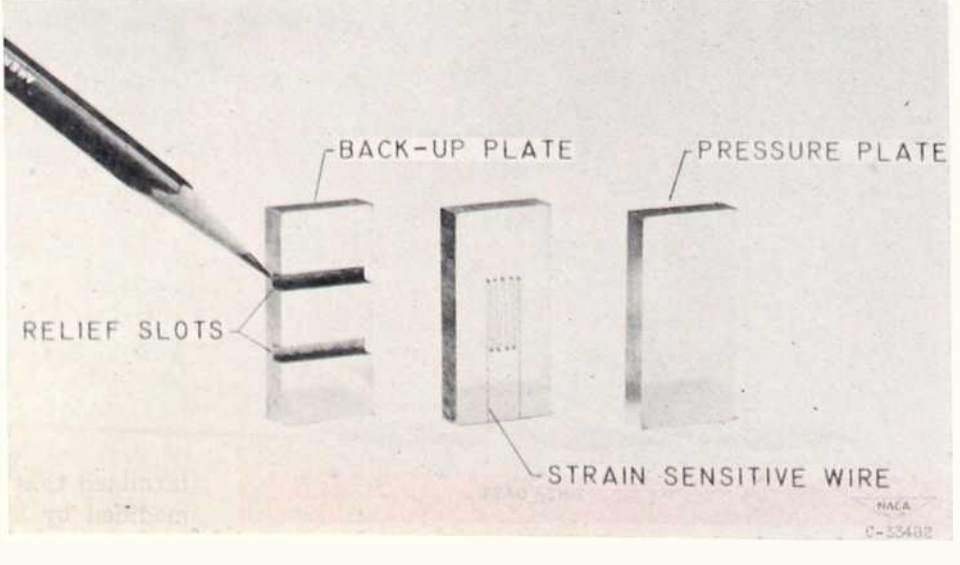
A static high-temperature strain gage using Karma wire and either Quigley 1925 or Brimor U529 ceramics has been found to be satisfactory for measuring static strains at temperatures up to 800° F. The gage can be applied to problems involving variable temperatures as well as a constant temperature during the loading and unloading cycles. For dynamic strain measurements at temperatures up to 1500° F, a coating material developed by the U.S. Army Corps of Engineers at Fort Belvoir Laboratories has been found superior to other cements tested.

Materials

The choice of Karma was made on the basis of previous research reported in Ref. 1. This reference, in a comparison of the temperature coefficients of resistance of the wire alloys 80 per cent platinum-20 per cent iridium, Nichrome V, Advance, and Karma, showed that Karma wire, as received, has a temperature coefficient (100° to 800° F) comparable with that of Advance. The temperature coefficients are presented in Table I in terms of apparent strain. The values shown were obtained from sample gages mounted on HS-21 alloy bars and should be considered only as approximate values, since wire from other batches will display somewhat different characteristics.

It will be noted that an error of 1° in the determination of the gage wire temperature would cause an error of 900 psi in the case of Nichrome V and an

Fig. 3: In this jig, gage grids are preformed by the pressure method described in text.



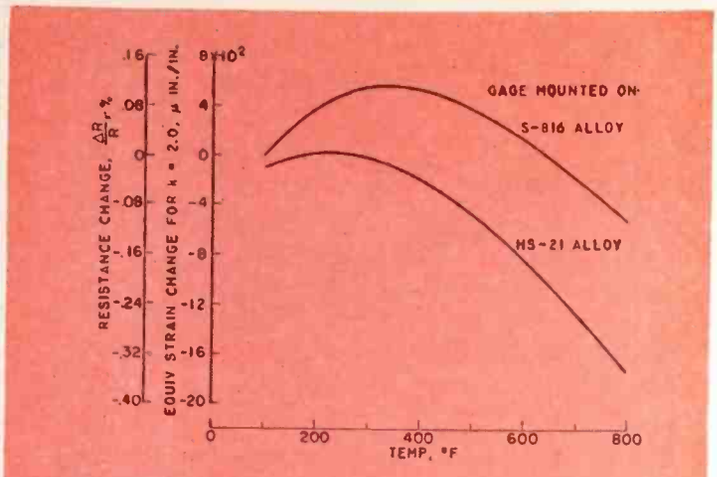


Fig. 4: Resistance vs temperature for mounted Karma gage.

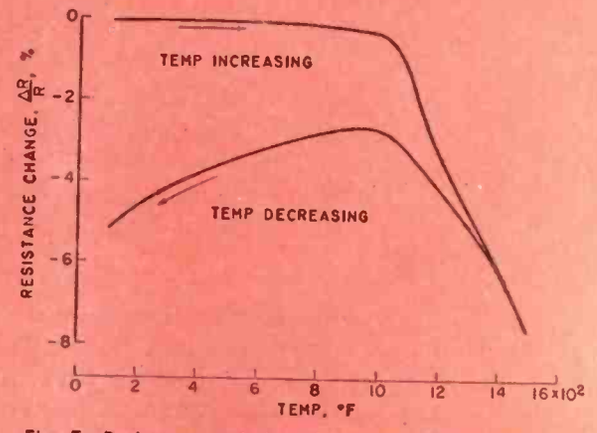


Fig. 5: Resistance variation of mounted Karma gages up to 800°F using the wire in the as-received condition.

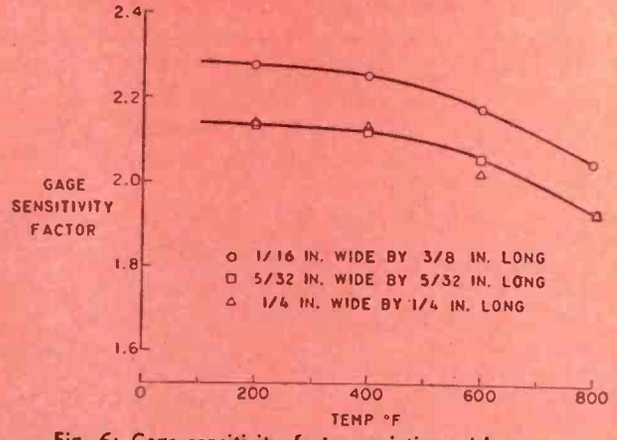
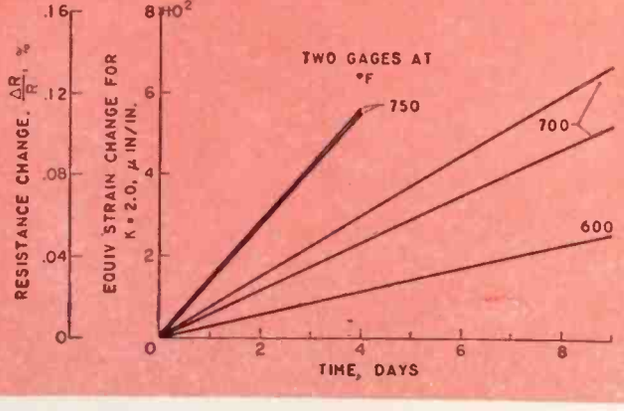


Fig. 6: Gage sensitivity factor variation with temp.

Fig. 7: Zero shift, Karma gages at T = 600, 700, and 750°F.



error of 2400 psi in the case of the Pt-Ir alloy, i these wires were used in static strain gages over th temperature range of 100° to 800° F. Karma, on th other hand, would result in only a 75 psi error. Th use of Advance for elevated temperatures is o course, restricted by its poor oxidation resistance. A further advantage of Karma lies in its high specifi resistivity (Table I) of approximately 800 ohms pe circular mil foot, which permits higher signal level to be obtained.

Lead Wir

Karma wire is also used for the lead wire materia because of its low temperature coefficient of re sistance. This property outweighs the disadvantag of its higher resistivity when compared with such materials as nickel or platinum. The leads are di vided into two parts. A primary lead of 0.010-inch Karma approximately ½ inch long is fastened to the 0.001-inch strain sensitive wire and serves as an intermediate connection to the secondary lead of 0.025 inch Karma which is carried out of the hot region to room temperature environment. Conversion is then made to copper for connection to the instrumentation.

Bonding materials for both the precoat and cover coat that have been used with a high degree of suc cess are Quigley 1925 (Quigley Co., New York City) and Brimor U529 (Morganite Inc., Long Island City, New York). Both of these materials are baked at 600° F, which does not exceed the temperature limit of the wire. In cases where the specimen can be heated to a higher temperature, it is preferred to use a 0.002-inch precoat of the NBS, L-6AC ceramic (available from O. Hommel Co., Pittsburgh, desig nated No. 3E2334) which is fired at 1750° F. The L-6AC provides an excellent base for the Quigley 1925 covercoat.

In using the Quigley 1925, it was necessary to make two modifications to produce the required results. First, it was necessary to mill the as-received mate rial in a porcelain ball mill for 48 hours using por celain balls. This reduced the particle size sufficiently to prevent interference with the 0.001-inch wires when mounting. In addition, it was found that incon sistent results were obtained when material from various batches was used. This inconsistency mani fested itself in the form of hardness and adhesion variations and tendencies for crazing or cracking.

Acid Deficiency

It was found that the phosphoric acid concentration was critical in affecting these properties. When it was deficient, the ceramic after baking was soft, had little resistance to abrasion, and had poor adhesion. When the phosphoric acid concentration was too high, the cement was very hard and tended to form a network of hairline cracks. Upon experimenting, it was de termined that each batch that was deficient could be modified by additions of phosphoric acid to produce

baked material having more or less optimum properties of good adhesion, ample hardness, and resistance to abrasion and cracking.

The Brimor U529 cement is a relatively recent product, and consequently the experience with the material is limited. However, the tests to date indicate increased hardness and adhesion compared with Quigley 1925 and perhaps improved handling qualities, particularly when using an air brush for application. The Brimor U529 is used in the as-received condition with no modifications required.

Gage Grid Construction

Several different methods of construction of the sensing elements have been employed. One of these is similar to the method described in Ref. 1 and is illustrated in Fig. 2. A strain sensitive filament is first prepared by attaching 0.010-inch Karma lead wires to a suitable length of 0.001-inch Karma wire. The attachment may be made by welding, by high temperature silver soldering, or through the use of the tube-tipped lead described in Ref. 1. The filament is wound around two rods that are held up against the mounting frame by a second frame and the lead wires are inserted in their respective holders. This stage of fabrication is illustrated in Fig. 2a. The gage length can be varied from ⅛ to ⅝ inch with one set of frame. Each loop of the grid is tied back to the mounting frame with a single strand of silk thread and the rods and rod-carrying frame are removed. The strain sensitive grid is then ready for mounting as shown in Fig. 2b.

Alternate Method

A second method of preparing the grid that has been used extensively at the Lewis laboratory involves the jig shown in Fig. 3. The jig consists of three blocks of hardened steel, one of which has .025-inch diameter pins inserted in holes that pass completely through the block. The pins are spaced to permit forming a wire grid of the required dimensions and resistance. After the strain sensitive wire is wound around the pins as shown in Fig. 3, the plain block is placed on top of the grid, and the block containing the relief slots is placed below the one on which the grid is wound. The stack of three blocks is then placed in a press and pressure applied. The pins move down through their respective holes and protrude into the slots in the relief block. The plain block moves into contact with the grid and deforms the wire, the amount depending on the pressure applied. The cold working of the wire stabilizes the grid shape and permits direct handling.

Gage Mounting Techniques

A precoat of the modified Quigley 1925 or the Brimor U529 is sprayed on the prepared specimen surface to a thickness of 0.002 to 0.004-inch with an artist's air brush. Spraying produces more uniform and more readily controlled thicknesses than brushing. The precoat is dried several hours at 150° F and then baked at 600° F for ½ hour.

When the grid prepared in the mounting frame is used, the frame is placed in position on the specimen surface with the grid in contact with the precoat. A thin coat of cement is applied to the grid area, leaving the loop ends uncovered. After drying at 150° F for 1 hour, the threads can be cut and removed together with the frame. A second coat of cement is applied that covers the entire installation; this coat is baked at 600° F for ½ hour after drying several hours at 150° F.

When a pressure stabilized grid is used, it is placed in position and held by means of strands of thread taped in place across the grid or by thin strips (1/32 inch wide) of masking tape placed across the grid ends. A thin coat of cement is applied to the grid (not on thread or tape) and baked. Tube-tipped leads or welded leads may be attached before or after this

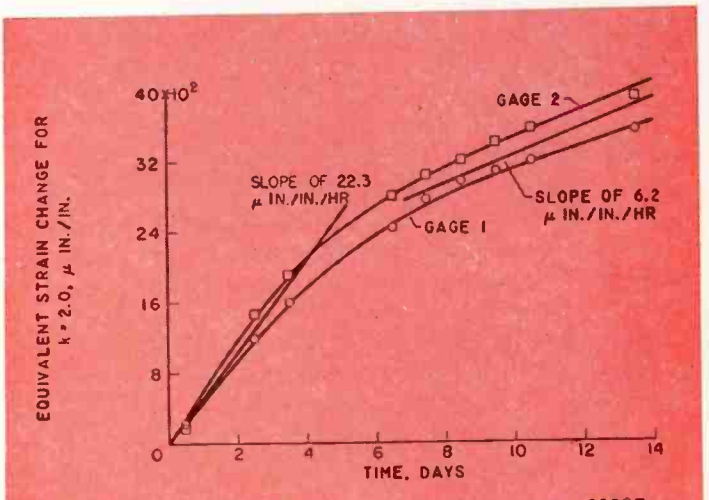


Fig. 8: Zero shift with time for two Karma gages 800°F.

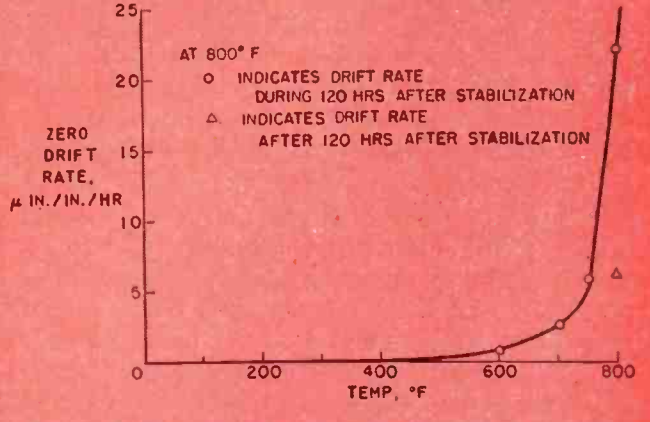
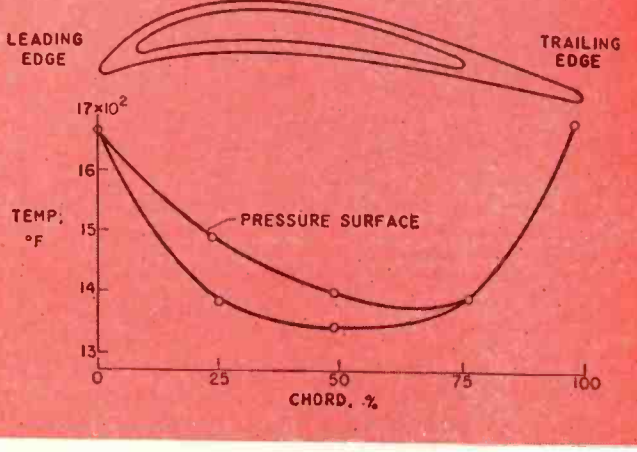


Fig. 9: Variation of zero drift rate with T, Karma gages.

Fig. 10: Results of a chordwise temperature distribution test on turbojet turbine stator vane shown in Fig. 10.



operation. The threads or tape are then removed, and a second coat of cement applied and baked.

Gage Characteristics

After the completed gage installation has been baked at 600° F for one hour, the gage can be used for strain measurements. In static applications, however, it is found that considerable zero shift inevitably occurs, generally in an erratic manner. This erratic shift continues to occur for as many as 50 hours after the gage is put into operation.

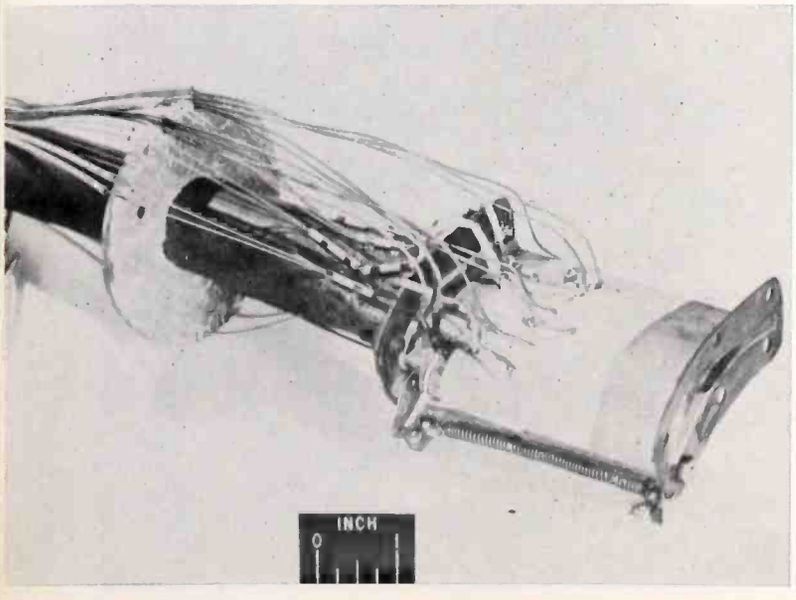
It is believed that there are three predominant factors that produce this phenomenon. First, the chemical reactions occurring in the cement during the baking cycles probably do not go to completion or equilibrium for some period of time after the gage is placed in operation. This could result in small dimensional changes in the cement and hence affect the gage resistance. Secondly, considerable time is probably required to establish a stable film on the surface of the wire; and thirdly, considerable time may be necessary to establish stable or equilibrium values of specific resistivity and temperature coefficient.

An indication of the extreme dependence of the zero shift on the surface film may be obtained by computing the thickness of a layer of metal that would have to be removed from the surface of a 1-mil wire to produce, for example, a change of 100μ"/" in indicated strain. It can readily be shown that the thickness t of such a surface layer that would have to be removed to produce a given indicated strain change is

$$t = -\frac{rK\epsilon}{2}$$

where r is the radius of the wire, K is the strain sensitivity factor of the wire, and ϵ is the indicated strain change. A change of 100μ"/" in indicated strain would therefore be obtained with the removal of a surface layer only 5×10^{-8} inch thick.

Fig. 11: Stator vane with high-temp strain gages and thermocouples.



Static Measurements

The variation of resistance with temperature for a completely installed Karma gage is shown in Fig. 4. As the temperature is increased, the resistance changes only a small amount, until approximately 900° F is reached. At this temperature a metallurgical change takes place in the wire and the resistance drops rapidly. On cooling to room temperature and on subsequent cycles of heating and cooling, the lower curve is traversed. It is the characteristic flat portion of the upper curve up to approximately 800° F that is used in making static strain measurements. Practical use of the flat portion of the curve above 800° F and up to 1000° F as shown in Fig. 4 is not recommended unless accuracy is to be sacrificed, because the actual position of the knee of the curve is a time-temperature function. At longer times, for example, the knee effectively moves to the left on the temperature scale. This will be discussed further in the section on long time characteristics.

Since the ordinate of Fig. 4 is highly compressed in terms of customary values of strain, an expanded scale is used in Fig. 5 to show the resistance variation of Karma in the as-received condition up to 800° F when mounted as gages on two different alloys, S-816 and HS-21. These curves indicate resistance changes in terms of equivalent strain of approximately 1700μ"/" for HS-21 and 1050μ"/" for S-816 for the temperature range of 100° to 800° F.

Sensitivity Factor

The gage sensitivity factor and its variation with temperature for the Karma gages was measured in a static constant bending moment apparatus. An Inconel bar that was used for the contant bending moment beam was surrounded by a furnace to permit heating the gages to any desired temperature. The beam was loaded to a stress of 25,000 psi at the gage locations with checkpoints taken at intermediate values to establish the fact that the gages were responding linearly with load. Three different gage sizes were investigated. These sizes and the nominal resistances obtained with each size configuration are as follows:

(1) 1/16-inch wide by ⅜-inch gage length—95 ohms.
(2) 5/32-inch wide by 5/32-inch gage length—115 ohms.
(3) ¼-inch wide by ¼-inch gage length—200 ohms.

The results of the gage factor determinations are shown in Fig. 6. The ¼ × ¼ and 5/32 × 5/32 gages have a gage factor of 2.16 at room temperature, which drops to approximately 1.93 at 800° F. The 1/16 × ⅜ gage shows a higher gage factor (2.28 at room temperature), which results from the lower cross sensitivity of this configuration.

It should be noted at this point that the information presented in regard to gage factors and other characteristics was obtained from a limited number of gages fabricated from specific batches of wire; the characteristics may vary considerably from batch to batch and also have been noted to change along the length of a given piece of wire from one spool.

In addition to the short time variations of resistance and gage factor with temperature, there is

additional problem of changes with time. These nges can either be involved in wire surface layer nges or in internal metallurgical changes, which turn cause changes in specific resistivity, tempera- e coefficient of resistance, and other related con- nts. An unknown change in these quantities, of rse, results in a loss of the initial reference zero nt and hence invalidates all further readings.

Zero Shift

To obtain some indication of the order of magni- le of these long time changes, gages were mounted annealed bars of S-816 and placed in a furnace h no loading applied. The strain gages were con- ted to static bridge equipment and the bridges re balanced or zeroed. A running check was then t of the zero shift with time while the tempera- e was held constant at various levels.

In all cases the zero shift was erratic during the st hours of operation, as noted previously. After hours at temperature the erratic nature of the o shift disappeared, and up to 800° F the re- tance change was then linear with time. In Fig. 7, e zero shift is plotted against time in days after bilization has occurred for three different tempera- res, 600°, 700°, and 750° F. It will be noted that e resistance change or zero shift is linear with ne and that the rate of change of resistance in- ases with temperature. At 600° F, the rate of ange is 1.23μ"/"/hr, at 700° F the two gages give average of 2.76μ"/"/hr, and at 750° F the two ges give an average of 5.83μ"/"/hr. The increase the rate of change of resistance is probably pre- minantly a result of an increased rate of corrosion the wire surface with increasing temperature.

At 800° F the zero shift no longer occurs in the me manner as already indicated for the lower tem- ratures. Fig. 8 shows the zero shift at 800° F of o gages that have previously undergone stabiliza- n treatments. It will be noted first of all that the te of change of resistance is not linear with time. owever, an approximation to the curves can be ade with two straight lines, the first having a slope 22.3μ"/"/hr and the second having a slope of 2μ"/"/hr.

A possible explanation for this phenomenon is as llows. The first portion of the curve is primarily result of corrosion of the wire as obtained at lower mperatures. However, after a period of approxi- ately 120 hours, the metallurgical phase change that curred at 1000° F under short time conditions now curs at 800° F. It is believed, therefore, that the cond part of the curve having a slope of 6.2μ"/"/hr a result of the combination of the tendency to in- ease resistance by corrosion and to decrease re- stance by the metallurgical phase change. If the st temperature were increased above 800° F, the ase change effect would occur more rapidly and gh rates of decrease of resistance would be en- untered.

The rates of zero shift at the various temperatures own in Figs 7 and 8 are plotted in Fig. 9 as a func- on of temperature. The slope of the initial portion the 800° F curve is plotted and connected by a

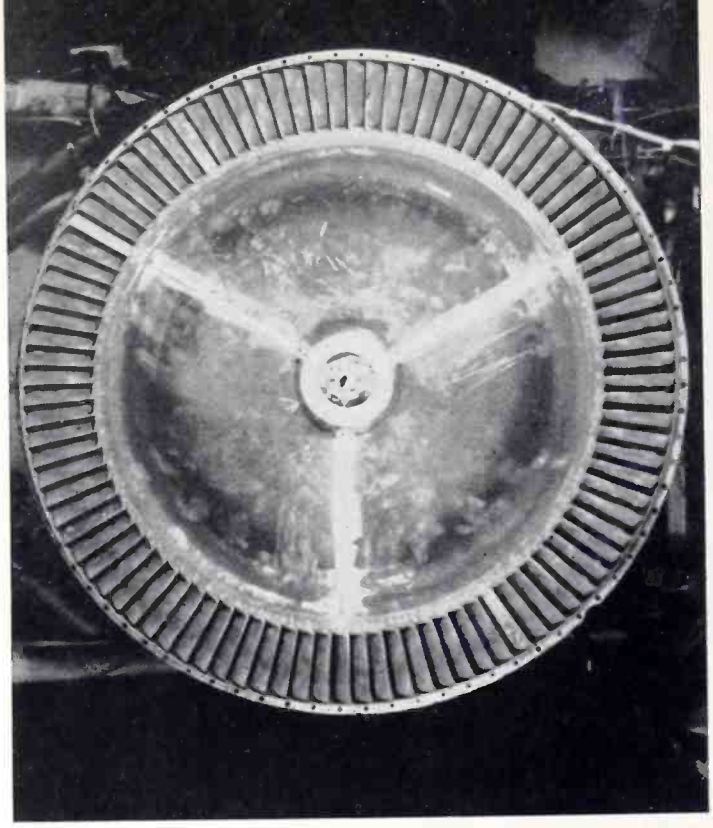


Fig. 12: Installation of three instrumented turbine blades in rotor.

curve with the slopes determined at 600°, 700°, and 750° F. As mentioned previously, it is believed that this represents predominantly corrosion of the wire. The slope of the latter portion of the 800° F curve is plotted in Fig. 9 as a separate point for comparison.

Resistance to Ground

Shunting a strain gage with high resistances produces a loss in signal output that results in lowered indicated strain readings. A discussion of this effect together with a nomograph for quick computation is presented in Appendix IV of Ref. 2. In the case of high-temperature strain gages it is generally found that this effect is particularly troublesome because the resistance of the ceramic cements decreases as the temperature is increased. For Quigley 1925, the resistance decreases considerably at temperatures in the neighborhood of 1500° F, as noted in connection with the dynamic work reported in Ref. 1. However, for the temperature range of 80° up to 800° F, measurements made on a series of six gages indicated a relatively constant shunting resistance of approximately 10 megohms. Therefore, the effect of the gage signal output was believed to be negligible.

The Quigley 1925 is, however, somewhat hygroscopic. When a gage remains at room temperature in a high humidity atmosphere, the zero point will be noted to shift because of the shunting resistance decrease due to the entrapped moisture. Correction is simply effected by heating the gage to 200° or 300° F. In cases where this has been a particular problem, a waterproof coating was applied over the mount, using a material such as Plastilock. This particular material has been used satisfactorily at temperatures up to 700° F.

Application

The turbine stator vanes of certain turbojet engine designs are cooled by passing air through the interior

(*Continued on page* 88)

By WERNER HASENBERG
Engineering Department
RCA Cherry Hill
Camden, New Jersey

Power Transistor Test Set

Fig. 1: This test equipment is designed to give the dc current transfer ratio.

Accurate knowledge of dc current transfer ratio, not usually available from data sheets, can be obtained with the test equipment described here.

ACCURATE knowledge of the dc current transfer ratio of a transistor is of great importance in large signal applications such as class B push-pull operations,[1] dc converters, or relay switching service. Breakdown voltage is a device characteristic of no less importance.[2, 4]

At the present time, however, no uniformity exists as to presentation of dc current gain figures. This equipment complements the facilities of the circuit designer and will enable him to readily obtain the data needed.

In the design presented, the equipment is capable of measuring current gain from 0-200 for collector currents as high as 2.5 amperes. Breakdown voltage can be determined at any collector current from 0.1 to 2.5 ma, and the maximum allowable voltage source is 200 volts.

A special feature of the equipment consists of an arrangement which permits direct reading of the collector-to-base current ratio. The dc forward current transfer ratio is indicated on the scale of a potentiometer whose position is proportional to the $I_C I_B$ ratio.

Because the saturation current of transistors suffers variation with increasing junction temperature, heating effects due to power dissipation must be avoided in order to obtain reliable results of the measurement. Therefore, in this equipment, base current is supplied by an ac source rather than a dc supply. At 60 cps, the period of the ac signal current is shorter than the thermal time constant of power transistors. This implies that heat produced in the junction is proportional to average dissipation only. As a result, use of a 60 cps ac signal source for establishing the base current greatly reduces the possibility of undue heating effects.

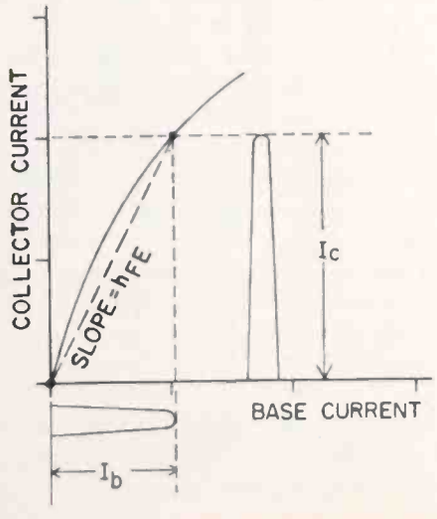
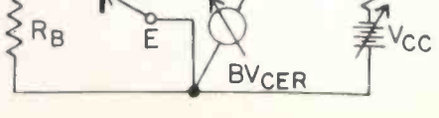


Fig. 2(1): Typical current transfer curve.

Fig. 3 (r): Principle of BV_{CER} measurement.



Principles

According to its definition, the forward current gain is the ratio collector current-to-base current measured at a specified constant collector voltage, and in the common emitter configuration. The standard letter symbol[3] used for the large signal forward current gain is h_{FE}. Thus,

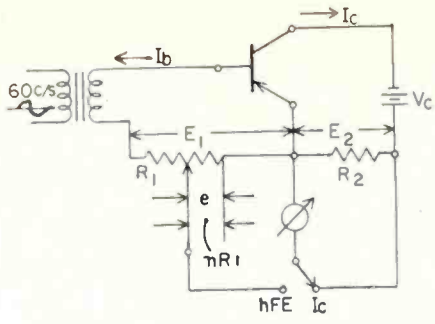


Fig. 4: Principle of h_{FE} measurement.

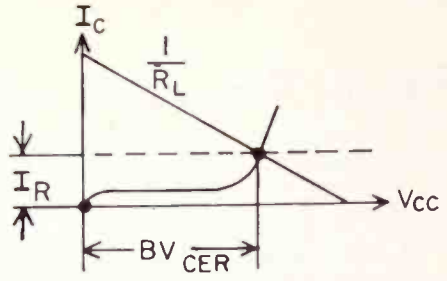


Fig. 5: Reverse current vs collector volts.

$$h_{FE} = I_C/I_B \quad (V_{CE} = \text{const.}) \qquad (1)$$

Both currents, I_C and I_B, are measured from the region of the current transfer characteristic, or they represent peak values in case when the base is driven from a sinusoidal ac source. This is illustrated in Fig.

The collector voltage is chosen as small as possible but greater than the saturation or knee voltage. It is common practice to apply about 1 to 2 volts to the collector, and measure h_{FE} at a collector reference current of 1.0 ampere.

Large Signal Gain

The circuit for measuring the large signal forward gain is illustrated in Fig. 3. The primary of the input transformer is connected to a 60 cps source of variable voltage (not shown). The collector supply voltage is taken from a suitable dc source. Current sampling resistors R_1 and R_2 are inserted in the input and output current paths respectively, to measure I_B and I_C. Therefore, by measuring across R_1 and R_2 respectively, the large signal current gain as defined in equation (1) can be obtained by:

$$h_{FE} = \frac{E_2 R_1}{E_1 R_2} \qquad (2)$$

Since the two current sampling resistors are by design of predetermined fixed values, the ratio R_1/R_2 is a constant, k_2. Accordingly, the current gain h_{FE} to be determined becomes directly proportional to the quotient of E_2 to E_1. Due to the convention by which gain is to be referred to a predetermined value of collector current I_C, E_2 in equation (2) becomes the independent variable, and h_{FE} is, therefore, a function of the reciprocal of E_1.

Rather than computing the reciprocal of E_1, the circuit for measuring h_{FE} shown in Fig. 3 permits direct reading of the gain. Instead of measuring the voltage E_1, which is developed across the total resistance of potentiometer R_1, the fraction $e = nE_1$ as developed between emitter and the slider of the potentiometer is read.

Substituting e for E_1 in equation (2) yields:

$$h_{FE} = \frac{E_2}{e} k_2 n \qquad (3)$$

where $k_2 = R_1/R_2$. The potentiometer is adjusted so as to obtain a voltage, e, that has a definite predetermined relationship to the independent variable, the voltage E_2. This is accomplished by keeping the ratio $E_2/e = k_1$ constant. Thus,

$$h_{FE} = k_1 k_2 n \qquad (3a)$$

Since the product of two constants is also a constant,

$$h_{FE} = C n \qquad (4)$$

Eq. (4) shows the position of the potentiometer at the condition when $e = E_1/k_1$ to be a direct indication of h_{FE}. It also shows that gain values can be read on the scale of the potentiometer. Eq. (3a) indicates that the range of the test circuit may easily be expanded, for if k_1 is doubled so are the h_{FE} values on the scale of the potentiometer.

For this potentiometer whose scale has 100 divisions, the following constants were chosen:

$R_2 = 1.00$ ohm
$R_1 = 50$ ohms
$k_2 = 50$ ohms
$k_1 = \begin{cases} 2 \text{ for a range of } h_{FE} = 0\text{-}100 \\ 4 \text{ for a range of } h_{FE} = 0\text{-}200 \end{cases}$

Thus the condition at which the position of the potentiometer becomes a direct indication of h_{FE} is met for either $e = 0.5\ E_2$ *or* $e = 0.25\ E_2$, and the scale factor is 1 or 2, respectively.

Breakdown Voltage

The voltage at which breakdown occurs for a particular transistor unit depends on both the circuit configuration and the termination of the input terminals. In order to give meaning to any particular value of breakdown voltage, it is necessary to specify the circuit configuration, the input termination, and the magnitude of collector current at which the breakdown voltage is measured.

The highest possible breakdown voltage of a given unit occurs between collector and base with the emitter open (BV_{CBO}), Measuring BV_{CES}, common emitter with the base tied to the emitter, or BV_{CE} with the base open yields smaller values. The same is true when the base is returned to the emitter through a resistor (BV_{CER}).

The test circuit presented and shown in Fig. 4 is based upon the common emitter configuration whereby the base is returned to the emitter by a resistance of 100 ohms. This choice of value should not be construed as implying a standard. It was done in order to cover certain applications in which base return resistances of this order of magnitude may be used.

Power Transistor

(Concluded)

A voltage source V_{CC} variable from 0 to 200 volts, is applied to the collector through a resistance R_L of 10,000 ohms (Fig. 4). The potential between collector and emitter, as well as the collector current, is measured. The supply voltage is increased until the reference collector current I_R is reached. At this point the breakdown collector voltage BV_{CER} is recorded, as is exemplified in Fig. 5.

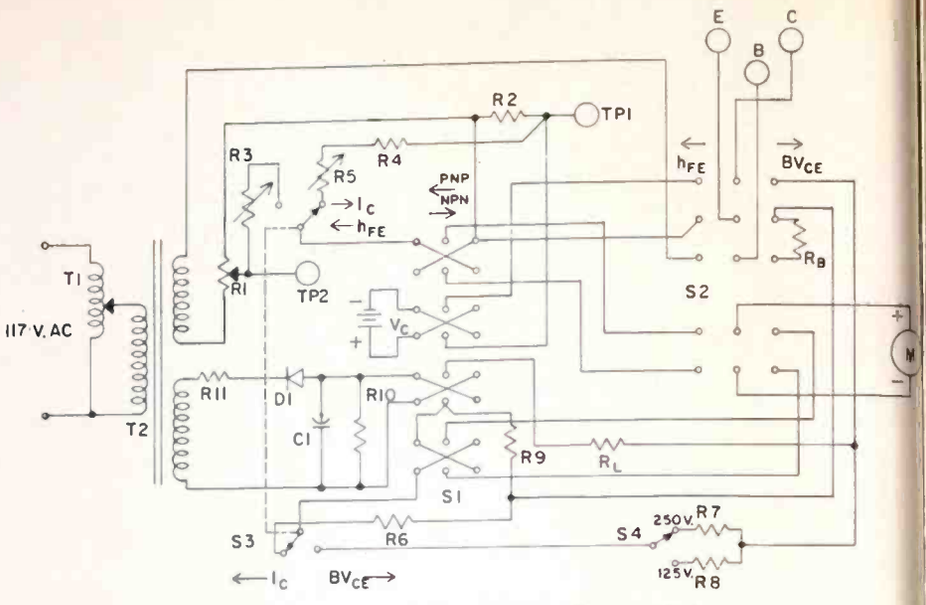


Fig. 6: Basic schematic of the equipment for measuring h_{FE} and BV_{CER}.

Circuitry

The two test circuits described above have been embodied in the test equipment together with some switches necessary for changing the polarity of bias voltages (*PNP-NPN*) as well as for establishing the circuit (h_{FE} — BV_{CE}). The schematic circuit diagram is shown in Fig. 6.

Switch S_3 is of the lever action, spring return type. It is used for both h_{FE} and BV_{CER} measurements. In its locked position, it provides for the measurement of the collector current I_C, both in the case of determining h_{FE} and in that of measuring BV_{CER}. When displaced, switch S_3 establishes the indication of either the voltage, e, (see Fig. 3) at the slider of potentiometer R_1 or of BV_{CER} (see Fig. 4).

In addition to R_1, R_2 and R_9 are current sampling resistors, the latter being used for the measurement of the reference collector current at which BV_{CER} is to be determined. Resistors R_B and R_L serve the purpose discussed in combination with Fig. 4. All remaining resistors shown in Fig. 6 are associated with the microammeter M.

Calibration

When the instrument is connected to the breakdown-voltage measuring circuit, it is used to indicate dc currents and voltages. For the collector current readings it should have a range of 0-2.5 ma, which is to be adjusted by means of R_6, Fig. 6. As a dc voltmeter, it has a dual range, 0-250 volts, and 0-125 volts in accordance with the calibration provided by resistors R_7 and R_8, respectively. The calibration of dc meters being of known art needs no further comment.

At this point, an explanation is in order to account for the use of two sensitivities for the peak voltmeter. According to the instrument constants chosen, particularly the constant k_1, the value of h_{FE} is indicated by the position of the potentiometer at which $e = 0.5\ E_2$. This applies to the range of $h_{FE} = 0\text{-}100$, which is considered to be the one most frequently used. The usefulness of increasing the sensitivity of the meter by a factor of 2 for measuring the voltage, e, results from the fact that both voltages to be established will produce the same meter movement.

Therefore, the procedure of measuring h_{FE} is reduced to the following steps: First, the desired reference peak collector current, as expressed in terms of E_2, is established while using T_1 as control (Fig. 6). Then, while moving switch S_3 back and forth, repeatedly, potentiometer R_1 is set to a position at which the switch operation has no effect upon the meter indication. This is the condition at which $e = 0.5\ E_2$, and h_{FE} is indicated by the position of the potentiometer.

This simplified procedure cannot be used, however, if the current transfer ratio of a particular transistor exceeds the value of 100. In that case, h_{FE} is determined when $e = 0.25\ E_2$ which occurs at one half of the deflection of the meter indication for E_2.

The following is the procedure that may be used for calibrating the meter in terms of peak voltages. A power transistor, preferably mounted on cooling fins, is connected to the equipment. A dc oscilloscope can be used as a standard, connecting its vertical amplifier to test point TP_1 (Fig. 6) and emitter. The sweep frequency of the oscilloscope is adjusted so as to obtain the half-wave pattern of the voltage to be measured. Adjust R_5 to obtain full deflection of the meter for a peak voltage of 2.5 volts as indicated on the oscilloscope. Then calibrate the meter scale at several points corresponding to different reference voltages.

References

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2. Hans Schenkel and Hermann Statz, "Voltage Punch-Through and Avalanche Breakdown and Their Effect on the Maximum Operating Voltages for Junction Transistors," *Proc. National Electronic Conference*, Vol. X, 1954; p. 614.
3. IRE Standards on Letter Symbols for Semiconductor Devices, 1956. *Proc. IRE*, No. 7, Vol. 44; July 1956.
4. R. A. Beale et al, "A Study of High-Speed Avalanche Transistors," *Proc. IRE, Part B*, No. 16, Vol. 104; July 1957.

Synchro Zeroing Problems . . .

Discussed here are some ambiguities in synchro system zeroing. Manufacturers using different zeroing specifications create problems when various components are put together to form a synchro system.

By TED POWELL
42 Nassau Road
Great Neck, L. I., N. Y.

HILLMAN and Galvin's[1] interesting notes on static zeroing synchros are useful for design and production purposes. However, zeroing such remote-ontrol and indication units out in the field involves ther and more obscure synchronization factors, particularly where multiple control-station switching nd servo drives are involved. These may not only onsist of synchro operational troubles other than tatic-zero errors, but also some rather confusing lectrical and mechanical signal "rotation" data in he synchro zeroing specs.

Some Problems

This signal rotation ambiguity problem might be roken down into some half-dozen categories:

A)—Reversed "phase-rotation" synchros. The S1-2-S3 Y-winding stator terminal markings on a military synchro (or R1-R2-R3 on a differential or commercial rotating-Y unit) merely enabled one to more onveniently static-zero a synchro system. This, however, did not necessarily guarantee that when a portable "standard test" synchro xmtr was actuated in a C.W. "increasing reading" direction, that an electrically zeroed synchro indicator motor connected to t properly, would do the same. Occasionally a synchro would be found that rotated in the opposite direction. f its dial was not calibrated in the reversed "2-wrongs-make-a-right" direction, it would give correct readings at only o° and 180°. In other words, one can reverse the S1-S3 leads on a synchro and it will still "zero" correctly.

Usually the S1-S3 or R1-R3 leads were swapped in the *external* wiring instead of at the offending synchro terminals. This swap quite often showed-up when other switches in the system were thrown, generally resulting in a vicious-circle of S1-S3 reversals throughout the system.

(B)—Reversed direction of rotating-dial indicator calibrations. Most indicator units came through with indicator dials. The calibrations were graduated in the conventional C.C.W. direction. The dial then worked in the normal C.W. direction for "increasing" readings against a fixed pointer. Other indicator instruments had their rotating dials calibrated in a C.W. direction. When such a unit was correctly wired into a standard system, all of the units would read 90°, while this one read 270°.

Again, if someone reversed S1-S3 or R1-R3 leads elsewhere in the system instead of at the offending instrument's terminals, another S1-S3 reversal routine was launched after several control switches were thrown.

(C)—Reversed dial readings produced by a rotating-pointer indicator in a rotating-dial system. Most military synchros with rotating indicator dials were designed having C.C.W. markings on them and C. W. rotation for "increasing" readings. The pointer was fixed. Some had moving pointers and fixed C.C.W. calibrated dials. When all of the system was following in a clockwise direction to 90° the moving-pointer synchro moved C.W. to 270°. There are 3 possible remedies to this problem; replace the pointer with a rotating C.C.W.-calibrated dial and fixed pointer, or swap the S1-S3 or R1-R3 leads at the synchro, or

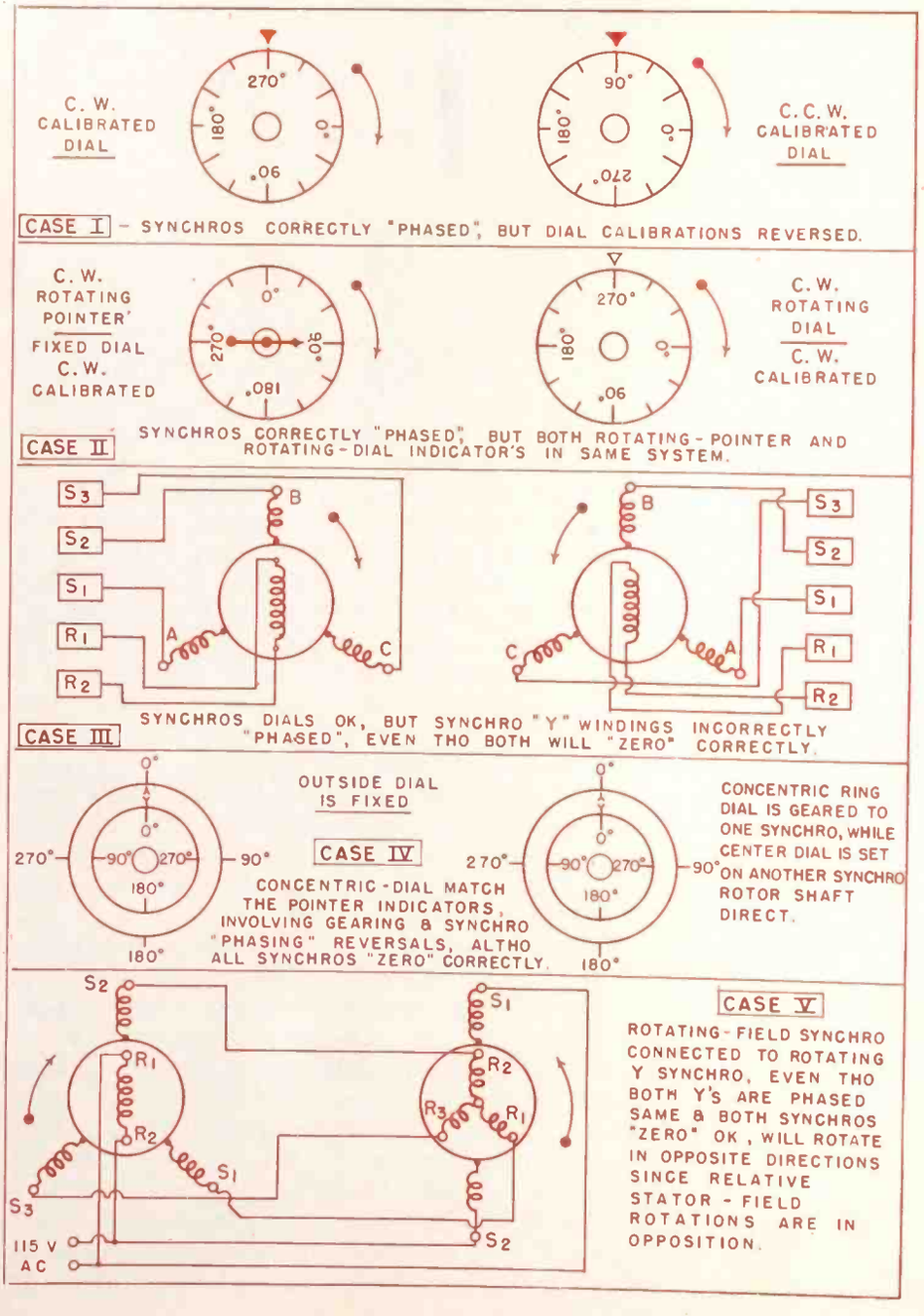
Synchro Zeroing Problems *(Continued)*

replace the fixed C.C.W.-calibrated dial with a C.W.-calibrated type.

(D)—Reversed mechanical rotation produced by gear-trains in multiple-indicator units. Some multi-purpose indicator units in military vehicles contained several synchros and indicator dials. Since some of the synchros involved were of the differential or summation type differentials or "B" motors, either they or their dials were often mechanically linked to control knobs or ordnance gear in order to get the mechanical summation, difference or match-the-pointer action. Hence gear trains were sometimes necessarily interposed between the synchros and their dials.

Some wartime instrument makers forgot that a gear-box may also have a "reverse" position. Hence indicator dials often went "west" when the xmtr said "east," even though everything had been nicely zeroed electrically and mechanically. This was a fairly obvious problem. The wrong-way synchro's S1-S3 or R1-R3 leads were then swapped at the instrument side of the terminal blocks.

Fig. 1: Some of the types of synchro zeroing problems encountered are shown graphically.



(E)—Reversed dial readings and/or rotations in multiple-concentric "relative-true bearing" and "match-the-pointer" dial indicators. This is usually a combination of troubles covered in (C) and (D), with (A) and (B) occasionally included, plus some system and instrument external wiring S1-S3 and R1-R3 reversals. In this case the solution effort varied directly as the number of trouble categories involved.

(F)—Reversed rotor rotation produced by interconnection of rotating-Y synchros with stator-Y synchros. Military synchros normally use the stator-Y design lay-out while marine and commercial types often employ the rotor-Y type set-up. Obviously, even though the Y-rotor winding was correctly "phased" with its stator field at static electrical-zero, in correspondence with a stator-Y rotor-field type synchro, their relative signal "phase" rotations would be in reverse to each other. Here, we have an analagous electrical equivalent to the rotating-dial-rotating-pointer reversal condition described in (C). That is, the *relative* rotation between the Y-windings and their respective fields will be in opposition, as will their signal rotation or "phasing." Here, where the synchros were correct electrically, they were wrong electro-mechanically because of "relativity" again. Hence commercial synchros that zeroed nicely at static zero, were improperly "phased."

To summarize (A) to (F) briefly, it appears that there is some need to elaborate upon military synchro specs so that not only electrical and mechanical zero are specified, but also the Y-winding electrical signal phasing in the "increasing reading" rotation direction.

Zeroing Procedures

In the field it is not enough for the engineer to merely "zero" a synchro. Neither is it enough for him to also check-out for the proper "increasing reading" signal rotation or phasing. He must also make a slow, full-rotation, operational check to spot installation system wiring errors, equipment mechanical troubles, etc. Also, he must make power-off, 180°-out, power-on checks to spot loose link-

s, defective rotor dampers, open R2 field leads, etc.—all taken h the assist of a reliable "stand- test" synchro. Such over-all rational-test checks are also ad- able in production work.

Equipment mechanical troubles y consist of loose or sticking ds, defective synchro rotor mpers, loose shaft or hub set- ews, binding gears, jamming kages, damaged or dirty syn- ro bearings, loose synchro clamp ews, etc. Electrical troubles in uipment may be reversed S1-S3 R1-R3 leads, dirty or pitted nchro slip-rings, loose wiring nnections, cold solder joints, oken wires, dirty relay contacts, c.

Wiring Trouble Indications

Installation system wiring oubles may consist of the fol- wing:

)—Y-winding S1-S2-S2 reversals which cause 120° or 240° errors, or reversed rotation in indicators.

)—Y-winding S1-S2-S3 opens which cause 120° no-torque zones.

)—Y-winding S1-S2-S3 shorts which cause lock-spots at 120° spots and heavy synchroniz- ing currents.

)—Field-winding R1-R2 rever- sals which cause 180° indica- tor errors or runaway or coarse-to-fine hunting servos.

)—Field-winding R1-R2 opens which allow indicators to work with inductor unit ac- tion and follow correctly or 180° out, with weak torque and heavy synchronizing cur- rents.

)—Field-winding R1-R2 shorts (at the instrument, but not across the ac supply lines) which allow the indicator to function as an induction unit and follow 90° or 270° out, with weak torque and heavy synchronization current.

)—Y-winding and field-winding cross-up which produce weird auto-transformer reverse-ro- tation spots.

)—Any combinations of the above which can produce odd angular errors and/or re- versed rotation. Note that there can be combinations of 120°, 240°, 180°, 90° or 270° errors, with correct rotation.

Operational Tests

Mechanical troubles can produce sticky and erratic synchro opera- tion, or erratic and unpredictable dial readings or control signals.

Obviously then, a field engineer- ing "electrical zero" test must be elaborated into a full 360° opera- tional test, plus a power-off-180°- out-power-on test, as follows:

(a)—Loosen the synchro and electrically zero it.

(b)—Mechanically zero the syn- chro and its indicator dial while its mechanical equipment is set on mechanical zero. Lock everything on zero.

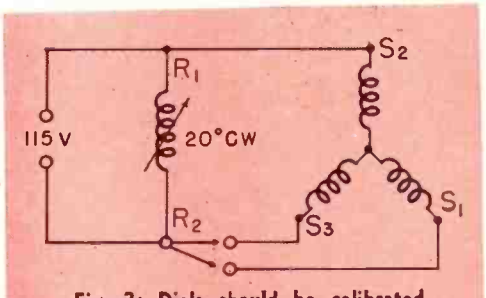


Fig. 2: Dials should be calibrated so that CW movement will pro- duce an increasing dial reading.

(c)—Energize system to see if indicator synchronizes exactly at zero in synchronism with its xmtr, which is also set at mechanical zero. This checks for installation wiring errors, except for R1-R3 re- versals or S1-S3 swaps, or for R1-R2 opens.

(d)—Check for correct "increas- ing reading" rotation by slowly actuating the xmtr in the "increas- ing" direction to see if the re- peater follows in the correct direc- tion.

(e)—Check repeater for full 360° operation by slowly and stead- ily actuating the control xmtr from 0° to 360°, and then back to 0° again. Watch repeater dial care- fully for any signs of jump, jitter, bind, sticky or sloppy-torque spots. (Fast operation of xmtr may cover up cluck spots). This checks for open or shorted stator leads S1- S2-S3 and no-torque or lock-spots; and for erratic synchro operation due to defective synchro slip-rings or bearings, sticking dials and binding mechanical linkages.

(f)—With xmtr back at 0° shut off power, actuate xmtr to 180° position and turn on power while watching repeater. Check to see that indicator snaps back to zero sharply, with a minimum of over- shoot and hunt, and rests exactly on zero. This checks for R1-R2 opens, loose mechanical linkages and a defective rotor damper. If indicator remains at 180°, R1 or R2 are open. If it overshoots zero badly, hunts increasingly and "mo- torizes" and "runs away" as an induction motor, the rotor damper is the problem. If the indicator now reads some odd error, the dial or some mechanical linkage is loose. Repeat above test at 90° and 270° also.

In summarizing (a) to (f), it appears that military synchro zero- ing specs might also include a full, slow 360° operational test, 90°- 180°-270° power-off-power-on tests, and some sort of an off-zero static- position check to check for correct synchro "phase" rotation, as fol- lows:

1—After zeroing the synchro electrically, rotate the synchro ro- tor shaft 20° in the normally in- creasing reading C. W. direction (looking directly at the dial or linkage hub shaft-extension end). In this position, with R1 tied to S2, the synchro's autotransformer voltages shall read as follows:

R2 to S3 = X volts
R2 to S1 = Y volts
(X & Y to be established)

2—All synchro units, wherever practical, should have their fixed or moving dials calibrated in such a manner that whether a fixed or moving pointer is used, a C. W. rotation of the rotor shaft-exten- sion end (looking directly at it), will produce an increasing dial reading.

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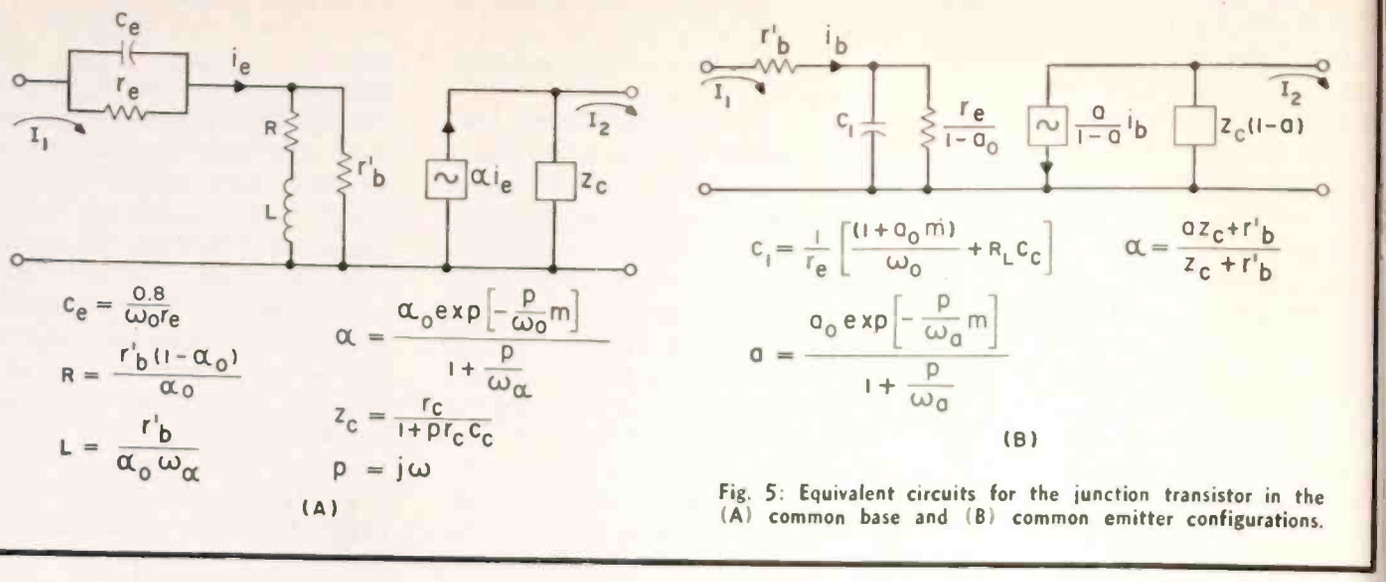


Fig. 5: Equivalent circuits for the junction transistor in the (A) common base and (B) common emitter configurations.

AN equivalent circuit of an electronic device is useful if it closely represents the device and is readily applicable to practical circuit design.

Fig. 5 shows equivalent circuits for the junction transistor in the common base and common emitter connections, respectively, which are particularly useful for designing multiple loop feedback amplifiers. The equivalent circuits permit the direct application of Theorem I in order to calculate the characteristic function for a given circuit.

The device parameter "a" is complex and has a dc value equal to a_o (very nearly equal to one) and a magnitude of 0.707 a_o at the radian frequency ω_a. The phase shift of "a" exceeds the phase shift associated with an R-C cutoff by m radians at the frequency ω_a.

For an ideal, one dimensional, junction transistor (one in which the minority carriers in the base region move only by diffusion) the excess phase at ω_a is 0.21 radians (12°).[9] High frequency types of junction transistors, particularly drift and diffused base junction varieties, have considerably more excess phase. This is due principally to the effect of an electric field in the base region and emitter depletion layer capacity. This excess phase must be taken into account when designing feedback amplifiers.

The parameter α is equal to the short circuit current gain of the transistor in the common base connection; r_c, the collector resistance; C_c, the collector capacity; r_e, the emitter resistance; C_e, approx. the emitter storage capacity; and, r_b', the ohmic base spreading resistance. Note that α_o is almost exactly equal to a_o and that ω_a is approx. equal to ω_α, the alpha cutoff frequency of the transistor.

Derivation Simplification

The principal simplification made in deriving these equivalent circuits is that all internal feedback paths between the input and output circuits of the device have been neglected.[10] The internal feedback is responsible for making the input impedance of the transistor a function of the output load impedance. In fact, if the load impedance has a magnitude com-

Part Two of Two Parts

For Transistor Amplifiers . . .

Designing Multiple Feedback Loops

The stability criterion is extended to include junction transistors in the common emitter configuration. Practical design techniques are discussed and an illustrative amplifier designed.

By FRANKLIN H. BLECHER

Head, Active Network Eng'g Group
Transmission Network Development Dept.
Bell Telephone Laboratories, Inc.
Murray Hill, New Jersey

rable with the output impedance of the transistor, en the internal feedback can cause the input im- dance to have a negative real part, thus leading to ssible instability.[11]

Fortunately, in most practical multiple loop tran- stor feedback amplifiers, the load impedance, agnitude is small compared to that of the transistor tput impedance.

In the common base equivalent circuit, it is sumed that the load impedance magnitude is very nall compared to the relatively large output imped- ce $|Z_c|$. For the common emitter circuit, it it as- med that the load resistance into which the ansistor operates is R_L. This resistance increases e size of condenser C_1 in the input circuit of the ansistor. This effect is somewhat analogous to the iller effect in common cathode vacuum tube nplifiers.[12]

A detailed discussion of the effects of internal edback on the stability of single loop transistor edback amplifiers is presented in Ref. 13. It is own that the internal feedback may be neglected, the magnitude of the external feedback is large ompared to the internal feedback at all frequencies f interest. Similarly, for multiple loop structures, e internal feedback may be neglected, if the external edback is large compared to it at all frequencies of terest.

Feedback paths introduced by parasitic capacities etween the input and output circuit of the transistor an be best treated as additional external feedback connections. The equivalent circuits, Fig. 5, are valid for frequencies up to about ω_a.

Function Relationship

The common base equivalent circuit shows that the gain parameter, W, for common base operation is equal to α_o. The complex factor by which α_o is multiplied to yield α is combined with the transmission characteristics of the passive networks in the circuit to obtain the functions $F_1(p)$, $F_2(p)$, etc. which appear in (3).

At first, it would seem that the analysis would be complicated by the presence of α_o in the expressions for R and L. However, this is not the case since for most junction transistors r_b' is of the order of 100Ω and the circuit which drives the transistor usually has a much higher output impedance. Therefore, even though R and L are functions of α_o, the characteristic function for the circuit is still, for all practical purposes, a linear function of α_o.

The short circuit current gain, Fig. 5B, for the common emitter configuration, $-a/(1-a)$, is equal to

$$-\frac{a}{1-a} = \frac{-W \exp\left[\frac{-pm}{\omega_a}\right]}{\frac{1+p(1+a_o m)W}{\omega_a a_o}} \qquad (8)$$

if $\omega m/\omega_a \ll 1$ and where $W = a_o/(1-a_o)$. From (8), it is evident that the current gain is not a linear function of the gain parameter W and in general the characteristic function, F, is not a linear function of W.[d]

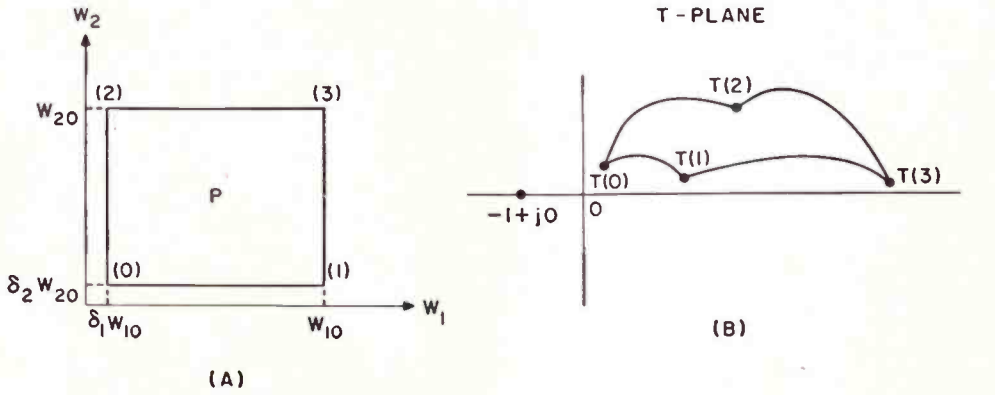


Fig. 6: (A) Space of operating points for 2 transistors in common emitter connection. (B) Image of P in T-plane, fixed frequency.

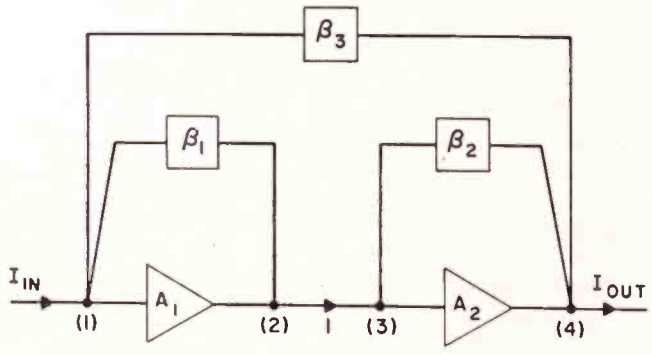


Fig. 7: A Block diagram of the tandem multiple loop feedback amplifier which illustrates the stability criterion and design techniques of this article.

Feedback Loops

(Continued)

Fig. 6A shows the space of operating points for a circuit employing two transistors in the common emitter connection; Fig. 6B, the image of the rectangle P in the T-plane at a fixed value of frequency.

Since the mapping function T is not a multilinear function of W_1 and W_2, the image of P is not a polygon. It is no longer sufficient to determine the location of only the vertices of P in order to obtain the image in the T-plane of all operating points in P. In fact, not all of the points in P map inside the closed curve T(0), T(1), T(3), T(2).

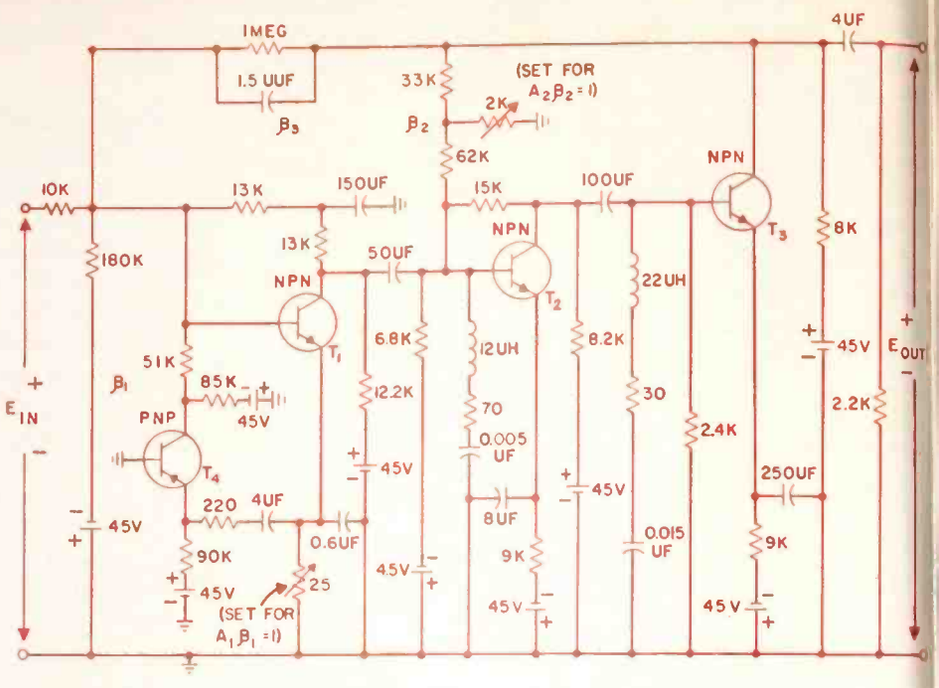


Fig. 8: Values of the junction transistors used in this amplifier are shown in Table 1.

These results are more of a theoretical limitation than a practical one. Eq. (8) is a linear function of W at frequencies less than the common emitter cutoff frequency, $\omega_a a_o/(1 + a_o m)$ W. It is also a linear function of W when W is less than ½ since the quantity W/a_b is then within 3 db of its smallest value of one.

In many practical designs, the image of P in the T-plane is near the critical point for small values of W or at relatively low frequencies. The criterion of stability (Theorem II) is directly applicable for these cases.

Another result that simplifies the design of conditionally stable common emitter amplifiers is that (8) is independent of W if

$$W >> \frac{\omega_a a_o}{\omega (1 + a_o m)} \qquad (9)$$

All points in the space of operating points which satisfy (9) at a particular frequency, map into the same point in the T-plane. This tends to compress the size of the image of P in the T-plane and, of course, simplifies the stability problem.

[d] It is possible to represent a common emitter stage by an amplifier with current gain, W, and with shunt negative feedback. The feedback fraction for the circuit is equal to $p \cdot (1 + a_o m) \cdot / \omega_a a_o$. The resulting characteristic function, F, is a linear function of W. In practice, though, it has been found that the modified stability criterion described in the article is more useful.

Stability Determination

The following technique has been found useful for determining the stability of multiple loop amplifiers employing common emitter stages. First, the images of the vertices of P in the T-plane are plotted, in the usual manner, as p moves along the real frequency axis from $p = 0$ to $p = j\infty$. The amplifier is designed so that the contour generated by each vertex has at least a 30° phase margin and a 9 db gain margin with respect to the critical point.

If the frequencies for which the contours have their closest approach to the critical point are less than the common emitter cutoff frequency, or if the corresponding values of W are all less than ½, then stability is insured. If not, then stability can be determined by mapping all of the operating points in P into the T-plane at the frequencies for which the contours have their closest approach to the critical point. In practice, this last step is usually not required. However, it is always required in the case of a conditionally stable amplifier in which all of the contours encircle the critical point (refer to Fig. 4C).

Two Design Precautions

It is important to point out two problems which arise in the design of conditionally stable amplifiers. If an amplifier is overloaded, then the δ in Fig. 4A corresponding to the output stage will become zero and as a result, the amplifier may oscillate. Depending on the design, the instability will or will not terminate when the overload is removed.

In general, the instability will be eliminated when the overload is removed if the gains of the negative feedback loops are much greater than the gains of the positive feedback loops. The instability can always be eliminated by momentarily turning off the bias power, but this is usually undesirable.

One scheme that has proven useful is to place a forward biased diode in each of the positive feedback

ops During normal operation the diodes have a egli ble effect because of their very low impedance vhen forward biased. However, when the output igna of the amplifier exceeds a specified level, the orw d bias on the diodes is removed and the positive eedlck loops are effectively opened. This can be nstr nented with a diode rectifier and in some cases, trisistor DC amplifier. By this technique, the mplier will not become unstable when overloaded.

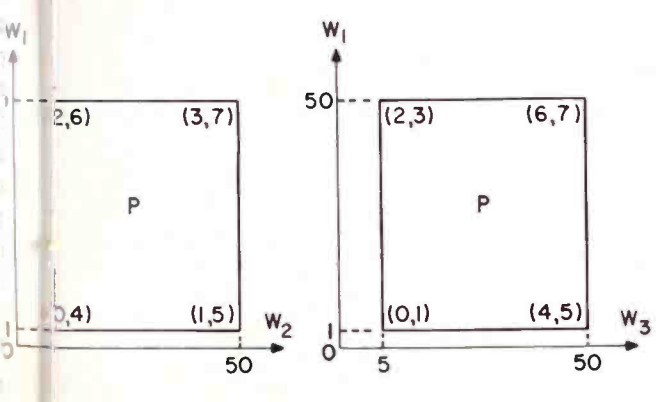
A econd precaution which must be observed in a ondionally stable amplifier is to design the dc bias ircu so that the amplifier does not tend to oscillate mmdiately after the circuit is energized. Even hou junction transistors have essentially no warm-p tie and in fact have a small gain with no external ias, he gain of the transistor can be reduced to ero it is improperly biased during the initial turn-n tnsient. Consequently, the bias circuit must be esiged so that the transistors are correctly biased t altimes after the circuit is energized.

Illustrative Amplifier Design

Th stability criterion and design techniques diss in this article will be illustrated by a tandem nult le loop feedback amplifier.[14] Fig. 7 shows a lock diagram of this amplifier.

Th loop gains $A_1\beta_1$ and $A_2\beta_2$ correspond to positive eedlck while the loop gain $A_1A_2\beta_3$ corresponds to iega ve feedback. The nodes (2) and (3) are sepa-ated by a unilateral branch which has the property hat current into node (2) is transferred to node 3)l while there is no transmission in the reverse irec on. The external current gain of this amplifier s rdily evaluated with the use of Theorem I.

$$\frac{I_{out}}{I_{in}} = \frac{A_1A_2}{1 - A_1\beta_1 - A_2\beta_2 + A_1A_2\beta_1\beta_2 - A_1A_2\beta_3} \qquad (10)$$



(0) $W_1 = 1,\ W_2 = W_3 = 5$

(1) $W_1 = 1,\ W_2 = 50,\ W_3 = 5$

(2) $W_1 = 50,\ W_2 = W_3 = 5$

(3) $W_1 = W_2 = 50,\ W_3 = 5$

(4) $W_1 = 1,\ W_2 = 5,\ W_3 = 50$

(5) $W_1 = 1,\ W_2 = W_3 = 50$

(6) $W_1 = 50,\ W_2 = 5,\ W_3 = 50$

(7) $W_1 = W_2 = W_3 = 50$

Fig. 9: Space of the operating points for a tandem feedback amplifier.

TABLE 1

Electrical Parameters of the Junction Transistors Used in the Tandem Feedback Amplifier

$a_o = 0.98$	$C_c = 10\ \mu\mu f$
$f_a = 5$ MC	$m = 0.21$
$r'_b = 125\ \Omega$	

The tandem feedback amplifier has the interesting property that if the loop gains $A_1\beta_1$ and $A_2\beta_2$ are initially set equal to one, then the external gain is theoretically independent of either the gain A_1 or A_2. This is immediately apparent if (10) is rewritten as

$$\frac{I_{out}}{I_{in}} = \frac{A_1A_2}{(1 - A_1\beta_1)(1 - A_2\beta_2) - A_1A_2\beta_3} \qquad (11)$$

If $A_1\beta_1$ is equal to one, then the external gain is independent of A_2. If $A_2\beta_2$ is equal to one, then the external gain is independent of A_1. It should be noted that this circuit can only be conditionally stable and if either A_1 or A_2 should vanish, the amplifier will become unstable.

Another property of the tandem feedback amplifier is that if $A_1\beta_1$ is equal one, then all of the output distortion due to A_2 is theoretically eliminated. This can be shown by applying a distortion current generator to node (3) and calculating the resulting output distortion current with the use of Theorem I. Since the numerator of the expression contains a factor $(1\text{-}A_1\beta_1)$, the output distortion due to A_2 is zero.

Tandem Feedback Amplifier

Fig. 8 shows the circuit diagram of a tandem feedback amplifier using junction transistors. The current gain A_1 is provided by a single common emitter stage T_1. To make the loop gain $A_1\beta_1$ correspond to positive feedback, the feedback current is taken from the emitter of the transistor.

A common base stage T_4 is employed in the β_1 circuit because of its low input impedance and high output impedance. This circuit arrangement has the desirable effect of isolating nodes (2) and (3), as required.

The current gain A_2 is provided by two common emitter stages, T_2 and T_3, in cascade. Transistor T_1 is operated at 3 ma. of collector current while transistors T_2 and T_3 are operated at 5 ma. of current. The common base stage is operated at 0.5 ma. of current.

The dc bias circuit is designed so that the transistors are correctly biased at all times during the initial turn-on transient. In addition, the bias circuit will maintain proper operating conditions even if the current gain of a transistor should be degraded by a factor of 50.

The gain of the negative feedback loop is set equal to 34 db while the gains of the two positive feedback loops are exactly one. Table 1 lists the parameter values of the transistors used in the amplifier.

The stability analysis to be presented will not take into account the effect of a degradation in the current gain of the common base stage. It is evident that if this transistor should completely fail, it will

Feedback Loops *(Continued)*

simply open up one of the positive feedback loops and will not materially effect the stability of the circuit.

Stability Analysis

The gain parameters of T_1, T_2 and T_3 are designated by W_1, W_2 and W_3, respectively. Fig. 9 shows the rectangular parallelepiped, P, in the space of operating points corresponding to all permissible values of W. It is assumed that the normal value of the gain parameters is 50, that W_1 can be as small as one and W_2 and W_3 can be as small as five. The rectangular parallelepiped has 8 vertices which are tabulated in the figure.

Fig. 10 shows the contours in the T-plane generated by the images of the vertices as p moves from $p = 0$ to $p = j\infty$ along the real frequency axis. The contours generated by vertices (0), (1), and (4) are not shown since the magnitude of T for these contours is less than —18 db at all frequencies.

The contour corresponding to vertex (2) makes the closest approach to the critical point and it occurs for frequencies between 500 and 5000 cps. Since these frequencies are considerably below the cutoff frequency of the common emitter current gain, the stability criterion given by Theorem II is valid. It is apparent that all of the other contours are sufficiently removed from the critical point to insure stability.

Fig. 11 shows plots of the external voltage gain of the amplifier for various values of the gain parameters. The amplifier was designed so that the loop gains $A_1\beta_1$ and $A_2\beta_2$ are equal to one for frequencies between 600 and 8000 cps. It is evident from the figure that the gain compensation predicted by (11) is very effective over this frequency band. It was found experimentally that the amplifier was stable when W_2 or W_3 was reduced to one even though the lower limit for these gain parameters, in Fig. 9, is five. Although not plotted in Fig. 11, it was found that when W_2 and W_3 were simultaneously reduced to five, the external voltage gain was very similar to that represented by curve 3. The amplifier became unstable when overloaded, but the instability terminated as soon as the overload was removed because of the large amount of negative feedback.

It must be pointed out that in order to achieve the performance shown in Fig. 11, the gains of the positive feedback loops must be initially set to one with an accuracy of ± 0.1 db. Consequently, the performance shown is obtained over the narrow temperature range of ± 3° Fahrenheit. The amplifier is suitable for either an air conditioned environment or for applications in which the temperature is naturally constant such as in a repeater for a submarine cable.

Acknowledgment

The stability criterion discussed in this paper was originally proposed by M. L. Curtis.

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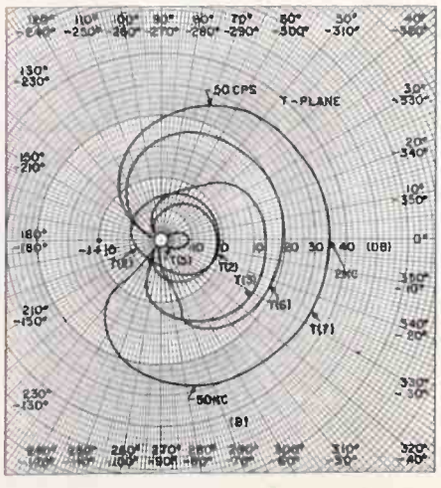
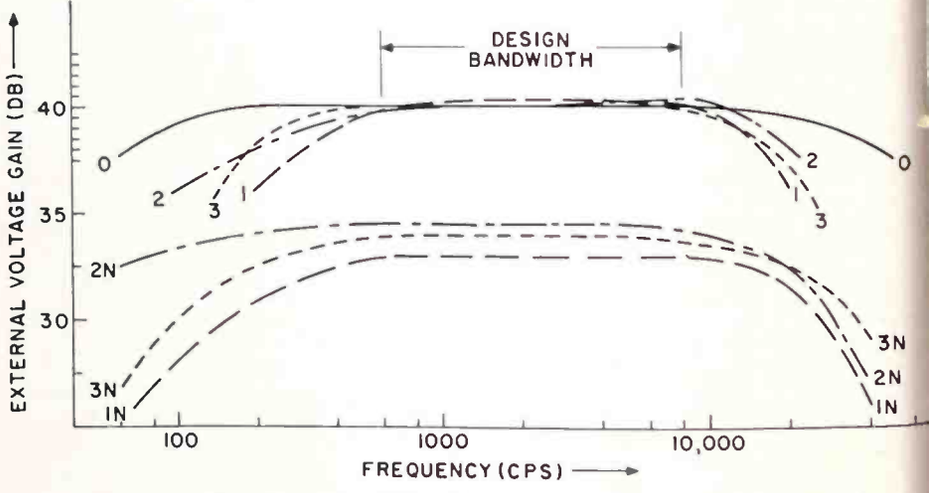
Fig. 10 (below): Contours generated by the images of the vertices of P in the T-plane for the tandem feedback amplifier.

Fig. 11 (right): The external voltage gain of the tandem feedback amplifier.





NOTE:
- 0 – $W_1 = W_2 = W_3 = 50$
- 1 – $W_1 = 1$, $W_2 = W_3 = 50$
- 2 – $W_1 = 50$, $W_2 = 1$, $W_3 = 50$
- 3 – $W_1 = W_2 = 50$, $W_3 = 1$

WITH POSITIVE FEEDBACK

- IN – $W_1 = 1$, $W_2 = W_3 = 50$
- 2N – $W_1 = 50$, $W_2 = 1$, $W_3 = 50$
- 3N – $W_1 = W_2 = 50$, $W_3 = 1$

WITHOUT POSITIVE FEEDBACK

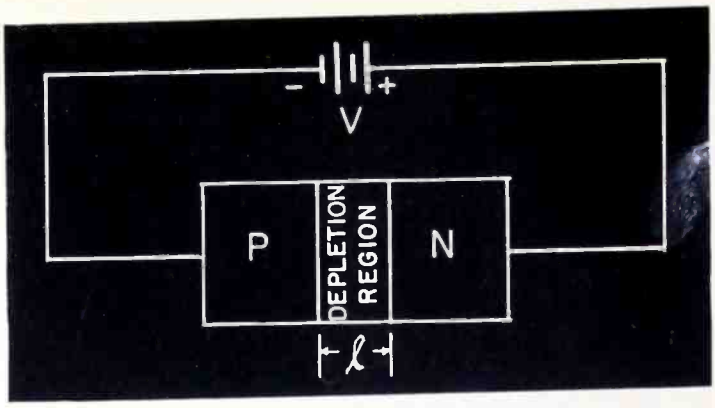


Fig. 1: The basic p-n junction from which the Varicap is formed.

A Voltage Variable Capacitor

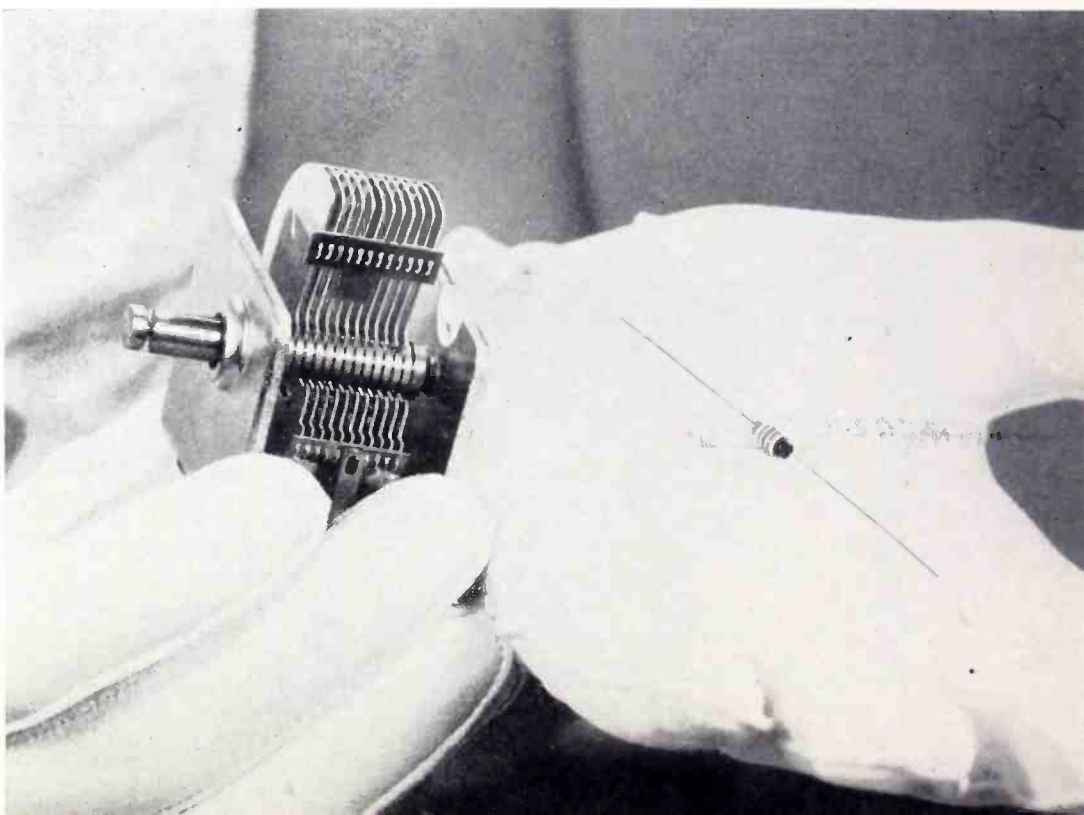
The design engineer now has a unique new component for electronic equipment. Here are the design characteristics of the new electronically variable, solid state capacitor.

By GENE F. STRAUBE
Pacific Semiconductors, Inc.
1041 West Jefferson Blvd.
Culver City, California

Part One of Two Parts

A VOLTAGE variable semiconductor capacitor was introduced to the electronics industry in October, 1957, by Pacific Semiconductors, Inc., under the trademark *Varicap*.[1] The Varicap is a subminiature silicon junction device with a variable capacitance controllable by adjustment of bias voltage. While the variation of capacitance with voltage across semiconductor junctions has been known for several years, no such device with controlled capacitance, Q and operating range has been commercially available until last October. Varicap have many useful applications in automatic frequency control, frequency modulation, amplitude modulation, voltage controlled oscillators, amplifiers and other circuits. They also offer significant advantages over reactance tubes, mechanical tuning capaci-

Fig. 2: The new Varicap is dwarfed by the tuning capacitor which it replaces.



Varicap, *(Continued)*

tors, and barium titanate capacitors. Early work on utilizing this p-n junction property was performed by Giacoletto and O'Connell,[2] Pan and Ramanus,[3] Muss[4] and others.

Theory

A capacitance-voltage variation occurs across semiconductor *p-n* junctions voltage biased negative to positive. A p-n junction contains mobile holes and bound acceptor ions in the *p* region and mobile electrons and bound donor ions in the *n* region. If a voltage is applied as in Fig. 1, the electrons in the *n* region and holes in the *p* region are drawn away from the junction. This leaves a region adjacent to the junction depleted of mobile charge. This depletion or barrier region, of width *l*, is free of mobile charge and is essentially a dielectric of permittivity ε. It is sandwiched between the hole-rich *p* section and the electron-rich *n* section. This combination of dielectric contained between two conducting areas exhibits capacitance properties. For a parallel plate arrangement, the *p-n* junction has a capacitance equal to:

$$C = \frac{\epsilon A}{l}$$

where ϵ = permittivity of the dielectric
A = junction area
l = width of the depletion region (1)

Depletion Region

The property of *p-n* junctions making this capacitance useable as a variable capacitor is that the effective width of the depletion region is dependent upon the applied bias voltage. Furthermore, the manner in which the depletion region varies with voltage is dependent upon the transition of mobile charge density from *p* to *n* in the vicinity of the junction. For the case of an abrupt junction, such as is achieved by alloying techniques, the depletion width is given by:

$$l = K_1 \sqrt{V + V_o} \quad (2)$$

Combining (1) and (2) for an abrupt junction:

$$C = \frac{K_2}{\sqrt{V + V_o}} \quad (3)$$

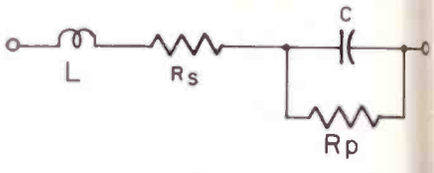
In the special case of extremely high *p* region doping, typical of aluminum alloyed silicon *p-n* junctions, the following formula can be derived.

$$C = \left(\frac{KA\sqrt{\epsilon}}{\sqrt{\rho}}\right)\left(\frac{1}{\sqrt{V + V_o}}\right) \quad (4)$$

where K = a constant
ρ = resistivity of the n region
V = applied bias voltage
V_o = internal contact potential (0.3 to 0.9 volts)

Since V_o is normally small with respect to V, an abrupt junction exhibits a capacitance which varies with the inverse square root of voltage. Other capacitance-voltage functions may be obtained across differently graded *p-n* junctions. If, for example, the semiconductor changes from *p* to *n* in a linear manner the capacitance varies as the inverse cube root of the applied voltage. The Varicaps considered in this paper are the subminiature *V* series silicon alloy Varicaps manufactured by Pacific Semiconductors (see Fig. 2, which exhibit an inverse square root relationship.

Fig. 3: This is the equivalent circuit of the Varicap unit.



Characteristics

Important characteristics of Varicaps include capacitance, series resistance, leakage resistance, *Q*, inductance and operating voltage range. The variation of these characteristics with voltage, temperature and frequency is also important.

Fig. 4: Capacitance voltage variation of typical Varicap normalized to 100% at 4 v.

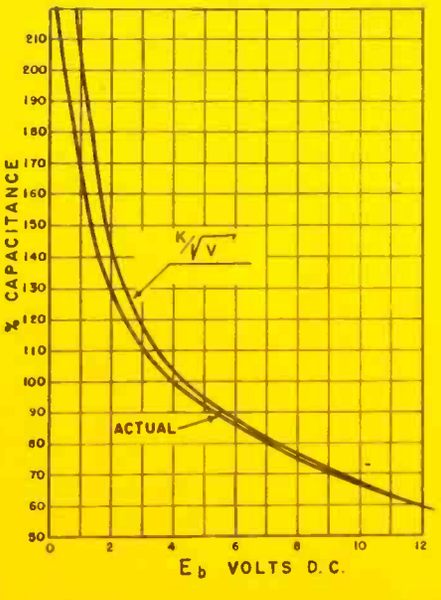


Fig. 5: Capacitance temperature variation normalized to 100% capacitance at 25°C.

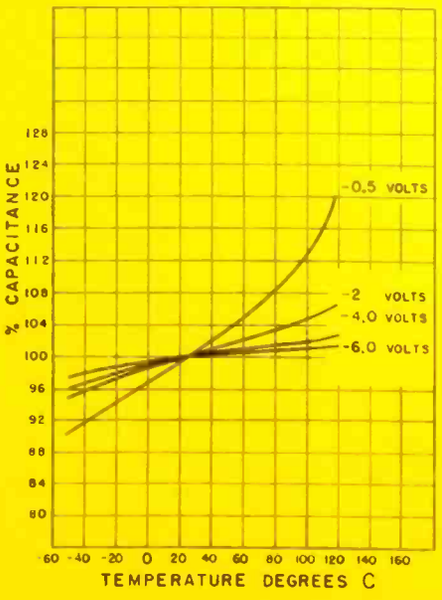
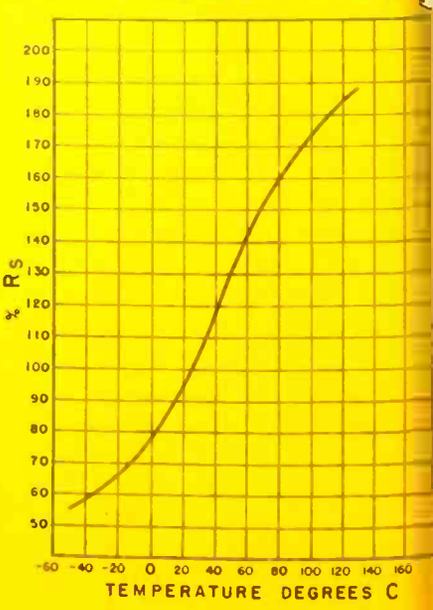


Fig. 6: Series resistance vs temperature normalized to 100% Rs at 4 volts and 25°C.



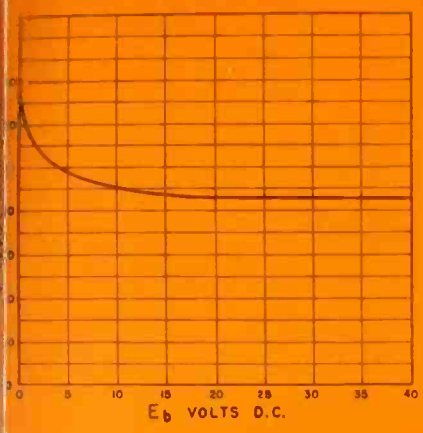


Fig. 7 (left): R vs V, for Varicaps.

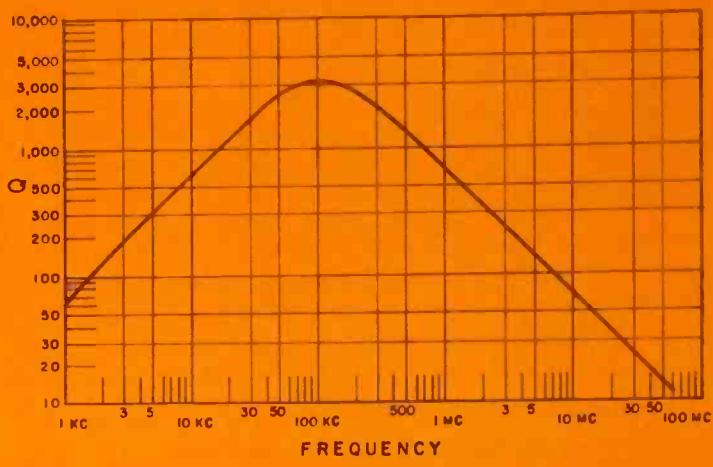


Fig. 8 (right): Q vs F for V47 Varicap.

The equivalent circuit is shown in Fig. 3 where:

C = the junction capacitance

R_s = series resistance due to the bulk resistivity of the semiconductor base and connecting leads

R_B = leakage resistance and is the dynamic inverse resistance of the junction

L = series inductance

Typical ranges are C (at 4 volts), from 7 to 100 μμf; R_s, about 5 ohms; R_B, one hundred megohms and higher; L, about 5 milli-microhenries; Q at 50 MC, from 10 to 20, and maximum operating voltage from 1 to 100 volts.

Sensitivity

The capacitance sensitivity of the V series silicon alloy Varicap approaches the theoretical inverse square root function for abrupt junctions. A typical normalized Capacitance-Voltage Curve is shown in Fig. 4. The actual curve is seen to closely follow the inverse square root function, particularly at the higher bias voltages where V_o becomes negligible. Capacitance variation with voltage and temperature is shown in Fig. 5. It is to be noted that the capacitance is fairly independent of temperature at the higher bias levels and that it becomes increasingly temperature sensitive with lower voltages. This is in good agreement with theory since the major uncompensated temperature effect is the internal contact voltage, V_o, term in Eqn. 4. For silicon, V_o is approximately 0.8 volts at 25°C and decreases to 0.4 volts at 150°C. The relative temperature insensitivity of the Varicap over a large portion of its operating range is one of its major advantages. Capacitance variation with frequency up to 50 MC appears to be quite small and not observable with the measurement accuracy achieved up to this time.

Resistance

The series resistance, R_s is due to the semiconductor bulk resistance and connecting lead resistance. For silicon alloy Varicaps the major effect is due to bulk resistance. R_s can be expressed as:

$$R_s = \frac{K_3 \rho (W - K_1 \sqrt{V + V_o})}{A} \qquad (5)$$

where K_1 and K_3 = constants

ρ = resistivity of the n region

W = effective bias thickness

A = effective junction area

The term $K_1 \sqrt{V + V_o}$ is recognized as the expression for depletion width (Eqn. 2). As the bias voltage is increased, effective base thickness is reduced by the penetration of the depletion region into the n-type base, thus reducing R_s. It is important to maintain R_s at a low value in order to minimize the energy lost, i.e., to achieve a high Q. Curves showing the variation of R_s with temperature and voltage are given in Figs. 6 and 7.

The leakage resistance is very high and is very temperature sensitive. The current-voltage relationship can be written:[5]

$$I = I_s (e^{qv/kT} - 1) \qquad (6)$$

$$I_s = \frac{k\,T\,A\sigma_i^2}{q} \times \frac{\mu_n/\mu_p}{(1 + \mu_n/\mu_p)^2} \left[\frac{1}{\sigma_n L_p} + \frac{1}{\sigma_p L_n}\right] \qquad (7)$$

where k = Boltzmann's constant

q = electronic charge

T = absolute temperature of the junction in °Kelvin

A = effective junction area

σ_i = intrinsic conductivity

σ_n = n region conductivity

σ_p = p region conductivity

μ_n = electron mobility

μ_p = hole mobility

L_p = diffusion length of holes

L_n = diffusion length of electrons

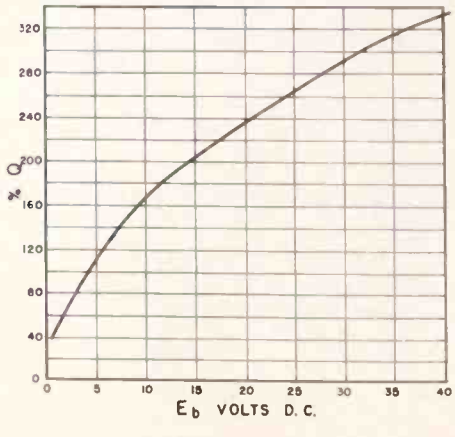


Fig. 9: Q vs V, normalized to 100% at 4-v bias.

Varicap, *(Continued)*

The saturation current, I_s, is well below one microampere and is normally of the order of 0.01 μa at 25°C. This current primarily determines the drain on the bias supply during operation. It is quite temperature-sensitive and approximately doubles every eleven degrees centigrade increase in temperature. The leakage resistance in the quivalent circuit of Fig. 3 is the dynamic resistance and is determined by the change of I with voltage, i.e., $R_B = \Delta V/\Delta I$.

The figure of merit, Q, is the ratio of stored energy to dissipated energy and is commonly used to define the efficiency of capacitors, coils, and tuned circuits. Q, then, for a capacitor is equal to the ratio of series reactance to effective series resistance. For the Varicap equivalent circuit, Q is determined as follows:

$$Z = R_s + \frac{\frac{1}{j\omega C} \times R_B}{R_B + \frac{1}{j\omega C}} \tag{8}$$

which simplified yields

$$Z = \frac{R_s R_B^2 \omega^2 C^2 + R_s + R_B - j R_B^2 \omega C}{R_B^2 \omega^2 C^2 + 1} \tag{9}$$

and

$$Q = \frac{X_C}{R} = \frac{R_B \omega C}{R_s R_B \omega^2 C^2 + R_s/R_B + 1} \tag{10}$$

also

$$Q_{max} = \frac{1}{2R_s}\left[\frac{1}{R_B}\left(\frac{1}{R_s} + \frac{1}{R_B}\right)\right]^{-1/2} \tag{11}$$

at

$$\omega = \frac{1}{C}\sqrt{\frac{1}{R_B}\left(\frac{1}{R_s} + \frac{1}{R_B}\right)} \tag{12}$$

The variation of Q with frequency for a typical *V47* Varicap of 47 μμf capacitance, 5 ohms R_s, and 200 megohms R_B, is shown in Fig. 8. The Q peaks at a value of 3,140 at 108 KC for this unit. For frequencies above about 2 MC the R_B term becomes negligible and Q may be expressed as:

$$Q = \frac{1}{R_s \omega C} \tag{13}$$

Substituting (4) and (5) into (13) and simplifying yields:

$$Q = \frac{\sqrt{V + V_o}}{\omega \sqrt{\rho}\,(W - l)\,K_1} \tag{14}$$

In order to maximize Q we therefore require low resistivity material with minimum base thickness. It should be noted that Q is independent of junction area. Experimental curves of the variation of Q with voltage and temperature are given in Fig. 9 and 10.

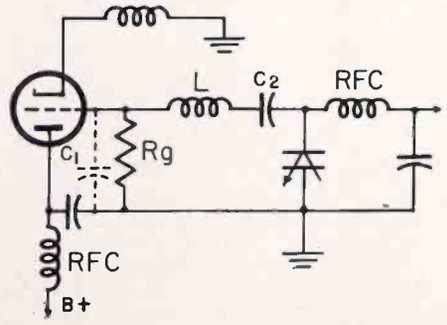


Fig. 11: TV oscillator with AFC.

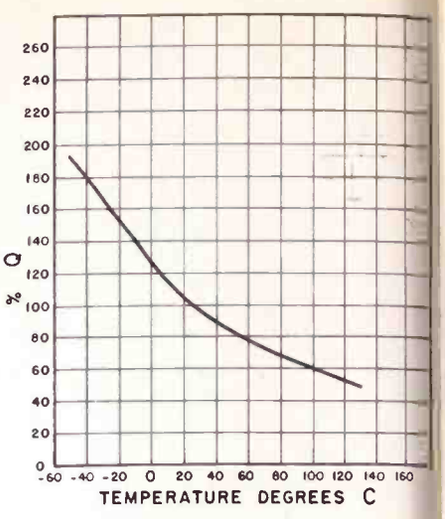


Fig. 10: Q vs T, normalized to 100% Q at 25°C.

Increasing Q

One way of increasing the effective Q is by series or shunt padding with a high Q capacitor. Series padding is normally preferable to shunt padding where more uniform Q and sensitivity are desired. Adding such a series loss-free capacitor, C_p, will increase Q by a factor $(C + C_p)/C_p$. This has the disadvantage, however, of reducing the net capacitance and capacitance sensitivity.

The series inductance of the Varicap and its leads is important at the higher frequencies. The inductance itself is of the order of 5 mμh. In addition, lead inductance must be considered and can be calculated for a straight wire by:[6]

$$L = 0.00508\, l \left(2.303 \log_{10}\frac{4l}{d} - .75 + \frac{d}{2l}\right) \tag{15}$$

where L = inductance in microhenries
l = length of wire in inches
d = diameter of wire in inches

The operating voltage range is determined by the saturation voltage. The maximum operating voltage for *V* series Varicaps is typically specified at 80% or less of the actual saturation voltage of the device. For silicon alloy junctions from 10 to 300 volts, the saturation voltage can be represented by:[7]

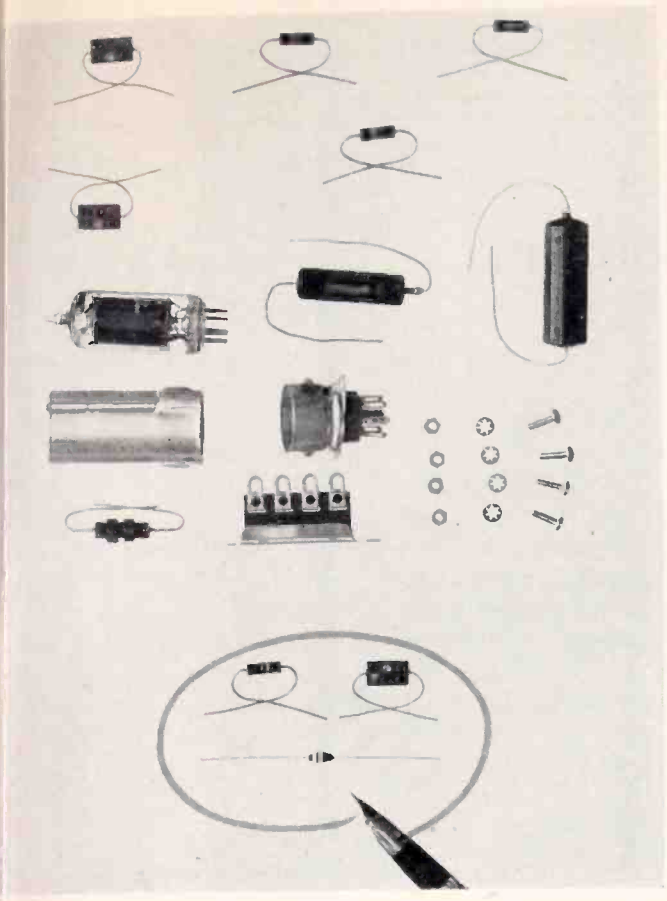
$$V_B = 2.2 \times 10^{12}\, N_I^{-0.66}$$

where V_B = saturation, or breakdown, voltage
N_I = net number of impurity centers per cc on the high resistivity side of the junction

Lower resistivities will therefore yield lower saturation voltages which often place a design limit on the Varicap. The limiting case of approximately 15 volts is obtained by utilizing silicon material of 0.1 ohm centimeters resistivity.

Applications

There are numerous applications for Varicaps in the design of electronic circuits. Some of these are discussed in this section. Many others will doubtless arise from the ingenuity of circuit design engineers



some circuits, the Varicap, with two tiny companion parts, can the work of 24 circuit components.

t an accelerated rate now that Varicaps with con-olled characteristics are commercially available. aricaps and associated circuitry can perform the nctions of amplitude modulation, frequency modu-tion, amplification, switching, and other control nctions. Amplitude modulation can be achieved by sing Varicaps as the capacitance section of a tuned rcuit or as a voltage sensitive reactance element a voltage divider network. Frequency modulation obtained quite simply by varying the voltage ap-lied to a Varicap in the tank of an oscillator. Ampli-cation is obtained by utilizing the Varicap in a esonant slope dielectric amplifier circuit. Switching s somewhat more difficult and less explored. It can e accomplished by the proper choice of series in-uctance and resistance and utilizing the increasing eactance with voltage characteristic of voltage varia-le capacitors to obtain two stable operating points n either side of an unstable condition.[8] Other con-rol applications include variable filter circuits, fre-uency multiplication and division, and mixing.

The applications that will be described in this sec-ion are: (1) automatic frequency control of tele-ision and FM receivers, (2) frequency modulation, 3) voltage controlled oscillators, (4) Varicap ampli-iers and (5) voltage controlled variable filter circuits.

AFC

Varicaps may be used in automatic frequency con-rol of television and FM receivers. They may also be sed to replace reactance tubes in conventional AFC ircuits. A practical AFC circuit for television receiv-rs using voltage variable capacitance semi-conductor devices has been described by Pan and Ramanus.[3] The television oscillator used is shown in Fig. 11. The input voltage, V, is fed back from a discriminator and serves to vary the capacitance of the voltage variable capacitor and, hence, the frequency of the local oscillator tank circuit such as to keep the receiver on frequency. Neglecting the V_o term of Eqn. 3, the frequency sensitivity and loading effect of this AFC oscillator may respectively be shown to be:[3]

$$\frac{\Delta f}{\Delta V} = -\frac{1}{4}\frac{f}{V}\frac{1}{1+\frac{C}{C_e}} \qquad (20)$$

and

$$\frac{Q'}{Q_1} = \frac{1}{1+\frac{Q_1}{Q}\times\frac{1}{1+\frac{C}{C_e}}} \qquad (21)$$

where C = voltage variable capacitance
C_e = additional series circuit capacitance
Q' = resultant circuit Q with varicap
Q_1 = initial circuit Q assuming zero varicap series resistance

$$Q = \frac{1}{W\,C\,R_s} = \text{varicap } Q$$

It is desirable to have large values of Q and C in order to minimize loading effect. On the other hand, C should be small in order to maximize frequency sensitivity. A similar design compromise enters in the choice of C_e which again oppositely effects frequency sensitivity and circuit loading.

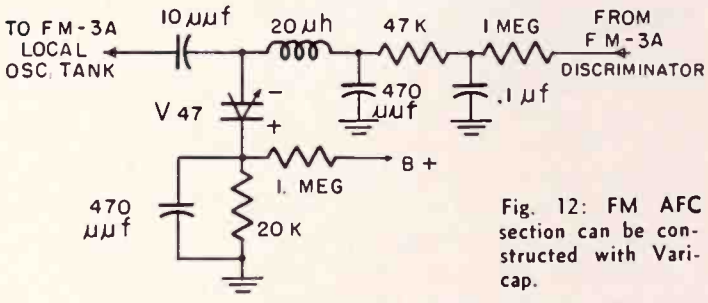


Fig. 12: FM AFC section can be constructed with Varicap.

Varicaps can similarly be used to provide AFC in FM receivers or to replace reactance tubes in existing AFC circuits. A Harman-Karden FM tuner has been modified at Pacific Semiconductors by replacing a tube with a Varicap to achieve AFC. This modification was made with a net decrease in the number of components used. In addition, a Heathkit Model FM-3A tuner without AFC was modified to provide Varicap automatic frequency control. The changes to this tuner are shown in Fig. 12. In this circuit the Varicap is supplied a filtered dc voltage from the output of the FM discriminator and a bias voltage of approximately 4 volts from a $B+$ voltage divider. The Varicap is coupled to become a part of the resonant tank circuit of the local Hartley oscillator and acts to tune the oscillator to the desired frequency when the discriminator output indicates a frequency discrepancy. The entire conversion can easily be accomplished in less than a half hour of assembly.

(To be continued)

What's New . . .

New Strain Gage Filament

A NEW technique is being used to produce one-piece strain gage elements. Micro-Test, Inc., of Los Angeles, Calif., is now using electrolytic etching to produce tapered filaments, thus eliminating the weld between gage filaments and leads.

In Fig. 2 the tapered transition between the large and the small diameter sections of this new device is compared with the rather abrupt change in the old jointed version wherein a small (.0007-in. diameter) wire was spot welded to the .007-in. lead wire.

An automatic electrochemical lathe is used to etch down the central portion of a .007-in. diameter *Evanohm* wire to form a unique resistance strain gage element.

This new filament provides many advantages in manufacturing and quality control. Of far more significance, however, is its contribution to the stability and reliability of the weldable high temperature strain gages.

The zero shift in these new jointless strain gages is consistently under 100 micro inches per inch when subjected to temperatures of 800° F. (provided the gage has been "cured" as described in later paragraphs).

Zero shifts in jointed gages have been as high as 40,000 micro inches per inch (several ohms) under similar temperature conditions.

The small diameter, high resistance strain sensing element of the Weldable Gage is relatively short (approximately .85 in. for the 60 ohms version). Thus an effective change in length of only .001 in., which might easily be introduced through oxidization or mechanical changes at a joint, would represent a fictitious strain of over 600 micro inches per inch —equivalent to a stress error of 18,000 psi in steel.

This follows from the fact that the resistance change $\Delta R/R$ would be proportional to the change in length $\Delta L/L$ (.001 in.).

$$\Delta R/R = \Delta L/L = \frac{.001''}{.85} = .0017.$$

The equivalent strain, ϵ, required to produce this same $\Delta R/_R$ would be (assuming a gage factor, G, of 1.85):

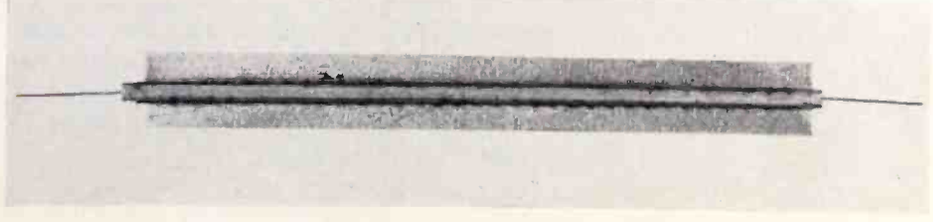
$$\epsilon = \frac{\Delta R/R}{G} = 630.$$

The short length of the strain sensing portion of the old gage filaments probably amplified the errors caused by contact changes at the joint. However, the junction between fine wire and lead wire has been a problem in all strain gages—a particularly difficult problem in gages intended for use at elevated temperatures.

Stress concentrations at the usual abrupt change in section of a joint and the possible thermo-

(*Continued on page* 126)

Fig. 1: This strain gage unit uses the new etched filament, with no welds in leads.



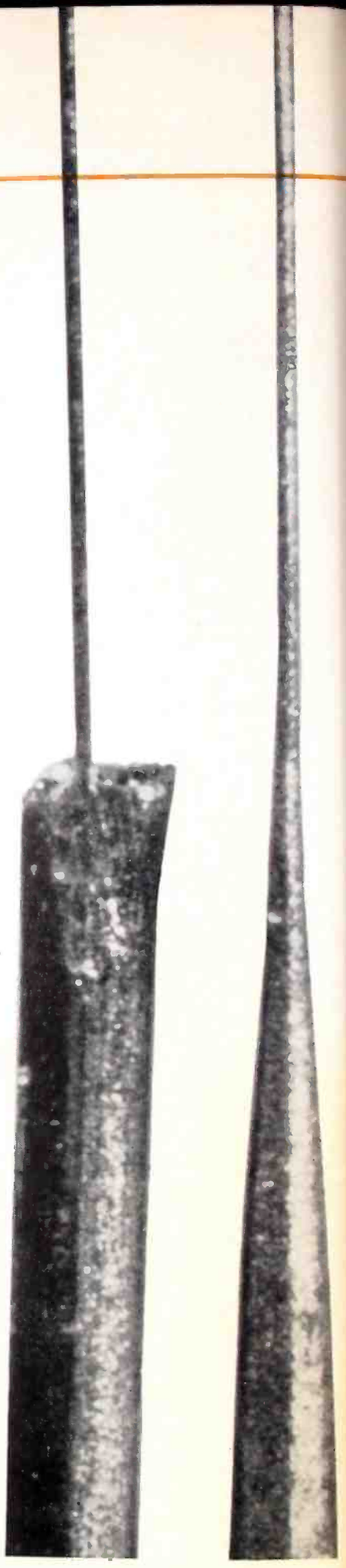


Fig. 2: The etched, tapered transition between leads and strain gage filament is stronger and more stable than welded joints.

Differential Triode

DC differential amplifiers require unusually high stability to avoid drift that is due to shock or thermal expansion. In a new subminiature double triode tube, the CK6832, Raytheon has used several design techniques to minimize such effects. Grids are placed under slight torsion, and cathodes are spring-loaded into wedge-shaped holes in the mica spacers. These measures give greatly improved stability under shock and repeated on-off cycles.

As an additional precaution, the heaters of the two triode sections are in parallel instead of in series. This greatly enhances the thermal balance between the two cathodes during operation. The net result of these special design features is a subminiature double triode particularly adapted to DC amplifier applications.

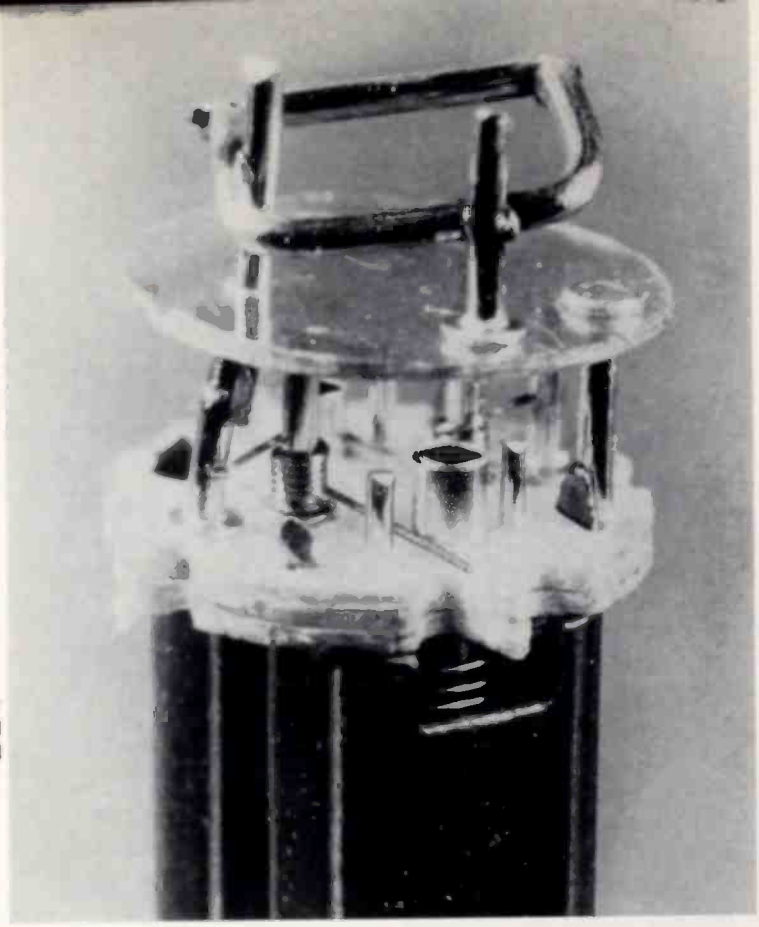


Fig. 1: The new subminiature dual triode differential amplifier tube.

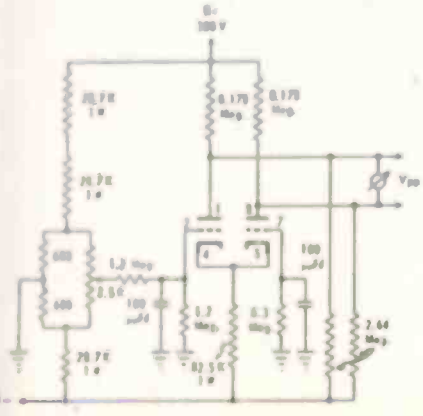


Fig. 2 (left): In this differential amplifier circuit, drift will cause false signals.

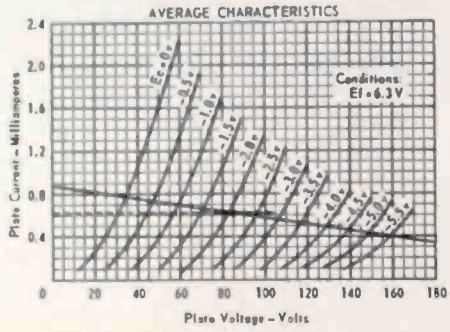
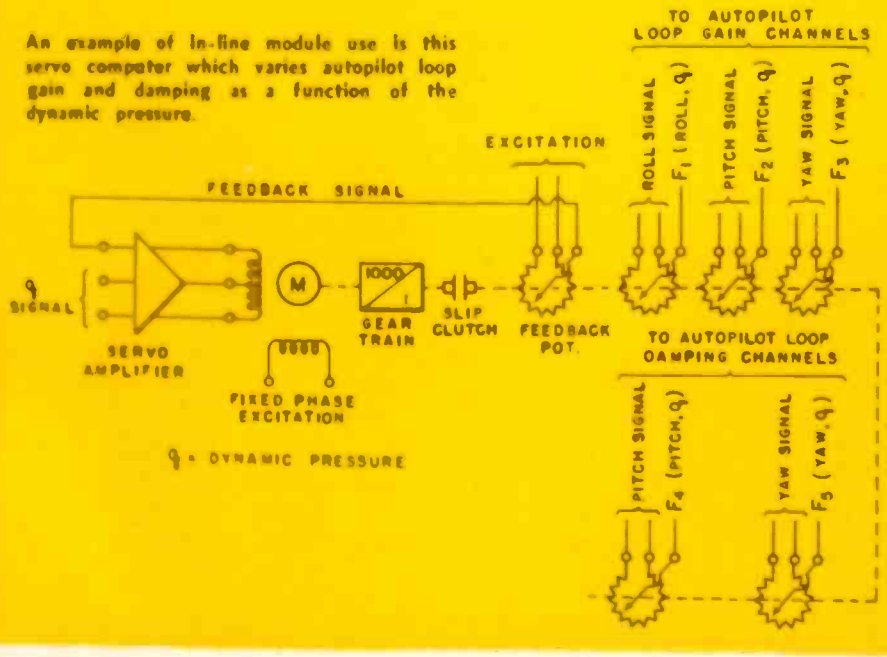


Fig. 3 (right): Average characteristics of the new Raytheon CK6832 dual triode.

In-Line Modules

A NEW "twist" has been given to sub-system module design. The design of logical system modules has been a difficult problem, usually requiring a disproportionate amount of engineering effort. Now, Spectrol Electronics Corp., San Gabriel, California, has designed a family of in-line units which can be simply assembled to form the required logical subassembly. Included are motors, gear trains, slip clutches, linear and non-linear potentiometers, switches, synchros, resolvers, induction potentiometers, and tachometer-generators.

An example of in-line module use is this servo computer which varies autopilot loop gain and damping as a function of the dynamic pressure.



"In-line" mechanisms are defined as a series of coaxially packaged components for which overall performance and environmental characteristics are specified. An example of such a system would be a coaxially mounted servo motor, a gear reduction, a slip clutch, and six precision potentiometers. No other fabricating principle is so effective in reducing the tolerance build-up within the mechanism, with space and weight optimization, and with

(*Continued on page* 119)

Improving the Deflection Amplifier

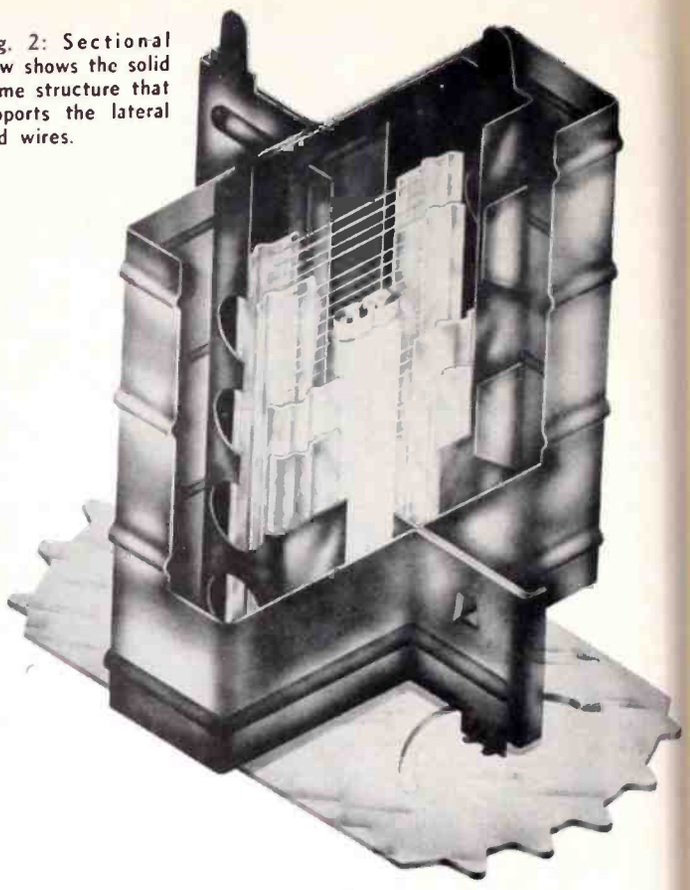


Fig. 2: Sectional view shows the solid frame structure that supports the lateral grid wires.

A radical new support positions the grid wires at exactly 90° to the vertical. Under constant tension, the wires do not warp, bow, or short circuit. The structure and unusual characteristics offer advantages not found in conventional types.

By CYRIL DROPPA

Advanced Application Laboratory
General Eng'g Dept.
Sylvania Electric Products Inc.
Emporium, Pennsylvania

THE horizontal-deflection amplifier has long been recognized as one of the most critical tube applications in a television receiver. The human eye continually monitors the operation of this tube in terms of its effect on picture scan and brightness. Thus, any loss in performance is immediately evident to the viewer.

Fig. 1: Comparative failure rates of tubes in critical applications.

CIRCUIT	PERCENT FAILURE BY CIRCUIT		
	1954-'55	1955-'56	1956-'57
HORIZONTAL AMP	25	34	17
VERTICAL AMP	25	29	16
DAMPER	33	17	9
VHF CASCODE AMP	22	18	7

The requirements imposed on this amplifier are quite severe. The energy it delivers to the horizontal-deflection system must perform many functions, such as providing horizontal scan, high-voltage to the picture tube, and focusing voltage. It must also provide filament voltage for the high voltage rectifiers, keying pulses for the AGC system, and a feedback timing pulse for some types of horizontal-oscillator control systems.

The horizontal-deflection system is being monitored not only by its ability to provide sufficient scan and high voltage, but also by other circuits whose operation depend upon the signal derived from the horizontal system.

Based on a paper presented by Mr. Droppa at the IRE National Convention, March 1958, New York, N. Y.

Fig. 1 illustrates the comparative failure rates of tubes used in the four most critical applications in TV receivers. The data is based on recorded observations of several-hundred commercial receivers of two different manufactures over a three-year period. Tests were conducted at 130 v. line, for 1500 hrs. This accelerated the tube failure rate by roughly 2.4 times the rate encountered at normal 117 v. operation.

In recognition of the problems encountered with horizontal-deflection types, an extensive program was undertaken to develop a fundamentally improved type for horizontal-deflection service.

The result of this investigation, the Sylvania "Framelok" Type 6FH6, is an unusual tube that represents a radical departure from conventional tube structures. Even though it embodies a new concept in tube design and requires new manufacturing techniques, it ultimately will be produced at a high-volume level and at a relatively low cost. A sectional view of the 6FH6 is presented in Fig. 2. It will be noted that the conventional, round, grid-support rods with the familiar wound grid lateral wires are not present in this structure; instead these are replaced with a solid-frame structure that supports the grid lateral wires at an exact 90° in relation to the sides of the frame.

Reasons for Tube Failure

Life data collected on deflection amplifier types discloses that short circuits, intermittent arcing between the elements, and screen emission account for the greater part of the high failure rate of these types. Experience has shown that these failures are aggravated by excessive screen dissipation and that failure can occur in either of two ways. First, the screen may simply burn up, or become bowed and short to the other tube elements. Second, the screen may become a primary emitter, and the uncontrolled flow of current from the screen to the plate will cause reduced scan and high voltage.

The usual expedients, such as heat-radiating tabs attached to the grid siderods, two grid connectors and heavier leads in the stem, are only moderately effective in minimizing the adverse effects of heat, because they are too far removed from that area most susceptable to heat, the grid lateral wires.

"Framelok" Grid Structure

Fig. 3 clearly illustrates how this grid structure can contend more ably with those factors that influence tube life. The mass and large-surface cooling area of the frame makes it inherently a more effective heat sink then the siderods of the conventional screen grid; cooler operation of the lateral wires is further enhanced by their short, straight, heat-conducting path to the supporting frame.

Fig. 3A is a view of that surface of the screen grid closest to the control grid. The reverse side of the screen grid is shown in Fig. 3B. Each of the grid lateral wires is under tension and is firmly anchored to the inner surface of the ridged frame by a nick and peen operation.

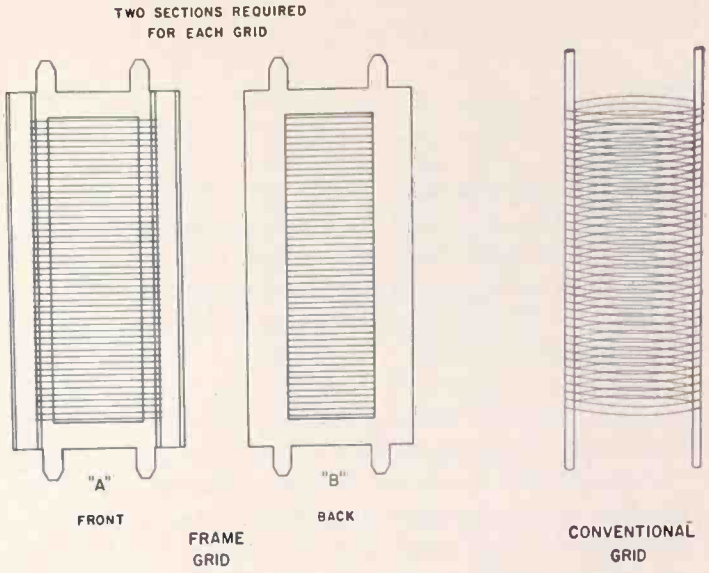


Fig. 3: Comparison of screen grids readily shows that the large surface cooling area of the frame makes it a more efficient heat sink.

The tension applied to the wire lateral prevents grid wire sagging, and bowing, and also virtually eliminates the possibility of shorts between the cathode, control grid and screen grid.

The end-view of a complete tube mount, Fig. 4, illustrates that two of these frames are contained in a complete grid. It will be noted that each frame is bent at the outer edges to give added rigidity. This formed edge is also a valuable aid in preventing jamming of the grid wires during the assembly of the tube. This view also demonstrates the exact parallel alignment, symmetry, and spacing that is attained between the elements, because of the absences of grid wire warping and bowing, a defect that occurs with the conventional wound grid.

Each of the two frames, comprising a complete grid, is accurately positioned by four mounting tabs that extend through the upper and lower mica supports. A view of the upper mica, Fig. 5, illustrates that both halves of each grid are joined together by a U-shaped strap.

Limiting Factors

Improvements in deflection components, more efficient circuits, and the small-neck picture tube have made the 110° TV receiver a reality. However, the

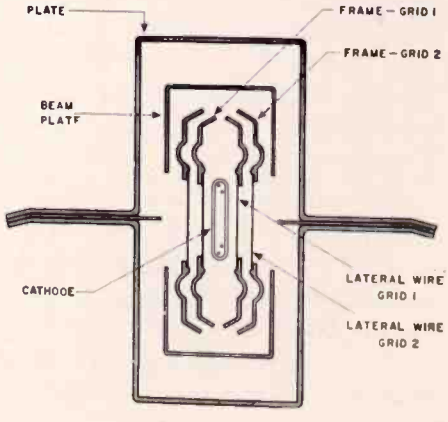


Fig. 4: Cross-sectional view of a complete tube mount employing frame grids.

circuit-design engineer still must contend with those conflicting requirements represented by marginal scan and high voltage at reduced line voltages. He must also consider excessive screen dissipation and short tube life of the horizontal-deflection amplifier at high line voltages.

Preceding comments indicate that some of the causes for tube failure are reduced by the 6FH6 structure. Further relief from these circuit design considerations is offered by the reduced screen dissipation made possible by virtue of the high plate-to-screen-current ratio of the 6FH6.

Plate-Screen Current Ratio

The reduced screen current and excellent plate-to-screen-current ratio of the 6FH6 is evident in the zero-bias plate- and screen-current curves displayed in Fig. 6. A 20 to 1 ratio is realized at a plate current of 300 ma. and a screen current of just 15 ma. at those plate and screen voltages shown in Fig. 6. Corresponding curves of the 6DQ6A disclose an 11 to 1 ratio at a plate current of 300 ma. and a screen current of 27 ma.

A brief description of the tube design considerations that affect the grid alignment of conventional wound grids will help to explain how a high plate-to-screen ratio is achieved in the 6FH6.

If low screen current is to be realized, it is essential that the screen lateral wires be directly in line with, or lie in the shadow of, the control grid wires. It is evident in the wound grids shown in Fig. 7B that even the turns-per-inch of both the control grid and screen grid are the same, the difference in the major diameter of these grids causes the grid laterals to have a different slope. It is equally evident that the ideal situation just described exists only at the midpoint. As the wires extend away from the midpoint, more of the screen grid becomes exposed to the cathode current. Obviously, this results in a less favorable plate-to-screen-current ratio. In addition, the screen intercepts cathode current that might have been realized as useful output in the plate circuit.

Compare this with the parallel-planar alignment that is attained with the frame grids shown in Fig. 7A. Cross-over of the grid wires has been completely eliminated and the ideal alignment exists over the entire length of each lateral wire. The plate-to-screen-current ratio can be further improved if the diameter of the screen lateral wire is smaller than

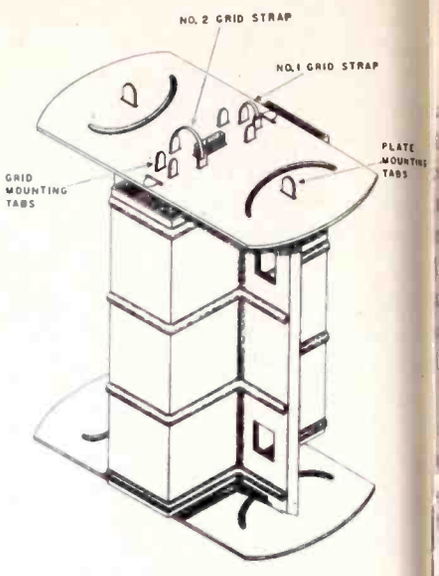


Fig. 5: Top view shows relation of mounting tabs and mica. Straps join grid halves.

that of the control grid. This was done with the 6FH6 grid. These are the two features of the "Framelok" structure that account for the high plate-to-screen-current ratio of the 6FH6 deflection amplifier.

High-Voltage Cutoff

Another aspect of TV set performance, insufficient high voltage and brightness, is often caused by a remote cutoff characteristic in the horizontal deflection amplifier. The spread in the cutoff characteristic that might be expected in tube production did not represent a problem with the TV set designs of several years ago, which invariably included a grid-drive control. With the current trend toward reduced costs and simplification of circuitry, this control has been eliminated and tighter cutoff specifications had to be adopted by the tube industry.

High-voltage cutoff in deflection amplifier types is affected by the grid-cathode spacing, alignment of the grids, the care taken to avoid jammed grid turns,

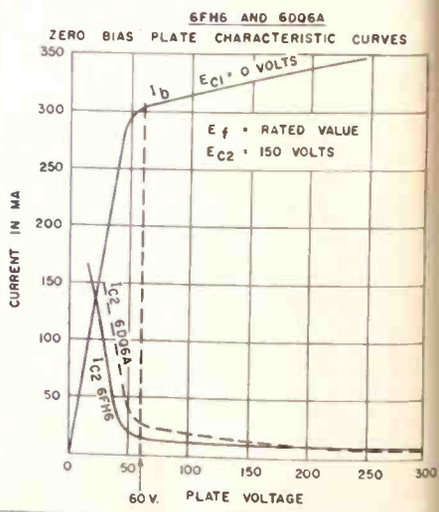


Fig. 6: These curves make evident the reduced screen current and excellent plate - to - screen - current ratio.

	I_b	I_{c2}	PLATE TO SCREEN CURRENT RATIO
6DQ6A	300	27	11:1
6FH6	300	15	20:1

ar conduction around the end turns of the grid structure.

'ig. 8 shows a section of the control grid that is acent to the mica support. Experience has shown t this part of the grid structure is the most susetable to uncontrolled conduction because the elec- flow in the vicinity of the mica is primarily inuenced by only the last turn of the grid winding. A variation in the position or distortion of this la turn, due to any one of a number of reasons, will e an adverse effect on the tube cutoff characteris-

'he bridge of the frame grid, also shown in Fig. 8, is a part of the solid structure that rests directly inst the surface of the mica. It prevents the ds from becoming jammed against the mica in mounting operation and automatically positions l aligns the grid laterals of the control grid with se of the screen grid.

Electrically, the bridge can be thought of as an ension of the control grid that contains an inased number of turns. The control grid is then ective over the entire length of the grid structure d provides better control over the plate current the presences of high plate pulse voltages.

t is the more uniform consistent cutoff characterstic and closer tolerances that can be attained in oduction with the frame grid tube that assure good h-voltage operation in horizontal-deflection circits.

Horizontal Deflection Evaluation

Both the 6FH6 and 6DQ6A were examined in the 0° deflection circuit shown in Fig. 9. This circuit typical of those presently used in most 110° TV eivers. Data recorded at a screen voltage of 150 v. eals that the low screen current, which is charteristic of the 6FH6, resulted in a screen dissipan of less than 1.0 w. This compares quite favorle with the 1.45 w. dissipation of the 6DQ6A. The v screen current also became evident as a lower hode current, and, even though conservatively

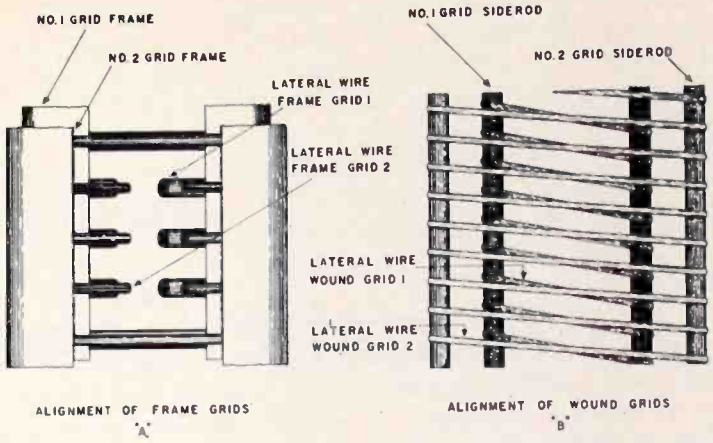


Fig. 7: A comparison of the conventional and frame grid alignments.

operated, both the width of scan and high voltage were slightly better than that of the 6DQ6A. The reduced grid drive required by the 6FH6 reflects its good high-voltage cutoff characteristics.

No doubt the 6FH6 will be also considered in terms of the increased scan and high voltage that might be realized in those deflection circuits presently using the 6DQ6A. At the higher screen voltage and increased grid drive shown in Fig. 9, the 6FH6 gave 1.0 kv more high voltage and 0.4 in. more scan than the 6DQ6A. The screen dissipation at 1.35 w. was quite reasonable and did not exceed that of the 6DQ6A.

The low screen current of the 6FH6 will also become evident as a higher screen voltage in most deflection circuits. And, if optimum circuit performance is to be realized, it may be necessary to increase the grid drive beyond that presently required with the 6DQ6A. A few trial-and-error adjustments should readily determine the correct grid drive for a given screen voltage.

These comparisons illustrate that the low screen dissipation that can be expected with the 6FH6 permits the circuit design engineer a wider latitude in selecting those operating conditions that give the desired set performance.

Fig. 8: Bridge of frame grid rests directly against mica surface.

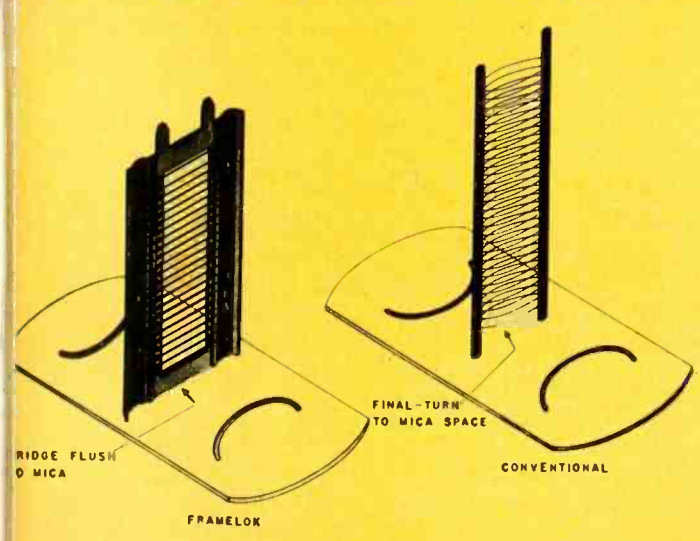
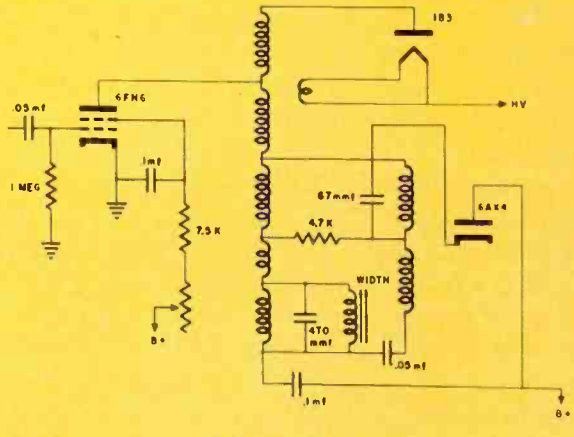


Fig. 9: A 110° deflection circuit in which the tubes were examined.



110° DELECTION DATA

	B+	I_K	I_{C2}	E_{C2}	P_{C2}	ORIVE	HV120µa	HV 0µa	SCAN
6DQ6A	250V	128ma	9.7ma	150 V	1.45 W	148 V	15.0 KV	15.9 KV	FULL
6FH6	250V	123ma	6.5ma	150 V	0.98W	134 V	15.2 KV	16.1 KV	+0.2"
6FH6	250V	134ma	8.3ma	162 V	1.35W	142 V	16.0 KV	17.0 KV	+0.4"

Weapons systems and controls require . . .

Automatic Checkout Equipment

You can't use hand checkout methods with modern weapons systems. But automatic checkout systems are expensive. One answer to this dilemma is to design the checkout system so it is easily adaptable to different systems. As the author points out, this requires a rational approach to both system design, and selection of sub-systems and components.

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

Part Two of Two Parts

IN order to develop automatic test equipment, it is necessary to establish what are the parallel paths of mechanization that can be utilized, and what commercial components and assemblies are available. This information will be presented for each of the separate sub-systems that were proposed in the design philosophy in Part 1 of this article: instruction center, stimuli, data summary and self-test.

Rem-Rand

The Remington-Rand card has 90 vertical columns with each containing six round holes. The card is usually divided equally into an upper and lower section, with each section utilizing the whole length of the card. Each column of the card is headed by a 0 position, with the next five positions beneath this representing (1, 2), (3, 4), (5, 6), (7, 8), and (9). The odd numbers and 0 are represented by a single punch; the even numbers are represented by a two-hole punch in each column, one punch in the hole for an even number, and the other in the nine position. For representing the alphabet, a two- or three-hole punch is required.

Both cards may be read one column at a time, a field or section at a time, or the entire card at a time, depending on the type or reading equipment used.

Data may be introduced to the punched cards in several different ways, such as from a manually operated keyboard punch, a tape-reading punch, or special purpose equipment for automatically transcribing data on the cards. Normally, with an experienced operator, the manual punching of numerical data from a clear set of instructions may be done at the rate of 125 cards per hour with 80 punches per card.

Punched Tape

Another popular type of instruction source is punched tape. This tape can be made of many different materials, such as paper, nylon, fibre, steel, etc. The tape is usually opaque to light, physically strong enough to operate feelers, and has a low electrical conductance. Information is contained in an array of holes which are placed in the tape and located in reference to socket perforations. An area in a tape may have two possible elementary states, punched and not punched. The data is almost always therefore in binary coded decimal form. One row across the width of the tape is known as a frame and the frame normally contains from zero to 8 perforations, but may contain as many as ten rows of zero to 8 perforations. However, some tape is available with as high as 0 to 24 holes, in one row; but the reliability is questionable.

The minimum spacing between holes and frames is determined by the tendency of the tape to shrink or stretch, the precision with which the holes can be

punched in the tape with reference to the sprocket perforations, and the minimum spacing of the read-out equipment. The minimum time interval between digits is, therefore, directly proportional to the minimum spacing between holes and inversely proportional to the maximum linear velocity at which the tape can be moved with accurate guidance. The cost of paper tape is very low, being on the order of one dollar per three million binary digits in the case of common five-hole teletype transmitting tape, and 75 cents per 1000 foot roll for five-hole paper tape used in many office desk calculators.

The tapes are normally prepared by special punching equipment designed by the same company who designed the tape reader, and are almost always of the keyboard type. The preparation of three-hole tape is usually fairly slow if done manually, being on the order of ten frames per minute; but automatic punching equipment is available that will greatly increase this speed.

Magnetic Tape

Magnetic tape is by far the fastest and largest capacity instruction source, and is similar to punched tape in operation. Information is stored in the tape utilizing a recording head, which is an electromagnetic energized by signal current. The recorded pattern of resonate magnetization along the tape or carrier is related to the pre-determined time variation of signal current. The magnetizable medium, or carrier, may take a variety of physical forms. It may be a homogenous metallic wire or tape. The magnetic material may be an alloy of appropriate magnetic properties, plated on the surface of a ductile non-magnetic tape utilizing metal, fiber, or paper base. The choice of carrier is dependent on several factors, such as speed, life, size available, environment, etc.

The capacity of coated paper tape is in the order of 3×10^9 digits per cubic foot, and the cost is in the neighborhood of 10^7 digits per dollar. Read-write speeds are as high as 10^5 digits per second, but for automatic check-out usage, top speed of 2500 digits per second is all that is recommended for reliable operation.

Instruction Reader

There are numerous instruction readers available for each of the different types of instruction sources previously listed. Table I presents a breakdown of the commercially available reading equipment that appear to be well suited for automatic check-out equipment; included are the size, weight, cost, and a brief description of their operations. Where possible, the equipment for coding the instruction source is also included since this is required as an accessory.

Table One (continued)

Classification	Vendor	Part No.	Weight	Size	Est. Cost
Electronic Digitizer with Electrical Digital Readout	Franklin Electronics, Inc., Bridgeport, Pa.	Model 310A	50 lbs.	19″x8¾″x 15″	

The Model 310A is a fast all-electronic digital voltmeter useful in making precision voltage measurements. The input range is 0.0 to 120 volts DC, with an accuracy of 1 count equivalent to 0.1 volt. sixty readings per second may be made. A true differential input is available to allow relative measurements. A four decimal digit visual readout as well as a coded decimal electrical are provided. A read trigger voltage initiates a linear saw-tooth sweep which is applied to two comparators. When the saw-tooth sweep equals the output of the zero comparators, a gate generator is turned on which actuates a pulse generator and a decade counter. When the saw-tooth voltage equals the output of the input comparator, the pulse generator is turned off. The accumulated count equals the difference between the input and reference voltages and is displayed visually and is available in a 1-2-2-4 binary coded decimal form to drive a printer.

Contact Meter Relay	Assembly Products, Inc., Palm Springs, Calif.	Model 455-C	10–15 oz.	4½″ D., 2.46″ deep	$50–$115

Meter-relays are indicating meters with built-in relay contacts. One contact is carried on the moving element of the meter and the other is in a semi-fixed pointer which can be rotated about the same axis as the moving element. The contact settings are adjustable to any point on the meter scale. Contact arrangements are single (high or low) or double high and low. Meter ranges can be furnished from 0-5 microamperes to 0–50 amperes or 0-6 millivolts to 0–500 volts. All ranges can be supplied in AC or DC except low millivolts (under 0–250 MV.) due to rectifier limitations. Locking contacts are normally provided to avoid chatter and damage to contacts with a built-in self-interruptor provided to break the locking action. Normal interruption rate is once/sec., but rates as high as 25/sec. have successfully been used. This model number listed is a ruggedized sealed version recommended where environment may be severe. This device can be used directly as an analog comparator if the percentage tolerance desired can be maintained constant for several tests at a time. The meter contacts can then give a Go–No-Go and a Lo-Go–Hi visual and electrical readout directly.

Digital Elements Suitable for Development of a Digital Comparator	Navigation Computer Corp., Philadelphia, Pa.	—	—	—	—

Several types of 19″ rack mounted modules are available such as the following:

Model 113A—Four Input Amplifying "OR" Tri-Unit. This unit contains three individual "OR" circuits, each having four inputs and two amplified outputs. Both positive and negative output signals are available, with a 10 volt swing. Cost is $89. Model 117A Exclusive "OR" Tri-Unit performs the logical functions of Exclusive "OR" or material equivalence. A typical application is performing addition or subtraction of binary numbers in a computing or data processing system. Cost is $279.

Model 113—Tri-Input Amplifying Gate, Decode Unit—Consists of ten individual gates, each with three inputs and an amplified output. A 10 input "OR" circuit is also included for mixing 1 to 10 outputs on a common buss. Also included is a common amplifier for driving from 1 to 10 gates simultaneously. Cost is $289. Model 115B—Pulse Standardizer—Tri-Unit—Primarily used to convert pulses from any external source into standard 2.5 volt 1.5 microsecond pulses for the other NAVCOR Units. There are three standardizing flip-flops with automatic reset and a 2.5 V pulse standardizer. Cost is $199. Other models include pulse generators, binary counters, shift registers and pulse delay units.

Classification	Vendor	Part No.	Weight	Size	Est. Cost
Digital Elements Suitable for Development of a Digital Comparator	Ransome Research, San Pedro, Calif.	—	—	—	—

Several types of plug-in, transistorized and printed circuit digital computer elements are available for the design of industrial counting equipment, logical control systems and digital systems. All elements are designed on standard 4½″ x 5″ printed circuit cards with connections made by means of a 22 pin printed circuit connector. All units are rated for at least 500 KC operation with higher speeds available. Life tests to date indicate trouble-free operation for periods in excess of 25,000 hours. Some of the basic elements available are as follows: Series A3 and A4 DC Logical gate. The gating circuits are composed of two sections, the AND gate and the OR gate. All gates are provided with emitter follower output to avoid loading of the output and input. These two series of gates are designed to provide circuits adequate for the solution of most gating and control problems, but special units can readily be provided for specific applications. The series A3 units have five gates each with three AND inputs, and the five gates are connected in various AND/OR combinations. The A4 units have four gates each with four AND inputs per gate and four gates are connected in various AND/OR combinations. Other units available are Binary Decimal Counters, Flip-Flops, Shaping Amplifiers and power supplies.

Digital Printer	Computer Measurements, Inc., North Hollywood, Calif.	Model 400A	50 lbs.	17″x8½″x 14½″	$850

This instrument provides a permanent printed record of digital data, and has a print-out capacity of 6 digits with up to 12 digits optional. The print-out rate is 4 lines/sec. The input requirements are 4-line, 1-2-2-4 coded decimal and parallel entry. The unit is primarily designed to go with the CMC counter specified previously, but can accommodate any digital electrical read-out with suitable conversion equipment.

Numerical Data Printer	Clary Corp., Electronic Div., San Gabriel, Calif.	Model 1901	30 lbs.	11″x7″x 14″	$595

Model 1901 is a parallel entry three-digit (may be extended to 11 digit) remotely controlled data printer. The speed of the machine is three read-out cycles per second (maximum), and the input pulse duration required is 25 milliseconds minimum for the entry solenoids and 50 milliseconds minimum for the print solenoid. The data record is on 2¼″ paper tape. Data input solenoids dissipate 35 watts and control solenoids dissipate 70 watts. Standard solenoids are 1150 AC and are rated at 25% maximum intermittent duty. Solenoids are available for 24, 48, or 110 volt DC operation. Nine amount entry solenoids are provided in each decade and zeros are printed automatically by mechanical means.

Digital Recorder	Hewlett-Packard Co., Palo Alto, Calif.	Model 560A	60 lbs.	20½″x12″ x18½″	$1265

Model 560A consists of a motor-driven printing mechanism with inked ribbon, printing paper, eleven identical number wheels and eleven identical mixer and comparator circuits which position the number wheel according to the count appearing on the input device being recorded. A printing speed of five, 11-digit lines per second is available. In addition, an analog output voltage is available, proportional in either voltage or current to the number represented by any three consecutive digits of the recorded data. The driving source consists of a parallel entry staircase voltage derived from standard digital frequency counters such as HP 523B. Staircase descends from +135 V to +55 V as the count progresses from 0 to 9. Internal impedance of staircase source should be approximately 700,000 ohms. The analog output is one milliamp for galvanometer strip chart recorders and 100 millivolts for potentiometer strip chart recorders.

Automatic Checkout *(Continued)*

Input, Output Selection

Once the instructions have been provided, it is necessary that the instruction center set up the test procedure accordingly, by suitable switching of the stimuli input and outputs, the system under test inputs, and the data summary inputs and outputs. Since this operation involves as many as several hundred wires for a complex weapon system or industrial control system, some sort of matrix is required. This may be designed using solid-state switching devices,

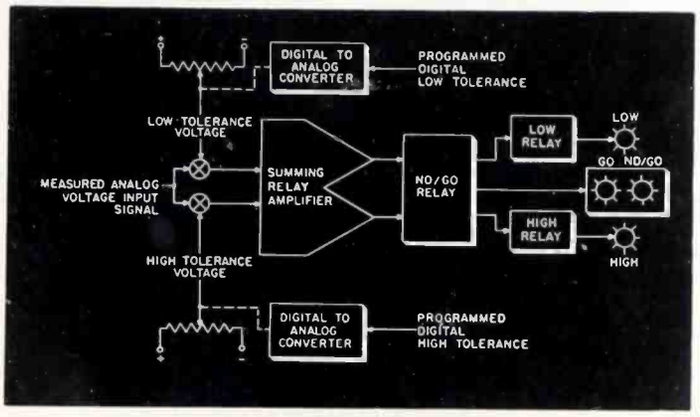


Fig. 7: Block diagram, computer functions of data summary subsystem.

relays, stepping switches, or crossbar switches. The problem is simplified somewhat since each test usually requires switching less than ten wires from the preceding tests. Switching design is well advanced, due to the vast amount of work done by the Bell Laboratories and Western Electric in order to develop telephone systems, and is referenced in the Bibliography.

Table I presents a summary of some of the most appealing types of components and assemblies that can be utilized to satisfy automatic switching requirements. The choice of which type to be used is a function of the complexity of the system to be tested.

Stimuli Sub-System

The generators utilized in this sub-system all receive commands for scale factor and desired output value from the instruction center, which appears most desirable to be mechanized in a digital fashion. Therefore, since all of the most common stimuli are analog in nature, it is necessary that each generator include a digital to analog converter. It should be recognized, however, that this is additionally desirable since the accuracy and repeatability of these generators must normally be very high.

As previously discussed, the stimuli generators required for automatic check-out equipment are not, in general, readily available, and typical units that are required will be discussed further along in this article. A few possible generators are listed in Table I, along with components that could be assembled together in order to produce complete generators.

Data Summary Sub-System

The most basic discussion affecting the design of this sub-system is to determine whether the final comparison between programmed tolerances and the measured output should be done with analog or digital information. Analog comparison is usually simple and probably more reliable due to less complexity, but lacks the accuracy and flexibility that goes along with digital techniques. However, the only practical way to automatically program large numbers of tolerance values is to use digital information. Therefore, if analog comparison is used, it is necessary to convert these tolerances into analog form, make the comparison, and then convert the analog outputs of the system being tested back into digital form in order to provide automatic data logging. The other possibility is to convert the measured system output to digital information, which is well within the state-of-the-art, using commercially available digital metering equipment listed in Table I, and then make a comparison with the programmed tolerances using well-established logical design techniques already proven in the digital computer field. Unfortunately, the exact mechanization required for automatic check-out equipment is not readily available. Requirements for what is really needed in the way of additional development will be discussed later in this article, but Table I presents a description of some of the important components that can be combined to prove such a comparator.

The actual readout of test data is normally not critical and several different schemes are possible. Since a permanent record is necessary for reliability studies, preventive maintenance, and system drift

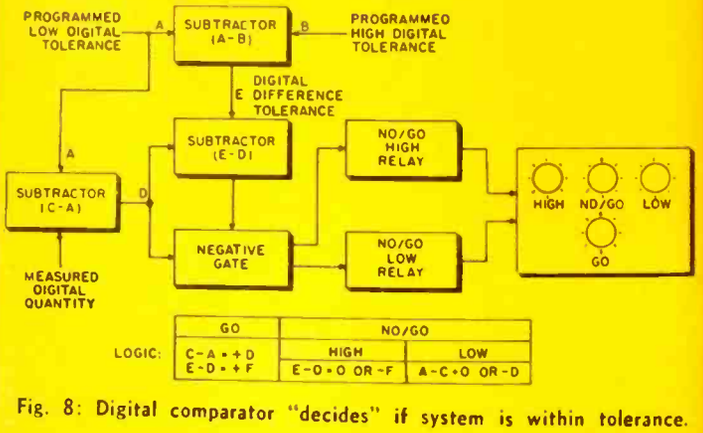


Fig. 8: Digital comparator "decides" if system is within tolerance.

studies, the field is narrowed down to punched card, punched tape, or printed tape. The latter of which can be accommodated by either an electric typewriter or an electric printer. Table I presents a description of the most appealing commercially available units, as to size, weight, speed, cost, etc.

Self-Check Sub-System

This is probably the simplest of all of the subsystems required for automatic check-out equipment, in that the major assemblies required are all off-the-

BLUE RIBBON CONNECTORS by CINCH

☆ VISUAL ALIGNMENT UNNECESSARY... RIBBON SPRING CONTACTS... FLOATING BUSHINGS...

The Wedge principle with the strong spring action of the contacts holds the connector in positive contact, and provides ease of insertion and withdrawal. The protective barriers between ribbon contacts insure uniform spacing. The entire length of the contacts is supported by quality dielectric. Multiple mounting makes it possible to make or break any number of circuits simultaneously. Molded-in mounting plates are of corrosion resistant passivated stainless steel.

24 CONTACT
PLUG AND SOCKET

IMPROVED TYPE

The above illustrates the improved design of plug and socket casting which eliminates any possible breakage.

Commercial plating and contact material. Mica body Type MFE per Mil.-M-14E.

36 - 4100 - 8P (355)
36 - 4200 - 8S (355)
36 - 4100 - 16P (355)
36 - 4200 - 16S (355)
36 - 4100 - 24P (355)
36 - 4200 - 24S (355)
36 - 4100 - 32P (355)
36 - 4200 - 32S (355)

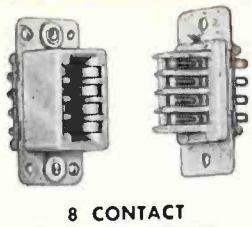
Military plating and contact material. Nylon filled Diallyl body Type MDG per Mil.-M-14E.

36 - 4100 - 8P (340)
36 - 4200 - 8S (340)
36 - 4100 - 16P (340)
36 - 4200 - 16S (340)
36 - 4100 - 24P (340)
36 - 4200 - 24S (340)
36 - 4100 - 32P (340)
36 - 4200 - 32S (340)

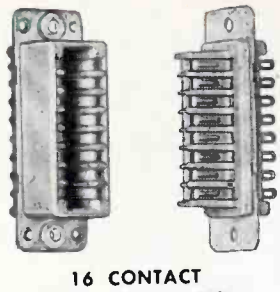
Commercial plating and contact material. Nylon filled Diallyl body Type MDG per Mil.-M-14E.

36 - 4100 - 8P (365)
36 - 4200 - 8S (365)
36 - 4100 - 16P (365)
36 - 4200 - 16S (365)
36 - 4100 - 24P (365)
36 - 4200 - 24S (365)
36 - 4100 - 32P (365)
36 - 4200 - 32S (365)

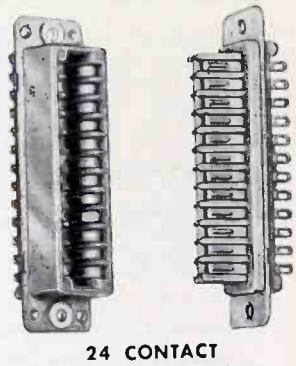
For your connector requirements — you can depend on CINCH



8 CONTACT
PLUG AND SOCKET

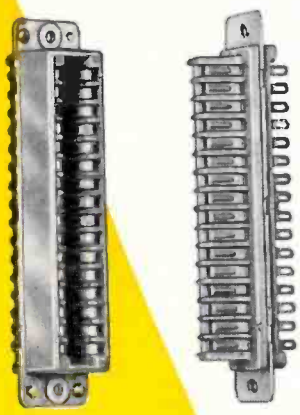


16 CONTACT
PLUG AND SOCKET



24 CONTACT
PLUG AND SOCKET

REGULAR TYPE:



32 CONTACT
PLUG AND SOCKET

Commercial plating and contact material. Nylon filled Diallyl body Type MDG per Mil.-M-14E.

36 - 4100 - 8P
36 - 4200 - 8S
36 - 4100 - 16P
36 - 4200 - 16S
36 - 4100 - 24P
36 - 4200 - 24S
36 - 4100 - 32P
36 - 4200 - 32S

Military plating and contact material. Nylon filled Diallyl body Type MDG per Mil.-M-14E.

36 - 4100 - 8P (334)
36 - 4200 - 8S (335)
36 - 4100 - 16P (334)
36 - 4200 - 16S (335)
36 - 4100 - 24P (334)
36 - 4200 - 24S (335)
36 - 4100 - 32P (334)
36 - 4200 - 32S (335)

☆ The ribbon contact principle, with dielectric guide and support eliminates the possibilities of damaged or bent contacts and prevents difficulties of plug-in. No dependence on contact arrangement or visual alignment is necessary.

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Circle 45 on Inquiry Card, page 99

Automatic Checkout *(Continued)*

shelf commercial equipment—such as amplifiers, power supplies, relays, instrument servos, resistors, condensers, etc. This general area of equipment is so broad that no reference is included in Table I; however, numerous vendors are available in every area, and reference 1.0 or equivalent can be utilized. The determination of how many and what types of these assemblies are needed is a function of the capacity of the automatic check-out equipment. However, it is important that this self-check system be as reliable and as simple and straight-forward in design as possible in order to establish a very high confidence level in the check-out equipment itself. In addition, the transfer function characteristics of each assembly should be extremely stable and well defined prior to inclusion in this sub-system. If possible, large amount of negative feedback should be used in all active elements to provide gain stability, and temperature compensation be provided for passive elements if they are at all sensitive to this factor.

Developments Still Needed

Two major areas of development are still urgently needed in order to hasten the availability of automatic check-out equipment. The first area is in the stimuli or function generator field.

Voltage Generator

The most commonly used assembly in the stimuli sub-system would be the voltage generator, which should consist of two independent generators, dc voltage (plus or minus) and AC voltage (in phase or out of phase). The latter would take ratios with respect to the weapon system ac line voltage and would be of the same frequency. It appears that a 0- to 100-volt range with 1000 increments is feasible, and if smaller increments are needed, a ten-volt range would be utilized. The input commands would consist of coded digital input commands and the output from the generator should have an internal impedance of less than 10 ohms, and supply on the order of 10 ma maximum current. In all cases, the output

---

Table One *(concluded)*

Classification	Vendor	Part No.	Weight	Size	Est. Cost
Category 5.0 Self-test Equipment					
This area is so broad that no specific reference is listed other than the Electronic Industries Annual Directory (June issue).					
Category 5.0 Complete Special and General Purpose Automatic Check-out Equipment					
Automatic Telemetering Test Set	Hoover Electronics Co., Baltimore, Md.	——	Not spec.	Part 1: 19¼" W 11" H 13⅜" D Part 2: 22" W 60" H 22" D	Not spec.
General: The test set was designed to evaluate the performance of FM/FM telemetering systems and analyses up to 16 sub-carrier channels for minimum, center and maximum frequencies. In addition, the amplitude of the audio and RF signals are checked as well as the stimulus voltage applied to the telemeter equipment under tests.					
Time Required: All checks are performed in approximately 1½ minutes.					
Operation: Three stimulus voltages are applied successively to each sub-carrier oscillator. The output frequencies are then measured and compared to pre-specified references. In addition, the output of the telemetering transmitter is also measured.					
Features: Stepping switches are utilized for programming. Tolerance levels are set by manual switches previous to test. Unit includes self-check and high, low and O. K. gates. Tester stops at out-of-tolerance indication and test may be repeated or continued or entire sequence started over at choice of operator. Further details available from Sales Manager, Hoover Electronics.					
Automatic Electrical Circuit Analyzer	DIT-MCO, Inc., Electronics Division, Kansas City, Mo.	Model 2000 (Several other models are also available, including a portable military version—Model 14YNX).	Not spec.	65¼" H 68" W 30⅞" D	$36,000
General: This test set is a ruggedized military electrical circuit tester and it detects continuity errors, shorts between circuits and circuits and ground and excessive leakage current. An electrical system of up to 2000 complex interconnected multiple circuits can be tested.					
Time Required: Every circuit is checked against all others in the system under test at the rate of ten per second.					
Electrical Specifications: 1. Low Voltage Test Continuity Test. a. Test Voltage—28 VDC. b. Continuity Current (adjustable) 1/10 to 2 amperes. c. Continuity Resistance (adjustable) 3/10 ohms to 100 ohms. 2. Low Voltage Short Test (simultaneously with low voltage continuity test). a. Test Voltage—28 VDC. b. Short Resistance Range 0–1 megohm. 3. High Voltage Leakage Test. a. Test Voltage—500 VDC. b. Short Resistance (adjustable)—0–200 megohms. 4. High Voltage Continuity Test (optional). a. Test Voltage—500 VDC. b. Continuity Current—1 milliampere. c. Continuity Resistance—10,000 ohms. 5. Ohmmeter. a. R x 1 to R x 10 meg b. Accuracy—plus or minus 3%. 6. Power Requirements. a. Voltage—105–125 VAC, 60 cps. b. Wattage—approximately 600 watts.					
Features: Utilizes rugged telephone-type relays and stepping switches. Plugboard programming systems are included with 400 positions on each one for ease of set-up changes. In addition, a 25 x 16 (400 point) matrix chart with indicator lamps is provided for rapid pinpointing of fault areas. Modular construction provides ease of accessibility and of maintenance.					
Automatic Hi-Pot-Impedance-Continuity Test System	Cal-Tronics Corp., Los Angeles, Calif.	Not spec.	Not spec.	19" W x 21" H x 17½" D	Complete Tester: $5772
Cal-Tronics HIC System is a fully automatic production line circuit tester which utilizes modular "building blocks" design for maximum flexibility of application. The type and number of module selected for a system test is dictated by the particular testing requirements, such as the number of leads to be checked and the type of test to be performed. Five different modules are available. The Model 900 Master Unit contains system controls and timing circuits. The Model 901 Hi-Pot and Continuity Tester and Model 902 Impedance Comparator are the tester units. The Model 901 supplies 500 or 1000 volts for leakage and insulation breakdown. Reject level can be from 0.2 meg to 10 megohms. Test current is 10 meg.					
Continuity selector has limits available of 1 to 50 ohms with test voltage 5 volts AC and maximum test current of 1.7 amps.					
The Model 902 Impedance Comparator measures resistances from 25 ohms to 0.5 meg., capacitances from 2000 μμfd to 50 μfd and inductances from 3 mh to 10 h. Test voltage, 6 volts AC, 1000 cps.					
The Model 903 and 904 Slave Units check single terminal and double terminal networks, respectively, with all other test terminals. Test intervals can be set at 0.1 sec/test, 1 sec/test or 1–5 sec/test adjustable.					
Universal Automatic Voltage Count and Time Measurement System	Northrop Aircraft, Inc., Anaheim Division, Anaheim, Calif.	Model M-1	Not spec.	Three (3) six foot standard relay rack type enclosure	$65,000
The Model M-1 is called DATICO, which stands for Digital Automatic Tape Intelligence Checkout. The standard unit will automatically check-out any system for voltage, count and time measurements. The major assemblies of the unit are Programmer, Scanner, Measurement Section, Comparator and Read-out. The Programmer consists of an 8 bit/frame punched paper tape and a patch board. The 8 bit information is multiplexed to give 80 bits/frame. The Scanner is an electro-mechanical communicator that performs the function of address and command. It essentially selects the proper input and output leads of the system being tested as well as controlling any required input signals. The Measurement Section consists of a digital VTVM and a frequency meter. Both visual and electrical output are provided. The Comparator has memory, decision and command capabilities and it is entirely electro-magnetic, making use of binary logic. Various read-outs of test information are available with the standard consisting of printed paper tape in addition to visual displays and visual high or low indications. GO readings are printed in black along with the test number, and NO/GO readings are printed in red. The printed information is decimal. Both packaging and detailed design can be tailored for each special testing job.					

Note: Only typical commercial items are listed, although several different manufacturers have similar equipment. Consult June Directory Issue.

rom this generator would be used to stimulate the arious amplifiers in any system under test.

Frequency Generator

This assembly must supply a fixed frequency output signal with fixed amplitude, both frequency and mplitude to be determined from digitally coded input gnals from the instruction center. It is felt that a 0 cps to 10 MC range with 1000 increments is posble, with 10 different amplitudes over the range of to 0.3 volt or 0 to 3 volts RMS. The output imedance of the generator should be less than 600 hms and, if possible, less than 50 ohms, and supply n the order of 15 mv. This unit would be used to heck frequency-gain parameters of electronic equipnent in any system being tested.

Pressure Generator

This assembly must have two independent output pressures. A differential and an absolute pressure output are required in order to test out the various pressure transducers in any system, such as altitude, Mach, airspeed, and other types of pressure pickups. The generator should have a range of —1000 feet to 100,000 feet for altitude, an airspeed range of 0 to 3000 mph, and a Mach range of 0 to 10.0, however, it is felt that this is not feasible for the present State-of-the-Art and if the Mach and airspeed requirements are reduced to 0-1000 mph and 0 to 3.0, a unit could be made. Other differential and absolute pressure requirements could be tailored to the system being tested. There should be between 10 and 100 increments but the accuracy of each increment should be better than 1%.

Motion Generator

This assembly is required to stimulate the various rate and displacement gyros and accelerometers in any system and would only be utilized where gyros can actually be removed from the system under test and placed on a separate stand. Two assemblies would be required. The first would be an angular position table capable of pitch, roll or yaw motions. one at a time, with a range of 0 to ±360 degrees and 0.1 degree increments. The second would be a rate table with an angular rate range of 0 to ±100 degrees per second in 1000 increments. These motion generators would receive digitally coded instructions from the instruction center and should be capable of supporting up to 20 pounds.

Time Interval Generator

An accurate timing source is required in many systems to turn switching circuits on and off in a pre-determined sequence. This generator would receive digitally coded inputs from the programming sub-system and supply up to ten on-off sequencing commands to the Weapon systems under test. The unit should have a range of 0 to 10 minutes with 10 millisecond intervals. In addition, this generator can be used for supplying On-Off commands where timing is not critical.

L-F Function Generator

This assembly should be capable of either providing a suppressed carrier modulated low frequency signal, or just the low frequency signal itself with a frequency range of 0.1 to 1 CPS or 1 to 10 CPS in ten intervals with a voltage range of 0 to 1 volts or 0 to 10 volts with ten increments, in response to digitally coded signals from the instruction center. This unit should have an interval impedance of less than 100 ohms and be capable of supplying up to 10 ma to the system under test. This unit would be utilized to stimulate the various instrument and control surface servos in any system. Other possible generators that might be developed would supply resistance variations, temperature variations, RF power variations, etc.

Comparison Equipment

The second area where additional development is needed is in comparison equipment. As discussed previously, this equipment can either be analog or digital depending on the accuracy desired. However, no commercial equipment appears to be available in either category expressly designed to accept programmed high and low tolerance settings, and giving an indication of whether or not the actual reading is in or out of tolerance. This does not appear to be a formidable problem considering the state-of-the-art in the analog and digital computer fields. It appears that all measured analog quantities can readily be converted to an ac or dc voltage thus simplifying the analog comparator development. In addition, either type of comparator must give a Go-No/Go visual as well as a voltage command for diverting the Instruction Center to continue the testing sequence, and should also give a Lo-Go-Hi visual reading that can be utilized where system adjustments are normally required and can easily be made without disturbing the test sequence. Table 2 gives a description of types and range of comparators needed:

Table Two

Type of Comparator Analog	Range of Inputs	Range of Tolerances
DC Voltage	(0 to ± 10 volts) (0 to ± 100 volts) (0 to ±1000 volts)	(plus 0% to +20% of input (minus 8% to —20% of input (not necessarily symmetrical)
AC Voltage	(0 to ± 10 volts) (0 to ± 100 volts) (0 to ±1000 volts)	Same

Type of Comparator Digital	Range of Inputs	Range of Tolerance
Straight Binary	10 digit plus sign	2-11 digit
1, 2, 4, 8 Coded Binary	12 digit plus sign	2-16 digit
2, 2, 2, 4 Coded Binary	12 digit plus sign	2-16 digit

Block diagrams of a typical analog and digital comparator are shown in Figs. 7 and 8.

David D. Thomas, Director of Air Traffic Control Civil Aeronautics Administration.

Aeronautical Electronics Conference Opens May 12

Exhibits by more than 100 manufacturers and the presentation of 125 technical papers will feature the three-day conference at Dayton's Biltmore Hotel.

DAYTON, Ohio, birthplace of aviation and a well-known center of research, development, and procurement for the United States Air Force, is the scene of the 1958 National Conference On Aeronautical Electronics for three full days beginning on May 12.

In the past ten years the NCAE has grown to be one of the most highly-regarded and professional Conferences on the important subject of aeronautical electronics. This year, in keeping with its theme — "Avionics — Key To Airways Modernization" — the 1958 NCAE presents 128 technical papers by recognized authorities in the aeronautical and electronic sciences. Increasing traffic on the world's airways and the imminent requirements for navigation and traffic control in space, or near-space, make this a challenging topic for the 25 technical sessions to be scheduled at the Conference.

Focal point of convention activities will be the Biltmore Hotel, Dayton's largest. The Executive Committee will maintain headquarters in Suite 508-9-10 for the duration of the Conference.

Pre-Conference inquiries and correspondence should be addressed to the National Conference on Aeronautical Electronics, P.O. Box 621, Far Hills Branch, Dayton 19, Ohio.

Technical Sessions

A complete listing of the 128 papers comprising the 25 technical sessions of the 1958 NCAE will be found elsewhere on this page. Scheduling of several simultaneous technical sessions has made it necessary for the Conference to engage meeting rooms away from the Biltmore Hotel. In addition to the hotel itself, technical sessions will be held at the Dayton Engineers' Club and the Shrine Club Antioch Temple.

No technical sessions have been scheduled for the afternoon of Tuesday, May 13, so that all Conference guests may have an opportunity to attend the 1958 NCAE FORUM. Mr. David D. Thomas, Director, Office of Air Traffic Control, CAA, will be the Moderator of a panel of well-known authorities on the Forum subject, "Air Traffic Control in the Jet Age." Audience participation in this Forum will be encouraged.

The Conference is continuing its tradition of providing a free copy of the NCAE Proceedings to each registrant at the time of registration. The Proceedings is a compilation of all the technical papers presented at the Conference. Extra copies may be ordered at a nominal charge.

Exhibits

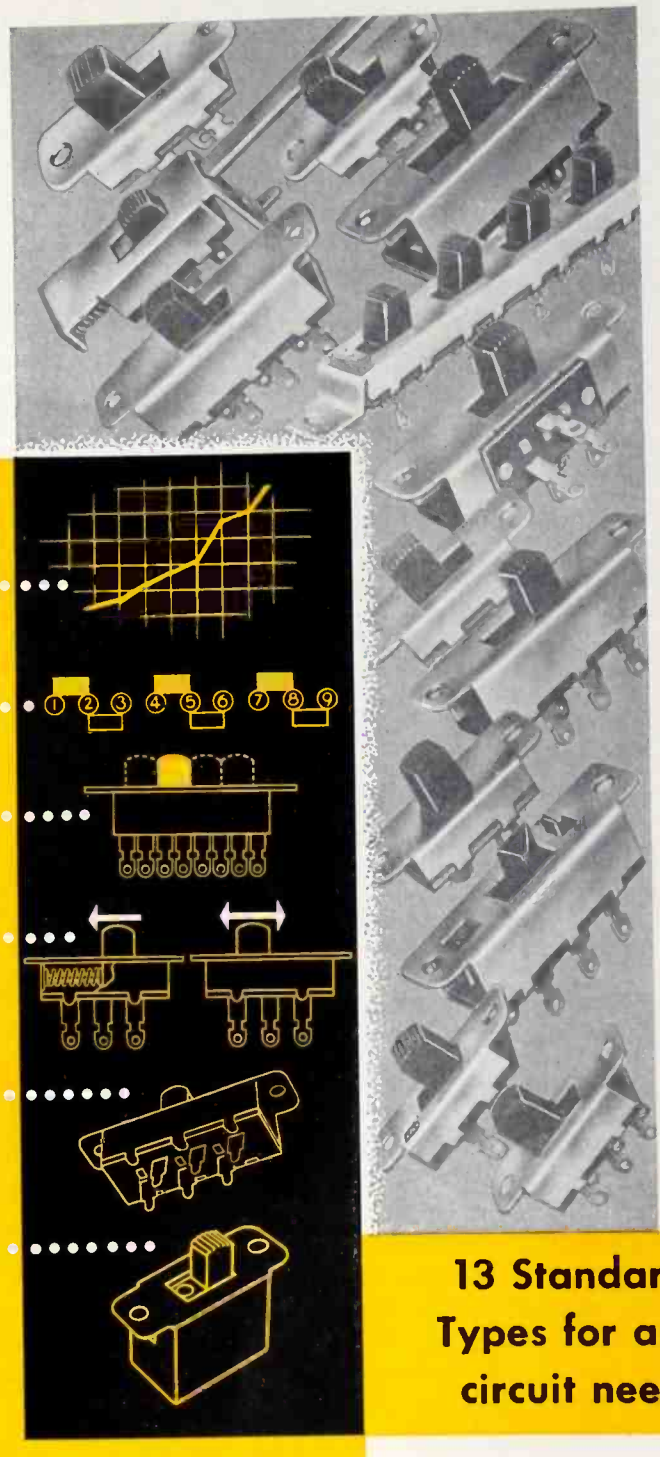
Approximately 100 official Conference exhibits will be located in the main lobby, fourth floor, and the exhibition halls of the Dayton Biltmore Hotel.

Social Activities

Highlights of the program of social activities arranged for the 1958 NCAE include the annual Welcoming Luncheon to be held in the Main Ballroom of the Biltmore Hotel on Monday, May 12 at 12:00 noon.

The tenth annual Conference Banquet is scheduled for 6:45 P.M. on Tuesday, May 13.

1001 USES
for these versatile, low cost switches



HIGHER RATINGS: Over 6 types with 3-amp, 125v ac U.L. ratings for small motors, appliances, etc. ½- and 1-amp ratings for others.

1 TO 3 POLES in compact, easily-mounted cases.

UP TO 4 POSITIONS with positive, sliding action that lends a modern touch to any product.

MOMENTARY OR MAINTAINED CONTACT in slide, pushbutton, or plunger-operated types.

PRINTED CIRCUIT TERMINALS optional on all types.

TERMINAL SHIELDS to meet Underwriters' requirements available for all types.

MANY STANDARD "SPECIALS" stocked for immediate delivery. Typical types include: **Type SS-5** with line cord prong guide for use as "battery-line" changeover switch in portable radios. **Type SS-19** an SPDT plunger switch with spring return. **Type SS-21** four-gang, SPDT on a common base.

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Strain Gages

(*Continued from page 57*)

of the hollow vanes. This results in chordwise temperature variation in the vane as shown in Fig. 10 with the leading and trailing edges approximately 300° F above the midchord region. The leading and trailing edges, therefore, go into compression, and the midchord region would be expected to go into tension. During the determination of the thermal stresses in a turbine stator it was found that the assumptions made in the theory were not valid, and therefore an experimental program was undertaken to determine the stresses with the high temperature static strain gage. A detailed discussion of this research is presented in Ref. 3.

Briefly, the temperature variation as obtained in the engine was duplicated in a sample vane in a bench setup at a reduced average temperature in order not to exceed the temperature limit of the strain gage. This procedure does not invalidate the strain results unless the elastic limit is exceeded under the engine conditions or the value of the expansion coefficient is changed considerably. However, if the measured strains are above the elastic limit at the engine conditions, an indication will still be afforded of the amount of plastic flow taking place.

Static gages were mounted at the leading and trailing edges and also in the midchord region on both the pressure and suction surfaces of the stator vane. Thermocouples were distributed around the vane, with particular attention paid to obtaining accurate readings of the gage temperatures. The completed installation is shown in Fig. 11.

Dynamic Gage

In order to take advantage of the low temperature coefficient of resistance of Karma wire for static measurements, it is necessary, as pointed out previously, to use a bonding material that does not require a baking temperature in excess of 800° F. This limitation does not apply to dynamic measurements where the rate of change of strain is considerably greater than the rate of change of temperature. Therefore, a bonding material having a higher baking or firing temperature may be employed, since the temperature coefficient is not important.

New Coating

A relatively recent development in the field of heat resistant coatings is the material prepared by the Protective Coatings Section of the Engineer Research and Development Laboratories at Fort Belvoir, Virginia. This material has been given the military specification number MIL-P-14105A(CE), and is being produced by the Glidden Co. at Reading, Pa. When dried at 150° F the coating hardens sufficiently to permit the intermediate steps required in the mounting of the gage grid. Final firing is performed at 1550° F, resulting in a coating of high hardness, excellent adhesion, and very good resistance to erosion and abrasion. The maximum coating thickness that can be applied per firing appears to be approximately 0.002-inch. However, additional coats can be fired on successively, and relatively thick build-ups thus be obtained.

In its original formulation, the Fort Belvoir coating contains a mixture of three frits having fusion temperatures of 1400°, 1500°, and 1600° F. In certain applications involving very high centrifugal force fields at elevated temperatures, it was found that the coating prepared by the Glidden Co. according to the specification MIL-P-14105A(CE) tended to flow on the surface of the specimen. Subsequently, a modification of the frit content was suggested and the 1400° and 1500° F frit portions were replaced by the 1600° F frit. This material, when fired at 1550°, was found to resist centrifugal force fields of 40,000 g's effectively at temperatures of around 1400° to 1500° F. (The modified coating material is labeled No. 9-92-4 by the Glidden Co.)

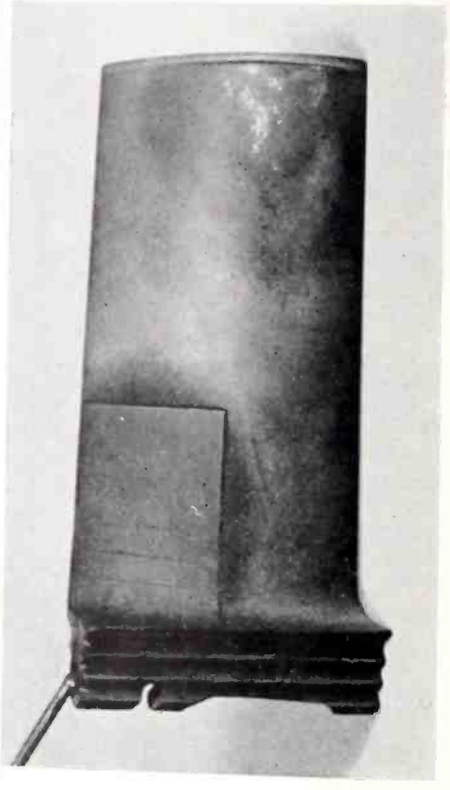


Fig. 13: Blade, with strain gage, before operation.

The preparation of the strain sensitive grid is the same as described previously for the static gages. Both the frame held grids and the pressure stabilized grids of 0.001 inch Karma wire have been used with equal success for the dynamic applications. The No. 9-92-4 is first applied to the specimen as a precoat with an air brush. After drying several hours at

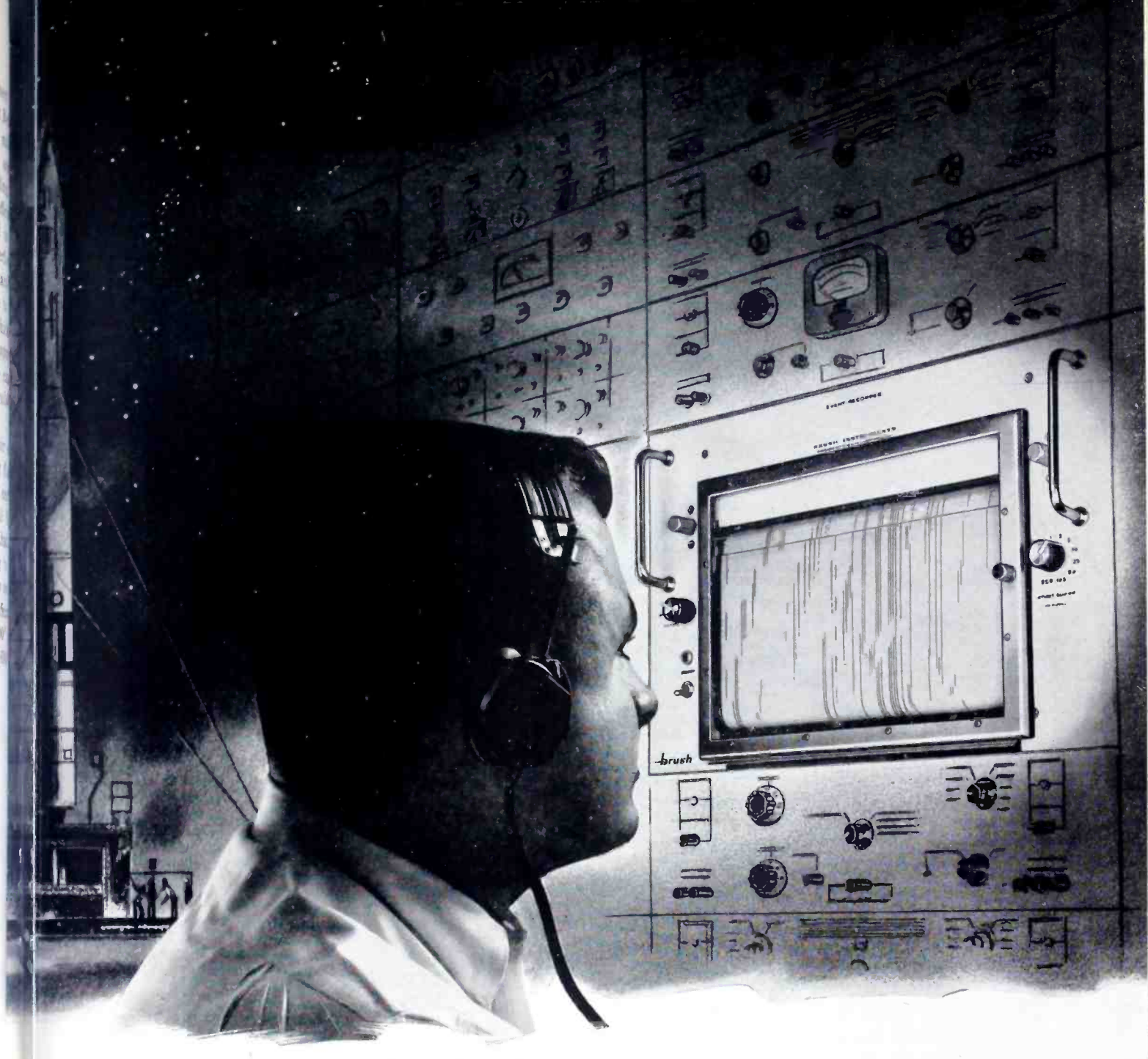
(*Continued on page 90*)

Table 1

Characteristics of Strain Gage Wires

	Specific resistivity, ohm/cir. mil-ft	Approx. gage sensitivity factor	Average temperature coefficient of resistance of sample gages on HS-21 alloy, $\mu''/''/°F$
Advance	294	2	[a]4
Nichrome V	650	2	[b]30
80 Percent Pt – 20 percent Ir	200	6	[b]80
Karma	800	2	[b]—2.5

[a]—100° to 400° F.
[b]—100° to 800° F.



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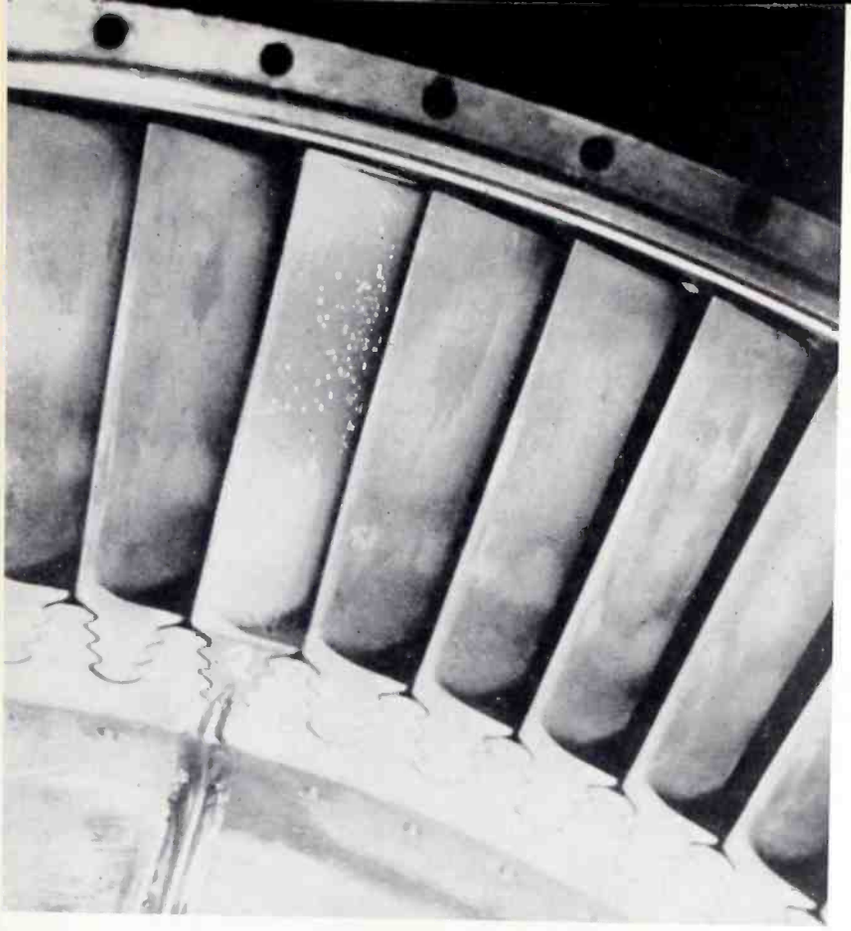

Fig. 14: High temperature strain gage installation on turbine blade after a full ten hours of engine operation under rated conditions.

Strain Gages

(*Continued from page* 88)

150° F, the specimen is placed in a furnace at room temperature and the temperature is gradually raised to 1500° F over a 2½ hour period. A resultant coat of 0.0010 to 0.0015-inch is desirable. The grids are then placed in position and the No. 9-92-4 again applied with an air brush over the entire mount to give a resultant coat of about 0.002-inch thickness. After drying at 150° F, the threads holding the grids are removed and the mount is fired by gradually raising the temperature to 1500° F.

Dynamic Test

One of the more important applications of the dynamic high-temperature strain gage has been in the measurement of the vibration of turbine blades during turbojet engine operation. The gage environment in this application is extremely severe. In addition to the temperature range of 1200° to 1500° F, the gage must withstand very high centrifugal force fields and be resistant to abrasion and erosion by the hot gases and the particles of matter contained in them. The coating material developed at Fort Belvoir has proved to be considerably superior to the other bonding materials that were tested in this application.

Fig. 12 shows an over-all view of an installation of three instrumented blades in a turbojet turbine wheel, with metal sheathed conduits leading down the face of the wheel to a terminal block at the center. From this point, wires are run through the center of the engine to a set of slip rings at the front. Signals from the three instrumented blades in addition to an RPM signal and a reference frequency signal are all recorded on ½-inch tape at a tape speed of 30 ips. An entire engine operation program is taped, and the information is analyzed later with the aid of various wave analysis equipment.

A closeup view of one of the No. 9-92-4 strain gage mounts on a turbine blade is shown in Fig. 13 before engine operation and in Fig. 14 after 10 hours of operation at rated engine speed and temperature.

Turbojet Liner

Another application of the dynamic gage has been in the measurement of the vibration of turbojet combustor liners. A general view of the installation of the gages and lead wire conduits is shown on the cover, and a closeup view is shown in Fig. 1. The gages shown are also mounted with No. 9-92-4 cement. In this particular case, a different type of lead wire connection has been employed. The intermediate tube tipped lead has been eliminated and connection made between the 0.001-inch Karma wire and the lead wire in the conduit by a spot of conducting silver paint. When fired at 1500°F the paint decomposes and leaves a tightly adhering silver deposit. Care must be taken to ensure that there are no pin holes in the precoat, since the silver tends to diffuse through and short out the gage.

Through the use of 0.001-inch Karma wire and either of the bonding materials (Quigley No. 1925 or Brimor U529), a satisfactory static high temperature strain gage can be constructed having an equivalent temperature coefficient of resistance of the order of $-2.5\mu''/''/°F$ over the temperature range of 80° to 800°F. This is sufficiently low to permit the application of the gage to those problems in which the temperature does not remain constant throughout the loading and unloading history. A temperature against resistance calibration curve is obtained for each gage, and the gage readings are corrected by referring to thermocouple measurements of the temperature of the gage.

For dynamic strain measurements at temperatures up to 1500°F, a coating material developed at the Fort Belvoir laboratories of the U. S. Army Corps of Engineers and now produced by the Glidden Co. has been used with considerable success. The coating is identified by the military specification number MIL-P-14105A(CE). A slight modification of this material, labeled No. 9-92-4 by the Glidden Co., has been used for mounting gages on turbine blades and combustion liners of turbojet engines. Operation for 10 hours at rated engine power has not adversely affected the gage mounts.

The author wishes to express thanks to the following NACA personnel who contributed information for this paper: Mr. C. R. Morse, Mr. W. C. Morgan, Mr. D. E. Gardner.

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A contributing factor to the remarkable sensitivity of these relays is the design of the armature retaining guard to minimize undesirable heel gap. A wide variety of hermetically sealed enclosures is available.

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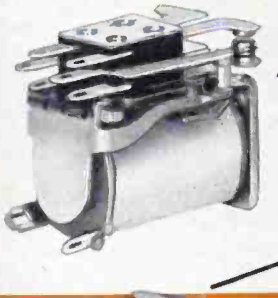
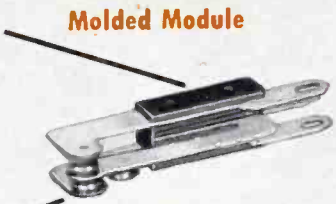
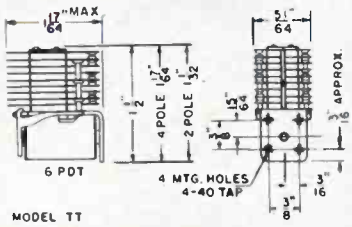






MODEL TT—
SPECIFICATIONS

COIL WATTAGE: Rated nominally at .150 watt per pole at an ambient temperature of 20°C.

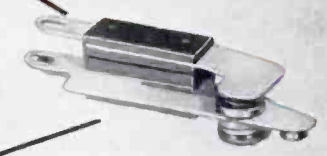
COIL OPERATING VOLTAGE RANGE: To 115 VDC.

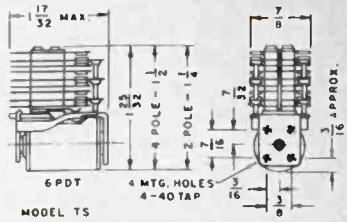
CONTACT RATINGS: Up to 5 amperes at 115 volts AC or 32 volts DC noninductive, with standard contact material, palladium. Other materials can be supplied.

CONTACT COMBINATIONS: Standard combinations are DPDT, 4PDT, and 6PDT (maximum). Others can be furnished.

WEIGHT: Approximately 2 ounces for 4PDT relay.

MODEL TS—
Molded Module





MODEL TS—
SPECIFICATIONS

COIL WATTAGE: Rated nominally at .250 watt per pole at an ambient temperature of 20°C.

COIL OPERATING VOLTAGE RANGE: To 115 VDC.

CONTACT RATINGS: Up to 10 amperes at 115 volts AC or 32 volts DC noninductive with standard contact material, silver-cadmium oxide. Other materials can be supplied.

CONTACT COMBINATIONS: Standard combinations are DPDT, 4PDT, and 6PDT (maximum). Others can be furnished.

WEIGHT: Approximately 3 ounces for 4PDT relay.

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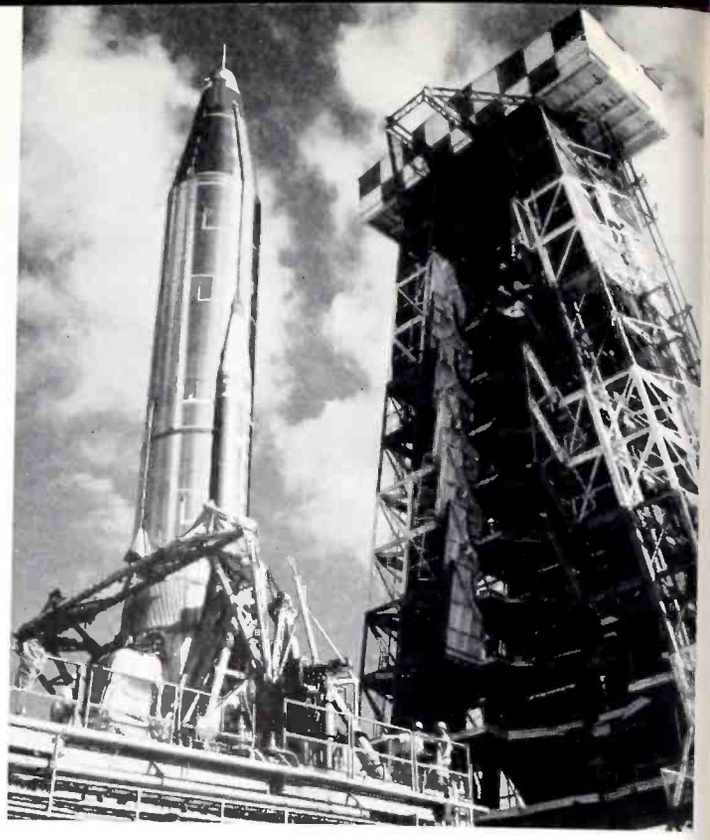
WRITE FOR BULLETIN 160

Circle 49 on Inquiry Card, page 99

AF Missile Test Center —Cape Canaveral, Fla.

The highest examples of the electronic art—of communication, of guidance, of telemetry—are being tested and evaluated over this 6,000-mi. test range off the coast of Florida



ATLAS missile towers aloft on launching stand as the gantry tower is moved away.

"A $400,000,000 shooting gallery," is the way Maj. Gen. Donald N. Yates describes the Air Force Missile Test Center at Cape Canaveral, Fla. As its commander he could also add that it will very likely be the U. S.'s jumping off point for the moon and other space destinations as well, but for the moment it is enough to concentrate on its primary function of testing military missiles.

The launching sites, with the associated support agencies, form one end of a test range that is nearly 6,000 miles long, extending to a point off the west coast of Africa. One of the missiles tested, the Snark, has already completed a flight of more than 5,000 miles.

Scattered down through the test range are eleven land-based monitoring stations and six specially-equipped ocean range vessels. These instrumentation stations contain facilities for radio communications, range clearance, in-flight safety, weather reporting, telemetry reception, and radar and optical tracking. The degree of "success" or 'failure" depends on the amount of information picked up from the missile by these stations. RCA Service Co. has responsibility for instrumentation at the range.

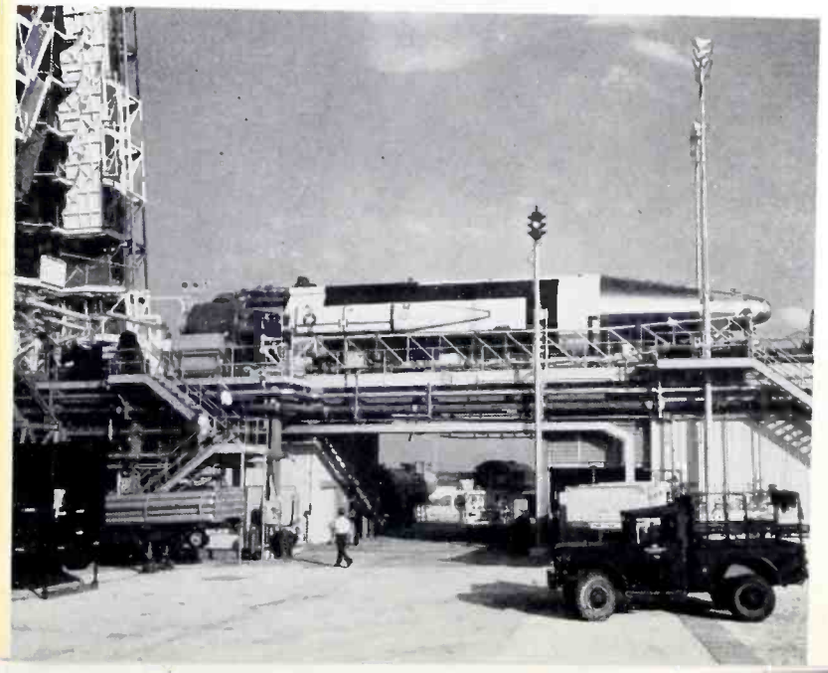
The "Cape" itself can best be described as "sparse." Small clusters of buildings are found, rather widely separated, scattered across the area. Buildings are uniformly low, and designed for utility. Soil is sandy, with little vegetation.

Missile contractors are furnished with hangar-type buildings in which to perform final tests on their missiles before the "shoot."

Dotted throughout the area are small, cube-like buildings—optical and radar tracking stations—connected through underground cables to central control facilities.

The problems of the test center are essentially two-fold — control and monitoring. Control of the missile must be maintained through the preparatory stages, and through its powered flight. In order to evaluate its performance data must be collected on the functioning of its various components throughout its flight.

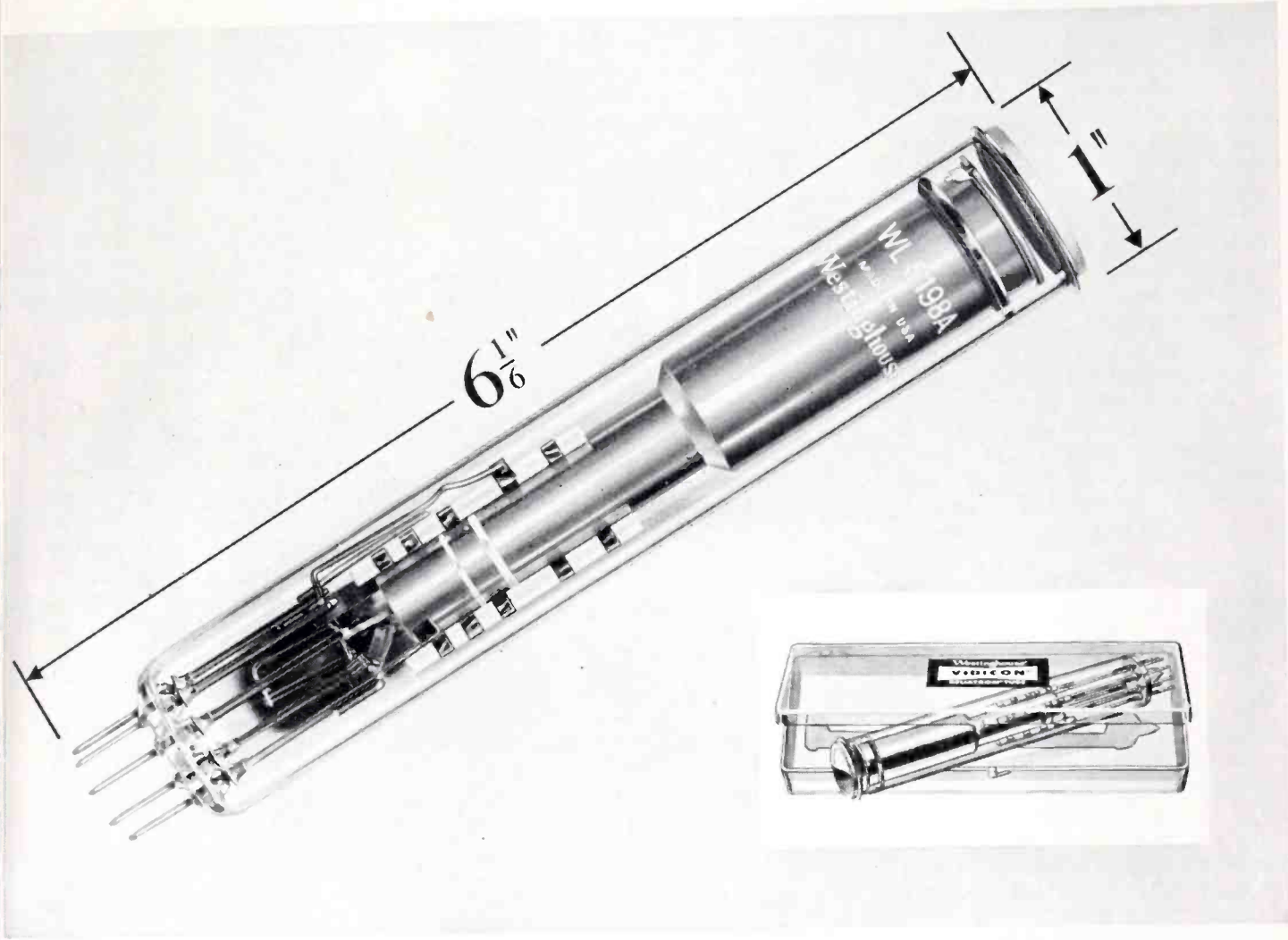
Missile personnel emphasized repeatedly that the "success" or "failure" can only be measured in terms of the amount of information collected from the "shoot." While



ATLAS rests on handling trailer on which it traveled cross-country from Convair.

Operations at the launching pad are viewed through a periscope in top of the blockhouse.

Now! Westinghouse **WL-6198A** Vidicon Tube ends flicker effect!



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Company _____

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Circle 41 on Inquiry Card, page 99

Missile Test Center *(Continued)*

a completely successful flight, in which the missile reaches its planned area, is valued as a great step toward the operational phase, many of the less successful firings are even more valuable for the information gathered on the weak-spots in a missile's design.

Let us take a look at the preparation for a typical launching.

The hours immediately before a "shoot" are filled with activity. The "countdown" may have started up to 18 hrs. before the time set for firing. For many weeks before that the missile contractor personnel will have been going over the rocket, checking each item, each operation. Only a week before the missile had been set up in the gantry, the tall tower-like structure that will hold the rocket during the last stages of preparation. Each gantry will be distinctive. The tall, thin one for "Vanguard"; a short, squatty configuration for Thor and Atlas.

With the time set for firing, the gantry now moves slowly along railroad tracks to the firing platform about 100 ft. away, sets the missile gently into firing position.

The entire "complex"—the missileman's tag for the launching pad, the control blockhouse, gantry and associated equipment—is now on alert. A traffic light that shone green when the pad was empty, then orange when the missile was delivered, now shines red, showing a "shoot" is imminent.

As the countdown goes into the final hours activity is centered in the concrete control blockhouse located about 600 ft. from the launching pad. Up to 30 technicians are tensely watching arrays of dials and meters that give the conditions on the rocket. Information is being transmitted through a thin "umbilical" cord attached high up on the rocket that will fall away on the firing signal.

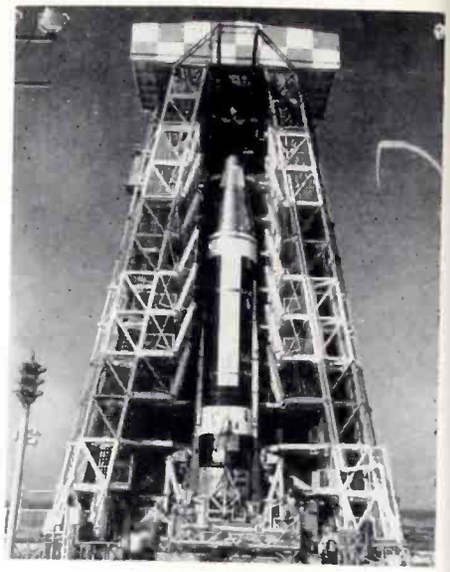
A search plane dispatched hours before the "shoot" has cleared the range area of ships, or advised a delay until all ships are out of danger.

An 1,800-mi. underwater cable linking all 11 down-range stations has flashed instructions, synchronizing all instrumentation with the base Central Control.

Responsibilities at the blockhouse and at Central Control are clear-cut. The pad personnel are charged with getting the missile off the ground and controlling it through its powered flight. Since virtually all the missiles being tested are ballistic missiles that will be powered only during the early part of the flight.

Central Control, located two miles or so away from the launching pad, will plot the course of the missile, and monitor its flight movements for irregularities.

Feeding information to Central Control will be the "Azusa" Impact Predictor, whose job it is to indicate continuously where the rocket will fall if it loses power at any given instant. The system uses 8



ATLAS ICBM is secured in its launching platform after being transported from San Diego.

ground antennas placed in the shape of a cross and a transponder in the missile. Utilizing an IBM 704 computer it calculates the missile's position to within a missile-length.

Information from the Impact Predictor will be flashed to the Range Safety Officer at Central Control. If a rocket goes beyond certain pre-determined bounds the "destruct" button is pushed, exploding the missile as a safety measure. Not a single civilian casualty has resulted from missile testing.

At Central Control representatives of each branch are ranged at control panels along one side of the room; the RCA instrumentation chief, the Pan-American Airway Range Officer, the Air Force Officer, an officer of either the Army, Navy or Air Force depending on the missile being fired, and a representative of the missile contractor. A plotting board on the side will show the missile's course.

At many of the complexes there are not even windows for personnel to see the launching. Closed circuit TV cameras grouped around the launching pad will flash the pictures to the control boards.

If the rocket is liquid-fueled in the hours preceding launching, liquid oxygen will be pumped into the missile's chambers at temperatures below 200°C. The liquid oxygen is manufactured at the test center.

Finally, with the countdown at an end, the umbilical cord drops loose, the rocket engines are ignited and the rocket lifts slowly from the pad. To protect the launching pad hundreds of gallons of water are pumped in a matter of seconds onto

(Continued on page 119)

Dome-shaped blockhouse houses instrumentation used in ATLAS check-out and launching.

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1N457	1 @ 20 mA	.025 μA	5 μA	60V	70V	
1N458	1 @ 7 mA	.025 μA	5 μA	125V	150V	
1N459	1 @ 3 mA	.025 μA	5 μA	175V	200V	
DR668	1 @ 200 mA	.025 μA	5 μA	60V	80V	
DR669	1 @ 200 mA	.025 μA	5 μA	125V	150V	
DR670	1 @ 200 mA	.025 μA	5 μA	175V	200V	
			100° C.			
1N625	1.5 @ 4 mA	1 μA	—	10V	30V	15KΩ in 0.15 μsec‡
	—	10 μA	50 μA	20V	—	————
1N627	1.5 @ 4 mA	20 μA	100 μA	75V	100V	400KΩ in 1.0 μsec†
1N629	1.5 @ 4 mA	20 μA	100 μA	175V	200V	400KΩ in 1.0 μsec†
DR677	1 @ 100 mA	0.5 μA	25 μA	20V	30V	15KΩ in 0.15 μsec‡
DR673	1 @ 100 mA	0.5 μA	10 μA	75V	100V	400KΩ in 1.0 μsec†
DR675	1 @ 100 mA	0.5 μA	10 μA	175V	200V	400KΩ in 1.0 μsec†

*Reverse voltage at which a reverse current of 100 μA flows.
†When switching from 5 mA to −40V.
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Circle 42 on Inquiry Card, page 99

WASHINGTON News Letter

NEW FCC COMMISSIONER—With a background of experience in radio-communications and broadcasting-television affairs as assistant chief of the State Department's Telecommunications Division since 1946 and four years' previously in Naval Communications, Captain John S. Cross (USNR) is well-qualified as the newest FCC Commissioner. He has a wide acquaintanceship in the radio-electronics industry, particularly among its engineering and technical officials, because of his participation in 18 international conferences on radio allocations and operating issues. These conferences in which he was a number of times either chairman or vice chairman of the U. S. delegation covered a wide field from North American broadcasting and television to Great Lakes maritime radiocommunications and Loran.

IMPROVE STANDARDS—To improve the standards of practice before the FCC, which have been under fire from the House legislative oversight subcommittee, Representative Charles A. Wolverton (R., N. J.), ranking Republican member of the House Interstate & Foreign Commerce Committee has offered a four-point program. He proposed that no written or verbal communications addressed to the FCC or any member be submitted except through an attorney of record for an interested party and that notice be given to the adversary; adoption of standards of ethics either by law or rules and regulations to provent any financial relationships or any unusual hospitality with any Commissioner or employee; and that attorneys of record be held responsible for any violation of such rules and regulations by their client or person of interest in the proceedings.

OUTER SPACE SATELLITES—The use of outer space satellites as relay stations for expansion of worldwide radio communications particularly intercontinental television, was one of the points in the 4000-word report on introduction to outer space of President Eisenhower's Science Advisory Committee which is headed by Massachusetts Institute of Technology President Dr. James R. Killian, Jr., the President's science advisor. The report stated that the satellites "could surely — and rather quickly — be pressed into service" for this usage. The radio transmitters of the satellite, powered by solar batteries, would provide relay stations in space which "should be able to keep working for many years." The committee declared that "Several suitably-equipped and properly spaced satellites would be able to receive TV signals from any point on the globe and to relay them directly—or perhaps via a second satellite—to any other point."

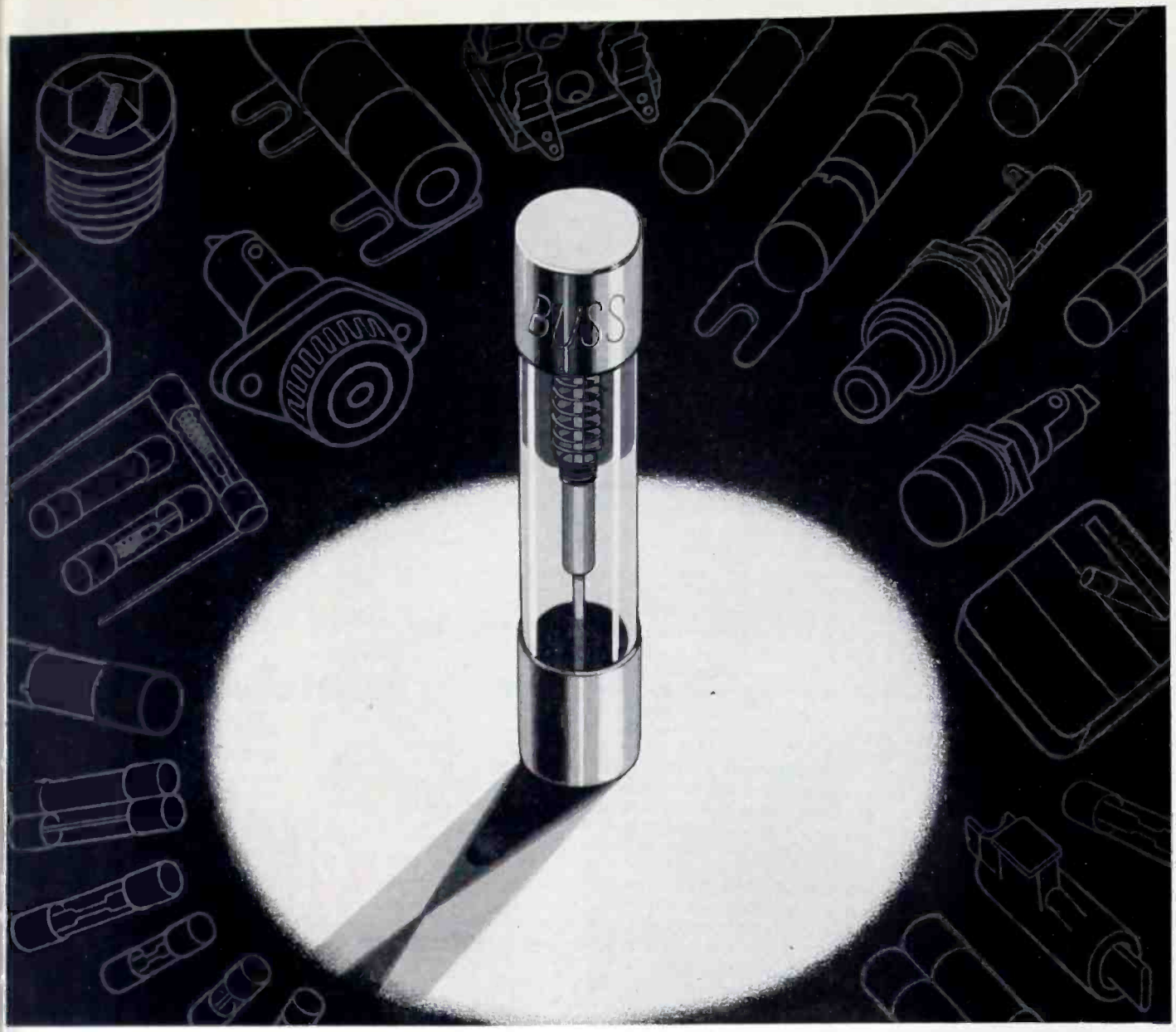
RADIO SPECTRUM STUDY—In the Senate Interstate Commerce Committee's hearings on the confirmation of new FCC Commissioner John S. Cross, the subject of the government's occupancy of the radio spectrum, particularly by the military services, was one of the issues propounded by committee chairman Senator Magnuson (D., Wash.). In answer to the Senator's observation that commercial TV might benefit from a trade with the military services (TV's uhf spectrum space for additional vhf bands now used by the military), Mr. Cross stated that he favored an "across-the-board" study of the radio spectrum by a high-level official group authorized to check classified uses of the spectrum. He stressed he long has been a proponent of "a study of the whole problem" of frequency use. He said that until a nationwide study is made no one can tell what circuits are being used and how efficiently.

EDUCATIONAL TELEVISION — The $50,000,000 aid-to-educational-television bill, introduced by Senate Interstate Commerce Committee Chairman Magnuson last year was the subject at hearings before the Interstate Commerce committee late in April. The measure is not expected to be enacted by this Congress and, if this situation prevails, will die in the current Congressional session and will have to be reintroduced in the next Congress. The bill provides for $1,000,000 aid for each state and territory for equipment for educational TV stations with the states and territories to supply buildings and land and to underwrite the stations' operations and maintenance.

FIFTH LARGEST INDUSTRY—The electronics industry in 1957 became "the fifth largest United States manufacturing group," according to the annual "Fact Book" of the Electronic Industries Association, issued at its Washington headquarters. The publication reported that the value of consumer products, tubes, semiconductors, components, and military and industrial equipment reached $7.6 billion last year. Government purchases of military electronic equipment attained an all-time high of $3.9 billion in 1957.

National Press Building
Washington 4

ROLAND C. DAVIES
Washington Editor



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Circle 43 on Inquiry Card, page 99

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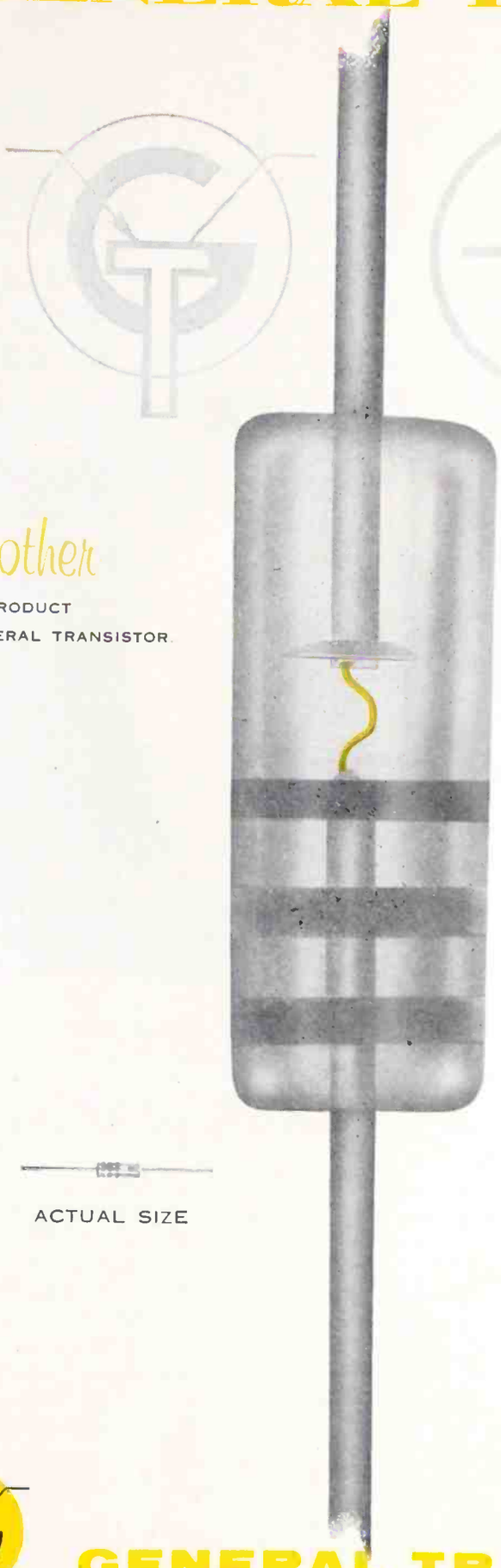

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75 Alford Manufacturing Co., Inc. — TV antennas

5 Allen Bradley Company—Miniature composition resistors

116 Allied Control Co., Inc.—General purpose relay

86 American Electrical Heater Co.—Electric soldering iron

79 American Time Products, Inc. — Frequency standards

71 AMP Incorporated—Automatic pigtailing machine

53 Amperex Electronic Corp.—Frame grid tube

93 Amperite Co., Inc.—Relays and regulators

100 Andrew Corp.—Air-dielectric cable

36 Armco Steel Corporation—Thin electrical steels

56 Arnold Engineering Co., The—Temperature stabilized powder cores

29 Assembly Products, Inc.—Meter relay

508 Bell Aircraft Corporation—Engineering personnel

111 Berndt-Bach, Inc.—Sound-on-film cameras

96 Biwax Corporation—Potting compounds

68 Bliley Electric Co.—Low-frequency high-temperature crystals

113 Bruno-New York Ind. Corp.—Pigtailing machine

31 Brush Instruments Division of Clevite Corporation—Direct recording systems

50 Brush Instruments Division of Clevite Corporation—Industrial event recorder

13 Burnell & Co., Inc.—Crystal filters

43 Bussmann Mfg. Division McGraw-Edison Co.—Fuses and fuseholders

72 Chicago Telephone Supply Corp.—Military variable resistors

45 Cinch Mfg. Co.—Plug and socket connectors

63 Clevite Electronic Components Division of Clevite Corporation—Flux-responsive magnetic heads

22 Corning Glass Works — Sub-miniature fixed glass capacitors

59 Columbian Carbon Co., Mapico Color Unit—Synthetic iron oxide reagents

76 Conrac, Incorporated — Monochrome, color monitors; audio, video receivers

109 Connecticut Hard Rubber Co.—Pressure sensitive TEFLON tape

27 Consolidated Electrodynamics, Alectra Division—Portable test instruments

94 Cutler-Hammer, Inc. — Positive action switches

8 Dale Products, Inc.—Deposited carbo resistors

10 Delco Radio Division, General Motor Corp.—High power transistors

64 Deutsch Company—Miniature electrica connectors

115 Dilectrix Corporation — Cast TEFLON film

18 Dorne & Margolin, Inc.—Airborne an tennas

7 Dow Corning Corporation—Silicones

58 Eisler Engineering Co., Inc.—Vertical spot welder

95 Elbe File & Binder Co., Inc.—Literature binders

83 Electra Manufacturing Co. — Deposited carbon resistor

81 Fairchild Controls Corp., Comp. Div.— Linear and non-linear pots

14 Fansteel Metallurgical Corp. — Sub-miniature tantalum capacitors

15 Fansteel Metallurgical Corp. — Silicon rectifier stacks

114 Film Capacitors, Inc. — Precision film capacitors

28 Filtors, Inc.—Micro-miniature relay

82 Fluocarbon Products, Inc. — Stand-off and feed-thru insulators

88 Freed Transformer Co.—Magnetic amplifiers

504 General Electric Co., Missile Guidance Product Section—Engineering personnel

505 General Electric Co., Jet Engine Department—Engineering personnel

44 General Transistor Corp.—Gold bonded diodes

87 Gertsch Products, Inc.—Frequency mete

89 Graphic Systems—Visual control board

38 G-V Controls—Thermal time delay relays

102 Heath Company, A Subsidiary of Daystrom, Inc.—Electronic analog computer kit

17 Hoffman Electronics Corp., Hoffman Semiconductor Div.—Zener reference elements

47 Howard Industries, Inc.—Induction motors

6 Hughes Aircraft Company—Cathode ray storage tubes

501 Hughes Aircraft Company—Engineering personnel

66 Hughes Aircraft Company—High-Q silicon capacitors

85 Indiana Steel Products Co.—Permanent magnets

16 Induction Motors Corp.—Size 8 servo motors

107 Industrial Test Equipment Co.—Phase meter

33 International Electronic Research Corp. —Electron tube shields

52 JFD Electronics Corp. — Subminiature precision capacitors

98 Johnson Co., E. F.—Miniature capacitors

92 Jones Div., H. B., Cinch Mfg. Co.— Plugs and sockets

30 Kester Solder—Solder

80 Kleinschmidt Laboratories Inc. — Teletypewriters

110 Kulka Electric Mfg. Co.—Power outlets

21 Lavoie Laboratories, Inc. — Pre-programmed test instrumentation

4 Lenz Electric Mfg. Co.—Free hookup and lead wire sample board

502 Lockheed Missile Systems, A Division of Lockheed Aircraft Corp.—Engineering personnel

Postcard valid 8 weeks only. After that use own letterhead fully describing item wanted. **MAY 1958**

Please send me further information on the items I have circled below. 1

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YOUR NAME .....TITLE.....

FIRM .....

FIRM ADDRESS .....

CITY or TOWN .....ZONE.....STATE.....

FIRST CLASS
PERMIT NO. 36

NEW YORK, N. Y.

BUSINESS REPLY CARD
NO POSTAGE STAMP NECESSARY IF MAILED IN UNITED STATES

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ELECTRONIC INDUSTRIES

P. O. BOX 73, VILLAGE STATION

NEW YORK 14, N. Y.

DVERTISERS IN THIS ISSUE

DVERTISERS FROM WHOM YOU DESIRE FURTHER INFORMATION

- Martin Co., The—Engineering personnel
- Melpar, Inc.—Engineering personnel
- Methode Mfg. Corp.—Precision printed circuits
- Microdot, Inc. — Micro-miniature coax cables and connectors
- New Hermes Engraving Machine Corp. —Engraving machines
- Ohmite Manufacturing Co.—Relays
- Onan & Sons, Inc., D. W.—Standby electric plants
- Panoramic Radio Products, Inc.—Spectrum analyzer
- Phelps Dodge Copper Products Corp.— Semi-flexible coaxial cable
- Philbrick Researches, Inc., George A.— Octal plug-in modules
- Polarad Electronics Corp. — Microwave generators
- Power Sources, Inc. — Semiconductor power converters
- Quan-Tech Laboratories — DC-Coupled Decade amplifier
- Radio Corporation of America—Electron tubes
- Radio Corporation of America—50 KW AM transmitter
- Radio Corporation of America—Traveling wave tubes
- Radio Materials Corp. — Temperature compensating capacitors
- Radio Receptor Co., Inc.—Silicon diodes
- Rohn Manufacturing Co.—Communication towers
- Salon International de la Piece Detachee Electronique — International Exhibition of Electronic Components
- Scintilla Division of Bendix Aviation Corp.—Connectors, miniature
- Slip Ring Co. of America—Slip ring assemblies
- Sperry Gyroscope Co.—High temperature silicon diodes and transistors
- Sprague Electric Co.—Miniature axial lead resistors
- Sprague Electric Co.—Solid-electrolyte tantalum electrolytic capacitors
- Stackpole Carbon Co.—Slide switches
- Sta-Warm Electric Co. — Plastic strip-coating melting pot
- Stevens Manufacturing Co. — Thermostats for missile, avionic and electronic applications
- Sylvania Electric Products, Inc.—PNP drift transistors
- Sylvania Electric Products, Inc.—Microwave and special tubes
- Sylvania Electric Products, Inc.—Engineering personnel
- Sylvania Electric Products, Inc.—Engineering personnel
- Synthane Corp.—Laminated plastics
- System Development Corp.—Engineering personnel
- Tektronix, Inc.—Dual-beam oscilloscope
- Telechrome, Inc.—Vertical blanking interval test signal keyer
- Tensolite Insulated Wire Co., Inc.— High-temperature hook up wire
- Texas Instruments Inc.—Silicon power transistors
- United Transformer Co.—High Q coils
- University Loudspeakers—High fidelity speaker systems
- Victoreen Instrument Co.—Corona type high voltage regulators
- Washington Aluminum Co.—Antennas and cabinets
- Westinghouse Electric Corp. — Vidicon tube

Employment—Use the handy card below to get more information on the engineering positions described in the "Professional Opportunities" Section which begins on page 147 of this issue.

Postcard valid 8 weeks only. After that use own letterhead fully describing item wanted. **MAY 1958**

PROFESSIONAL ENGINEERING OPPORTUNITIES

Please send me further information on the engineering position I have circled below.

501	506	511	516	521
502	507	512	517	522
503	508	513	518	523
504	509	514	519	524
505	510	515	520	525

YOUR NAME ..... TITLE .....

HOME ADDRESS .....

CITY or TOWN ..... ZONE ..... STATE .....

NEW Subscription Order

Please enter a new complimentary subscription to ELECTRONIC INDUSTRIES **MAY 1958**

Company Name: .....

Name: ..... Position .....

Company Address: .....

City: ..... Zone ..... State .....

Specific Products Manufactured .....

Postcard valid 8 weeks only. After that use own letterhead fully describing item wanted. **MAY 1958**

Please send me further information on the items I have circled below. 3

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YOUR NAME ..... TITLE .....

FIRM .....

FIRM ADDRESS .....

CITY or TOWN ..... ZONE ..... STATE .....

New Products and Technical Data—May '58

222 Analyzer, panoramic—Panoramic Radio Products, Inc.
218 Balun, universal—Barker & Williamson, Inc.
206 Base station—Motorola, Inc.
221 Bearings, miniature—The Fafnir Bearing Co.
228 Capacitors, glass—Corning Glass Works
201 Capacitors, mylar—Pyramid Electric Co.
213 Cleaners, ultrasonic—Narda Ultrasonics Corp.
230 Connectors—AMP, Inc.
211 Connectors, bulkhead—Deutsch Co.
196 Cores, memory — Ferroxcube Corp. of America
215 Converter, current—Weston Instrume
199 Eyelets, flanged — Circon Compon Corp.
195 Fuses, sealed—Busmann Mfg.
220 Isolator, ferrite—Sperry Gyroscope C
197 Laminates, epoxy—National Vulcani Fibre Co.
194 Molding machine—Newbury Industr Inc.
203 Meter, frequency—Varo Mfg. Co.
212 Meter, noise figure—Brocker Labo tories
227 Modulator, tube pulse—CBS-Hytron
207 Monitor, small—Conrac Inc.
225 Oscillator, H. F.—General Radio Co
205 Preamplifier—Minneapolis-Honeywell
198 Power supply—John Fluke Mfg. Co.
214 Probe, lox—Arnoux Corp.
210 Receiver, test—Scientific-Atlanta, Inc
219 Recorder—Brush Instruments
202 Rectifier circuits—General Electric C
229 Rectifiers, silicon—Bendix Aviation Co
226 Sockets, subminiature tube—Fluoroc bon Products, Inc.
223 Switch, p-c commutation—Mycalex El tronics Corp.
204 Switch, tr—E. F. Johnson Co.
208 Tape, magnetic—Radio Corp. of Amer
216 Tape, teflon—The Connecticut Hard Ru ber Co.
224 Tube, small camera—Radio Corp. America
200 Tube, camera—Allen B. DuMont Labs
209 Tube, test picture — Sylvania Electr Products, Inc.
231 Voltmeter, vacuum tube—Radio Co of America
217 Wire, miniature—Lenz Electric Mfg. C

NEW TECH DATA

182 Bearings, miniature, precision — Min ture Precision Bearings, Inc.
187 Capacitors, precision — Condenser R search Corp.
183 Capacitors, tantalum — Fansteel Meta lurgical Corp.
173 Capacitors, tantalum—Pyramid Electr Co.
163 Computer analog—George A. Philbric Research, Inc.
161 Control equipment, remote—The Bu Industrial Co., Inc.
168 Creative Engineering Techniques — D signers for Industry
175 Dynamotors—Carter Motor Co.
192 Enclosures systems, modular — Eig Metalformers Corp.
185 Electrical equipment—The Murray Mf Corp.
191 Fasteners—Simmons Fastener Corp.
176 Ferramic material — General Ceramic Corp.
164 Filters, quartz crystal—Burnell & Co.
184 Insulation material—Minnesota Minin & Mfg. Co.
167 Klystrons—Varian Associates
179 Klystrons, ceramic reflex—Eitel-McCul lough, Inc.
190 Microwave components—Microwave A sociates, Inc.
174 Numerical drilling control—Strombers Carlson
169 Potentiometers and dials—The Georg W. Borg Corp.
178 Potentiometer instruments—Bourns Lab oratory, Inc.
171 Regulator, ac voltage—Sorenson & Co. Inc.
170 Regulators, zener power—Hoffman Elec tronics Corp.
172 Relays, sub-miniature — Iron Firem Mfg. Co.
188 Servo breadboard equipment—Sterling Precision Corp.
177 Silicon diodes—Radio Receptor Co.
166 Silicon rectifier handbook—Sarkes Tar sian, Inc.
189 Synchro data charts—Theta Instrumen Corp.
165 Television, closed circuit—The Insul-8 Corp.
160 Test equipment—Simpson Electric Co.
193 Transducers, rectilinear—Crescent En gineering & Research Co.
162 Transductors—Magnetics, Inc.
181 Transistor and diode closures—Hermeti Seal Corp.
186 Transistors, junction — General Electri Co.
180 VHF-UHF equipment — General Radio Co.

FREQUENCY STANDARDS

*3⅛" high
400 - 1000 cy.

PRECISION FORK UNIT
TYPE 50

Size 1" dia. x 3¾" H. Wght., 4 oz.*

Frequencies: 240 to 1000 cycles
Accuracies:—
Type 50 (±.02% at —65° to 85°C)
Type R50 (±.002% at 15° to 35°C)
Double triode and 5 pigtail parts required
Input, Tube heater voltage and B voltage
Output, approx. 5V into 200,000 ohms

FREQUENCY STANDARD
TYPE 50L

Size 3¾" x 4½" x 5½" High
Weight, 2 lbs.

Frequencies: 50, 60, 75 or 100 cycles
Accuracies:—
Type 50L (±.02% at —65° to 85°C)
Type R50L (±.002% at 15° to 35°C)
Output, 3V into 200,000 ohms
Input, 150 to 300V, B (6V at .6 amps.)

*3½" high
400 to 500 cy.
optional

PRECISION FORK UNIT
TYPE 2003

Size 1½" dia. x 4½" H. Wght. 8 oz.*

Frequencies: 200 to 4000 cycles
Accuracies:—
Type 2003 (±.02% at —65° to 85°C)
Type R2003 (±.002% at 15° to 35°C)
Type W2003 (±.005% at —65° to 85°C)
Double triode and 5 pigtail parts required
Input and output same as Type 50, above

FREQUENCY STANDARD
TYPE 2005

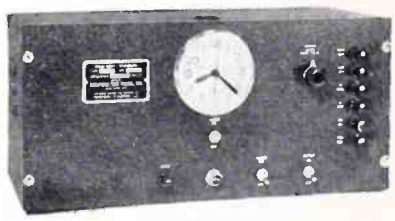
Size, 8" x 8" x 7¼" High
Weight, 14 lbs.

Frequencies: 50 to 400 cycles (Specify)
Accuracy: ±.001% from 20° to 30°C
Output, 10 Watts at 115 Volts
Input, 115V. (50 to 400 cycles)

FREQUENCY STANDARD *NEW*
TYPE 2007-6
TRANSISTORIZED, Silicon Type

Size 1½" dia. x 3½" H. Wght. 7 ozs.

Frequencies: 400 — 500 or 1000 cycles
Accuracies:
2007-6 (± .02% at —50° to +85°C)
R2007-6 (±.002% at +15° to +35°C)
W2007-6 (±.005% at —65° to +125°C)
Input: 10 to 30 Volts, D. C., at 6 ma.
Output: Multitap, 75 to 100,000 ohms



FREQUENCY STANDARD
TYPE 2121A

Size
8¾" x 19" panel
Weight, 25 lbs.

Output: 115V
60 cycles, 10 Watt
Accuracy:
±.001% from 20° to 30°C
Input, 115V (50 to 400 cycles)

FREQUENCY STANDARD
TYPE 2001-2

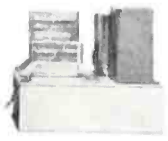
Size 3¾" x 4½" x 6" H., Wght. 26 oz.

Frequencies: 200 to 3000 cycles
Accuracy: ±.001% at 20° to 30°C
Output: 5V. at 250,000 ohms
Input: Heater voltage, 6.3 - 12 - 28
B voltage, 100 to 300 V., at 5 to 10 ma.

FREQUENCY STANDARD
TYPE 2111C

Size, with cover
10" x 17" x 9" H.
Panel model
10" x 19" x 8¾" H.
Weight, 25 lbs.

Frequencies: 50 to 1000 cycles
Accuracy: (±.002% at 15° to 35°C)
Output: 115V, 75W. Input: 115V, 50 to 75 cycles.



ACCESSORY UNITS
for TYPE 2001-2

L—For low frequencies multi-vibrator type, 40-200 cy.
D—For low frequencies counter type, 40-200 cy.
H—For high freqs, up to 20 KC.
M—Power Amplifier, 2W output.
P—Power supply.

This organization makes frequency standards within a range of 30 to 30,000 cycles. They are used extensively by aviation, industry, government departments, armed forces—where maximum accuracy and durability are required.

WHEN REQUESTING INFORMATION
PLEASE SPECIFY TYPE NUMBER

American Time Products, Inc.

Watch Master
Timing Systems

Telephone: PLaza 7-1430

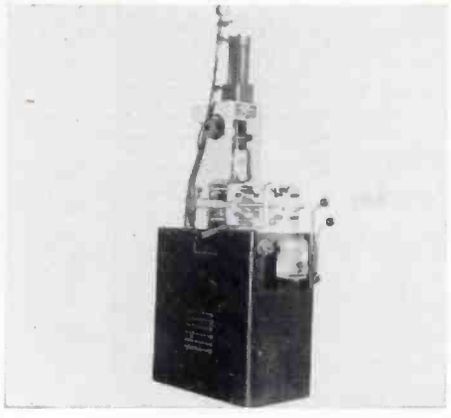
580 Fifth Ave., New York 36, N. Y.

Circle 79 on Inquiry Card, page 99

New Products . . . for the Electronic ndustries

MOLDING MACHINE

Practically unlimited varieties of small, plastic injection molded items up to 1 oz. are now developed and produced at major savings using a single machine introduced as the

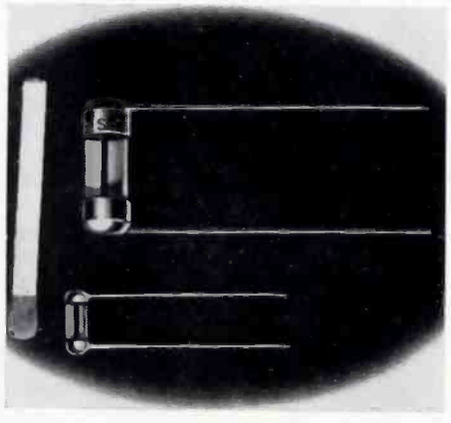


Mini-Jector "Universal" Super-Hornet. It enables industry to do its small capacity molding in all thermoplastics, including Nylon, on the same machine. Exceptionally flexible, it is recommended for many fields. Available to suit requirements—air or hydraulic power, lever or push-button controls. Newbury Industries, Inc., Newbury, Ohio.

Circle 194 on Inquiry Card, page 99

SEALED FUSES

Fuses of minute physical dimensions for use with miniaturized circuits, controls, electronic devices, and electrical equipment are made of hermetically sealed glass tubes with lead-ins. They meet requirements for potting and encapsulating. Designed to withstand heavy shocks and vibrations. Available in two sizes: 0.140 x 0.300 in., in an amperage range of 1/20 to ½, rated at 125 v.; ¼ x ⅝ in., in an amperage range of 1 to 5,

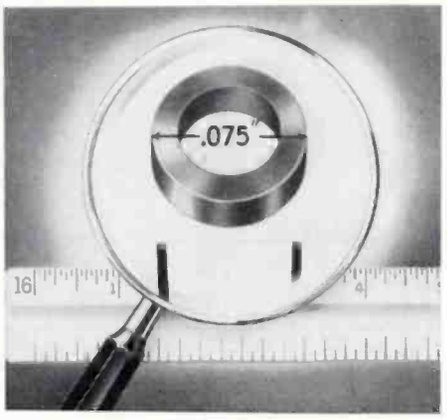


rated at 32 v. The larger size has ⅛ in. ferrules, and can be furnished with or without lead-ins. Bussmann Mfg., University at Jefferson, St. Louis 7, Mo.

Circle 195 on Inquiry Card, page 99

MEMORY CORE

The M3 memory core, specifically designed for transistorized memory circuits and requiring very low driving current, is available. Made of Ferroxcube 681 material, the core has

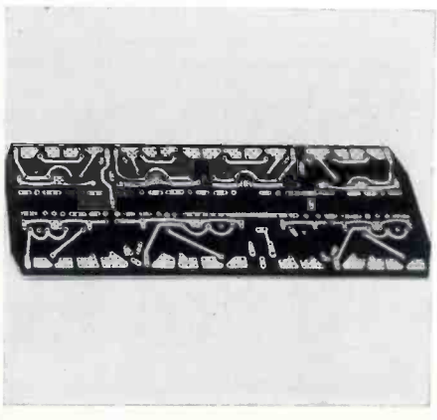


a switching time of 2 microseconds with a current of 450 ma. at 40° C. It can be furnished in complete arrays, such as the 10 by 10 memory array, and is delivered 100% tested to guaranteed specifications. This tiny toroid cone measures 0.075 x 0.048 x 0.022 in. thick. Ferroxcube Corp. of America, 50 E. Bridge St., Saugerties, N. Y.

Circle 196 on Inquiry Card, page 99

EPOXY LAMINATES

An epoxy bonded fiber glass laminate with improved flexural strength retention at elevated temperatures is available. Material is identified as Phenolite Grade G-11-861. It retains 70 to 80% of its original flexural strength when tested at 150° C. after conditioning for 1 hr. at that temperature. G-11 material overcomes the limitations of G-10 epoxies in applications requiring mechanical strength at elevated temperatures. It

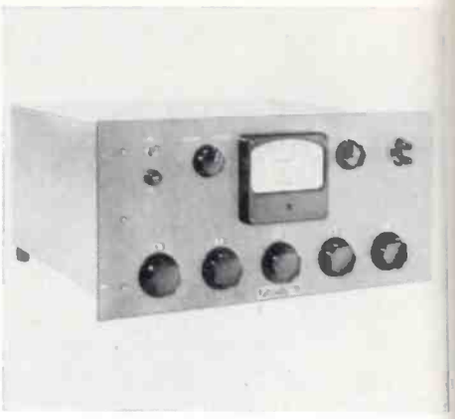


also offers all the good electrical properties and great mechanical strength of epoxy bonded materials. National Vulcanized Fibre Co., Wilmington, Del.

Circle 197 on Inquiry Card, page 99

POWER SUPPLY

Power supply, Model 301E, has good stability and accuracy, combined with direct "read-out" controls to enhance its versatility. It features chopper stabilization and built-in standard

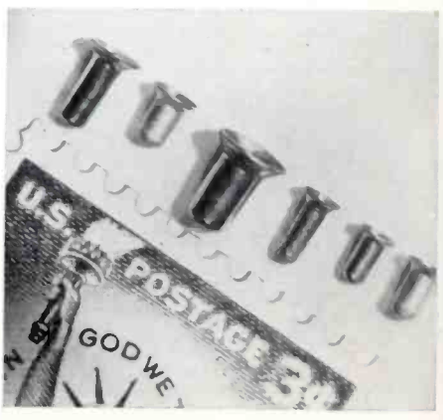


cell reference. Output voltage is 1.02 to 512 vdc at 0 to 300 ma. Polarity is selective. Regulation against line or load is better than 0.005%. Resolution is better than 500 μv. at any output voltage. Resetability is 0.01%. Calibration accuracy from the direct reading controls is better than 0.01%. John Fluke Mfg. Co., Inc., 1111 W. Nickerson St., Seattle 99, Wash.

Circle 198 on Inquiry Card, page 99

FLANGE EYELETS

Used for terminal and feed-through connections on printed circuits, the flared flange of these eyelets provides a good fillet of solder between the eyelet and the circuit pattern. No other head flux inclusions in the connection are possible because of the open character of the installed eyelet. There are 12 standard sizes to cover the entire range of printed circuit needs. The smallest eyelet is less than 1/32 in. dia., 1/16 in. long



and has a 1/16 in. head dia. Sizes range upward to 3/32 in. dia., 5/32 in. long with a 0.150 head dia. Circon Component Corp., Santa Barbara Municipal Airport, Goleta, Calif.

Circle 199 on Inquiry Card, page 99

New Products . . . for the Electronic Industries

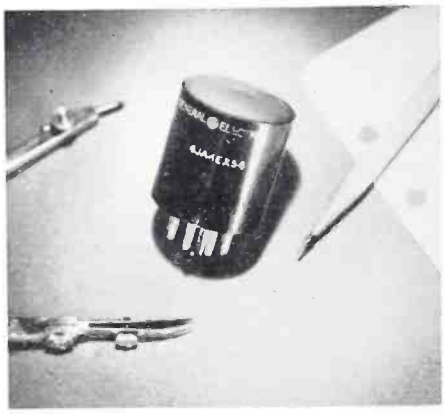
STORAGE TUBE

A direct-view storage tube incorporates a black-background screen. The new DVST, one of a complete line of such devices, combines the black-background screen and storage features to make it an indispensable device for military, industrial, and laboratory equipment which require long retention of electrical transients and half-tones, and viewing in open areas or brightly lighted enclosures. The regular screen types include 5 in., 10 in., 15 in., and 21 in. screen sizes. Allen B. Du Mont Labs, Inc., 750 Bloomfield Ave., Clifton, N. J.

Circle 200 on Inquiry Card, page 99

RECTIFIER CIRCUITS

Complete germanium and silicon rectifier circuits potted in epoxy resin in octal socket tube bases are now being produced. Advantages of potted rectifier circuit use include ease of equipment assembly, greater ruggedness than lead-mounted rectifiers, stocking of standard rectifier circuits and practicability of directly replacing standard vacuum tube rectifiers. Any standard or special rectifier circuit requiring from one to six low current germanium or silicon rectifier cells can be supplied. General Electric Co., Syracuse, N. Y.



Circle 202 on Inquiry Card, page 99

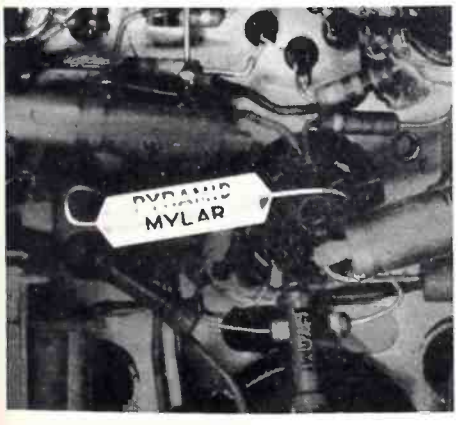
TR SWITCH

The new TR Switch provides instantaneous high efficiency electronic antenna switching. Double-gated cascode circuitry insures good receiver isolation and improved noise figure in addition to signal amplification up to 6 db. Frequency range continuous from 3.5 through 30 MC. Advanced design permits handling the high peak power capabilities of new linear amplifiers rated at 4,000 watts peak power. Instantaneous break-in on SSB, DSB, CW or AM—will not affect transmission line swr. E. F. Johnson Co., Waseca, Minn.

Circle 204 on Inquiry Card, page 99

MYLAR CAPACITORS

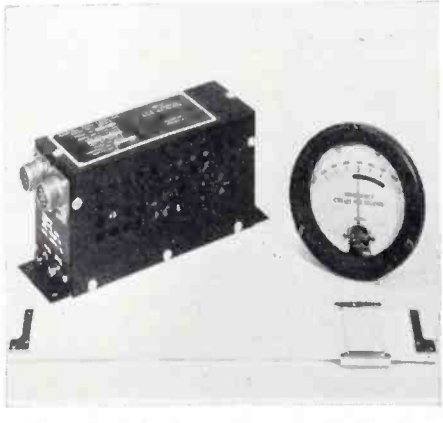
The Mylar Capacitors have an extremely high insulation resistance rating, high dielectric strength and high resistance to moisture penetration. Commercially available immediately, they have an operating range between −30°C to +125°C with voltage re-ratings above +85°C. Features are: Small size; Made with non-hygroscopic polyester dielectric and wrap (Mylar); Ends and wrap sealed with thermosetting resin; Passes rigid humidity requirements and has high insulation resistance. Pyramid Electric Co., 1445 Hudson Blvd., North Bergen, N. J.



Circle 201 on Inquiry Card, page 99

FREQUENCY METER

A completely transistorized precision frequency meter for 400 CPS is available. It provides 0.05% accuracy at 400 CPS by calibration of the discriminator with an internal tuning fork. Accuracy of 0.1% is achieved at full scale, 397 to 403 CPS. Some primary features of the 6506 are: Transistorized for dependability, low current consumption, small size and light weight; Extreme Accuracy achieved by use of a tuning fork frequency standard as an internal calibration reference. Varo Manufacturing Co., Inc., 2201 Walnut St., Garland, Tex.



Circle 203 on Inquiry Card, page 99

PREAMPLIFIER

D-C signals as low as 20 μv can produce full scale deflection of a high speed 12 in. chart potentiometer in ¼ sec. or less with this new preamplifier recently developed. Model 2HLA-7 has an isolated differential input, 20 CPS frequency response, 1 μv recorded noise and drift, and gains as high as 100,000. Designed for use with the ElectroniK recorder and other circular and strip chart potentiometers, it has a voltage divider output to provide a standard 10 mv full scale output signal. Minneapolis-Honeywell, 1400 Soldiers Field Rd., Boston, Mass.

Circle 205 on Inquiry Card, page 99

New Tech Data for Engineers

Test Equipment

Simpson Electric Co., 5200 W. Kinzie St., Chicago 44, Ill., has just issued their latest catalog describing a complete new line of test equipment. The 6-page, 2-color catalog contains photographs, mechanical and electrical specifications along with prices. Their new, improved Model 260 multimeter is also included.

Circle 160 on Inquiry Card, page 99

Remote Control Equipment

The Rust Industrial Co., Inc., 130 Silver St., Manchester, N. H., has just issued a 6-page, 2-color brochure describing their complete line of remote control equipment for the broadcast field. Complete electrical and mechanical specifications and information are included.

Circle 161 on Inquiry Card, page 99

Transductors

A 2-color, 16-page booklet, T-10, issued by Magnetics, Inc., Butler, Pa., describes their complete line of transductors. Booklet is complete with specifications, diagrams, photographs, graphs and tables.

Circle 162 on Inquiry Card, page 99

Analog Computer

George A. Philbrick Research, Inc., 230 Congress St., Boston 10, Mass., has issued a 4-page brochure on a new analog computer, the K5-U. Bulletin contains a general description of the computer, specifications and a brief comparison of the K5-U techniques with other methods of analog formulation.

Circle 163 on Inquiry Card, page 99

Quartz Crystal Filters

A 2-color, 4-page brochure outlining their comprehensive product line of stock and special miniaturized quartz crystal filters is available from Burnell & Co., Inc., Pelham Manor, N. Y. Brochure includes technical data, typical and representative curves of crystal filters that have been developed and manufactured.

Circle 164 on Inquiry Card, page 99

Closed Circuit Television

The Insul-8-Corp., 1369 Industrial Rd., San Carlos, Calif. has issued a 2-color, 6-page brochure which describes their closed circuit television systems and equipment. Bulletin V-1-58 is complete with photographs and descriptions.

Circle 165 on Inquiry Card, page 99

Silicon Rectifier Handbook

Handbook No. 67 contains 40 pages of technical information on silicon rectifiers. Issued by Sarkes Tarzian, Inc., Rectifier Div., 415 N. College Ave., Bloomington, Ind., the 2-color booklet also contains electrical and mechanical specifications on their complete line of rectifiers. Normally selling for $1.00, the booklet will be given free to our readers.

Circle 166 on Inquiry Card, page 99

Klystrons

Varian Associates, 611 Hansen Way, Palo Alto, Calif. has issued a 4-page, 2-color brochure describing their new line of klystrons. Photographs of the klystrons are included with various technical information.

Circle 167 on Inquiry Card, page 99

Creative Engineering Techniques

"Planned Products," a 4-page bulletin outlining a new concept in creative engineering techniques for industry has been issued by Designers for Industry, 4241 Fulton Pkwy., Cleveland 9, Ohio. Six separate services are discussed in detail.

Circle 168 on Inquiry Card, page 99

Potentiometers and Dials

The George W. Borg Corporation, 120 So. Main St., Janesville, Wis. has issued a new catalog No. BED-A90 featuring special data and engineering information for electronic design engineers about potentiometers and direct reading microdials. Liniarity definitions, resolution curves, power rating curves, applications, operation and other valuable data about components are included.

Circle 169 on Inquiry Card, page 99

Zener Power Regulators

The second in a series of new application notes, "The Use of Zener Power Regulators as Vacuum Tube Heater Voltage Stabilizers" has been published by the Semiconductor Div. of Hoffman Electronics Corp., Evanston, Ill.

Circle 170 on Inquiry Card, page 99

AC Voltage Regulator

A new tech data sheet from Sorensen & Co., Inc., Richard Ave., So. Norwalk, Conn., describes their universal AC voltage regulator, Model APR1010. A detailed explanation is included.

Circle 171 on Inquiry Card, page 99

Sub-miniature Relays

A new catalog now available describes miniature and sub-miniature relays manufactured by the Electronics Div. of Iron Fireman Mfg. Co., 2838 S. E. 9th Ave., Portland, 2, Ore. Included are sensitive and high-speed miniature relays, as well as micro-miniature relays in both voltage-sensitive and current-sensitive models. Besides specifications, the catalog contains adjustment schedules, dimensional and circuit diagrams.

Circle 172 on Inquiry Card, page 99

Tantalum Capacitors

A new 4-page Engineering Bulletin issued by Pyramid Electric Co., 1445 Hudson Blvd., No. Bergen, N. J. describes their complete new line of tantalum capacitors.

Circle 173 on Inquiry Card, page 99

Numerical Drilling Control

Stromberg-Carlson Co., 2231 So. Barrington Ave., Los Angeles 64, Calif. has issued a 2-color brochure describing their Digimatic Control System for Table Positioning of Drill Presses. Automatic drilling of a typical part is illustrated step by step and a cost comparison with hand drilling is made.

Circle 174 on Inquiry Card, page 99

Dynamotors

A new 28-page dynamotor catalog describing the entire line of Carter Motor Co., 2760A W. George St., Chicago 18, Ill. Complete information and photographs are included in this comprehensive catalog of dynamotors.

Circle 175 on Inquiry Card, page 99

Ferramic Material

Permanent data on Ferramic S-4 material is now available from General Ceramics Corp., Keasbey, N. J. Bulletin describes S-4 material in the F394 size for magnetic cores to be used in high-speed coincident current memoty. General, electrical and mechanical engineering data is included, as well as switch time curves.

Circle 176 on Inquiry Card, page 99

Silicon Diodes

A 2-color bulletin S-61 issued by the Radio Receptor Co., Inc., 240 Wythe Ave., Brooklyn 11, N. Y. contains charts, graphs, line drawings of the subminiature glass silicon diodes. Diode specifications are given in an easy to follow tabular form.

Circle 177 on Inquiry Card, page 99

(*Continued on page* 114)

Teleprinted Communications...on the double!

The Kleinschmidt teletypewriter set sends teleprinted messages from tape at speeds up to 100 words per minute.
AT THE SAME TIME, on the same unit, the operator perforates and prints other messages for transmission.

Day after day, Kleinschmidt teletypewriters and related equipment at U. S. Army Communication Centers receive and transmit thousands of teleprinted messages. This tremendous communications traffic, accelerated by multiple-function Kleinschmidt equipment, developed in cooperation with the U. S. Army Signal Corps, flows smoothly and precisely. Both sender and recipient receive a teleprinted original, identical in every respect.

Since the century began, the Kleinschmidt name has been associated with every major development in teleprinted communications. Now a member of the Smith-Corona family, Kleinschmidt looks ahead to new attainments in broadening the field of electronic communications for business and industry.

KLEINSCHMIDT

KLEINSCHMIDT LABORATORIES, INC., DEERFIELD, ILLINOIS

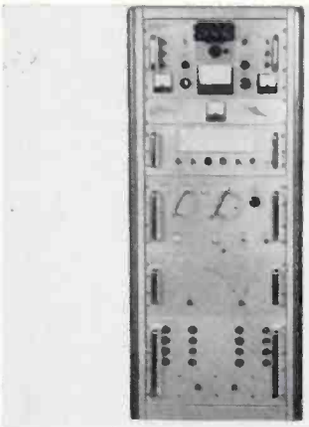
Pioneer in teleprinted communications equipment • A subsidiary of Smith-Corona Inc

Circle 80 on Inquiry Card, page 99

New Products

TEST RECEIVER

A new test receiver covers the frequency range from 30 MC to higher than 75 KMC, without plug-in units. The S-A Series 402 Wide Range Receiving System is a superheterodyne receiver designed primarily for appli-

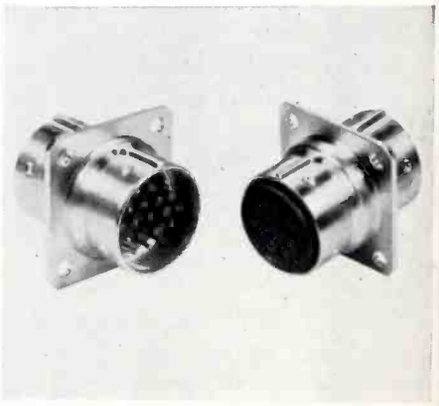


cation in antenna pattern measurements where maximum linear dynamic range and sensitivity are required. The receiver has a linear dynamic range exceeding 40 db and sensitivities greater than —90 dbm at 30 MC and 70 dbm at 75 KMC. Scientific-Atlanta, Inc., 2162 Piedmont Rd., N.E., Atlanta, Ga.

Circle 210 on Inquiry Card, page 99

BULKHEAD CONNECTORS

Newest addition to a line of miniature electrical connectors is an environmental unit that carries connections through a bulkhead and has the advantage of positive push-pull connection from either side. The contacts are pin to socket. Model DM9603 may be used with a rack-and-panel plug for drawer installations. It also provides many application possibilities for hanging cables and sealed compartments. Both ends of the DM9603 will



mate with Models DM6502 and DM-9700. The unit meets or exceeds the latest revision of MIL 5015. The Deutsch Company, 7000 Avalon Blvd., Los Angeles 3, Calif.

Circle 211 on Inquiry Card, page 99

Florida Electronic Industry Association

Following preliminary meetings held at Miami and Orlando, formal organization of The Association of Florida Electronic Industry was effected and a Constitution adopted at a meeting of some twenty leading electronic firms.

The following officers were elected to serve for 1958: T. F. Grieser (Vice Pres.-Electronic Communications, Inc., St. Petersburg)—President; J. Johnson (Pres.-Johnson Electronics, Orlando)— 1st Vice-Pres.; James F. Thompson (Contract Manager-RCA Service Div., Patrick AFB, Cocoa Beach)—2nd Vice Pres.; W. Pierpont (Purchasing Agent-Radiation, Inc., Melbourne)—Secretary; E. G. Balstraz (Division Manager-Frank C. Brown & Company, Inc., Miami)—Administrator.

Elected to the Board of Directors were: T. F. Grieser, Electronic Communications, Inc.; H. W. Getting, Radiation, Inc.; E. S. Johnson, Johnson Electronics Company; Frank X. Martel, Radio Electronic Television Schools; Francis P. Rice, Circuit Instrument Company; P. S. Thorn, Centronix, Inc.; William Rose, Milgo Electronic Corporation; J. F. Thompson, RCA Service Division; Parker Painter, Jr., Dynatronics, Inc.; M. Kaplan, Systems, Inc.; O. F. Quartullo, Visioneering Company, Inc.; Cliff E. Mattox, Dbm Research Corporation; E. G. Balstraz, Frank C. Brown & Company, Inc.; James W. Coupman, Missileonics, Inc.; and David Caldwell, Florida Power Corp.

Publication of Index to Scientific Journals

ELECTRONIC INDUSTRIES is among the 510 periodicals that are being indexed by subject and author in a new publication announced recently. The indexes, comprising several hundred thousand entries, have been compiled by the Library of the U. S. Naval Research Lab.

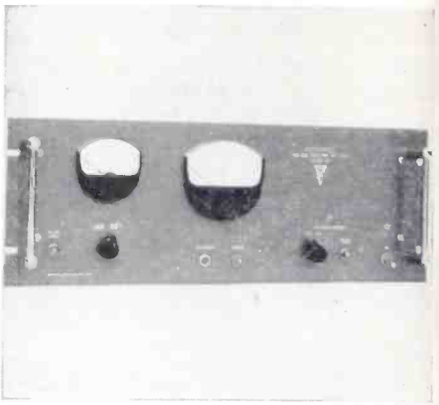
The original index cards are to be reproduced in book form by offset printing.

The publication will be available only to those who subscribe in advance of printing, which will start in the 3rd quarter of this year. It is being offered by Micro-Photography Co., 97 Oliver Street, Boston 10, Mass.

New Products

NOISE FIGURE METERS

An automatic Noise Figure Meter for traveling wave tubes has been introduced. Noise figure is read directly for a 15.2 db noise source, a phantom scale being used with other than a



standard source. A meter for TWT power output level indicates relative change in gain during adjustment of TWT potentials for optimizing noise figure. Model 501 operates at 30 MC input with sensitivity sufficient to measure TWT noise figure without external amplification. Brocker Laboratories, Box 967, Sunnyvale, Calif.

Circle 212 on Inquiry Card, page 99

ULTRASONIC CLEANERS

A mass-produced line of high capacity, production-size ultrasonic cleaners, metal-finishing and chemical process machines has been introduced. The Series 600 line comprises 13 ultrasonic systems made up of various combinations of the SonBlaster Generator and SonBlaster Ultrasonic Transducer Models NT-601 to NT-609. Stainless steel transducerized tanks range from ½ gal to 1 gal. with single or double tank compartments. Some feature inlet and outlet

taps for hook-up with external recirculating systems; others have self-contained recirculating pumps. The Narda Ultrasonics Corp., 160 Hericks Rd., Mineola, L. I., N. Y.

Circle 213 on Inquiry Card, page 99

Air Force Takes Over White Alice Network

A new, 3000-mile telephone and telegraph network has been put into operation to provide both military and public service to some of Alaska's most remote northern points.

The Alaskan Air Command formally accepted the White Alice Network at a ceremony at Elmendorf Air Force Base. Telephone calls were placed over the system to its most distant points—including Cape Lisburne, on the northwest tip of North America; St. Lawrence Island, in the Bering Sea, and Wales, only 50 miles from the coast of Russia.

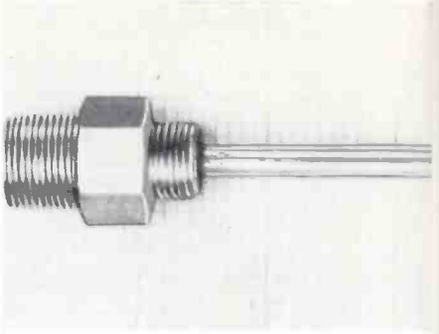
Speakers at the ceremony stressed the significance of the completed network to the development of the nation's "last frontier." It was predicted that Alaska's first widespread communications network will be both a stimulant and unifying force for the Territory.

The network was delivered to the Air Force by the Western Electric Company, which was prime contractor for White Alice.

New Products

LOX PROBE

A low-temperature Probe, the Semiconductor Series 7XXXL is available. It will provide output in volts (from 0 to 5 vdc) for a temperature span of only 20° F in the liquid oxygen



(LOX) temperature range. The probe also can be used with liquid nitrogen, liquid argon, and almost any liquefied gas in the range from —240° F to —320 ° F. Applications are temperature - stratification measurements (temperature gradients through a LOX tank), sensing liquid levels in tanks, and pipeline measurements during LOX-fueling operations. Arnoux Corp., 11924 W. Washington Blvd. Los Angeles 66, Calif.

Circle 214 on Inquiry Card, page 99

CURRENT CONVERTER

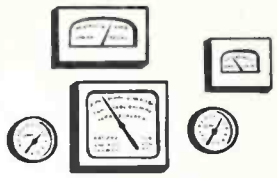
A new current converter providing a direct current output proportional to an alternating current input is available. This transformer-rectifier assembly is designated as Model 9886 Current Converter. It is available in 3 types for 60 CPS use in current circuits up to 5 a. One is designed for d-c output of 1 ma. into 100 ohms for use with indicating instruments and Sensitrol relays. Another type pro-

vides a d-c output of 5 ma. into 100 ohms for use with sensitive relays. The third is for 50 mv open circuits d-c output. Weston Instruments, Newark, N. J.

Circle 215 on Inquiry Card, page 99

How Magnets Help Solve Your Measurement Problems

This is a review of how magnets, magnetic devices and magnetic phenomena can be used to solve certain measurement problems, to improve production efficiency and to cut manufacturing costs.



Highly accurate and efficient measurement is an essential part of modern manufacturing. Today's mass production techniques require speedy analysis of conditions and dimensions of parts and materials. Literally hundreds of measurement problems are being solved effectively with instruments and devices that employ magnets.

ELECTRICAL MEASUREMENTS

Most common of the uses of magnets in measurement is in electricity—in such devices as ammeters, voltmeters, voltage protectors, KVA meters, power factor meters, arc-back indicators, limit and flow switches, frequency meters, galvanometers and oscillographs. In the ammeter there is either a stationary coil and a magnet that rotates when a current is passed through the coil, or a stationary magnet and a moving coil. The voltmeter is similar, with a high resistance in series with the coil.

Also similar is the galvanometer, but it is much more delicate and sensitive. An oscillograph is a special form of moving-coil galvanometer. Potentiometers, which measure small electromotive forces, consist of a circuit of resistances and a galvanometer. Frequency meters depend on the effect of the currents in two shunt circuits on a moving coil. One circuit contains inductance and the other capacitance.

Magnets in galvanometers and oscillographs combine with electromagnetic waves and electrons to provide integrated and recorded measurements, often remote from the locations of the measurements.

LINEAR MEASUREMENTS

Even the most simple linear measurements are assisted by magnets — by magnetic bases on height gauges, indicators, dials, roundness gauges, carpenter levels and magnetic plumb-bob. The thickness of a non-magnetic coating on iron can be determined by measuring the gap between the magnet in a tester and the iron object.

Radar sends out a high-frequency electromagnetic wave which is reflected back from the target to a receiving antenna. Speed of the wave is known, so that distance can be determined by measuring the time between emission and reception of the wave. The heart of this instrument is the magnetron vacuum tube, which depends on a high-intensity, uniform, permanent magnet field. Sonar is similar to radar except that its energy is in ultrasonic waves of 10 to 40 kilocycles.

Distance is also measured by proximity fuses and switches. The fuse depends on a permanent magnet generator for energy. It sends out a signal which is reflected by the target to actuate a firing mechanism; thus, a direct hit is not necessary. In the switch, a magnet is attracted to any iron or steel that comes near, closing the switch.

Direction can be measured by the aircraft direction indicator, the compass and the remote-reading compass transmitter. All these devices depend on magnets.

AREA MEASUREMENTS

Applications of magnets in land measure are numerous. We have magnetic maps, charts and markers, and vast areas are surveyed and measured by radar and sonar.

In the future it is likely that television, which uses magnets for focusing, ion traps and loudspeakers, will be used to measure areas.

VOLUME MEASUREMENTS

Liquid-level indicators and float switches often transmit the motion of a float to the indicating mechanism by magnetic attraction. In flow meters, volume of liquids and gases may be measured through a seal by such devices as a permanent magnet rotor turning in a venturi, a rotor in a liquid cutting flux lines of a magnet, molten metal flowing through a pipe and cutting magnetic flux, a magnetic clutch between a float and a recording mechanism.

TIME MEASUREMENTS

Permanent magnets are contributing much toward accuracy and ruggedness in actuators, clutches and brakes in clocks, timers, timing motors and traffic signals.

TEMPERATURE MEASUREMENTS

Magnets are used extensively in pyrometers, which are thermocouples connected to galvanometers calibrated in degrees. The optical thermometer employs a magnetic ammeter and in other thermometers magnets indicate the maximum or minimum temperature in a period. In many thermostats, magnets accelerate the contacts to increase accuracy and life.

SPEED MEASUREMENTS

Two of our best known modern instruments are the speedometer, based on eddy currents generated by a rotating magnet, and the tachometer, which is simply a permanent magnet generator. Magnetic couplings are used to connect tachometers to such machines as high-pressure turbines and other sealed equipment.

NEW MEASUREMENT INSTRUMENTS

There are possibilities for the development of new measuring instruments, based upon the following magnetic phenomena:

1 Magnetostriction effects, such as the change in length and volume of a rod when magnetized; the bending of a magnetized rod; the twist in a rod in a magnetic field; the change in magnetic induction of a rod under stress in a magnetic field.

2 The production of characteristic sounds and vibrations of bodies in a magnetic field; changes in period and frequency of vibrating bodies in a magnetic field.

3 Changes in apparent resistance of conductors introduced into a magnetic leld.

4 Changes in thermal conductivity of metals when exposed to a magnetic field; changes in permeability of magnetic materials; changes in boiling points and specific heats of some substances in a magnetic field.

5 The plane of polarization of light can be rotated by a magnetic field; double refraction of light has been observed in several mediums subjected to a magnetic field; similar effects occur with electromagnetic waves.

6 Transformations that occur in pure metals and alloys are affected by magnetic fields.

The foregoing discussion is condensed from an article which appears in "Applied Magnetics," Vol. 2, No. 4. Write for your free copy. If you would like to explore any of the possibilities discussed in the article, Indiana's engineering staff will be glad to offer recommendations and consultation.

NEW CATALOG AVAILABLE

Send for your free copy of the new "Cast and Sintered Alnico Magnet Catalog No. 19," which describes and lists typical sizes and shapes of these two most popular types of magnetic materials for experimental use. Also shown are permanent and electro-magnetizers and demagnetizers. Address Dept. N5.

Circle 85 on Inquiry Card, page 99

New Tech Data for Engineers

Potentiometer Instruments

Bourns Laboratories, Inc., P. O. Box 2112, Riverside, Calif. has issued a 2-color, 4-page brochure which describes their linear motion potentiometers, pressure potentiometers and acceleration potentiometers. Brochure is complete with photographs and descriptions.

Circle 178 on Inquiry Card, page 99

Ceramic Reflex Klystrons

A 12-page, 2-color booklet issued by Eitel-McCullough, Inc., San Bruno, Calif. describes their new line of Eimac Reflex Klystrons incorporating ceramics in their construction. Brochure is complete with photographs, graphs, tables and descriptions.

Circle 179 on Inquiry Card, page 99

VHF-UHF Equipment

A 12-page booklet issued by the General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass. describes in complete detail their integrated line of high frequency measuring equipment. Described are rugged instruments and accessories for signal and pulse generation, impedance measurement, detection, modulation, attenuation, and transmission through shielded coaxial lines.

Circle 180 on Inquiry Card, page 99

Transistor and Diode Closures

The Catalog No. 657D describing its complete line of end seals, crystal holders and mounts, and transistors and diode closures has just been issued by Hermetic Seal Corp., 29 S. 6th St., Newark 7, N. J. The 16-page folder contains complete physical dimensions and line drawings of over 1000 different styles and sizes of military and EIA type hermetic seals and their appropriate part numbers. Also offers specific illustrations and information about custom design engineering service on all types of glass-to-metal seals.

Circle 181 on Inquiry Card, page 99

Miniature Precision Bearings

A 24-page, 2-color booklet describing miniature ball bearings is now available from Miniature Precision Bearings, Inc., Keene, N. H. Bulletin describes in complete detail a full line of miniature ball bearings which range in size from ⅜ in. outside diameter down to 1/10 in. outside diameter. Brochure contains photographs, outline drawings, mechanical specifications, conversion charts, graphs, nomographs, and other descriptive information.

Circle 182 on Inquiry Card, page 99

Tantalum Capacitors

Fansteel Metallurgical Corp., N. Chicago, Ill. has issued a 2-color, 4-page brochure which lists their complete line of tantalum capacitors. Complete specifications are given in tabular form along with drawings and graphs.

Circle 183 on Inquiry Card, page 99

Insulation Material

Mica Insulator, Div. of Minnesota Mining & Mfg. Co., Schenectady 1, N. Y. has issued an 8-page, 2-color booklet describing their Isomica Epoxy Micaceous Insulation. Bulletin No. A-58 contains complete electrical and mechanical specifications along with graphs, charts, and photographs.

Circle 184 on Inquiry Card, page 99

Electrical Equipment

The Murray Mfg. Corp., 1250 Atlantic Ave., Brooklyn 16, N. Y. has just issued a 70-page catalog describing their electrical distribution equipment. Included in the catalog are complete mechanical and electrical specifications, photographs, graphs, circuits, outline drawings and price list.

Circle 185 on Inquiry Card, page 99

Junction Transistors

A new 4-page illustrated brochure on germanium alloy junction transistors, types 2N43 and 2N44 has just been published by the Semiconductor Products Dept. of the General Electric Co., Syracuse, N. Y. Brochure contains complete specification information and 3 pages of new graphs characterizing performance of the devices.

Circle 186 on Inquiry Card, page 99

Precision Capacitors

Condenser Research Corp., Seymour, Ind. has issued a 17-page catalog showing complete specifications and engineering data on precision film capacitors in Mylar, Polystyrine, Teflon and Metallized Mylar.

Circle 187 on Inquiry Card, page 99

Servo Breadboard Equipment

Sterling Precision Corp., 17 Matinecock Ave., Port Washington, L. I., N. Y. has just issued a booklet which describes their complete line of servo breadboard equipment. Booklet describes in detail their various types of gears, couplings, stops, and adjustable hanger assemblies along with photographs, outline drawings, and mechanical specifications.

Circle 188 on Inquiry Card, page 99

Synchro Data Charts

Theta Instrument Corp., 48 Pine St., E. Paterson, N. J. has just issued two small wall charts for users of synchros and resolvers. One card accurately defines the important parameters designated on manufacturers' data sheets. The other card designates the synchro and resolver windings at which null voltages may be found for various input connections and rotor angles.

Circle 189 on Inquiry Card, page 99

Microwave Components

A new 48-page catalog describing in detail more than 300 different types of microwave waveguide components, test equipment, and pressure windows is available from Microwave Associates, Inc., Burlington, Mass. In two colors, Catalog 58CP includes complete electrical operating characteristics, performance curves, application data, outline drawings, dimensions, and prices of components in the 1.12 KMC to 90.0 KMC frequency range. Photographs of each product are also included.

Circle 190 on Inquiry Card, page 99

Fasteners

Detailed specifications, engineering drawings, applications, and installation information is provided in the new 40-page Simmons Fastener Corp. catalog. They are located at North Broadway, Albany 1, N. Y. Data on the new Hinge-Lock and Spring-Loaded Link-Lock is given, as well as complete details on other special fasteners: dual-lock, quick-lock, roto-lock, spring-lock and the regular link-lock.

Circle 191 on Inquiry Card, page 99

Modular Enclosure Systems

Elgin Metalformers Corp., Elgin, Ill. has just issued a 36-page catalog, No. 105, which describes in complete detail their various cabinets such as equipment, racks, consoles, and component parts of these units. Complete mechanical specifications along with outline drawings, photographs, tables, and handy ordering guide are included.

Circle 192 on Inquiry Card, page 99

Rectilinear Transducers

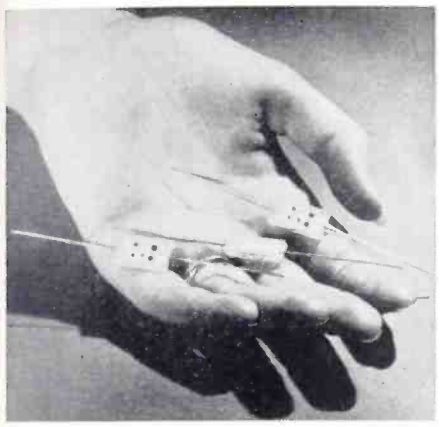
A 2-color, 4-page brochure issued by Crescent Engineering & Research Co., 5440 N. Peck Rd., El Monte, Calif. describes their rugged ac linear pickoffs for measurement and servo applications. All technical and mechanical specifications are included along with photographs, charts, graphs, and curves.

Circle 193 on Inquiry Card, page 99

New Products

GLASS CAPACITORS

Miniature CY-type fixed glass capacitors are now being produced with a full rating at 125° C. Meeting all MIL-C-11272A requirements, these capacitors are available in voltage

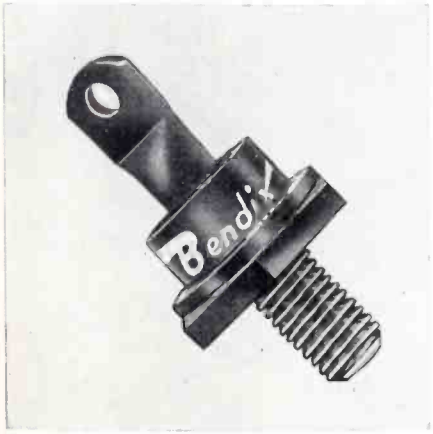


ratings of 300 v. and 500 vdc. They have a continuous operating range of —55° C to 125° C. The capacitors are suitable for guided missiles systems, hypersonic aircraft communications systems, and other critical high temperature applications. Capacitance drift is less than 0.1% or 0.1 $\mu\mu$f, whichever is greater. Corning Glass Works, Corning, N. Y.

Circle 228 on Inquiry Card, page 99

SILICON RECTIFIERS

A series of new silicon rectifiers have just been released for production. They have p.i.v. ratings ranging from 50 to 600 v. and can deliver 30 a. of rectified current. The operating temperature extends from —65° C to +175° C. The rectifier package is in conformance with the latest JETEC proposed standards. The rectifiers are of the diffused junction type for lower



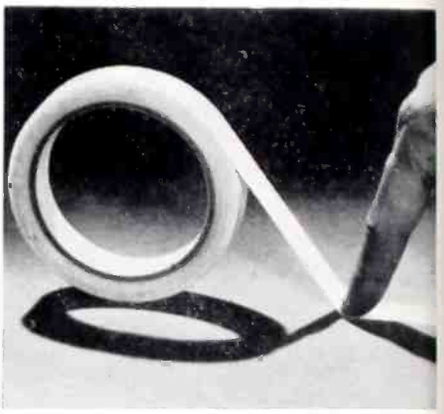
forward drop and lower reverse leakage current. EIA has reserved the JETEC designations 1N1434-1N1438 for this series. Bendix Aviation Corp., Red Bank Div., Long Branch, N. J.

Circle 229 on Inquiry Card, page 99

New Products

TEFLON TAPE

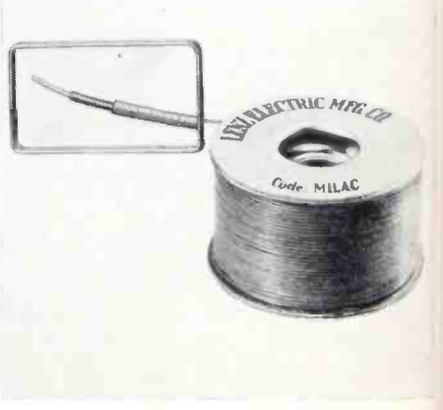
A new thermal curing pressure-sensitive Teflon tape is only 0.002 in. thick. Called Temp-R-Tape C, it is designed primarily for electrical insulation, particularly where a high dielectric, extremely thin, easy-to-apply insulation is desirable such as in miniature electronic components. The tape provides 2750 v. per mil dielectric strength and has an operating temperature range of —100° F to 500° F. It is made of specially produced 0.0015 in. cast Teflon film. To this backing, 0.0005 in. of thermal curing pressing-sensitive silicone polymer adhesive is added. The Connecticut Hard Rubber Co., 407 East St., New Haven 9, Conn.



Circle 216 on Inquiry Card, page 99

MINIATURE WIRE

To meet the growing trend toward miniaturization of all electronic components, a new miniature type, low cost lead and circuit hookup wire that combines the qualities of good electrical characteristics, abrasion resistance and small size has been developed. MILAC is particularly valuable as a coil lead wire. It is furnished in sizes No. 26 thru 20 with stranded or solid tinned copper conductors. Lenz Electric Mfg. Co., 1751 N. Western Ave., Chicago 47, Ill.



Circle 217 on Inquiry Card, page 99

The following Back Issues of Electronic Industries (Tele-Tech) Are available at 75¢ each

1942
DEC.—2
NOV.—2

1943
JAN.—1
FEB.—2
MAR.—2
APRIL—2
MAY—1
JUNE—2
JULY—2
AUG.—2
SEPT.—2
OCT.—2
NOV.—2
DEC.—2

1944
JAN.—1
FEB.—2
MAR.—2
APRIL—2
MAY—2
JULY—2
AUG.—2
SEPT.—2
OCT.—2
NOV.—2
DEC.—2

1945
JAN.—2
FEB.—2
MAR.—2
APRIL—2
MAY—2
JUNE—2
JULY—2
AUG.—1
SEPT.—2
OCT.—2
NOV.—1
DEC.—3

1946
JAN.—1
FEB.—2
MAR.—2
APRIL—2
MAY—2
JUNE—2
AUG.—2
SEPT.—1
DEC.—2

1947
JAN.—2
FEB.—2
MAR.—2
MAY—2
JUNE—1
JULY—1
OCT.—1
NOV.—1

1948
FEB.—2
MAR.—1
APRIL—1
MAY—1
JUNE—2
JULY—1
AUG.—1
SEPT.—1
OCT.—2
NOV.—2
DEC.—1

1949
FEB.—2
MAR.—1
JULY—2
AUG.—2
SEPT.—2
NOV.—1
DEC.—2

1950
FEB.—1
APRIL—1
JULY—1
NOV.—1
DEC.—1

1951
AUG.—1
SEPT.—4
OCT.—1
NOV.—2

1952
FEB.—1
MAR.—3
APRIL—2
MAY—3
JUNE—3
JULY—1
AUG.—1
SEPT.—5
OCT.—24
NOV.—4

1953
FEB.—2
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APRIL—2
MAY—2
JUNE—6
AUG.—6

1954
JAN.—7
MAR.—1
APRIL—10
JUNE—32
JULY—50
SEPT.—39
OCT.—8
NOV.—15
DEC.—35

1955
JAN.—10
FEB.—38
APRIL—1
AUG.—5
JULY—1
OCT.—1

1956
JAN.—1
MAY—30
JULY—13
SEPT.—11
OCT.—5
NOV.—12
DEC.—7

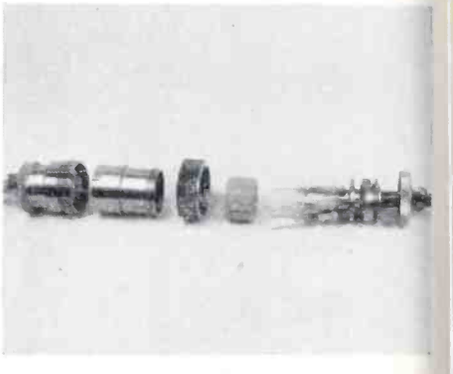
1957
JAN.—39
FEB.—11
MAY—40
JUNE—12
JULY—15
AUG.—50
SEPT—65
NOV.—84
DEC.—50

Make checks payable to Electronic Industries. Send your order to the Circulation Department.

New Products

CONNECTORS

New connectors employ high temperature stainless steel, high temperature silver alloy contacts, special formulae temperature resistant ceramic dielectric materials, fine silver seals

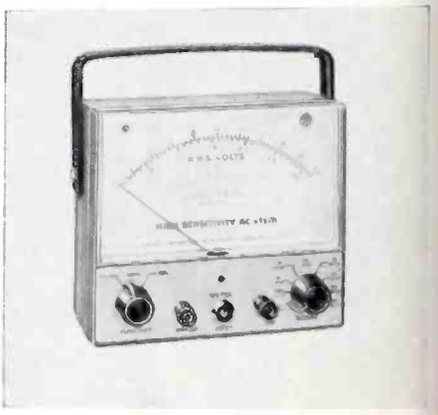


for high altitude and extreme atmospheric conditions, etc. These connectors may also be produced of special materials to meet individual specification requirements. The new SP-IB-AMP 7-contact connector for 17-16 AWG MIL-C-25038 wire features crimped on contacts. It can be used for an operating environment of 100,000 ft. plus altitude. AMP Inc., Harrisburg, Pa.

Circle 230 on Inquiry Card, page 99

VACUUM TUBE VOLTMETER

A new high-sensitivity alternating current vacuum tube voltmeter (RCA WV-74A), designed for laboratory and service use is available. It can be used in measuring ac voltages from 0.01 to 100 volts, and for decibel measurements from −40 to +40 db. The voltmeter is also useful as a wide-range audio preamplifier,



having approximately 39 db maximum gain. Frequency range on all measurement and amplifier functions is from 20 CPS to 500 KC. Radio Corporation of America, Harrison, N.J.

Circle 231 on Inquiry Card, page 99

In-Line Modules

(*Continued from page* 75)

an opportunity for increased overall accuracy.

Spectrol engineers comment, "With the modular approach applied to electromechanical assemblies . . . the block concept of system design can be utilized to the fullest." The in-line modular units can relieve the system designer of much of his present design and specification detail for logical system components.

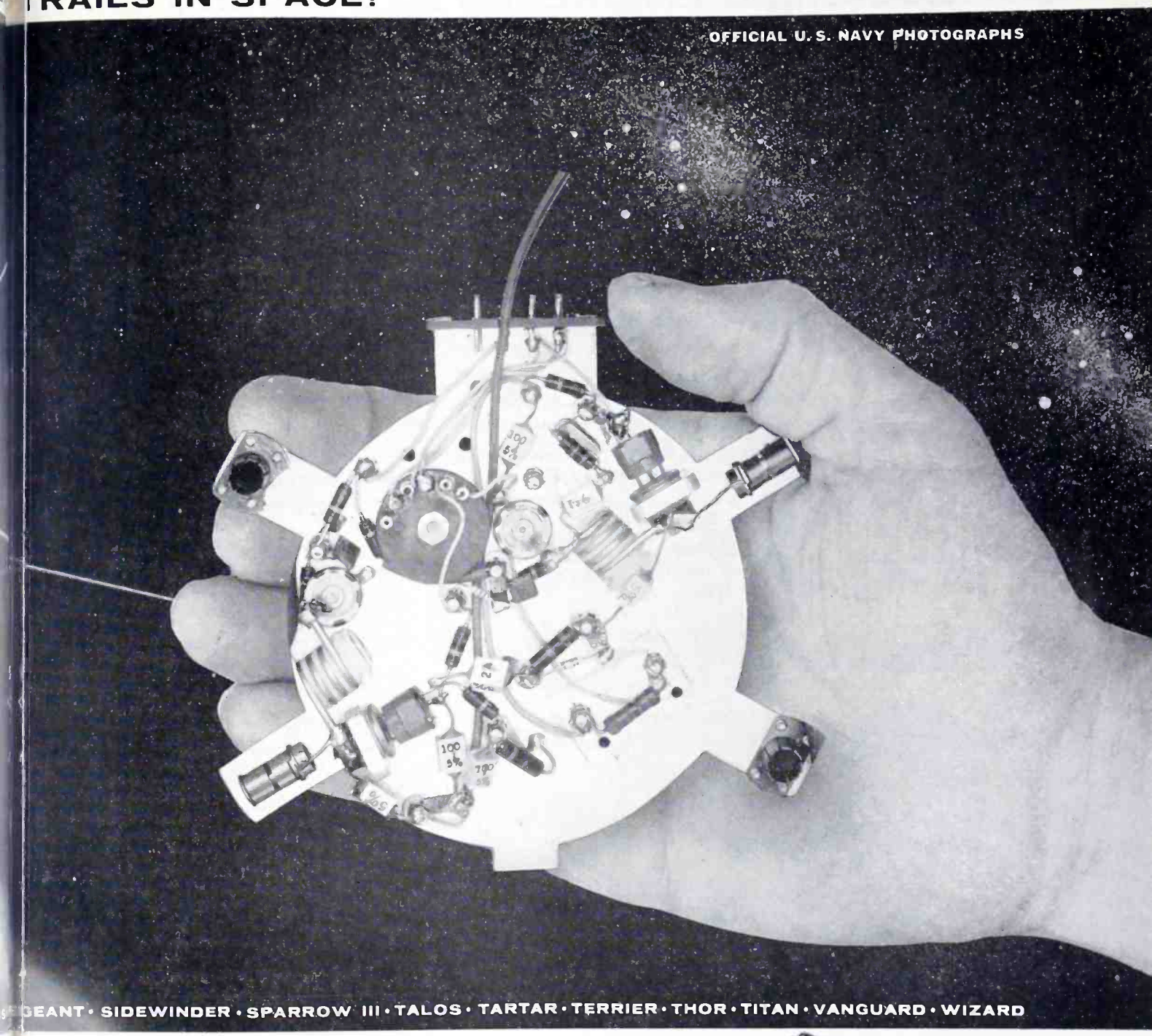
Cape Canaveral

(*Continued from page* 94)

the pad itself. Clouds of steam arise as the hot rocket blast hits the water.

As the missile roars down the test range recording stations are busily gathering every detail on the missiles operation through telemetering channels. When the flight is completed the tapes carrying the recorded data will be shipped back, in most cases, to the contractor to be run through computers that will indicate how each component of the missile operated.

PRECISION CAPACITORS
TRAILS IN SPACE!

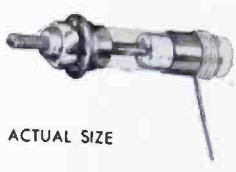


Systems of Explorer and Vanguard Satellites

Whether you are designing electronic equipment for a giant step into space or equally demanding applications, JFD Piston Capacitors belong. Their unique combination of physical and electrical characteristics speed circuit or system development—meet and beat exacting performance demands. Send for the new JFD 1958 Engineering File Folder covering 71 JFD Trimmer models. Or send us your special application requirements for recommendations by our engineering staff.

ACTUAL SIZE

model VC9G 0.8 to 8.5 mmf



ACTUAL SIZE

model VC5 0.6 to 6 mmf

model VC11 0.8 to 10 mmf

Pioneers in Electronics since 1929

JFD Electronics CORPORATION

1462–62 STREET, BROOKLYN, N.Y.

PHONE DEwey 1-1000

JFD Canada Ltd.
51 McCormack Street
Toronto, Ontario, Canada

JFD International
15 Moore Street
New York, New York

Circle 52 on Inquiry Card, page 99

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

LOCKHEED ENGINEERS DEVELOPING TRANSISTOR FLIGHT CONTROLS FOR POLARIS

Lockheed engineers are testing and developing transistor flight control systems for the Polaris ballistic missile program. Transistorization of missile control systems has been receiving top attention at Division laboratories in Palo Alto and Sunnyvale. Advantages of transistor designs over present systems include reductions in weight and space requirements.

Flight control activities cover synthesis and analysis of systems; development or procurement of necessary hardware; bench and systems testing of complete control systems; specifications of required flight test programs; and analysis of actual flight tests.

Division scientists and engineers are making many significant contributions that earn Lockheed leadership in missile development. Through their efforts, our Polaris has become the first and only solid fuel strategic ballistic missile program.

As greater emphasis is placed on missiles' role in U.S. defense, our missile projects will continue to grow. This means more career positions are open for qualified engineers and scientists—positions that offer unequalled opportunities for you to move ahead rapidly.

In addition to **Flight Controls,** openings are in: **Electronics, Information Processing, Ground Support, Reliability-Producibility,** as well as **Guidance, Propulsion, Aerodynamics, Thermodynamics, Systems Integration, Human Engineering,** and **Structures.**

Qualified engineers and scientists are invited to write
Research and Development Staff, Palo Alto 5, California.

Lockheed **MISSILE SYSTEMS**

A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

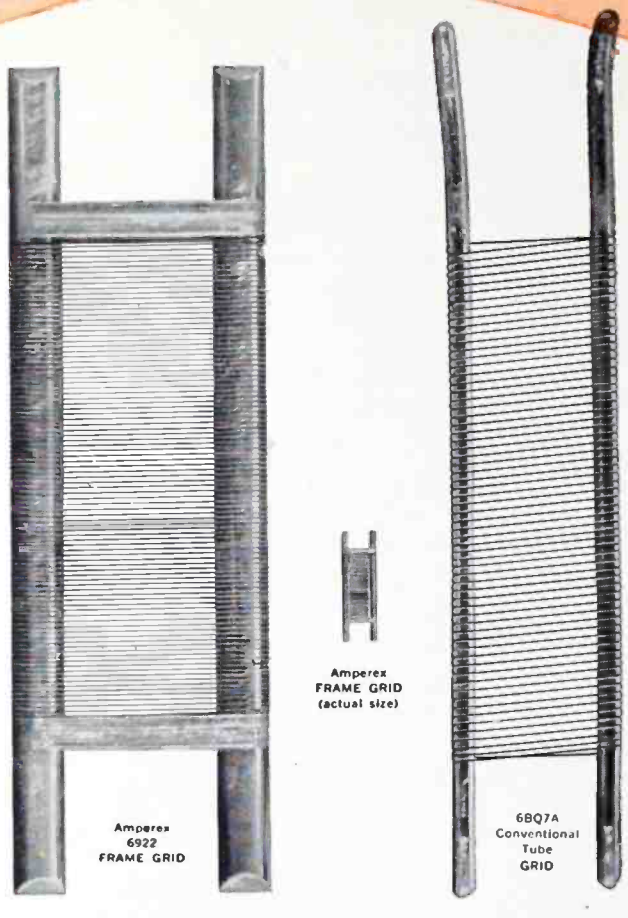
SUNNYVALE • PALO ALTO • VAN NUYS • SANTA CRUZ • CALIFORNIA
CAPE CANAVERAL, FLORIDA • ALAMOGORDO, NEW MEXICO

Gene Schott, Flight Controls Department Manager, right, talks over results of a recent test with design engineer Carlos Avila.

Circle 502 on "Opportunities" Inquiry Card, page 101

A NEW Amperex FRAME GRID TUBE

It's the
frame grid construction
that makes the difference...



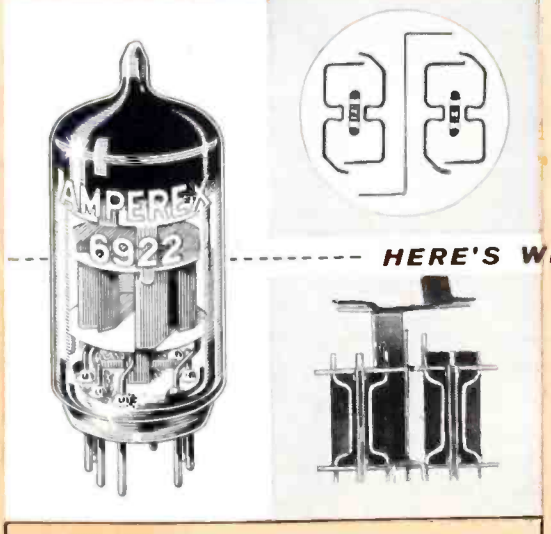
- Higher transconductance
- Tighter G_m tolerance
  (all tubes — G_m = 12,500 $^{+2500}_{-2000}$)
- Low transit time
- Low capacitances
- Better grid and plate current division

In the Amperex 6922 Frame Grid, note the fine wires under tension with the tight tolerances of the grid-to-cathode spacing determined by the carefully controlled diameter of the centerless ground grid-support rods and the frame cross-braces between these rods.

In conventional tubes, the grid dimensions are obtained by stretching on a mandrel. The tolerance of grid-to-cathode spacing is therefore dependent upon this operation as well as the tolerances of the holes in the top and bottom mica rod supports.

ADDITIONAL FEATURES

- Passive cathode for long life
- Ruggedized construction
- New 'dimple' anode



TYPICAL OPERATION

Plate Supply Voltage	100 volts
Grid Supply Voltage	+9 volts
Cathode Bias Resistor	680 ohms
Plate Current	15 ma
Transconductance (min. 10,500; max. 15,000)	12,500 umhos
Amplification Factor	33
Equivalent Noise Resistance	300 ohms
Grid Voltage (rms)	0.75 volts

Amperex PREMIUM QUALITY 6922

ruggedized, low-noise, broad-band twin triode

HERE'S WHAT THIS MEANS TO THE DESIGN ENGINEER...

- Reliable radar cascode stages
- Higher speed computer operation
- Lower noise, higher gain RF amplifiers
- Minimum guaranteed 10,000 hour life

ask Amperex

about "premium quality" frame grid tubes for communication, instrumentation and industrial applications.

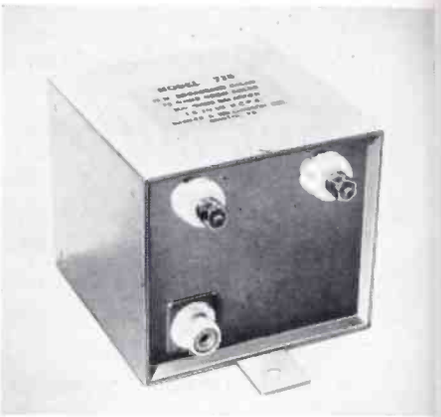
Amperex ELECTRONIC CORPORATION, 230 Duffy Avenue, Hicksville, L. I., N. Y.

In Canada: Rogers Electronic Tubes & Components, 11-19 Brentcliffe Road, Leaside, Toronto 17

New Products

UNIVERSAL BALUN

A new universal Balun is available. The interesting feature of this unit, known as Model 725 is that it solves the problem of impedance matching on any multiband type antenna having a 300 ohm feed point. It is ideal for feeding either single and folded type dipoles or the driven element in a beam antenna. Frequency coverage is 1.5 to 30 MC with an impedance of 75 ohms unbalanced to 300 ohms balanced. Maximum power rating 1 kw on CW and AM (100% modulated), 4 kw P.E.P. on SSB. Barker & Williamson, Inc., Canal St. & Beaver Dam Rd., Bristol, Pa.

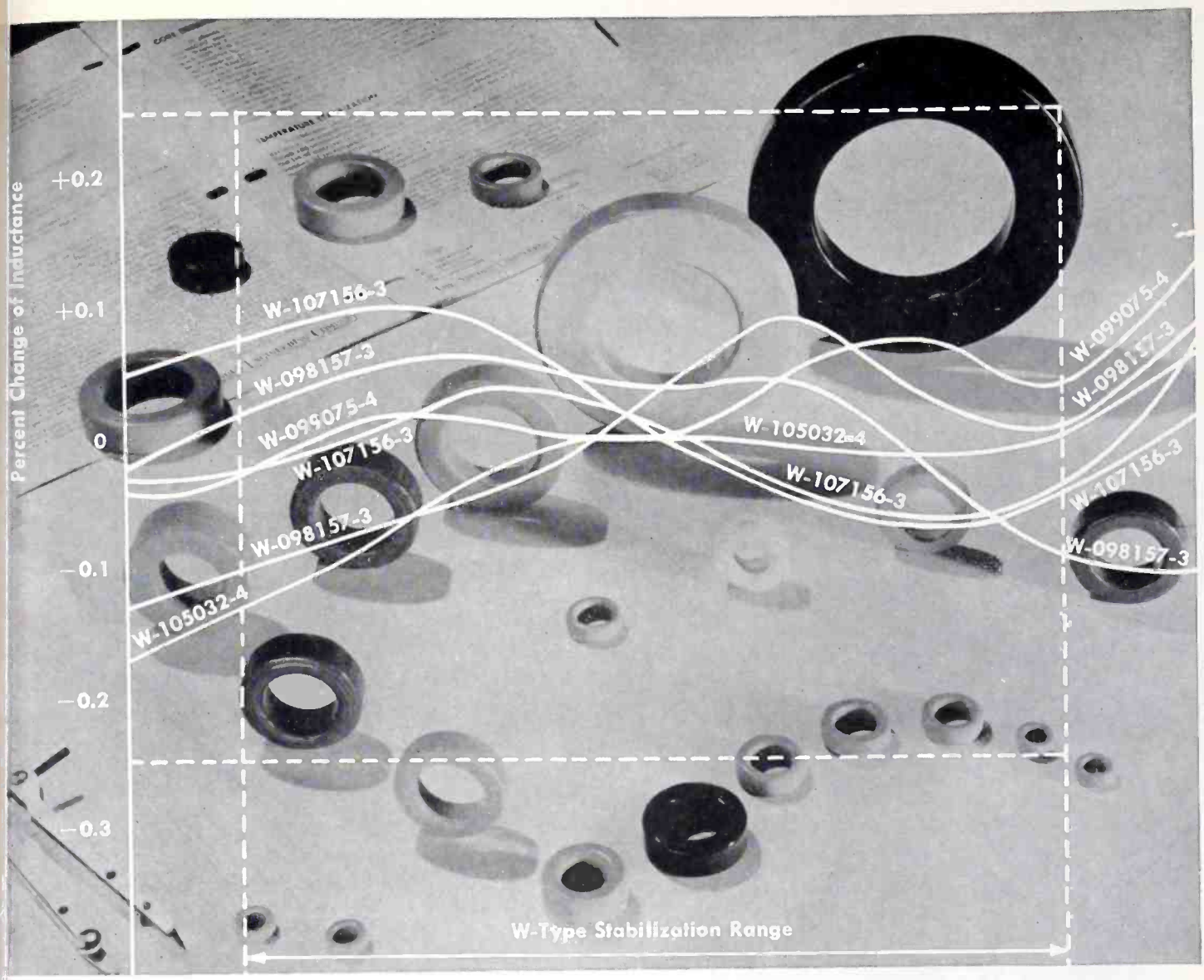


Circle 218 on Inquiry Card, page 99

RECORDER

The Brush Mark II, a dual channel recorder which takes direct writing recording out of the limited areas of complex, highly specialized scientific applications, is available. It provides immediately visible, permanent chart recordings on 2 channels over a wide amplitude and frequency range (d.c. to 100 cps). Oscillograph and amplifiers are incorporated as an integral unit operated by connecting its one power cord to any a.c. outlet. It also provides a sensitivity of 10 mv./chart line. Brush Instruments, 3405 Perkins Ave., Cleveland 14, O.

Circle 219 on Inquiry Card, page 99



ARNOLD offers you the widest selection of Temperature Stabilized MO-PERMALLOY POWDER CORES

Arnold Molybdenum Permalloy powder cores are available with the temperature coefficient of inductance controlled within certain limits over specific temperature ranges. Most core sizes and permeability combinations can be supplied in at least one of the four different types of temperature stabilization available.

For example, most of the popular core sizes are manufactured in the new type of wide range—"W"—stabilized cores whose temperature coefficient of inductance does not exceed 0.5% over the temperature range covered by the MIL-T-27 specification of −55° C to +85° C.

This type of guaranteed maximum change of inductance with temperature, as well as the constancy of permeability with time and flux level, are of particular importance to apparatus and circuit engineers. Many precision military and industrial applications demand the uniform performance and the excellent physical properties found only in Arnold Mo-Permalloy powder cores.

For design flexibility they are furnished in a full range of sizes, up to 5.218" O.D., in four standard permeabilities: 125, 60, 26 and 14. You will find them dependable and easy to use. You will find most sizes and types in stock *now* for immediate shipment.

● Let us furnish your requirements for temperature stabilized Mo-Permalloy powder cores, or any magnetic materials you need, from the most complete line in the industry.

WSW 6999

For more information write for Bulletin PC-104B

Lists complete line of Mo-Permalloy Powder cores . . . available in 25 sizes from 0.260" 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-85

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.

Circle 56 on Inquiry Card, page 99

Strain Gage

(*Continued from page 74*)

couple voltages where metals are dissimiliar are other sources of significant errors.

The stability of the Weldable Strain Gage is further improved by subjecting it to temperature cycling before use. Three cycles to 850° F. in an oven with no special atmospheric conditions are used for tests involving 800° F. or less. The cycle time is approximately forty-five minutes. For best results, all gages of a bridge circuit are subjected to the stabilizing cycle simultaneously.

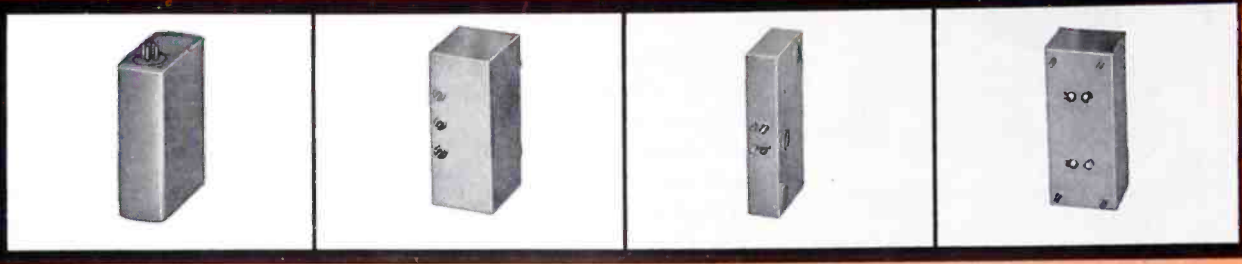
After temperature stabilization a single gage on stainless steel exhibits less than 100 micro inches per inch of zero shift after cycling to 800° F., and the apparent strain of a single gage on stainless steel is less than 1000 micro inches per inch for a temperature change of 800° F. The new gage has been used for dynamic tests to 1600° F.

For Your Special Applications

The bulk of UTC production is on special units designed to specific customers' needs. Illustrated below are some typical units and some unusual units as manufactured for special applications. We would be pleased to advise and quote to your special requirements.

FILTERS

All types for frequencies from .1 cycle to 400 MC.



400 ⁓ telemetering, 3 db at ± 7.5%, 40 db at 230 and 700 ⁓, ⅜ x 1¼ x 2".

15 ⁓ BP filter, 20 db at 30 ⁓, 45 db at 100 ⁓, phase angle at CF less than 3° from —40 to + 100° C.

LP filter within 1 db to 49 KC, stable to .1 db from 0 to 85° C., 45 db at 55 KC.

LP filter less than .1 db 0 to 2.5 KC, 50 db beyond 3 KC.

HIGH Q COILS

Toroid, laminated, and cup structures from .1 cycle to 400 MC.

Tuned DO-T servo amplifier transformer, 400 ⁓ .5% distortion.

Toroid for printed circuit, Q of 90 at 15 KC.

Dual toroid, Q of 75 at 10 KC, and Q of 120 at 5 KC.

HVC tapped variable inductor for 3 KC oscillator.

SPECIALTIES

Saturable reactors, reference transformers, magnetic amplifiers, combined units.

RF saturable inductor for sweep from 17 MC to 21 MC.

Voltage reference transformer .05% accuracy.

Multi-control magnetic amplifier for airborne servo.

Input, output, two tuned interstages, peaking network, and BP filter, all in one case.

PULSE TRANSFORMERS

From miniature blocking oscillator to 10 megawatt.

Wound core unit .01 microsecond rise time.

Pulse current tansformer 100 Amp.

Pulse output to magnatron, bifilar filament.

Precise wave shape pulse output, 2500 V. 3 Amps.

POWER COMPONENTS

Standard and high temperature . . . hermetic, molded, and encapsulated.

Multi-winding 140 VA, 6 KC power transformer 1¼ x 1¼ x 1"

200° C. power transformer, 400 ⁓, 150 VA.

400 ⁓ scope transformer, 20 KV output.

60 ⁓ current limiting filament transformer, Sec. 25 Mmfd., 30 KV hipot.

UNITED TRANSFORMER CORPORATION

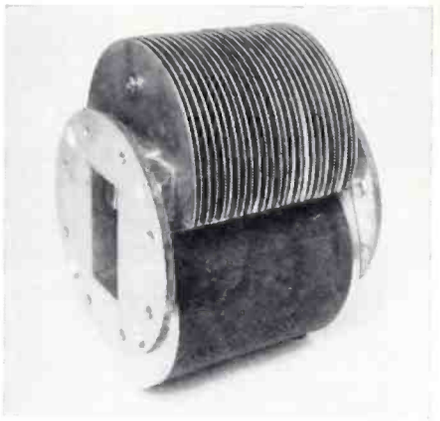
150 Varick Street, New York 13, N. Y. • EXPORT DIVISION: 13 E. 40th St., New York 16, N. Y.,

CABLES: "ARLAB" PACIFIC MFG. DIVISION 4008 W. Jefferson Blvd. Los Angeles, Cal.

New Products

FERRITE ISOLATOR

A miniaturized ferrite isolator rated at 5 megawatts for large S-band radars is available. The air-cooled device is 6 in. long and 8 in. in diameter. By effecting a minimum 10

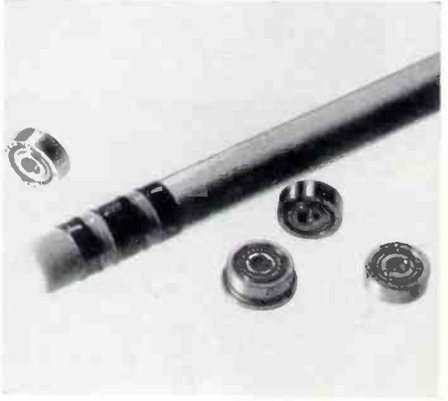


db one-way isolation in the transmission waveguide, it protects high-power tubes from mismatches, and eliminates frequency and power variations due to changing load impedances. It introduces less than 0.3 db insertion loss in the line. Power ratings are 5 megawatts peak and 5 kw. average over a frequency band of 2.7 to 2.9 KMC. Input vswr measures 1.10. Sperry Gyroscope Co., Great Neck, N. Y.

Circle 220 on Inquiry Card, page 99

MINIATURE BEARINGS

A new line of miniature ball bearings are made entirely of vacuum-melt 440-C stainless steel. Intended for use in sensitive control instruments, missiles, and computer elements. Each bearing size has its own specially designed retainer, producing a superior balance of parts. They are



made to ARGC-5 tolerances or better. Seven basic sizes and four design variations of each size are included in the new line. The Fafnir Bearing Co., New Britain, Conn.

Circle 221 on Inquiry Card, page 99

CLEVITE 'BRUSH'

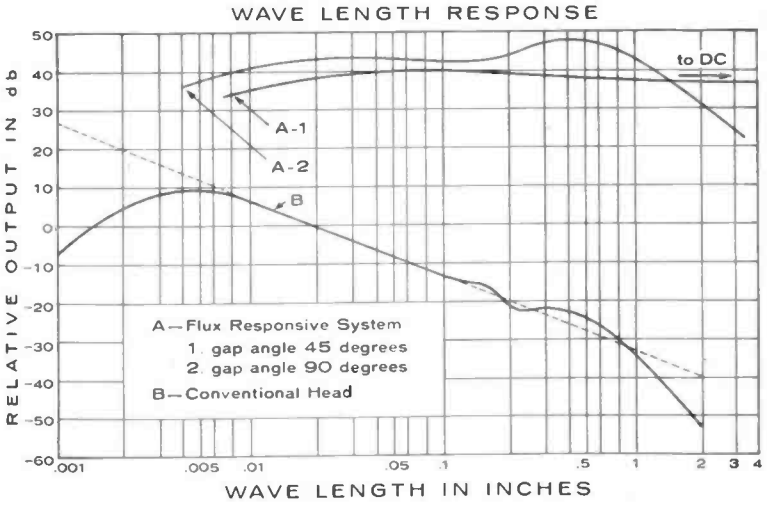
Flux-Responsive Magnetic Heads

REDUCED BUFFER STORAGE EQUIPMENT, FASTER DATA ACCESS, EARLIER RELEASE OF MAIN COMPUTER

Clevite "Brush" Flux-Responsive Heads respond to the magnitude of signal flux instead of the rate of flux change. Output of flux heads is independent of tape or drum speed and, therefore, independent of frequency or pulse repetition rate. The signal reproduced by the flux-responsive head is an accurate facsimile of the recorded flux pattern and of the original recorded information.

The output of a computer, recorded at high speed, can be played back later at much slower speeds with a flux-responsive head to exactly match the relatively slow processing rate of typewriters, card punching machines and other output devices. Clevite Flux-Responsive Heads can also operate in the conventional manner. This permits one head to search recorded data at high speed, locate it, and then be switched to flux-responsive operation for operating of output devices.

Special flux-responsive heads have been developed by Clevite to meet specific customer applications. They are now commercially available in 1 to 32 channel form in a variety of mechanical configurations. These designs, slightly modified, may fit your present requirements. One of our specialists will be pleased to discuss your application by detailed correspondence or personal visit. Write: Product Manager, Magnetic Heads, Clevite Electronic Components, 3311 Perkins Avenue, Cleveland 14, Ohio.



Typical Clevite multi-channel flux-responsive head, with .032 in. track and .070 in. spacing.

Clevite 'Brush' Flux-Responsive Heads for low speed or static read-out of digital information • reproduction of high frequency analog recording at low tape speeds • extended-period process control • reproduction of low frequency recording • measurement of low angular or low linear velocities and recorded transients • position control

CLEVITE ELECTRONIC COMPONENTS

DIVISION OF CLEVITE CORPORATION

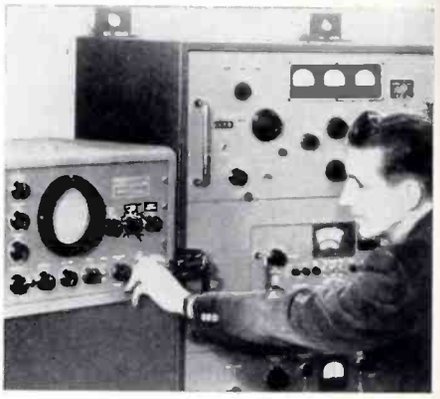
MAGNETIC HEADS
TRANSDUCERS
PIEZOELECTRIC CRYSTALS, CERAMICS AND ELEMENTS

Circle 63 on Inquiry Card, page 99

New Products

PANORAMIC ANALYZER

A new Analyzer, Model SB-12a, Type T-100, has been introduced. Specifically designed for SSB investigations, it offers increased dynamic range and many other new features.



Operation is simplified with convenient pre-set narrow band scans of 150, 500, 2000 and 10,000 CPS and a new 20 db range-extending attenuator to speed the standard two tone test, hum side band determinations and other spectrum measurements. In-band (odd order) intermodulation products are suppressed at least 60 db. Panoramic Radio Products, Inc., 514 S. Fulton Ave., Mount Vernon, N. Y.

Circle 222 on Inquiry Card, page 99

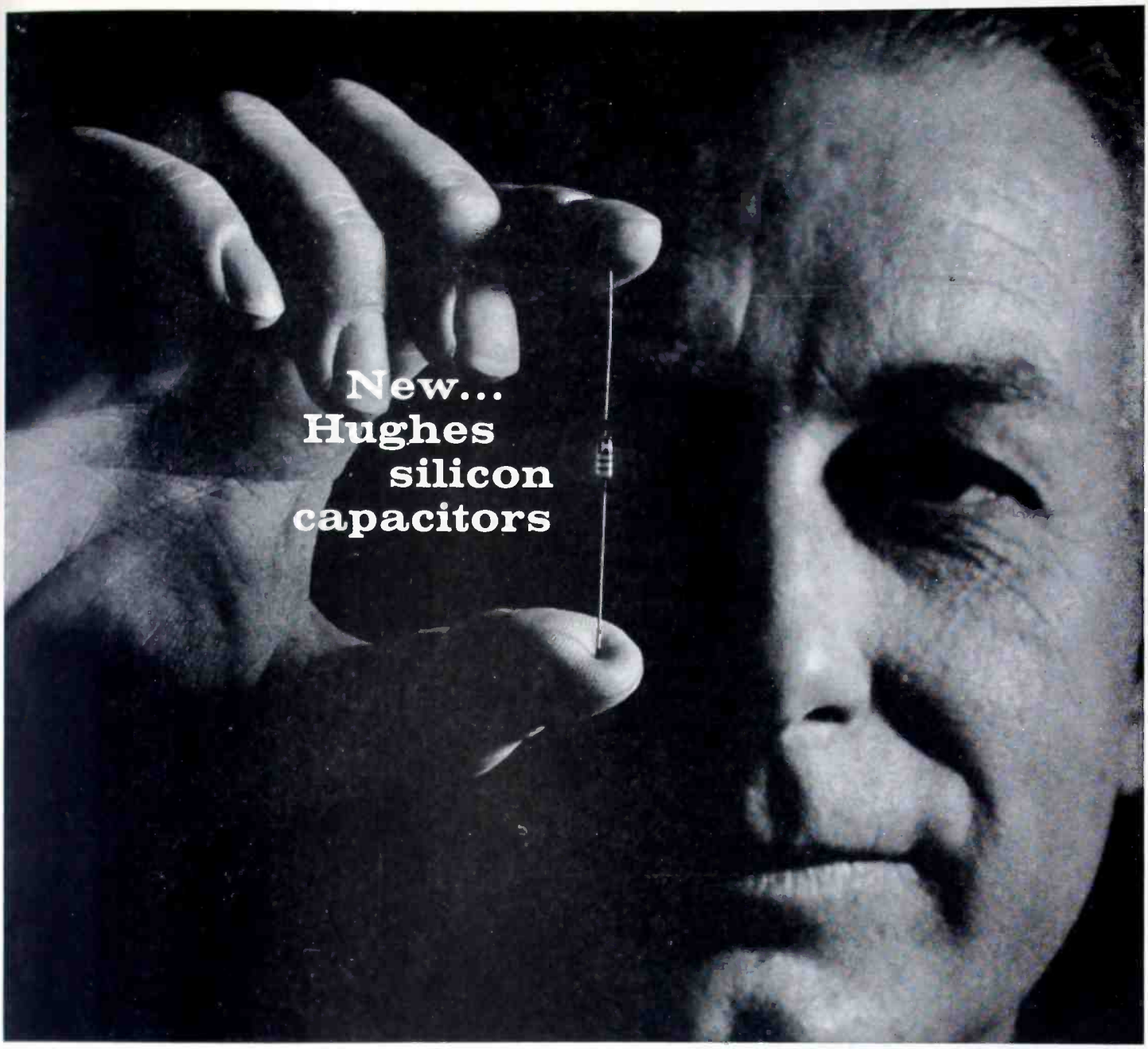
P-C COMMUTATION SWITCH

A series of high quality commutation switches, designated Mycalex PC, with printed circuit commutation plates made from SUPERMICA 560F ceramoplastic, are available. Designed for telemetry, sampling, data handling and automatic control applications, switches provide high quality, low noise-level switching in a moderately priced, motor driven device. Anticipated life depends on speed and type of service, but is expected

to exceed 200 hours. Switches are guaranteed for 100 hours continuous operation at 600 rpm. Mycalex Electronics Corp., 125 Clifton Blvd., Clifton, N. J.

Circle 223 on Inquiry Card, page 99

Circle 64 on Inquiry Card, page 99



high Q • wide capacitance range

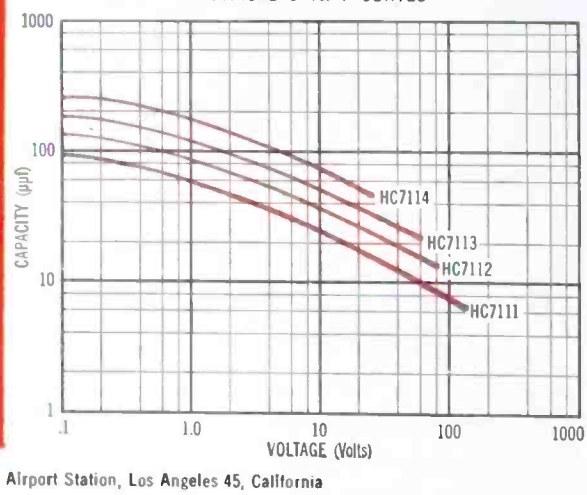
This is a practical series of new components; capacitors whose capacitance is determined by the applied DC voltage. The Q is high and the capacity range, great. For the first time, circuits can be tuned by electrical rather than mechanical methods.

The concept opens up a whole domain of useful applications. And, in every instance, circuit simplification plus considerable reduction in space and weight result. When designed around Hughes silicon capacitors, remote tuning becomes practical. Automatic frequency controls, modulators, automatic gain controls, and band pass filters become smaller, lighter, and simpler. Additional possibilities are numerous.

SPECIFICATIONS

Type	Capacity @ −4VDC ± 20% (μμf)	Typical Capacity Range (μμf)	Voltage Range Over Which Capacity Is Varied (VDC)	Typical Q @ 25Mc and Maximum Voltage
HC7111	35	6- 90	0.1-130	75
HC7112	50	12-120	0.1- 80	70
HC7113	70	20-170	0.1- 60	58
HC7114	100	44-240	0.1- 25	43

TYPICAL C vs. V CURVES



For additional data, please write: Semiconductor Division, HUGHES PRODUCTS, International Airport Station, Los Angeles 45, California

Creating a new world with ELECTRONICS

HUGHES PRODUCTS

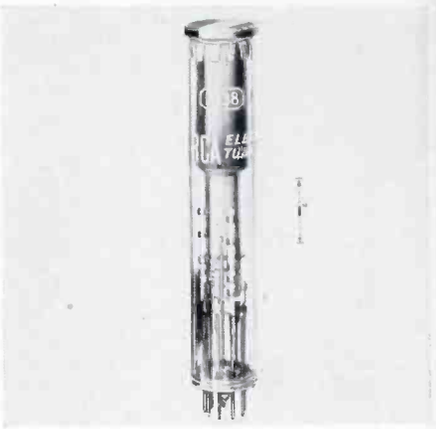
HUGHES SEMICONDUCTORS

Circle 66 on Inquiry Card, page 99

New Products

SMALL CAMERA TUBE

A new one-inch vidicon camera tube (RCA-7038), having effective sensitivity much higher than existing types, has been introduced. It was designed for live or film pick-up use

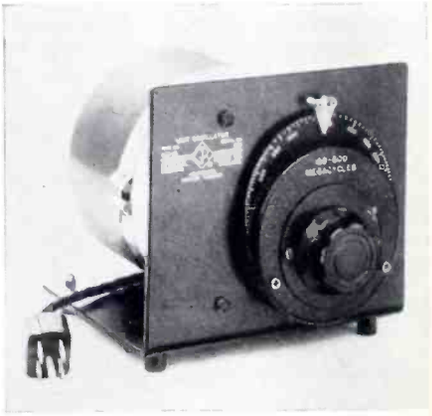


in broadcast, industrial and military TV applications. It can deliver broadcast-quality pictures with as little as one foot-candle of highlight illumination on its faceplate. Maximum resolution obtainable with the new tube is approximately 600 television lines. Radio Corporation of America, Harrison, N. J.

Circle 224 on Inquiry Card, page 99

H. F. OSCILLATOR

Designed primarily to cover the military aeronautical bands, the new 1209-BL Unit Oscillator has a single frequency range from 180 to 600 MC. The 4 in. dial with slow-motion drive is direct reading in frequency with a guaranteed accuracy of ± 1%. A modified butterfly circuit with no sliding contacts is used. At least 300 mv. output power is available into



50 ohms at any frequency. A jack is provided for plate modulation from an external audio-frequency source. General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.

Circle 225 on Inquiry Card, page 99

MILITARY CIRCUITS by METHODE

NOW, a special division for this high precision work:

★ Seporote monogement ond operoting teom specializing in reliooble production of precision printed circuits

★ Special focilities for accurote ond uniform short run punching ond fobricotion of printed circuits

★ Complete precious metol electroploting deportment to hondle oll finishes

★ The newest in equipment with the industry's largest monufocturing copocity devoted to printed circuitry

★ A number of important projects for missiles, rodor ond oirborne ordnonce continuously in production

METHODE also offers film insulated wiring harness and connectors for printed circuit applicotions. Write for bulletin.

Address:
Military Contracts Coordinator

METHODE Mfg. Corp.
7447 W. Wilson Ave., Chicago 31, Ill.

Circle 91 on Inquiry Card, page 99

For HIGHEST ELECTRICAL & MECHANICAL Efficiency!

New

JONES 2400 SERIES PLUGS & SOCKETS

Improved Socket Contacts. Four individual flexing surfaces. Positive contact over practically their entire length.

Both Plug and Socket Contacts mounted in recessed pockets greatly increasing leakage distance, INCREASING VOLTAGE RATING.

Plug and Socket Contacts cadmium plated. Add to appearance of your equipment. Interchangeable with Jones 400 Series.

P-2406-CCT
Plug—with Cable clamp in top.
S-2406-SB
Socket with shallow bracket for flush mounting.

Ask for Catalog 21, Complete line Jones Plugs, Sockets, Terminal Strips.

HOWARD B. JONES DIVISION
CINCH MANUFACTURING CORPORATION
CHICAGO 24, ILLINOIS
SUBSIDIARY OF UNITED-CARR FASTENER CORP.

Circle 92 on Inquiry Card, page 99

AMPERITE PREFERRED

by design engineers—because they're
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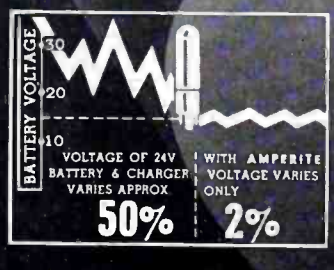

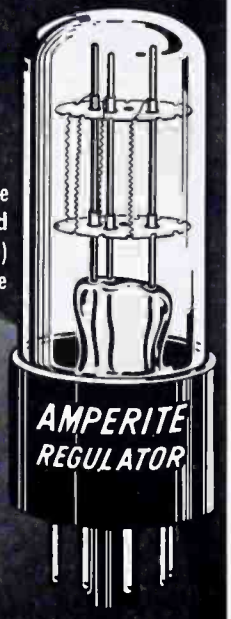

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ELECTRONIC SOURCES

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ANTENNAS, PROPAGATION

Highly Directive Antennas Used in NRL's Radio Astronomy Program, Part 1—The Fifty-Foot Paraboloid, J. E. Sees. "NRL." January 1958. 11 pp. Although larger radio telescopes are being planned and built at vantage points all over the world, the "big dish" is still the largest steerable radio telescope with surface and pointing accuracies suitable for studying cosmic radio emissions at frequencies up to 35,000 megacycles. (U.S.A.)

Loaded-Lens Antenna Tracks Missiles, Lee S. Miller. "El." March 28, 1958. 3 pp. Concentric hemispheres of foam plastic, each covered with metal disks, serve as artificial dielectric lens to provide nutation of circularly polarized feed source for illuminating 60-foot parabolic antenna in 216-245 mc telemetry band. (U.S.A.)

AUDIO

An Evaluation of the Acoustic Echo Criterion with the Aid of the Intelligibility of Syllables, H. Niese. "Hochfreq.," Vol. 66, No. 3. November 1957. 14 pp. The article outlines a new method for the qualitative analysis of the acoustics of auditoriums. Experience has shown that there exists a wide difference in intelligibility in various auditoriums. These differences cannot be determined by the reverberation time. Outlined in great detail are the following two tests: 1) the reading of logatomes, which should be copied by an audience, 2) an "echo grade" evaluation, which consists of the generation of a pop-like sound received by microphones placed at the ears of a dummy. The received sounds are recorded on magnetic tape for evaluation. (Germany.)

CIRCUITS

A Twin-T Variable-Slope Filter, G. B. Miller. "Elec. Eng." March 1958. 3 pp. By suitable modification a twin-T notch filter is converted into a low-pass filter in which the rate of attenuation up to a specified upper frequency is controlled by a single potentiometer. Design data are given and a detailed circuit is described. (England.)

Stairstep Integrator Analyzes Rotation, George E. Edens. "El." March 28, 1958. 3 pp. Pressures, velocities, torque and rate of angular motion are indicated by angular displacement of a rotating disk and converted into electrical signals for oscilloscope display. (U.S.A.)

Quartz Controlled Transistor Oscillators, H. Awender and A. Ludloff. "El. Rund." March 1958. 6 pp. Quartz controlled transistor oscillator circuits may be constructed corresponding to quartz controlled tube oscillator circuits. In the present article the parallel resonance circuit is discussed and hints for design of this kind of quartz controlled transistor oscillator are given after excitation conditions having been mentioned. (Germany.)

Magnetic Amplifiers Regulate D-C Supply, M. B. Meuner. "El." February 28, 1958. 3 pp. Magnetic amplifiers combined with saturating transformer maintain output regulation well within three percent when supply voltage varies in steps of as much as 20 v. Silicon rectifiers in bridge configuration convert a-c supply to d-c output at five levels from —50 to +500 v. (U.S.A.)

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REGULARLY REVIEWED

AUSTRALIA

AWA Tech. Rev. AWA Technical Review
Proc. AIRE. Proceedings of the Institution of Radio Engineers

CANADA

Can. Elec. Eng. Canadian Electronics Engineering
El. & Comm. Electronics and Communications

ENGLAND

ATE J. ATE Journal
BBC Mono. BBC Engineering Monographs
Brit. C.&E. British Communications & Electronics
E. & R. Eng. Electronic & Radio Engineer
El. Energy. Electrical Energy
GEC J. General Electric Co. Journal
J. BIRE. Journal of the British Institution of Radio Engineers
Proc. BIEE. Proceedings of Institution of Electrical Engineers
Tech. Comm. Technical Communications

FRANCE

Ann. de Radio. Annales de Radioelectricite
Bull. Fr. El. Bulletin de la Societe Francaise des Electriciens
Cab. & Trans. Cables & Transmission
Comp. Rend. Comptes Rendus Hebdomadaires des Seances
Onde. L'Onde Electrique
Rev. Tech. Revue Technique
Telonde. Telonde
Toute R. Toute la Radio
Vide. Le Vide

GERMANY

AEG Prog. AEG Progress
Arc. El. Uber. Archiv der Elektrischen Uebertragung
El Rund. Electronische Rundschau
Freq. Frequenz
Hochfreq. Hochfrequenz-technik und Electroakustik
NTF. Nachrichtentechnische Fachberichte
Nach. Z. Nachrichtentechnische Zeitschrift
Rundfunk. Rundfunktechnische Mitteilungen
Vak. Tech. Vakuum-Technik

POLAND

Arch. Auto. i Tel. Archiwum Automatyki i Telemechaniki
Prace ITR. Prace Instytutu Tele-I Radiotechnicznego
Roz. Elek. Rozprawy Elektrotechniczne

USA

Auto. Con. Automatic Control
Av. Age. Aviation Age
Av. Week. Aviation Week
Bell J. Bell Laboratories Journal
Comp. Computers and Automation
Con. Eng. Control Engineering
El. Electronics
El. Des. Electronic Design
El. Eq. Electronic Equipment
El. Ind. ELECTRONIC INDUSTRIES
El. Mfg. Electronic Manufacturing
IRE Trans. Transactions of IRE Prof. Groups
I. & A. Instruments & Automation
Insul. Insulation
M/R. Missiles and Rockets
NBS J. Journal of Research of the NBS
NRL. Report of NRL Progress
Proc. IRE. Proceedings of the Institute of Radio Engineers
Rev. Sci. Review of Scientific Instruments

USSR

Avto. i Tel. Avtomatika i Telemakhanika
Radio. Radio
Radiotek. Radiotekhnika
Rad. i Elek. Radiotekhnika i Elektronika
Iz. Acad. Bulletin of Academy of Sciences, USSR.

OTHER

Radio Rev. La Radio Revue (Belgium)
Kovo. Kovo Export (Czech)
J. ITE. Journal of the Institution of Telecommunication Engineers (India)
J. IECE. Journal of the Institute of Electrical Communication Engineers (Japan)
Phil. Tech. Philips Technical Review (Netherlands)
Eric. Rev. Ericsson Review (Sweden)
J. UIT. Journal of the International Telecommunication Union (Switzerland)

International ELECTRONIC SOURCES

The Design of Function Generators Using Silicon Carbide Non-linear Resistors, E. Brown and P. M. Walker. "Elec. Eng." March 1958. 4 pp. (England.)

Feedback Circuit Analysis Using Impedance Concepts, Gustave Pellegrino, Jr. "El. Des." February 5, 1958. 4 pp. In the usual analysis of feedback circuits it is difficult to visualize what is taking place in the circuit. The mathematics beclouds the actual circuit operation. The solution obtained with impedance concepts, while no simpler, helps to explain what is happening in the circuit. It simplifies the choice of design parameters and allows one to see how any term affects the overall design. (U.S.A.)

A Delayed Trigger for Oscilloscope Operation, K. Raylec. "Radio Rev.," Vol. 10, No. 2. February 1958. 5 pp. The design and operation of a delayed trigger for oscilloscope presentation is described. (Belgium.)

Transposition of Four-Terminal Network in Accordance with the Theory of Operating Parameters, C. Kurt. "Freq.," Vol. 12, No. 1. January 1958. 8 pp. The article is a mathematical treaty of this subject based on the theory of operating parameters. This approach provides not only a good approximation of the transfer factors, but also provides a simple mathematical approach for establishing the electrical components. (Germany.)

Amplitude Stabilized Low Frequency Oscillator, A. K. Choudhury. "J. ITE." December 1957. 10 pp. The performance of a low frequency oscillator, stabilized with biased diodes or with lamps is described. The harmonic content in the output with different initial negative damping has been calculated and depicted in graphical form. Variation of the output amplitude with the variation of initial damping is also calculated. (India.)

Direct Drive Amplifier For Two-Speed Servos, B. E. Orr. "El." March 14, 1958. 2 pp. Five-transistor servo amplifier directly drives standard size-11 motor, eliminating need for an output transformer. Used in two-speed systems, amplifier contains a switching circuit and three-stage feedback network. (U.S.A.)

Circuit Designed for High Voltage Gain from Transistors, Maurice Price. "Can. Elec. Eng." March 1958. 2 pp. Following a similar vacuum tube circuit, a high voltage gain transistor circuit has been designed which overcomes many previous problems. (Canada.)

An Approach to the Design of Constant-Resistance Amplitude Equalizer Networks, J. S. Bell. "Proc. BIEE." March 1958. 5 pp. The paper suggests a method of designing constant-resistance amplitude equalizers to give a desired slope over the working range concerned. (England.)

Permissible Impedance Values of Filter Circuits in Intermediate Frequency FM Systems, E. G. Woschni. "Hochfreq.," Vol. 66, No. 3. November 1957. 4 pp. The tube capacity between grid and anode in intermediate state FM receivers results in an unsymmetric transfer factor of the filters. The permissible distortion caused by this factor is specified by the filter impedance. The existing formula in the literature is closely examined and expanded. (Germany.)

Simplifying Circuit Design with Floating Power Supplies, John F. Walton. "El. Des." March 5, 1958. 4 pp. With substantial currents available, isolated supplies can be used to furnish plate and screen energy, resulting in new and simple circuits with many advantages. (U.S.A.)

VHF Matching Network Design, A. E. Sanderson. "El. Des." March 19, 1958. 4 pp. (U.S.A.)

Combined Limiter and Discriminator, J. W. Head and C. G. Mayo. "E. & R. Eng." March 1958. 4 pp. The output voltage from a diode limiter is constant in amplitude and is associated with low impedance. The effect of applying such a voltage to a phase discriminator is discussed. A modified discriminator circuit is described for which performance (which is easily computed) is not adversely affected by the limiter. Distortion less than 0.1% of any harmonic is easily obtained. (England.)

Practical RC Differentiator Design, Lester Saporta and James Rarity. "El. Des." February 5, 1958. 3 pp. This article considers the design of practical RC differentiators which are driven by a source with finite internal resistance and operating into a load having a finite shunt capacitance. (U.S.A.)

COMMUNICATIONS

***Spectrum Crowding Demands New Trends in Directional Communications,** R. C. Benoit, Jr., and F. Coughlin, Jr. "El. Ind. Ops. Sect." May 1958. 4 pp. To provide sufficient and reliable communications, more effective use must be made of the available frequency spectrum. Described here are steerable directional communication concepts which approach this objective. (U.S.A.)

***For Broadcasters . . . Inexpensive Audio Switching,** H. D. Schaaf. "El. Ind. Ops. Sect." May 1958. 2 pp. Broadcasters are constantly faced with the problem of switching audio quickly. Any system which accomplishes this switching inexpensively is highly desirable. This article explains a simple method of constructing such a panel. (U.S.A.)

Packaged Broadcast Console Simplifies Installation, K. Mackenzie. "Can. Elec. Eng." March 1958. 2 pp. The installation of broadcast studio facilities has, in the past, been largely a case of assembling small components in the field to try to form an integrated system. To avoid the problems of this method, a packaged control console system has been designed that can be installed in a few hours. It includes disc, tape, amplifier and control facilities that can be tailored to fit station requirements. (Canada.)

Radio Links for ON Carrier, C. I. L. Cronburg, Jr., and C. W. Schwieger. "Bell Rec." March 1958. 5 pp. The versatility of Bell System short-haul carrier circuits has been greatly increased by the development of radio-link arrangements for the type-ON carrier system. Particularly in situations where open wire or cable systems are not practicable, ON on radio will permit economical extension of service. (U.S.A.)

The Broadcasting Concert-Hall of the Hessischer Rundfunk, Herbert Schreiber. "Rundfunk." January 1958. 6 pp. The large studio of the Hessischer Rundfunk required special acoustic treatment on account of its unusually long shape. The slight curves of the walls of the hall result in a favorable distribution of sound and are clad with acoustically transparent wooden battens behind which there are variable sound absorbers, whereby the reverberation time of 2.0 s may be changed by about ± 0.2 s. (Germany.)

Radio Plays Big Part in Canada's Expanding Telephone Network, S. Bonneville. "Can. Elec. Eng." February 1958. 4 pp. Radio for both long and short haul work is finding increasing use in the ever-growing Canadian telephone network. Microwave systems, operating more economically than coaxial cables, are used on high capacity routes while light route and scatter systems are providing service to more remote points with lower circuit requirements. Radio will play an even bigger part in future expansion. (Canada.)

F-M Exciter for Sight or Scatter Systems, A. E. Anderson and H. D. Hern. "El." March 14, 1958. 4 pp. Capable of operation in either a tropospheric scatter system or standard uhf line-of-sight communication systems, exciter accepts multichannel output of the telephone terminal equipment as a modulating signal and produces an output power of 15 w from 700 to 1,200 mc and 8 w from 1,700 to 2,400 mc. (U.S.A.)

Electronic Equalizer, S. Subrammanian. "J. ITE." December 1957. 6 pp. A description of an electronic equalizer constructed in the Research Department of All India Radio is given in the paper. It consists of an audio amplifier whose frequency characteristics are widely variable at both high and low frequency ends resulting in a variety of equalization curves. (India.)

Three-Channel Tape Recorder Monitors Test Flight Talks, P. A. Hallam, et. al. "Can. Elec. Eng." March 1958. 4 pp. A Canadian firm required the development of a three channel tape recorder using standard quarter inch tape and operating for four hours. The response was limited to voice frequencies. Specially designed transistorized record and playback units solved noise and frequency compensation problems. (Canada.)

Selection of Modulation for Speech Communication, George J. Kelley. "El." March 28, 1958. 3 pp. Type of modulation used for a given communications application depends upon a number of variables. A logical method may be employed for evaluating the relative merits of a-m, f-m, ssb and dsbsc for a specific requirement. (U.S.A.)

COMPONENTS

***Synchro Zeroing Problems . . .,** T. Powel. "El. Ind." May 1958. 3 pp. Discussed here are some ambiguities in synchro system zeroing. Manufacturers using different zeroing specifications create problems when various components are put together to form a synchro system. (U.S.A.)

***A Voltage Variable Capacitor, Part One,** G. F. Straube. "El. Ind." May 1958. 5 pp. The design engineer now has a unique new component for electronic equipment. Here are the design characteristics of the new electronically variable, solid state capacitor. (U.S.A.)

Ceramic Capacitors—A complete Substitute for Paper and Mica Capacitors, C. V. Ganapathy, et. al. "J. ITE." December 1957. 10 pp. The basic electrical characteristics of paper, mica and ceramic capacitors are compared. The interesting characteristics of the new high permittivity ceramics are discussed in detail with appropriate curves and tables. Apart from the reduction in size, which is obvious due to the much higher permittivities shown by these ceramics, the large temperature coefficient exhibited by some of the ceramic bodies can be utilized for certain special applications. (India.)

Miniature Ferrite Tuner Covers Broadcast Band, E. A. Abbot and M. Lafer. "El." February 28, 1958. 2 pp. Rotary-axial tuner consists of two pairs of ferrite cups with ground D-shaped center cores ganged to produce linear frequency variation from 500 to 1,600 kc with mechanical motion. (U.S.A.)

The Versatile Vamistor, R. C. Langford. "Can. Elec. Eng." February 1958. 5 pp. This recently announced component can span the diverse requirements of a computer needing performance for many hours and guided missiles requiring it for only a few minutes. Construction, specifications and performance are all described. (Canada.)

Toroidal Transformers for an Analogue System of Machine Tool Control, D. A. Alexander. "J. BIRE." February 1958. 11 pp. The use of toroidal transformers makes possible analogue computing circuits with an accuracy of a few parts in a million. Among many applications the use of such circuits has proved of great value in the control of machine tools. Some details are given of the transformers and of design procedure, and the simulation of mathematical operations, such as multiplication and interpolation, is shown. (England.)

Designing Transformers for Blocking Oscillators, R. D. McCartney. "El." February 28, 1958. 3 pp. Design data for blocking-oscillator transformers is obtained by using four common circuits with three tube types. Pulse-initiation curves indicate turns ration for maximum power output of each load conductance. Pulse-width curves show turns level that gives desired pulse width. (U.S.A.)

DC Transformer Has Continuous Adjustable Ratio, Horace E. Darling. "El. Des." March 5, 1958. 4 pp. (U.S.A.)

COMPUTERS

A Decimal Product Accumulator, Robert R. Hoge. "J. BIRE." February 1958. 9 pp. As a step towards a digital correlator, a machine has been built which accumulates the sum of products of pairs of numbers. This device can determine the correlation between two series of numbers, provided all terms in the series are positive. (England.)

An Analogue-Digital Converter for Current, Voltage, Resistance and Capacitance, H. Nottebohm. "El. Rund." March 1958. 4 pp. The unit described renders possible the conversion of analogue values of current, voltage, resistance and capacitance. The conversion is achieved by time coding with a measuring precision at 0.01% of the final value. (Germany.)

New Job for an Old Method: Capacitor Storage Used in Analogue Memory, W. S. Kozak. "Can. Elec. Eng." February 1958. 5 pp. Storage devices have been successfully developed for use with digital computers but so far there has been little need for them in the analogue field. This memory unit was developed to fill that shortage. It uses the technique of charging a string of capacitors to discreet voltage levels, then reading off at a later period. It has undergone continuous environmental and life testing totalling 1,000 hours. (Canada.)

A Chebycheff Fitting Criterion, A. Sptizbart and D. L. Shell. "J. Assoc. for Comp. Mach." January 1958. 10 pp. This paper concerns a method for approximating functions by polynominals, using a Chebycheff fitting criterion. (U.S.A.)

Analogue Computers and Their Use in Nuclear Reactor Safety Studies, I. Wilson and R. Potter. "J. BIRE." February 1958. 6 pp. Computational and circuit techniques are described which have been used successfully to study the various aspects of nuclear plant kinetics which are relevant to reactor safety. These include an examination of the overall stability of the system, the effects of coolant pump failure, burst steam lines and control rod maloperation. Particular reference is made to a revolving capacitance storage drum which simulates transport lags in coolant circuits. (England.)

Read and Write Transistor Circuits for Magnetic Drums—1, B. A. Mangan. "El. Des." February 5, 1958. 2 pp. This article discusses the integration of transistors in magnetic drum read-write circuits. A general approach to the design of these circuits for high reliability is outlined. Part 1 deals with the design of writer circuits. (U.S.A.)

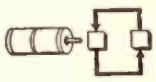
SWAC Experiments on the Use of Orthogonal Polynominals for Data Fitting, Marcia Ascher and George E. Forsythe. "J. Assoc. for Comp. Mach." January 1958. 13 pp. (U.S.A.)

Comparing Digital Computing Systems: An Increasing Problem, John A. McGann. "Comp." February 1958. 4 pp. (U.S.A.)

A Decimal Adder Using A Stored Addition Table, M. A. MacLean and D. Aspinall. "Proc. BIEE." March 1958. 7 pp. A serial decimal adder is described which accepts numbers in binary-coded form. The binary digits, which are handled in parallel, are decoded into a set of pulses which actuate a built-in addition table storing all the possible sums. (England.)

The Design of the Control Unit of an Electronic Digital Computer, M. V. Wilkes, et. al. "Proc. BIEE." March 1958. 8 pp. The paper discusses a number of related ways in which a systematic and flexible design for a control unit may be achieved. (England.)

A New Bistable Element Suitable for Use in Digital Computers, Part 2, C. D. Florida. "Elec. Eng." March 1958. 6 pp. (England.)



CONTROLS

Determination of Parameters of Corrective Devices in Linear Servo-Systems Using Given Generalized Parameters, M. M. Kreimerman. "Avto i Tel." February 1958. 13 pp. An analytical method of determining parameters of corrective devices in a linear servo-system using its generalized parameters is described. The paper includes the table of main formula and calculation of parameters of series and parallel corrective devices. (U.S.S.R.)

Maintenance Control and the Automatic Factory, Roland A. Cail. "El. & Comm." February 1958. 3 pp. A piece of electronic equipment that could bring a long step nearer the day of the completely automatic factory, operated from a switchboard in the works manager's office, is nearing completion in a small factory in High Wycombe, England. (Canada.)

Backlash and Resilience in Servo Systems, J. McC. Foyle. "El. Energy." March 1958. 5 pp. The effect of resilience and backlash on the performance of position control systems is discussed. Previous investigations, which have been carried out to assess this effect, are then considered. (England.)

Cascading Resolvers Without Booster Amplifiers, Jack Gilbert. "Con. Eng." March 1958. 6 pp. This article presents formulas by means of which the effect of cascading any practical number of resolvers can be calculated, and, in many cases, those expensive amplifiers saved. (U.S.A.)

The Form of Adaptive Systems, Raymond N. Auger. "Auto. Con." March 1958. 3 pp. Existing control systems can be divided into two groups and the combination of such systems produces highly adaptive properties. (U.S.A.)

Stability of Nonlinear Control Systems Described by Differential Equations of the 5th and 6th Order, E. N. Rozenwasser. "Avto i Tel." February 1958. 13 pp. On the basis of Lourie theorem (1) sufficient conditions of stability of certain control systems described by differential equations of the 5th and 6th order are obtained. (U.S.S.R.)

The Theory and Design of Sampled Data Control Systems, S. Bellert. "Roz. Elek." Vol. 3, No. 4. 70 pp. The fundamentals of the theory of feed-back control systems working on sampled data are given in this paper. The present theory is based on the integral Laplace transformation. (Poland.)

A Cine-theodolite Control System Used on Guided Missile Ranges, R. J. Garvey. "Elec. Eng." March 1958. 7 pp. Cine-theodolites are used to determine the trajectory and velocity of experimental guided missiles; a number of them being dispersed on the range and operated by a central controller. This controller operates the cine-theodolite shutters and triggers flash lamps which expose the theodolite bearing and elevation readings on the cine film. (England.)

Feedback Amplifier Design with the Nichols Chart, William D. Wade. "El. Des." March 19, 1958. 3 pp. The Nichols chart, useful in servo and feedback amplifier design, provides advantages over more popular design aids. Unlike the Bode chart or phase-attenuation curves, it allows the designer to obtain closed loop data directly from open loop data. (U.S.A.)

Analytical Formulation of the Synthesis Problem of Corrective Devices in Linear Servo-Systems, V. G. Segalin. "Avto i Tel." February 1958. 14 pp. Analytical formulation of the synthesis problem of corrective devices in linear servo-systems is proposed. The determination of transfer functions of corrective devices is treated using initial equations of the synthesis obtained in paper. The method described is illustrated by an example of solving the synthesis problem. (U.S.S.R.)

GENERAL

The Foucault Pendulum in the United Nations Building in New York, J. A. Haring and H. van Suchtelen. "Phil. Tech." February 10, 1958. 6 pp. In the entrance hall of the United Nations building in New York is suspended a Foucault pendulum, presented in 1955 as a gift from the Netherlands. To prevent the pendulum from describing an elliptical path, a suspension system was designed which is equivalent to a simpler system designed by Charron but greatly reduces the risk of wear and breakage. The drive is provided by a coil with ferroxcube core which is mounted under the pendulum and energized by alternating current. Eddy currents produced in a copper plate inside the pendulum bob cause repulsion. An electronic relay operated by the pendulum itself controls the moment at which the current is switched on and the duration of the current. (Netherlands.)

Modified Rice Neutralization, B. C. Das. "J. ITE." December 1957. 3 pp. Theory of Rice and modified Rice neutralization has been discussed, and mathematical expressions have been derived for maximum stability with no feed-back voltage at grid. Conditions for degenerative and regenerative feed-back have also been derived and this would enable problems on Rice neutralization to be tackled with ease and confidence. (India.)

INDUSTRIAL ELECTRONICS

Some Criteria for the Reliable Operation of Transistorized Pulse Converter Circuits in Industrial Circuit Techniques, A. Haidekker. "El. Rund." March 1958. 2 pp. It is examined what kind of criteria are necessary to guarantee reliable operation of transistorized pulse converter circuits. (Germany.)

International ELECTRONIC SOURCES

Automatic Control in Steel Strip Manufacture, G. Syke. "J. BIRE." February 1958. 7 pp. The paper discusses thickness gauges on strip rolling mills and their use for automatic screw control, measurement and control of extension on skin-pass or temper mills, and automatic sorting of steel sheet and tin-plate on cut-up lines. (England.)

Solid-State Thyratron Switches Kilowatts, R. P. Frenzel and F. W. Gutzwiller. "El." March 28, 1958. 4 pp. Applications for the silicon controlled rectifier, a recent addition to the growing list of semiconductor switches, include replacement of relays, thyratrons, magnetic amplifiers, power transistors, and conventional rectifiers of all types. (U.S.A.)

Inverter with Thyratrons, I. H. Becker. "El. Rund." March 1958. 2 pp. A self-excited inverter with 200 V dc input and 220 ac output, 50 c/s, for 20 W output is described. (Germany.)

Analog Comparator for Production Testing, Carl N. Boode and Carl E. Calohan. "El." March 28, 1958. 3 pp. Records of continuous performance of potentiometer-type pressure-sensing instruments over their operating ranges show error from standard manometer, resolution, hysteresis and dynamic response at varying rates of pressure change. (U.S.A.)

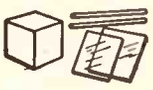
Control in Man-Machine Systems, George W. Hoover. "Con. Eng." March 1958. The author maintains that there is no system in which a man does not exercise control, if only during critical start-up or launching periods. (U.S.A.)

Numerical Control: Punched Tape or Cards? Malcolm L. Russell. "Auto. Con." March 1958. 4 pp. Here are some of the pivotal reasons why one medium could be more favorable than the other. (U.S.A.)

Applying Machine Control Computers, George E. Amber and Paul S. Amber. "Auto. Con." March 1958. 5 pp. (U.S.A.)

INFORMATION

Information Theory in the U.S.S.R., Paul E. Green, Jr. "El. Des." February 5, 1958. 4 pp. (U.S.A.)



MATERIALS

Crystal-Oriented Ferroxplana, A. L. Stuijts and H. P. J. Wijn. "Phil. Tech." February 10, 1958. 9 pp. Since the magnetization of ferroxplana materials is strongly bound to the preferred plane, the particles of a powdered specimen can be aligned in an external magnetic field. In a uniform field all preferred planes become parallel to the direction of the field ("fan" texture); in a rotating field all preferred planes are more or less mutually parallel ("foliate" texture). (Netherlands.)

The Effect of Free Electrons on the Conduction in Metals and Alloys, M. E. Damois. "Bul. Fr. El.," Vol. 7, No. 84. December 1957. 10 pp. This is a highly theoretical article describing the motion of free electrons in pure metals as well as in alloys. The theories by Drude-Lorentz and Sommerfeld are used as a starting point for the present theories. (France.)

Designing with Ferrite Isolators, W. A. Hughes. "Can. Elec. Eng." February 1958. 4 pp. High isolation to insertion loss ratio of modern ferrite isolators is pointed out with examples. Various applications are mentioned and the design techniques involved in selecting an isolator are described. A nomogram for Unilateral Isolation is introduced, and its use in conjunction with the Rieke Diagram for the magnetron or oscillator being used is illustrated by an example of limiting magnetron frequency pulling. (Canada.)

Analysis of Residual Gases at Very Low Pressure, J. Amoignon and G. Mongotin. "Vide." Vol. 12, No. 71. Sept.-Oct. 1957. 6 pp. A very compact spectrometer is described for measuring the residual gases. The ion source, deflector, and target are placed directly into the gas to be analyzed. Thus, the working pressure is precisely the same as the one in the unit under test. When the limits of the pumping unit is reached the analyzer can only detect the pressure of water vapor, carbon dioxide, and nitrogen. It was proven that metal gaskets provide a much better vacuum than rubber gaskets. (France.)

Rotine Crystal Orientation of Germanium and Silicon by High-Intensity Reflectograms, G. H. Schwuttke. "Syl. Tech." January 1958. 4 pp. Two optical methods developed in the research laboratories for the orientation of single crystals of Ge and Si are described. Both methods employ light beams to produce reflectograms from the principlal crystal faces. (U.S.A.)

MEASURE & TESTING

***Strain Gages for Jet Engine Research,** R. H. Kemp. "El. Ind." May 1958. 8 pp. At Lewis Labs they are testing turbojet engines at rated conditions with strain gages mounted on the turbine blades. New bonding materials and techniques make these high temperature operating tests possible. (U.S.A.)

***Automatic Checkout Equipment, Part Two,** L. S. Klivans. "El. Ind." May 1958, 5 pp You can't use hand checkout methods with modern weapons systems. But automatic checkout systems are expensive. One answer to this dilemma is to design the checkout system so it is easily adaptable to different systems. As the author points out, this requires a rational approach to both system design and selection of sub-systems and components. (U.S.A.)

The Creation and Test of Ultra-High Vacuums, F. A. Baker and J. Jarwood. "Vak. Tech.," Vol. 6, No. 8. December 1957. 6 pp. This is the second part of an article on this subject. An analysis is made of the theoretical exhaust speeds which can be obtained with various vacuum systems. Very low gas pressures are measured with the omegatron. The principle of operation and the construction of an omegatron are given. (Germany.)

A Simple Apparatus for Contact Microradiography Between 1.5 and 5 kv, B. Combee and A. Recourt. "Phil. Tech." February 10, 1958. 13 pp. The article describes an apparatus for contact microradiography (CMR 5) equipped with a sealed-off X-ray tube having a beryllium window only 50 microns thick and a focal spot of 0.3 x 0.3 mm. The apparatus contains a small H. T. generator for the X-ray tube, and controls for varying the anode voltage (max. 5 kV) and the tube current (max. 5 mA). The maximum permissible power is 10 W. (Netherlands.)

Measurement of Small Phase Shifts with a Phase Sensitive Voltmeter, D. J. Collins and J. E. Smith. "Elec. Eng." March 1958. 2 pp. The design of precision electronic circuits sometimes requires the measurement of very small phase errors to a reasonable accuracy. The article describes a method of measuring phase errors of the order of one degree using conventional instrumentation. (England.)

Ignition Analyser Eases Aircraft Engine Maintenance, L. S. Eggleton. "Can. Elec. Eng." March 1958. 3 pp. The difficulty of locating faults in complex ignition systems brought about the necessity for an ignition analyser. The unit which has been developed not only locates faults but also serves to prevent them occurring. (Canada.)

A Theoretical Study of an Ion Resonance Spectrometer, J. Amoignon and J. Rommel. "Vide," Vol. 12, No. 71. Sept.-Oct. 1957. 6 pp. The article describes the theory and operation of a resonance spectrometer for ions. (France.)

Acoustic Cavity Detects Breaks in Film, Edward L. Withey and Richard G. Seed. "El." March 28, 1958. 2 pp. Interference by film passing through resonant chamber affects energy transfer between crystal transducers to control film processing equipment and reduce rethreading and film spoilage. (U.S.A.)

Methods for Generating the Intermediate Frequency for a Calibration Receiver from the Received Carrier Frequency, R. Kersten. "Freq.," Vol. 12, No. 1. January 1958. 10 pp. This is the second part of a paper which analyzes the factors which must be considered in the design of a calibrated receiver. Extensive amounts of mathematics supports the analysis. Photographs of the receiver are included. (Germany.)

A Simple Three-Channel C.R.O. Beam Switch, W. F. Lovering and M. P. Hearn. "Elec. Eng." March 1958. 2 pp. It is often desirable to display several different phenomena simultaneously on a single beam c.r.t. In this article details of a three-channel beam switch are given using a three-phase multivibrator circuit which utilizes only six valves. (England.)

New Canadian CRO Has Unique Features, R. Wilton. "Can. Elec. Eng." February 1958. 5 pp. A medium priced cathode ray oscilloscope has been completely developed, designed and produced in Canada. The new instrument is capable of performing almost all the operations for which much higher priced laboratory scopes are normally used. Circuits include a slide-back amplitude measurement system with a built-in meter and a novel calibration arrangement. (Canada.)

Modern Hot Wire Vacuum Gauges, H. van Ubisch. "Vak. Tech.," Vol. 6, No. 8. Dec. 1957. 7 pp. Described are the principles of hot wire vacuum gauges. Formulae are given for heat convection from hot wires, and molecular heat conduction of various gases. The article is supported by a number of graphs. (Germany.)

ZETA (The Control Room Monitoring and Recording Instruments), E. P. Butt. "Elec. Eng." March 1958. 5 pp. ZETA is a large experimental device and it is, therefore, necessary to make a large number of measurements and recordings of them. In this article the necessary measurements are detailed and the control room monitoring and recording instruments are described. (England.)

ZETA (The Main Recording and Monitoring Equipment), A. E. Cawkell and R. Reeves. "Elec. Eng." March 1958. 6 pp. To operate and evaluate the results obtained with ZETA a large number of signals have to be recorded and monitored. The derivation of these signals has been described elsewhere. In this article the main recording and monitoring equipment is described. This comprises an eight channel oscilloscope with photographic facilities and a two channel oscilloscope incorporating "Memotron" transient storage tubes. (England.)

Go No-Go Meter Speeds Resistance Check, Donn S. Randall. "El." February 28, 1958. 2 pp. Amplified error voltage from a Wheatstone bridge feeds 75-0-75 microammeter to indicate whether resistance under test is

higher or lower than desired value and also if it is within a preset tolerance. (U.S.A.)

Temperature Measurement with Thermistors, J. C. Anderson. "E. & R. Eng." March 1958. 5 pp. Characteristics of thermistors are discussed, and three temperature-measuring devices described:—an industrial thermometer for 0-100° C using a Wheatstone bridge, a medical thermometer covering 85-105° F incorporating a balanced transistor amplifier and a high-sensitivity device using a two-stage transistor amplifier. Some observations on thermistor stability are included. (England.)

Magnetometer Makes Continuous Measurements, Ferdinand Voelker. "El." March 14, 1958. 3 pp. Developed for use in an electron cyclotron, instrument monitors magnetic field strength continuously with accuracy of 0.1 percent. Probe design varies with application, one type employing quadrupole construction for magnetic isolation and a heat sink for cooling. (U.S.A.)

Fault Analysis of Nucleonic Equipment, R. B. Shields. "El. & Comm." February 1958. 3 pp. (Canada.)

The Measurement of Earth Loop Resistance, G. F. Tagg. "El. Energy." March 1958. 3 pp. For safety it is necessary for fuses to blow in the event of a fault to earth. This article discusses the instruments designed to measure the earth loop impedance or resistance. (England.)

An Instrument for the Measurement of Surface Impedance at Microwave Frequencies, A. E. Karbowiak. "Proc. BIEE." March 1958. 9 pp. A theory is given of an instrument for the measurement of surface impedance at microwave frequencies. (England.)

RADAR, NAVIGATION

A Radar Sonde System for Upper Air Measurements, N. E. Goddard and H. A. Dell. "Phil. Tech." February 27, 1958. 6 pp. Short description of a radar sonde system, developed by the Mullard Research Laboratories in conjunction with the Royal Radar Establishment, for mensurements of wind speed, wind direction, temperature, pressure and humidity up to high altitudes. (Netherlands.)

The Birth of Radar, G. R. M. Garratt. "Elec. Eng." March 1958. 3 pp. Few great inventions have such a well defined and documental pedigree as that of radar. Two current events make the subject one of topical interest, the publication of an autobiography by Sir Robert Watson-Watt and the recent acquisition by the Science Museum, South Kensington, of the original historic apparatus. (England.)

SEMICONDUCTORS

***Power Transistor Test Set,** W. Hasenberg. "El. Ind." May 1958. 3 pp. Accurate knowledge of dc current transfer ratio, not usually available from data sheets, can be obtained with the test equipment described here. (U.S.A.)

***For Transistor Amplifiers . . . Designing Multiple Feedback Loops, Part Two,** F. H. Blecher. "El. Ind." May 1958. 5 pp. The stability criterion is extended to include junction transistors in the common emitter configuration. Practical design techniques are discussed and an illustrative amplifier designed. (U.S.A.)

Electrical Breakdown in P-N Junctions, A. G. Chynoweth. "Semicon." March/April, 1958. 4 pp. In semiconductor devices, p-n junctions can "break down," or permit a sudden flow of electricity in the direction that normally shows high resistance. For some time a puzzle to physicists, the mechanism of this phenomenon can now be described as a result of recent research studies. (U.S.A.)

Equivalent Circuitry for Transistors, H. Schenkel. "Radio Rev.," Vol. 10, No. 2. February 1958. 7 pp. This article, submitted by a Raytheon engineer, provides the formulae for transistor circuits in table form. (Belgium.)

Residual Images in Vidicon Type Camera Tubes, C. Kunze. "Hochfreq.," Vol. 66, No. 3. November 1957. 6 pp. Methods are outlined for determining the various internal impedances as well as the discharge times of Vilicon tubes. Operating methods are outlined which permit a reduction of residual images. (Germany.)

Transistor Circuits for Use with Gas-Filled Multi-Cathode Counter Valves, J. B. Warman and D. M. Bibb. "Elec. Eng." March 1958. 4 pp. A technique is described which enables complex digital circuits using both transistors and Dekatrons to operate from a low-voltage power supply. A transistor d.c. convertor is used to generate the 475V h.t. supply. Output pulses from the Dekatron cathodes drive transistor circuits. A transistor blocking oscillator feeds stepping pulses to Dekatron guide cathodes and a similar circuit is used for resetting the Dekatron to its home cathode. (England.)

Research Into Transistor Surfaces Helps Improve Reliability, C. G. B. Garrett. "Can. Elec. Eng." March 1958. 4 pp. In the manufacture of transistors, diodes and other semiconductor devices, inadequate control of surface technology may lead to serious degradation of initial performance and long-term reliability. Much of this trouble is known to be associated with a thin film of oxide on the semiconductor surface. Though much remains to be learned, recent experiments on the effects of light and of electric field on germanium surfaces have helped to establish the basic physics and chemistry of these effects. (Canada.)

The Effect of Base Resistivity on Power Transistor Performance, Bernard Reich. "Semicon." March/April, 1958. 3 pp. Starting with the variation of resistivity of impure germanium with temperature, the author develops its effect on device characteristics and circuit performance. (U.S.A.)

Controlled Saturation in Transistors and its Application in Trigger Circuit Design, Part I, N. F. Moody. "Elec. Eng." March 1958. 7 pp. It is usually considered that the speed of a transistor switching circuit becomes grossly degraded if saturation is allowed to occur. That this need not be so, if the saturation is appropriately controlled, is demonstrated by the design of a trigger circuit. This saturated circuit is able to approach the performance of its non-saturated counterpart, which it may often replace with economy in both power consumption and cost. Part I of the article is devoted to a study of carrier storage in both saturated and non-saturated transistors. This study leads to a concept known as "controlled saturation," which defines the maximum charge storage the transistor can exhibit whether saturated or not. (England.)

The Application of Transistors to Video-Frequency Equipment, Herbert Fix. "Rundfunk." January 1958. 8 pp. The article examines the question of the extent to which transistors may be successfully used in television, in particular in connection with video equipment. After a brief summary of the basic problems of transistor amplifiers the author discusses the special requirements which must be fulfilled for use in wide-band amplifiers and in pulse technique. (Germany.)

Semiconductor Diode Test Methods, W. B. Mitchell and J. Gillette. "Semicon." March/April, 1958. 7 pp. Semiconductor diode characteristics are presented and representative circuits are shown to measure these characteristics. Circuits are included for measuring the static, dynamic, and operational characteristics. (U.S.A.)

70 MC Silicon Transistor, Charles Earhart and William Brower. "Semicon." March/April, 1958. 8 pp. Design considerations, device fabrication, electrical test methods, and typical electrical characteristics of a newly developed n-p-n silicon tetrode transistor made by the grown-diffused technique. (U.S.A.)

The Intrinsic-Barrier Transistor — How It Works, J. M. Early. "Bell Rec." March 1958. 5 pp. The now familiar transistor structure typically includes three semiconductor layers of the negative and positive types. There are, however, certain limitations in this structure —principally the extent to which the thickness and resistivity of the central or base layer can be reduced. An "intrinsic" or neutral layer incorporated between the base and collector layers has permitted transistor operation at higher voltages and higher frequencies. (U.S.A.)

Intermetallic Semiconductors, Henry T. Minden. "Syl. Tech." January 1958. 13 pp. The intermetallic semiconductors indium antimonide, indium arsenide, indium phosphide, gallium arsenide, cadmium telluride, mercuric telluride, and bismuth telluride are discussed. Methods of synthesis, purification and single crystal growth are described. (U.S.A.)

Fast Transistor Relay, Dorrance L. Anderson. "El." March 14, 1958. 1 p. Push-pull switching unit capable of handling up to 10 amperes has a rise time of 50 sec. Zener diode control triggering voltage level to eliminate need for step-waveform control voltage to provide equivalent to mechanical relay. (U.S.A.)

Zener Diode Characteristics. "El. Des." March 19, 1958. 6 pp. (U.S.A.)

TELEVISION

Image Distortions by RC Four Terminals Networks of a Cathode Ray Oscillograph and their Correction at Low Frequencies, H. Wittke. "El. Rund." March 1958. 5 pp. For any video voltage the original voltage having passed RC four terminals networks can be restored by one of both formulae for the correction of distortion. This method can not be applied when a diagram is designed by two original voltages over RC four terminals networks. (Germany.)

Dosimetry of the Very Weak X-radiation Generated in Television Receivers and X-ray Diffraction Apparatus, W. J. Oosterkamp, et al. "Phil. Tech." February 27, 1958. 4 pp. Television picture tubes emit very soft, extremely weak X-radiation, which can be detected at the outside surface of a home television receiver. To preclude all danger for the user, the dose rate according to international recommendations should not exceed 2 millirontgens per hour (in the future the permissible limit may well be set still lower.) The dose rate can be checked with thin-windowed Geiger-Muller counters, whose windows are sufficiently transparent to the soft radiation. (Netherlands.)

Pulse-Cross Modification of Tv Receivers, Harold E. O'Kelley. "El." February 28, 1958. 2 pp. Phantastron circuits delay horizontal and vertical sync pulses when added to monitor or tv receiver to provide pulse-cross display. System gives simple means of checking operation of station sync generator. (U.S.A.)

International ELECTRONIC SOURCES

A Television Camera with Prolonged Storage Time for Televising Objects of Slow Light Intensity, in Particular for Use in Television Astronomy, Peter Piepereit. "Rundfunk." January 1958. 2 pp. For use in a television telescope, it was necessary to have a camera with a higher degree of photosensitivity. An image-orthicon with reduced storage capacity gave a rise in sensitivity that was insufficient. In addition, the storage time of the camera was increased. A suppression signal consisting of a train of pulses at a multiple of the standardized vertical frequency applied to the mesh gave rise to disturbances. (Germany.)

Video Tape Withstands Tremendous Heat, Pressure and Abrasion, L. F. Bennett. "Can. Elec. Eng." February 1958. 2 pp. New manufacturing techniques with different materials had to be evolved for the video recording tape used with the Ampex Video Recorder. Head pressure on the tape is 20,000 lbs per square inch and coating temperatures are around 240°C. It is expected that tape will eventually be used in video to the same extent as it is today in radio. (Canada.)

Etched I-F Amplifier Pares Color TV Cost, Linus Ruth. "El." March 14, 1958. 3 pp. Vane-tuned inductances and rejection traps, etched on the same board as the wiring of a 41-mc i-f strip for color tv, provide neat and economical design technique. (U.S.A.)

Corrections for Frequency and Phase Variations in Broad Band Amplifiers for TV Transmission, H. Dobesch. "Hochfreq.," Vol. 66, No. 3, November 1957, 4 pp. The author analyzes the broad band filters most frequently used for TV transmission and suggest the use of certain correction factors. (Germany.)

The Behaviour of the Image-Orthicon Television Camera Tube with Extremely High Photo-Currents, Richard Theile and Franz Pilz. "Rundfunk." January 1958. 9 pp. Following earlier investigations into the typical functional faults of the image-orthicon camera tube (1) the article describes further experiments in this connection, with special reference to its functioning with very high photo-currents, when the storage time of the tube amounts only to the duration of about one line. (Germany.)

The Influence of the Optical System of a Television Camera on the Frequency Response Characteristic of the Television System, Dieter Frenzel. "Rundfunk." January 1958. 9 pp. The paper deals with the effect of optical systems on the overall performance of a television chain. Every measurement is made according to two different methods (pattern method and step-function method). In both cases, the light pulses which have been transformed into current pulses by a photo-electric cell are recorded. (Germany.)

THEORY

Frequency Methods of Remote Control of Distributed Objects, V. A. Ilyin and K. P. Kurdjukov. "Avto i Tel." February 1958. 13 pp. The frequency method of selecting and controlling distributed objects in conducting transmission channels is developed. Construction of remote control devices including frequency relays with series oscillatory circuits is considered. (U.S.S.R.)

A Theoretical Treaty of Band-Pass Filters with Purely Real Impedances, E. Trzeba. "Hochfreq.," Vol. 66, No. 3, October 1957. 5 pp. This is the first part of an article which describes coupled multi-stage band-pass filters. It is shown that a filter with zero points in the transmission frequency characteristic provides much sharper cut-offs than transmission frequency curves without zero points. (Germany.)

Energy Spectra of Cascade Electrons and Photons, Charles A. Olson "NBS J." February 1958. 12 pp. The equations for the energy spectra of electrons and photons in a cascade shower are written in a form suitable for numerical applications with accurate cross sections. Trial calculations were carried out to check the feasibility of a step-by-step numerical integration procedure similar to that used successfully at low energies in noncascade problems. (U.S.A.)

A Coder for Halving the Bandwidth of Signals, A. R. Billings. "Proc. BIEE." March 1958. 3 pp. It is shown that it is possible to code a continuous message of finite bandwidth into a continuous signal of smaller bandwidth, provided that sufficient signal power is available. (England.)

Masers and Related Quantum-Mechanical Devices, Part II, G. E. Weibel. "Syl. Tech." January 1958. 18 pp. In the main part of this installment, the quantum theory of microwave interaction with a two-level system is derived. The inversion transitions in the ammonia molecule are emphasized, but most of the formalism developed will prove later to be applicable to more general situations. (U.S.A.)

RF Coupling Between Embedded Cables and Vehicles, H. Fricke and H. Rummert. "Freq.," Vol. 12, No. 1, January 1958. 7 pp. This is a continuation of an article started in the December issue. Analyzed are various physical and technical aspects of coupling between a moving vehicle and an embedded cable. The optimum conditions are highlighted. The theory is supported by measurements. The optimum frequency band seems to be in the 10-100 kc region. A power of 1-10 watts is sufficient. A two-stage amplifier is used for receiving the signals. (Germany.)

Amplifier Low-Frequency Compensation, J. E. Flood and J. E. Halder. "E. & R. Eng." March 1958. 9 pp. General expressions are deduced for the indicial response, the gain-frequency response and the phase-frequency response at low frequencies. The expressions are used to obtain the conditions for maximal flatness of the indicial response, gain-frequency response or phase-frequency response of particular circuits. A single resistance-capacitance coupled stage can have up to second-order compensation of its indicial response, up to fourth-order compensation of its phase-frequency response or up to fifth-order compensation of its gain-frequency response. The design of multistage amplifiers is also considered. (England.)

On the Truncation of Discrete Approximations to the Solutions of Dirichlet Problems in a Domain with Corners, Pentti Laasonen. "J. Assoc. for Comp. Mach." January 1958. 7 pp. (U.S.A.)

A Correlation Between the Transient and Frequency Responses in Servomechanisms, Z. J. Jelonek and G. I. Boomer. "J. BIRE," February 1958. 14 pp. The need is stressed for simple correlation between the time and frequency responses in servomechanisms in order to rationalize synthesis procedures. Some existing methods of correlating features of the unit step response with frequency response parameters are examined and their shortcomings noted. (England.)

TRANSMISSION

Microwave Field Strength and Fading in the Presence of Intervening Ridges, R. Vikramsingh. "J. ITE." December 1957. 7 pp. Experimental studies on microwave propagation in 2,000 mc./sec. region on two paths, 14 and 54 kilometers long respectively, are compared with theoretical prediction of received field intensity and fading in the shadow region behind intervening ridges. (India.)

Broad-Band Slot-Coupled Microstrip Directional Couplers, J. M. C. Dukes. "Proc. BIEE." March 1958. 8 pp. The paper describes a new design technique for directional couplers in a printed strip-above-ground microwave transmission system (microstrip). (England.)

The Application of Printed-Circuit Techniques to the Design of Microwave Components, J. M. C. Dukes. "Proc. BIEE." March 1958. 18 pp. A brief resume is given of the basic theory of strip transmission lines including unwanted effects such as spurious mode transmission and radiation. (England.)

Transmission Line Low-Pass Filters, F. Charman. "E. & R. Eng." March 1958. 9 pp. This article describes the design of low-pass filters in the v.h.f. range and the appendices give the mathematical analysis of the design work. (England.)

TUBES

•The Grids Were Framed for . . . Improving the Deflection Amplifier, C. Droppa. "El. Ind." May 1958. 5 pp. A radical new support positions the grid wires at exactly 90° to the vertical. Under constant tension, the wires do not warp, bow, or short circuit. The structure and unusual characteristics offer advantages not found in conventional types (U.S.A.)

High Frequency Mass Spectrometer and its Application in the Vacuum Technique, P. F. Varadi, L. G. Sebestyen, E. Rieger. "Vak. Tech.," Vol. 7, Issue 1, February 1958. 3 pp. This is the first part of an article which describes two types of light weight portable mass spectrometer operating at high frequencies. These units are especially suited for the electron tube industry. One unit operates at the range from 10^{-3} to 10^{-7} torr, and can be used as ionization manometer. The second unit has a resolution of 25, and is well suited for quantative gas analysis in the range from 5×10^{-4} to 10^{-7} torr. The accuracy is 10%. (Germany.)

Analysis of the Gaseous Contents of Sealed Cathode-Ray Tubes With the Aid of the Omegatron, J. Peper. "Phil. Tech." February 10, 1958. 3 pp. The residual gases in cathode-ray tubes (particularly picture tubes) have been qualitatively analyzed with the aid of the omegatron. This is a type of mass spectrograph, small in dimensions, which can be connected to the bulb of a partly-manufactured cathode-ray tube. (Netherlands.)

Roof-Top-Target Tubes Pulse X-Rays, E. F. Weller. "El." March 14, 1958. 2 pp. New pulsating X-ray tube designs and systems for their use are described. The most successful system uses two tubes. Each tube is controlled by applying a relatively low-voltage square wave to a special tube element called a diaphragm. (U.S.A.)

The Constant Current Magnetron Valvo 7090, W. Schmidt. "El. Rund." March 1958. 3 pp. Valvo 7090 is a constant current magnetron for 200 W output power at 2400 Mc/s. Particularly it has been developed for the application in diathermic devices. (Germany.)

Developmental Position and Method of Operation of Microwave Tubes, III, R. Muller and W. Stetter. "El. Rund." March 1958. 2 pp. In the final part of the series of articles the designs of travelling-wave magnetron type tubes, backward-wave magnetron type tubes and magnetron-oscillators are dealt with. (Germany.)

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.

A Second Survey of Domestic Electronic Digital Computing Systems, M. H. Weik, Aberdeen Proving Ground. June 1957. 439 pages. $7. (PB 111996-R) Prospective users of electronic digital computers will find aid in the choice of proper equipment in the Army's new report of engineering and programming characteristics of 103 commercially available systems. The book was published for guidance agencies and their private contractors. For potential computer users, data is provided for applications, cost, personnel requirements, and power and space requirements for specific systems. Suggestions are included on modifications and improvements useful to present operators of digital systems. Reliability problems are also dealt with. Each of the 103 systems is illustrated. Also included are an analysis of data from the survey on which the report is based, comparative tables, a discussion of trends, a bibliography, and a complete glossary of computer engineering and programming terminology.

Layout of Workplaces: Chapter 5 of the Joint Services Human Engineering Guide to Equipment Design, J. H. Ely, et al, Dunlap and Associates, Inc. Sept. 1956. 113 pages. $3. (PB 121802, OTS) A critical factor affecting operator performance in any man-machine system is the layout of his workplace. This report contains a compilation of human engineering recommendations concerning various aspects of workplace layout. The illustrated volume is divided into four main parts: General Considerations, Workplace Dimensions, Location of Controls and Display, and Direction-of-Movement Relationships. The report is part of a project sponsored by the Joint Army-Navy-Air Force Steering Committee of the Department of Defense to provide designers of military equipment with human engineering data and design recommendations.

Human Engineering Aspects of Radar Air Traffic Control—II and III: Experimental Evaluations of Two Improved Identification Systems Under High Density Traffic Conditions, L. M. Schipper and others, Ohio State Univ. July 1956. 54 pages. $1.50. (PB 121799, OTS) Studies of two major identification systems were made on the University's Air Traffic Control Simulator. The experiments investigated radar controller performance in simulated return-to-base problems at several traffic densities. The systems were the Clock Code omnipresent system using a symbolic code attached to each blip, and the Light Pencil interrogator system which gave on-demand identification. They were found equally satisfactory from a human engineering viewpoint. With either of the systems, a single experienced controller appeared to have little difficulty moving very high density traffic through a 50-mile approach control zone.

A Practical Handbook for Location and Prevention of Radio Interference from Overhead Power Lines, U. S. N. Civil Engineering Research and Evaluation Laboratory. Nov. 1956. 48 pages. $1.25. (PB 131017, OTS) This handbook provides practical information useful to power line designers, construction foremen, and maintenance crews for a better understanding of electromagnetic interference phenomena. It also aids in the design and maintenance of interference-free power distribution systems. The volume describes in non-technical language the common causes of radio interference from overhead power lines and lists practical measures required for location and elimination of the causes. The handbook is illustrated.

A Practical External Cardiac Pacemaker-Defibrillator, T. F. McGuire, Wright Air Development Center. Dec. 1956. 29 pages. 75 cents. (PB 121888, OTS) A simple electronic instrument which restores normal heartbeat in cases of cardiac arrest has been designed by the Air Force's Aero Medical Laboratory. The instrument is effective in restoring cardiac function after cardiac standstill, where the heart has stopped contracting, and ventricular fibrillation, where individual muscle fibers of the heart are contracting asynchronously. The pacemaker-defibrillator can also increase the output of a feebly beating heart by forcing more complete contraction and, if needed, increasing heart rate. The device alleviates the necessity of thoractomy, or opening the chest, and manual heart massage. It is described as simple, compact, safe, and reliable, and ideally suited for emergency use in surgical or experimental situations. Included in the report are discussions of the history and physiology of pacemaking and from cardiac standstill internal defibrillation. The theory, design, and use of the pacemaker-defibrillator are described in detail.

Spectrographic Analyses of Solid Titanium, J. A. Winstead, Wright Air Development Center. May 1957. 27 pages. 75 cents. (PB 131185, OTS) This study was concerned with the feasibility of spectrographic analysis of solid titanium alloys by the point-to-plane technique. Emission spectrographic excitation conditions were developed and line pairs established for analysis of solid titanium. Data from analyses of seven alloys are given. Among major results, satisfactory excitation conditions were established for analysis of the solid titanium and titanium alloys. The low inductance condition appeared to produce a satisfactory, reproducible spectrum. The means of analyses compared favorably with chemical and spectrographic values using the vapor injection technique. The data indicates that spectrographic analysis can be performed on homogenous samples when certified titanium standards are available.

Preferred Orientations and Kinetics of Recrystallization In Titanium, C. J. Sparks, Jr., and J. P. Hammond, Univ. of Kentucky. July 1956. 73 pages. $2. (PB 121693, OTS) Preferred orientations were produced in titanium by cold rolling and cross rolling and in a titanium-aluminum alloy by cold rolling. The reorientations occurring during annealing were studied quantitatively using an x-ray diffractometer. The kinetics of recovery and recrystallization were studied for isothermally annealed 94 percent cold-rolled titanium. This included grain growth, hardness, line breadth recovery, and measurements of reorientation on annealing. Titanium was found to behave somewhat differently than other metals to annealing. The process of recovery and recrystallization occurs almost simultaneously in cold-rolled titanium. Variations of yield strength with direction in the rolled sheet for commercial titanium and a titanium-aluminum alloy were found to be qualitatively predictable by applying the law of critical resolved shear stress to the pole figures of annealed sheet.

Reusable Seals for Electronic Equipment. W. Brown and A. Razdow, General Hermetic Sealing Corp. May 1957. 94 pages. $2.50. (PB 131194, OTS) Hermetic sealing of airborne electronic assemblies, subassemblies, and equipment has become increasingly important as a reliability safeguard against rugged operation in extremes of altitude and environment. Maintenance problems have also increased, and now techniques have become necessary to permit repeated sealing and unsealing of a protective enclosure without damage to it or its contents, while still maintaining an effective hermetic seal. This report describes the investigation, development, design and tests of the fused type seal which can be opened and resealed 15 times without harm to the contents of a container. Temperature measurement techniques were devised to determine exact heat distribution in and on the seal. Comparative measurements produced criteria for the best possible seal joint, the best metal for the can enclosures, and the most efficient heat transfer method. Also developed was a heat reflecting baffle which decreases temperature inside a sealed enclosure to below 85C. The "band heater" technique was shown to be best for sealing and unsealing containers. The report gives practical details for the operation.

Vibration and Shock Evaluation of Airborne Electronic Component Parts and Equipment, R. H. Jacobson, Armour Research Foundation. Dec. 1956. 206 pages. $5.50. (PB 121937, OTS) Electronic components and equipment frequently become inoperative when exposed to severe environmental conditions in airborne operation. The principal purpose of this research was to determine the ability of electronic parts and devices to withstand known conditions of vibration, shock, and acoustic excitation, conditions particularly harmful to equipment. This final report reviews findings of a study of their effects on equipment and components. The parts were relays, tubes, potentiometers, transformers, capacitors, and pressure switches.

Strength and Corrosion Resistance of Ultrasonically Soldered Aluminum Joints, J. B. Jones and J. G. Thomas, Aeroprojects, Inc. Mar. 1956. 61 pages. $1.75. (PB 121965, OTS) A variety of tin-base, cadmium-base, and zinc-base solders—32 in all—were effective in the fluxless tinning of aluminum by ultrasonic techniques. Specimens of 2024-T3 Alclad aluminum were prepared with each of the solder alloys and subjected to alternate immersion in 3.5 percent sodium chloride solution. The best solder, an alloy of 95 percent zinc and 5 percent aluminum-silicon eutectic, showed essentially no loss of strength after 900 hours of alternate immersion. Other solders containing 14 percent zinc or greater alloyed with tin and/or aluminum showed comparatively good resistance in the salt-solution environment. The solders which were most effective during earlier immersion in distilled water displayed poor resistance in the salt-water environment. Correlation of the data obtained in the two environments indicated that solders must be specifically selected for the environments in which they are to be used.

Ultrasonic Welding of Metals, J. B. Jones, C. F. DePrisco, and J. G. Thomas, Aeroprojects Inc. Apr. 1955. 105 pages. $2.75. (PB 131084, OTS) Significant improvements in welding equipment and techniques are claimed in this final report of an investigation of the possibilities of the ultrasonic process for joining similar and dissimilar metals. Results indicated that the technique has a potential for a wide range of metal joining problems. Among the achievements were successful welds in gages of 1100 aluminum through .062 inch and in several other metals and alloys. Shear strengths of the welds equalled those of the materials themselves. No reduction in strength was observed after about 5000 hours exposure in each of two corrosion environments. Grain orientation in the materials to be welded was found not significant. Surface films adversely affected weld strength, and polished surfaces seemed more readily weldable than rough surfaces. Based on the results of the study, recommendations are made for further development of the ultrasonic process, with emphasis on improvement of the elastic vibratory energy system, and identification of the mechanism of the process.

PATENTS

Complete copies of the selected patents described below may be obtained for $.25 each from the Commissioner of Patents, Washington 25, D. C.

Cathode Ray Amplifier, #2,808,526. Inv. D. W. Davis. Assigned International Telephone and Telegraph Corp. Issued October 1, 1957. An image storage element is placed adjacent the anode of an image signal tube. An additional source of electrons coaxially surrounds the conventional beam, its electrons being initially directed radially inwardly toward the beam. The electrons are, however, deflected towards the storage element to flood it.

Wave Generating Circuit, #2,808,454. Inv. B. S. Vilkomerson. Assigned Radio Corporation of America. Issued October 1, 1957. A control oscillation harmonically related to the horizontal deflection frequency is derived therefrom and superposed on the vertical synchronizing control input, the vertical synchronizing voltage being supplied by a squedging oscillator.

Electron Discharge Device Structures and Circuitry Therefor, #2,808,470. Assigned Radio Corporation of America. Issued October 1, 1957. An intensity-modulated beam impinges on a plural-element electron collecting electrode. This electrode consists of a member on which the beam tends to impinge and a multiturn coil through which it is projected. A resonant output circuit supplies different signal-depending potentials to the member as well as to the coil.

Audio Frequency Amplifier with Variable Frequency Characteristics, #2,808,472. Assigned North American Philips Co., Inc. Issued October 1, 1957. A phase-shifting network each is connected between the cathode and plate of two amplifier tubes, the phase-shift outputs being fed to the grid of the other tube in both instances. In one of the reactor-resistor networks the resistor is connected to the plate and the reactor to the cathode, and in the other network their position is exchanged. The time constants of these two networks are substantially different, and the positive feedback gain is reduced to less than unity by the negative feedback introduced in the unbypassed cathode resistors.

Grounded Grid Power Amplifier, #2,810,793. Inv. W. B. Bruene. Assigned Collins Radio Co. Issued October 22, 1957. The signal source is connected across a tuned cathode circuit and in parallel with a voltage detector; a current detector is connected in series with the signal source. The error input to a servo circuit is connected between a tap on a potentiometer, receiving the current and voltage detector outputs, and a grid current detector. The servo output controls an impedance in the amplifier output circuit.

Saturable Reactor Tuning of Superheterodyne Receiver with Differential Control of Saturation for Tracking, #2,810,826. Inv. Chas. W. Hargens. Assigned Radio Condenser Company. Issued October 22, 1957. Each of a pair of variable tuning circuits contains a saturable reactor with a control windings for tuning. Both control windings are connected in series with a variable current source and one control winding is further connected to a constant current source.

Alternating Current Motor, #2,810,843. Inv. C. E. Granqvist. Assigned Svenska Aktiebolaget Gasaccumulator. Issued October 22, 1957. The stator winding of a motor is simultaneously the oscillator coils of a transistor converter which transforms the a.c. into d.c. to be used by the motor.

Serpentine Traveling Wave Tube, #2,810,854. Inv. C. C. Cutler. Assigned Bell Telephone Laboratories, Inc. Issued October 22, 1957. The electron path traverses a serpentine-like wave guide structure, defining a plurality of interaction regions. The electron path is parallel to and displaced an odd number of quarter wavelengths of the operating frequency from the axis of the serpentine structure, severing it into short and long wave propagation paths between adjacent interaction regions. The length of each long section is equal to the length of each short section plus an integral number of wavelengths.

Subscriber Television System, #2,809,231. Inv. E. M. Roschke. Assigned Zenith Radio Corp. Issued October 8, 1957. Several repetitive mode-changing signals, representing different mode-changing schedules, are developed and selectively applied to a subscription television system. Their application is controlled in accordance with a repetitive selecting schedule. The relative phase between the mode-changing signals and the selecting schedule is varied according to a phasing schedule.

Motor Control Device, #2,810,778. Inv. W. A. Manty, G. D. Poole. Assigned Nestor Engineering Co. Issued October 22, 1957. A two-tube, three-relay circuit in a telegraph system is designed to start a motor on reception of a spacing signal, to continue operation of the motor during reception of a message, and to stop the motor a predetermined time after the cessation of the reception of a message and a predetermined time after the beginning of a prolonged failure of signal line voltage.

Compressed Frequency Communication, #2,810,787. Inv. M. J. Di Toro, W. Graham, and S. M. Schreiner. Assigned International Telephone and Telegraph Corp. Issued October 22, 1957. The voiced and unvoiced sounds in a speech signal are detected and an identifying signal is developed. Different frequency subbands for these two types of sounds are filtered out and the two bands are superposed. At the receiving side, the two sub-bands are separated by means of the identifying signal.

Television Band Width Reducing System, #2,811,578. Inv. J. W. Rieke. Assigned Bell Telephone Laboratories, Inc. Issued October 29, 1957. Either monochromatic or NTSC color television signals, i.e., color signals having bursts of energy at the subcarrier frequency f, can be processed. The frequency f is relatively high compared to the line scanning rate and located so that monochrome energy is substantially less than the burst energy. The automatic monochrome-color switching is controlled by the amplitude of the incoming signal in a narrow band surrounding the subcarrier frequency f.

Color-Television Electro-Optical Apparatus, #2,811,579. Inv. A. V. Loughren. Assigned Hazeltine Research, Inc. Issued October 29, 1957. A high-definition monochrome reproduction of the image to be displaced is combined with at least one low-definition color reproduction. Thus preciseness of registry of the separate reproductions is not required.

Series-Energized Cascade Transistor Amplifier, #2,811590. Inv. J. A. Doremus, R. P. Crow and H. Korn. Assigned Motorola, Inc. Issued October 29, 1957. A continuous direct current conducting paths is provided between the input electrode of a first transistor, a coupling circuit intermediate the first transistor and a second transistor to an output circuit. Suitable biasing voltages are supplied by the impedances in the path.

Feedback Network Compensations, #2,811,591. Inv. D. P. Kennedy. Assigned Raytheon Manufacturing Co. Issued October 29, 1957. The return ratio of an amplifier is made to vary from a value exceeding unity to a value less than unity. An attenuating network is inserted in the feedback path reducing the amount of feedback, at a rate not exceeding 10 dbs per octave starting at a low frequency corresponding to a noise frequency to be reduced, to below unity throughout the passband. A second compensating attenuation network is inserted before the amplifier to suitably predistort the signal.

Receiver Selectively Responsive to Amplitude Modulation, Single Side Band or Continuous Wave Signals, #2,811,638. Inv. N. J. Regnier. Assigned Hoffman Electronics Corp. Issued October 29, 1957. Three channels amplify, respectively, the carrier wave signals only, the lower side-band and the upper side-band only. A local oscillator is coupled to either input or to none of a two-input detector tube, the carrier wave signal being coupled to one input stage of the two-input detector tube and the two side-band signals to the other input.

Ultra High Frequency Signal Generation, #2,811,640. Inv. R. J. Hannon. Standard Coil Products Co., Inc. Issued October 29, 1957. An ultra-high frequency tube is provided with a plurality of plate leads and an equal plurality of grid leads. One capacitor each connects one of the plate leads to one of the grid leads to establish a resonant circuit with the inherent inductance. The cathode is capacitively coupled to the plate and grid leads to enhance oscillation.

Traveling Wave Tube Arrangement, #2,812,469. Inv. W. Klein. Assigned International Standard Electric Corporation. Issued November 5, 1957. The wave transmission path extends substantially parallel to the electron beam and comprises a helix of magnetic material consisting of a nickel-manganese alloy of at least 90% nickel.

Transmission Line, #2,812,501. Inv. D. J. Sommers. Assigned Sanders Associates, Inc. Issued November 5, 1957. A thin narrow inner conductor is separated by two wider dielectric material layers from two outer conductors also wider than the inner conductor. Conductive rods extend from one outer conductor through both dielectrics to the outer conductor, the rods being spaced less than a half wavelength apart. This permits the propagation of a substantially pure TEM wave.

Spiral Slot Antenna, #2,812,514. Inv. C. E. Smith. Issued November 5, 1957. First and second spaced edges are provided in the peripheral surface of a conduit defining a dielectric filled slot of a resistivity different from that of the conduit. The spiral slot circumscribes at least half the conduit periphery. A transmission line is connected across the edge.

Transistor Amplifier Circuit, #2,812,390. Inv. A. J. W. M. van Overbeek. Assigned North American Philips Co., Inc. Issued Nov. 5, 1957. A network connects two transistors in tandem. A capacitor in this network has a capacitance which is a function of the transmitted frequency, the internal collector impedances of the transistors. An inductance in series with the capacitor having a high value compared to the input impedance of the second transistor, the capacitor and inductance producing resonance at the transmitted frequency.

Plural Band Frequency Converter with Intermediate Frequency Trapping Means, #2,812,433. Inv. J. Stolk. Assigned North American Philips Co., Inc. Issued November 5, 1957. A plurality of series resonant circuits are each tuned to the i.f. frequency; parallel resonant circuits are tunable within a predetermined band of frequencies of the input wave. These circuits are connected to the grid of a i.f. tube.

Transistor Oscillator, #2,812,437. Inv. G. C. Sziklai. Assigned Radio Corporation of America. Issued November 5, 1957. Two opposite polarity transistors are both biased to normally conduct and, when conducting, they close a current path from an energy source through an inductive load. A circuit is coupled to the base electrodes and responsive to the voltage developed in the inductive load for periodically rendering both transistors simultaneously nonconducting.

NOW... AUTOMATED PIGTAILING ...AT 75% LESS COST – with the NEW AMP Automachine Shielded Wire Ferrule

● machine-fed ferrules and pigtail wire ● controlled compression termination, with AMP automachine technique ● dual applicator permits termination of two leads or double-ended jumper, simultaneously ● pigtails cut to desired length, automatically!

Designed especially for television and commercial electronics applications.

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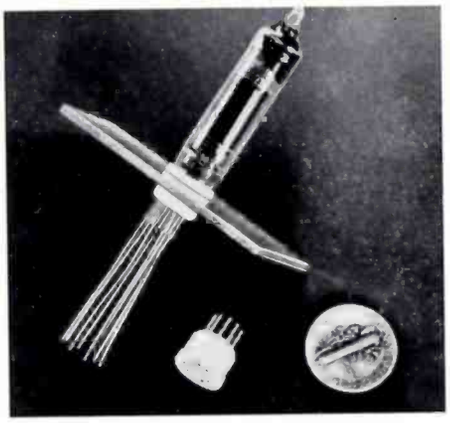
Circle 71 on Inquiry Card, page 99

New Products

SUBMINIATURE SOCKETS

The Chemelec Teflon subminiature tube socket has high reliability under extreme shock, vibration, high temperature; low-loss insulating qualities, zero moisture absorption. In



addition, its compression-mounted design requires no mounting hardware and saves space and assembly time. It is simply pressed into a single chassis hole, slightly smaller than the Teflon body of the socket. Adaptable to printed circuitry; also can be used as chassis mounted tube lead insulator. Fluorocarbon Products, Inc., Camden, N. J.

Circle 226 on Inquiry Card, page 99

PULSE MODULATOR

The USN-3D21B pulse modulator, a compact, economical beam power tube, is capable of delivering 21 kw in 10 μsec. pulses. It may also be used as a high-voltage blocking oscillator, hard switch tube, deflection amplifier, and regulator or pass tube in high-voltage supplies. It features an open-type plate of large area for high

thermal dissipation, a non-warping cathode and gold-plated special alloy grids with heavy side rods and oversize heat radiators. CBS - Hytron, Parker St., Newburyport, Mass.

Circle 227 on Inquiry Card, page 99

PHAZOR PHASE METER

Pat. Pend.

MODEL 200 A

PRICE $349.50 F.O.B. NEW YORK

- HIGH ACCURACY
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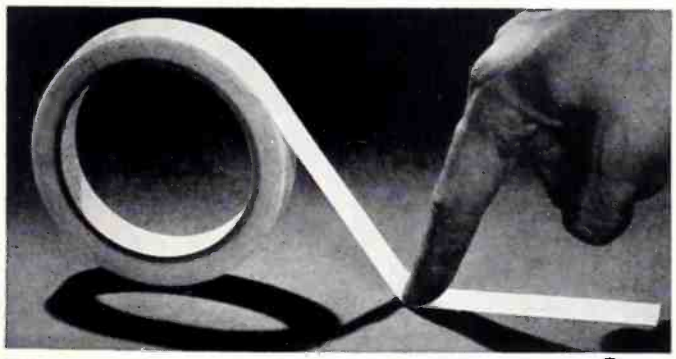

New TEMP-R-TAPE® C

.002" thick, 2750 v/m pressure sensitive TEFLON* tape For -100°F to 500°F applications

TEMP-R-TAPE® C, CHR's newest pressure-sensitive tape, is made of ultra-thin, high dielectric, cast Teflon film to which a silicone polymer adhesive has been applied. Both pressure-sensitive and thermal curing, the adhesive sticks well to any surface over a −100°F to 500°F (−70°C to 260°C) temperature range. Providing an easy-to-apply, extremely thin, high dielectric insulator (2750 volts/mil), TEMP-R-TAPE C was designed for and is now being used in the manufacture of miniature electronic units to withstand Class H and higher temperature requirements. *Send for data on TEMP-R-TAPE C and CHR's other extreme temperature, electrical and mechanical pressure-sensitive tapes.*

CONNECTICUT HARD RUBBER

NEW HAVEN 9 CHR CONNECTICUT

*du Pont TM.

Circle 109 on Inquiry Card, page 99

Strip-Coating Keeps Resharpened Tools SHARP

Sta-Warm dipping unit in packaging dept. of leading cutting tool manufacturer showing protective strip-coating being applied to new tools.

Tool manufacturers ship new drills, reamers, counterbores, hobs and dies to *you* well protected with plastic strip-coating. It's equally simple, fast and inexpensive for you to continue protecting tools after they have been used and resharpened. Do just what the tool manufacturers do . . . quick-dip cutting edges in fast drying plastic strip-coating compound.

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Choose large or small size to meet your requirements. It will pay for itself over and over in dependable tool protection.

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- SMALLEST MADE
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- MOUNT FROM TOP OR BOTTOM OF FLAT BRACKET
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- PHENOLIC BLOCK HAS BARRIER TO PREVENT SHORTS
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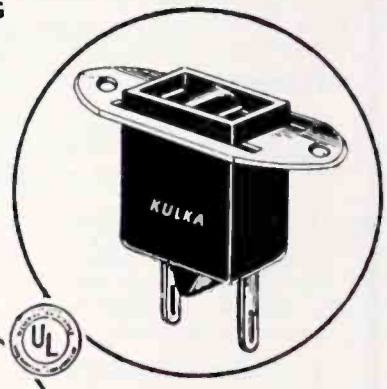

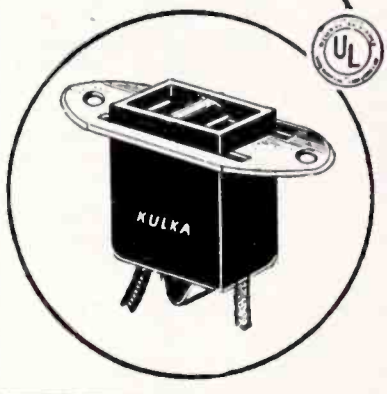

No. 221 (above) with soldering terminals and steel bracket with # 6 clearance mounting holes. Also No. 222 with 6-32 tapped mounting holes. No. 223 (left) with 8" #14 or #16 plastic wire leads and steel bracket with #6 clearance mounting holes. Also No. 224 with 6-32 tapped mounting holes.

KULKA ELECTRIC CORP.
Manufacturers of Electrical Wiring Devices
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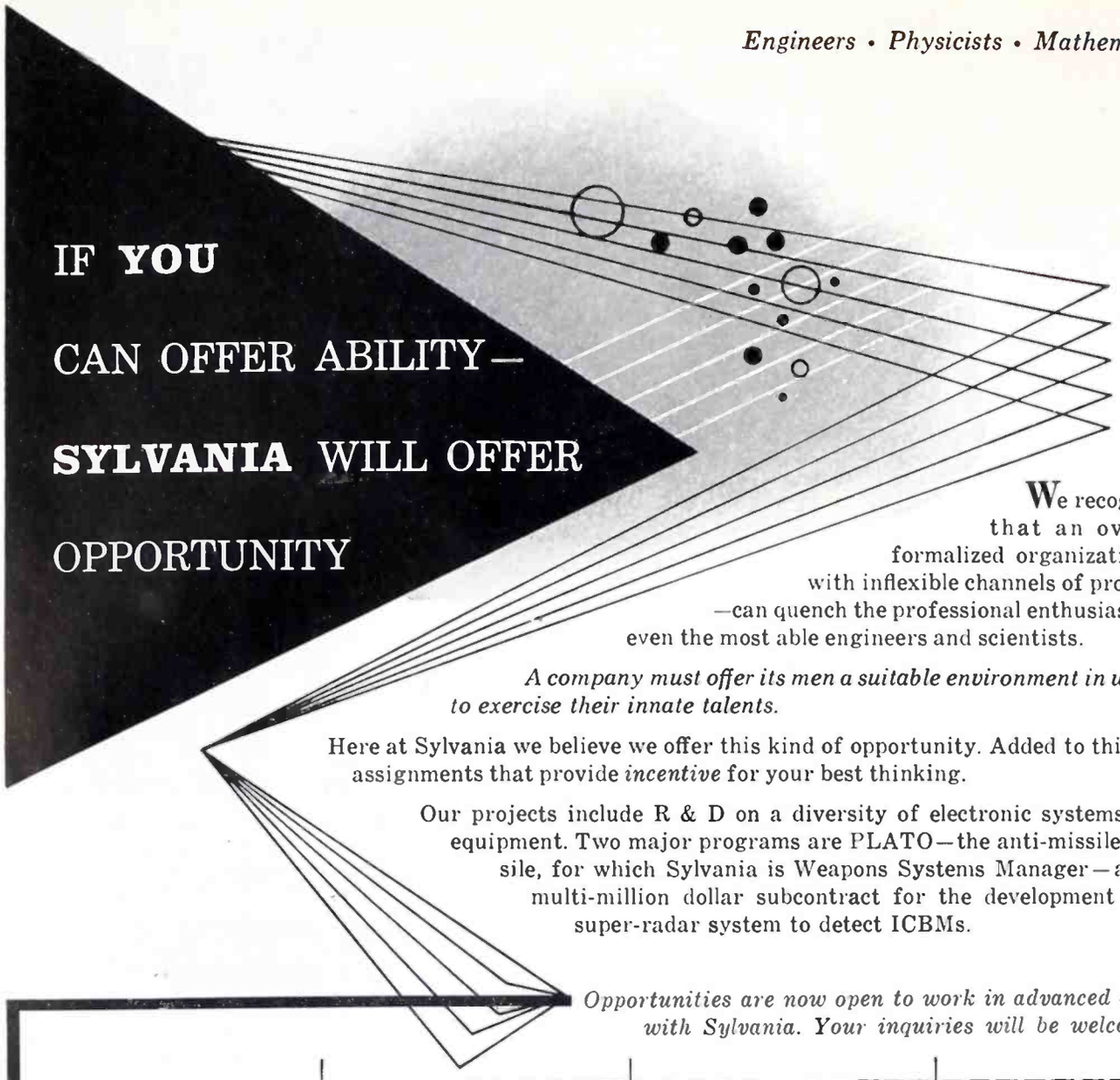

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Opportunities are now open to work in advanced areas with Sylvania. Your inquiries will be welcomed.

Research Engineers: New systems techniques & applications in operations research, analysis & applied physics.

Sr. Project Engineers: Evaluate project requirements; determine responsibility; schedules; budgets; technical negotiations with customer.

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Missile System Analysis Group Leaders: Radar and antenna system preliminary design.

Missile System Development Group Leaders: Low noise receivers, pulse transmitters, broad band techniques, antenna arrays, phase measurement and other instrumentation.

Sr. Transistor Engineers: Circuitry, systems, and hardware.

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Sr. Mechanical Engineers: Design and packaging airborne and ground electronic and electromechanical equipment. 5-10 years pertinent exp. required.

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PROFESSIONAL OPPORTUNITIES

Reporting late developments affecting the employment picture in the Electronic Industries

Design Engineers • Development Engineers • Administrative Engineers • Engineering Writers
Physicists • Mathematicians • Electronic Instructors • Field Engineers • Production Engineers

U. S. Will Train 150 Foreign Scientists

The United States is expanding its program to assist free world countries to meet the world-wide demand for highly trained scientific personnel.

A training program to be carried out under contract for the International Cooperation Administration provides that 150 scientists will be brought to the United States from free world countries for two years of advanced scientific training and research. The contract is with the National Academy of Sciences, which will administer the project.

Of the 150 scientists who will receive advanced training in the United States under the new program, 60 will be participants from Europe and Africa, and 30 each from the Far East, Near East and Latin America.

The participating scientists will receive two years of advanced training and research at some 60 United States universities, colleges, medical centers and laboratories. The National Academy of Sciences has responsibility for operation of the program and for placement of the scientists.

A similar project for scientific training and research — applicable only to European countries — has been carried on in cooperation with the National Academy of Sciences since 1953, and to date 216 scientists from 12 countries of that continent have participated.

OPEN-SHUT CASE

Spacious radome on Lockheed's prop-jet Electra swings open for easy maintenance of C-band weather radar unit. H. I. Thompson Fiber Glass Co. supplied the radome.

Program for Writers

A two-week program for members of publications groups engaged in technological writing for industry and government will be presented at Tufts Univ. in Medford, Mass., during the last two weeks in July. Enrollment is limited to 25.

Dr. Paul H. Flint, Assistant Dean of the Tufts Graduate School, will direct the program, and the staff will be drawn chiefly from members of the Boston Chapter of the Society of Technical Writers and Editors. The fee is $150.

EARNED DEGREES, 1955-56 AND 1956-57

	Bachelor		Master		Doctor	
	1955-56	1956-57	1955-56	1956-57	1955-56	1956-1957
All fields	311,298	340,347	59,370	61,955	8,815	8,756
Agriculture	7,286	7,943	1,467	1,549	398	353
Biology	12,566	13,868	1,759	1,801	1,022	1,103
Mathematics	4,660	5,546	892	965	224	249
Physical sciences	11,672	12,934	2,640	2,704	1,635	1,674
Psychology	5,665	6,191	969	1,095	632	550
(Subtotals)	41,849	46,482	7,727	8,114	3,911	3,929
Engineering	26,312	31,211	4,724	5,233	610	596
Total	68,161	77,693	12,451	13,347	4,521	4,525

Hughes Will Add 3,500 to Payroll

Hughes Aircraft Co., Culver City, Calif., plans to employ 2,000 additional scientists and engineers and 1,500 professional and technical workers to support their activities during the remainder of 1958.

The company currently employs more than 29,000 in Southern California and in Tucson, Ariz. It manufactures electronic armament control systems for interceptor airplanes of the United States and Canadian Air Forces and the United States Navy; Falcon guided missiles, ground radar systems and commercial electronics products.

The categories of engineers and scientists sought include: Systems analysts with Ph.D. degrees; digital computer engineers; field engineers, circuit design engineers, atom physicists and nuclear electronics engineers.

Lawrence A. Hyland, vice-pres. and general manager, said Hughes hoped to obtain "several hundred" from 1957-58 graduating classes.

6,000 Laid Off At Convair-Ft. Worth

The phasing out of several small programs has resulted in layoffs totalling about 6,000 workers over the last months at the Ft. Worth plant of Convair, division of General Dynamics Corp.

Present employment is between 21,000 and 21,500, compared with average employment of 25,399 in 1957.

Despite the layoffs, however, Convair's total payroll in 1957 hit a record $142,818,735, an increase of about 10% over 1956. The firm also said current employment is well above the average of 18,377 over the last 16 years.

FOR MORE INFORMATION . . . on positions described in this section fill out the convenient inquiry card, page 101.

ENGINEERS, E E

A program that is attracting some of the best minds in electronics now calls for additional creative engineers

GUIDANCE SYSTEM FOR AIR FORCE ICBM ATLAS

UNDER DEVELOPMENT AT GENERAL ELECTRIC

There is an unprecedented challenge for electronic engineers in developing the command radio-radar system for Atlas.

Portions of this system must achieve *accuracies on order of 1 part in 10 million* ...and maintain them without degradation under the extreme conditions of shock, vibration and temperature encountered during an ICBM's blast off and acceleration along the initial portion of its trajectory.

Men who can work to these stringent operational requirements will be well equipped to handle still more demanding "command" problems. As the Manager of General Electric's Missile Guidance Section said recently: "With this job behind us, there will remain no significant obstacle to the practical guidance and navigation of other space vehicles."

Current opportunities at the Section are at all levels... and exist in practically every phase of the program.

If your field of special competence appears in the list below there may be a position open to you, with high professional implications for the future.

Systems analysis, evaluation & integration • Systems and component reliability • Transistorized circuits, pulse circuitry, IF-Video circuits • RF and Microwave components & plumbing • Communications control devices • Doppler radar design & development • Digital data processing techniques, data transmission involving D & D of ground-based & airborne antennae, transmitters, receivers; application of transducers, transponders, etc. • Test operations, including planning, range instrumentation & test execution; development & application of automatic test equipment.

Positions are at Syracuse and Utica, N. Y. facilities.

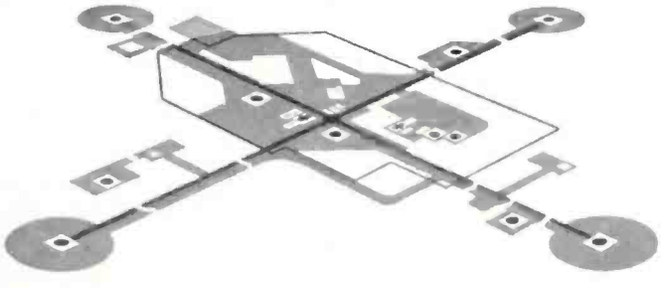
Please address your resume to Mr. E. A. Smith, Dept. 5-D

If your qualifications approximate job "specs," he will arrange a convenient interview.

MISSILE GUIDANCE SECTION

GENERAL ELECTRIC

Court Street, Syracuse, N. Y.



GENERAL ELECTRIC GUIDED MISSILE CONTROL FACILITY WS107A-1

Rx For Unemployed Executives

A veteran executive recruiter advises: don't take a vacation; don't rely on friends; don't send out long, detailed resumés; stay away from employment agencies; and tell the family what the situation is.

By E. A. BUTLER
E. A. Butler & Associates, Inc.
1500 Walnut St., Phila. 2, Pa.

The present recession has engendered an unusual number of available executives. The lack of business has not only affected skilled labor, but quite naturally, has had a very serious effect on men at the executive level from the $18,000 per year mark upward. This increased executive unemployment can be cut sharply and the morale and attitude of the executive can be salvaged if he will apply the following information to his own campaign and recognize that this information is the result of over five and one-half years of concentrated executive recruiting, interviewing literally hundreds of executives and reading thousands of their resumes for innumerable positions. The following points should be followed religiously:

No Vacation

An executive *should not* take a vacation prior to searching for a new position as he usually does. He *should* start searching for a new position immediately upon *hearing* of the possibility of termination of employment, for almost in every case, an executive is aware when the axe is to fall. This course of action will avoid suspicions on the part of people considering his application that this man must have been turned down by a number of other employers for reasons unknown.

Don't Depend On Friends

He *should not* depend on his friends and acquaintances who have offered him jobs in the past. He *should* eliminate friends and casual acquaintances as a source of obtaining employment and regard any comments from these people as mere speculation and a desire to bolster his ego.

No Employment Agencies

He *should not* approach standard employment agencies. He *should* bear this in mind: Employment agencies usually confine their activities to location of salaried personnel earning up to $10,000 and oftentimes regard a man beyond the age of 38 as too old to be considered for an opportunity. Also, executive hiring is usually more detailed and prolonged and therefore these agencies are unable to devote the time and energy necessary on a speculative basis.

Detailed Resumes Are Out

The executive *should not* prepare long drawn out, detailed resumes for presentation and for answering of advertisements, for they are rarely read. He *should* consider that the average executive position has numerous applicants and the executives screening resumes are looking for brief, concise, to-the-point information relative only to their particular problem and at that reading, are not concerned with detailed resumes appealing to every facet of company administration. For example, a sales manager in a tight spot will also point out his ability as a good purchasing agent, or a comptroller in his abilities in overall plant management. This information is only of use when the hiring executive is personally familiar with the wide variety of administrative abilities of an individual, and who is hiring a man not to fill a specific

wanted:

an expression of interest!

General Electric's Jet Engine Dept., Cincinnati, Ohio, is now interviewing Engineers with 3 or more years experience in the following fields:

Mechanical Design	Aero-thermo Design—Analysis
Control Systems Design	Control Component Design
Accessories Design	Test and Evaluation

Please check your field of interest above, fill out the coupon below, and mail entire ad to:

J. A. McGovern
Jet Engine Dept. EI-5
General Electric Co., Cincinnati 15, Ohio

This is *not* an application for employment; it is merely your expression of interest. Upon receipt of this coupon, we will forward a brief form to return to us describing your interests and experience. You may then be asked to visit Cincinnati, at our expense, to discuss with us, in as great a detail as you wish, your future with the Jet Engine Dept. of GE.

HERE IS WHAT WE OFFER:

- Opportunity to work with top engineers in a field in which you are most interested.
- Freedom to follow your own ideas.
- Pleasant working conditions and complete work facilities.
- Attractive salary plus 39 added aids for better living, including Medical Plan and Stock Bonus Plan.
- Opportunity to continue your education at either of two fine Universities under our 100% tuition refund plan.
- Sympathetic supervision that recognizes ability and rewards it.
- Security; we are a prime contractor with the government, with long-range contracts.

Gentlemen:
I am interested in the possibility of an association with the Jet Engine Dept. of General Electric.

Name_____
Address_____
City_____ Zone___ State_____ Phone_____
Degrees_____ College_____ Date_____

Be sure to Check Your Field of Interest Above. EI-5

GENERAL ELECTRIC
JET ENGINE DEPARTMENT *CINCINNATI 15, OHIO*

Circle 505 on "Opportunities" Inquiry Card, page 101

ELECTRONIC ENGINEERS

needed at

MARTIN

New long-term developments at Martin in the field of electronics have created exceptional opportunities for top electronic engineers. At least 5 years' experience required. Salaries from $9,000 to $12,000.

Openings in these areas:

- Circuit Design
- Systems
- Inertial Guidance
- Countermeasures
- Digital Computers
- Test Equipment Design

WRITE TO:

William Spangler, Manager
Professional Employment
The Martin Company
Baltimore 3, Md.

MARTIN
BALTIMORE

Circle 506 on "Opportunities" Inquiry Card, page 101

Rx For Unemployment *(Cont.)*

job, but to wear several hats in a small (under 200 employees) operation.

Make Letters Brief

He *should not* write brief, one-paragraph letters in hopes of stimulating further interest without giving any information relative to his profile and employment history, for this type of approach is rarely acknowledged. It is *always* wiser for the executive to avoid the use of a resume whenever possible when applying for positions. Information can be adequately contained in a formal letter personally written or typed covering the salient features applicable to the industry.

Prepare To Move

He *should not* restrict himself on a geographical basis after he has been unemployed for two months. An executive *should* always remember that with the exception of a few metropolitan cities, it is unlikely that he can make a lateral shift of employment without making a geographical move. Starting out with geographical restrictions is a definite handicap and prolongs his unemployment.

Tell The Family

As executive contemplating a change *should not* withhold information from his wife or teenage children. Family discussion *is* of paramount importance for the executive. The average wife and teenager are more than willing to cooperate in time of crisis, and with the present inability to accumulate cash, executive unemployment is a crisis.

Expect Salary Cut

Unemployed executives *should not* hold out for precisely the same salary they have most recently been earning. He *should* appreciate that his value as an administrator is indeed important. However, his lack of knowledge of the individual company on particular problems must be adjusted to, and his value is not as great at the outset of a new job as it was at the finish of an old position after perhaps ten years of service. A period of acquaintance and adjustments is to be expected as a matter of common sense.

State Base Pay Only

In stating salaries earned on his application, the executive *should not* include bonuses and gratuities as part of his base salary. He *should* always distinguish between base salary, pointing out clearly bonuses received, for bonuses paid on a group basis as a rule are not considered part of a base salary, although, true, it is income, it is not guaranteed income. To incorporate bonus, salary and gifts is misleading and indicates a higher base pay. This oftentimes leads to embarrassment when verified with the former employer.

Contact Recruiting Firms

In summation, if an executive will follow simple, practical and relatively new (within the past five years) rules and contact a nationally recognized executive recruiting firm or firms with locations in the East, Midwest, and West, he would have far greater access to employment in a relatively short period of time than can be effected by all the floundering he may do over a period of six months to a year on his own. These recruiters have established relationships with national, multi-plant, individually owned and medium sized corporations who are constantly retaining them to locate qualified administrators. The average executive who contacts his college alumni placement bureau will be told, in the event the bureau has nothing of consequence to offer, to contact an executive recruiter. It is also advisable to contact one of the many reputable management consulting firms, and if nothing else, leave a resume with them, for they are oftentimes doing consulting work for companies who have a need, and the consulting firm can place the man in contact with the company. Recruiting firms and consulting organizations are retained by the company and do not charge the job-seeking executive in any way. They will oftentimes establish contact with many firms who have a need for their particular abilities. This, of course, is expensive and time consuming and would otherwise have to be underwritten by the individual seeking a position.

We know that if these rules are adhered to, the above average executive can cut his job seeking time from an estimated six months to a year down to three months, which in dollars and cents represents a good amount.

New Electronic Industries Assoc. Standards

Three new recommended standards for the electronics industry are being made available by the Electronic Industries Association:

RS-206—Recommended Practice for Preparation of Basing or Terminal Diagrams (this standard from standards proposal No. 542, is new material)—60 cents.

RS-208—Definition and Register, Printed Wiring (this standard from standards proposal No. 566, is new material)—25 cents.

RS-209—EIA-NEMA Standards for Electron Tubes (this standard is a revision and combination of Standards ET-103-D, Bases, Caps and Terminals; ET-105-C, Dimensional Characteristics; and ET-106-C, Gauges)—$3.50.

Copies of the standards may be obtained through the EIA Engineering Department, 11 West 42nd St., New York 36, N. Y. (a minimum charge of $1 is made on all orders).

SPACE RADIO

Telemetering units for the "Explorer" satellite were supplied by American Missile Products Co., Hawthorne, California.

Single-Unit CC-TV Camera Costs $1200

General Electric's Technical Products Department has developed a $1,200 single-unit TV camera which operates without separate control power units, or cable connections.

The TE-6-A camera will be available in three types, with an integrated control panel or systems panel. Depending on the model, the camera weighs from 13 lbs. to slightly more than 15 lbs., and measures 7 13/16 by 12⅜ by 5⅛ in.

The television camera line offers these features: regulated vidicon focus which assures a resolution of better than 300 lines over line voltage changes ranging from 100 to 130 volts; crystal-controlled RF frequency which minimizes tuning readjustments and makes possible filtering and audio-mixing in multichannel systems; transistor L-C oscillator which permits stable horizontal scanning and lessens the drift problem in multi-camera installations; and a basic control panel which can be remoted up to 1000 feet. With accessories the TE-6-A can be controlled from distances up to a mile.

A "gain" control permits adjustment of sensitivity for efficient signal-to-noise ratio on scenes of high brightness.

Drone Guidance System To Test Air Defense

An electronic guidance system to help the Air Force test U. S. defenses against the most modern air weapons has been successfully demonstrated, according to the U. S. Air Force (ARDC) and Sperry Gyroscope Co.

The microwave command guidance system was specifically engineered for use with Q-4 and Q-5 supersonic drones. But it now is being considered as a universal system for controlling other target drones for test purposes, pilotless aircraft and missiles.

The system enables a control team to track a drone, command its engine and flight controls and receive flight data. All three functions of the system are carried out on a single radar frequency band.

The ground director station containing all elements needed for directing a mission—radar and control equipment, communications, and recording equipment, and personnel—is housed in a specially-designed trailer or van.

A radar operator picks up the flight of the drone to assure its adherence to a pre-set flight path.

Two controllers, seated before a control console and flight plotting board, monitor and command changes in the flight by reading flight and engine instruments on a control panel and observing the ground track of the drone displayed on a plotting board.

Coded signals are received and transmitted directly between the ground director station and the drone when relatively short or high-altitude missions are being performed. Where great distances or low-level operations are involved, the signals are relayed through the airborne director, an aircraft fitted out with similar equipment. The airborne director also can control flight of the drone without assistance from the ground station.

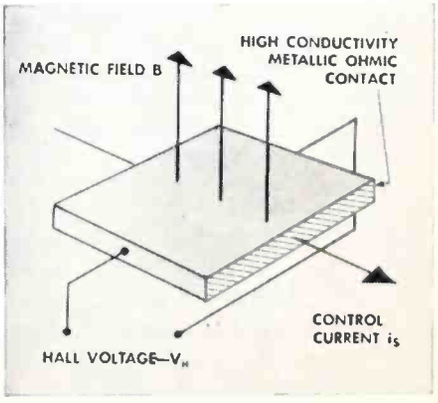
The drone, equipped with highly-transistorized transmitting-receiving equipment, transmits coded information to either the airborne or ground directors and receives coded commands in return.

Computer Use Seen For Hall Generator

Westinghouse scientists have employed two semiconductor materials, indium antimonide and indium arsenide, to make a commercially usable and novel circuit element called a Hall Generator.

The Hall Generator is essentially a solid state multiplying device that provides a voltage output proportional to the product of the current passing through it, and the magnetic field perpendicular to it. This suggests its use as an analog computer element.

Output Hall voltages of .5 v are easily obtained in the Westinghouse device using magnetic fields of 5 kilogauss and control currents of .5 a. In addition, the output impedance of these devices can be adjusted from 0.01 to 20 ohms and their maximum frequency response ranges from 10^7 to 10^8 cycles per second.



Industry News

Paul D. Williams has been appointed to the post of Assistant Director of Research at Eitel-McCullough, Inc.

E. U. Da Parma is now Executive Vice President of Sperry Gyroscope Co. **Herbert Harris, Jr.** has been appointed Manager of the Air Armament Div.

Dr. Louis N. Ridenour, head of research for Lockheed Missile Systems Div., has been appointed to the U S AF Scientific Advisory Board.

J. R. Whiteside has been made President of Simpson Electric Co.

J. R. Whiteside

W. N. Snouffer

William N. Snouffer has been appointed Project Manager of PLATO anti-missile missile system at Sylvania Electronic Systems.

John O. Gantner, Jr. has joined the Western Div. of Arthur D. Little, Inc. as a Senior Staff Member of the management services group.

John T. Hickey has been appointed to the Motorola, Inc., corporate staff in Chicago as Assistant to the President for long-range planning. Mr. Hickey was formerly Manager of the Semiconductor Div. in Phoenix.

Curtis Kelly has joined National Company Inc. as Sales Manager-Consumer Products. Mr. Kelly was formerly with the Ratheon Mfg. Co. in their Baltimore office.

George M. Ballee will now serve as Vice-President and Director of Sales for the Electro-Snap Switch & Mfg. Co.

Henry E. Bowes has been promoted to the post of Vice President-Marketing of Philco Corp.

Norman Caplan will now serve as Manager, Communications Products Dept., Telecommunications Div., Radio Corporation of America.

Kenneth V. Tindall is the newly appointed Eastern Regional Manager for Arnoux Corp.

(*Continued on page* 154)

(*Continued from page* 155)

Lt. Gen. James M. Gavin, USA, (Ret), has been elected a Vice President and Director of Arthur D. Little, Inc.

Major Gen. Kenneth P. Bergquist is the new ARDC Deputy Commander for Air Defense Systems Integration. He will also head the newly named Air Defense Systems Integration Div.

Carroll M. White has accepted the appointment as Executive Secretary of the Special Industrial Radio Service Assoc. Mr. White has served since July 1, 1946, as Manager of the EIA's Mobile Radio Dept.

More Coming On "Tecnetron"

Dr. A. V. J. Martin, who described technical details on the new French semiconductor, the "Tecnetron," in the March 1958 issue of EI reports that the flood of mail he has received asking for further information has reached "the saturation point." There is little new to add, he says, but he is staying in close contact with the French inventors and hopes to soon have enough additional details for another and more comprehensive article.

ELECTRONIC INDUSTRIES Advertisers — May 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.

THE $10 BILLION ELECTRONIC MARKET

. . . and why it takes a monthly to sell it

YOU CAN BE SURE OF THIS When you recommend ELECTRONIC INDUSTRIES . . . a monthly publication frequency is best adapted to the unique character of the electronic market. Here's why:

THE MARKET CHARACTERISTICS

To take away the abstraction from the electronic market, it is only necessary to remember you are selling to an industry based largely on light machinery and hand assembly operations—a "light industry."

It's quite different from the more common industrial markets where capital and engineering investments in "heavy" capital equipment are responsible for most of the value added by manufacture. In "heavy" industries, management decisions on capital spending are necessary in all stages of the product idea-to-final production cycle, and are the key to the salesman's success or failure.

In the "light" electronic technology, however, little capital or engineering is ordinarily invested in production equipment. The value added by manufacture depends principally on the number of engineering-hours invested in the design of the end-product.

This is why engineering decisions—not management capital spending decisions—are the key to the electronic market. Salesmen are finding that the constantly growing complexity of electronic systems is making this more true today than ever before.

One conclusion is inescapable. Electronic technology generates a market structure altogether different from those in aircraft, chemical process, metalworking, and other heavy industries.

The management buying influences which give advertising effectiveness to weekly media in these other engineering fields simply do not exist in the electronic market.

THE MONTHLY

The electronic engineers' need for closer and more exact communication with fellow specialists grows greater with each new technical advance. ELECTRONIC INDUSTRIES, backed by the full resources of the Chilton Company, is therefore expanding its efforts to give him the engineering leadership that only an aggressively edited monthly can supply. Advertisers will continue to have the strong monthly it takes to sell the electronic market.

THE EDITORIAL CONCEPT

Engineering treatment in depth—the first essential of technical communication — is made possible by EI's monthly publication schedule. The electronic engineers' hunger for the ideas of other specialists can be met only if they reach him with the precision and completeness a monthly allows. This is proved by the many hundreds of requests for reprints of feature articles in every issue of ELECTRONIC INDUSTRIES.

THE READER RESPONSE

Reprint Requests—An average of 90 letters per day come in to EI on company letterheads requesting reprints of current articles. Better than 75% of these letters ask for reprints of two or more articles. One staff assistant devotes full time to nothing but processing reprint requests.

Inquiries — Current issues of ELECTRONIC INDUSTRIES are producing more than 20,000 inquiries for advertisers and manufacturers' literature per issue! This completely contradicts the tradition that magazines of engineering stature are weaker inquiry producers than those edited with inquiries as their primary purpose.

ADVERTISING RESEARCH SERVICES

Starch Readership Service — EI is the only electronic publication to offer Starch advertising readership studies. Six issues are scheduled for Starch Studies in 1958 and in 1959—January, March, April, July, October and December.

Copywriting Suggestions—A Series of bulletins entitled "Copywriting Suggestions for Advertisers to the Electronic Industries" will be sent on request. These bulletins have been widely commended by the advertising fraternity in the electronic field.

MARKET RESEARCH SERVICES

Most industrial market research is based on the SIC code. But all electronic components and accessories are lumped together under a single three-digit SIC number. In addition, many major classes of electronic equipment are grouped indiscriminately with non-electronic products of other industries by the SIC code.

To extricate electronic market research from this long-existing handicap, a complete private census of the electronic industry is being carried out by ELECTRONIC INDUSTRIES.

This private census data is being punched on IBM cards in accordance with a new Electronic Industries Classification, called the EIC code. The EIC code divides electronic products into 101 major classifications and gives to each an average of 20 subclassifications.

For information on the kinds of market data it will soon be possible to obtain through the EIC code and the publisher's IBM facilities, contact your ELECTRONIC INDUSTRIES' representative.

EI has more electronic O.E.M. circulation than any other publication

ELECTRONIC INDUSTRIES

Chilton Company Executive Offices: 56th & Chestnut Sts., Phila. 39, Pa.

New York 17
Menard Doswell
Gerald Pelissier
100 E. 42nd St.
OXford 7-3400

Chicago 1
George Felt
360 N. Michigan Ave.
RAndolph 6-2166

San Francisco 3
Don May
1355 Market St.
UNderhill 1-9737

Philadelphia 39
Joseph Drucker
56th & Chestnut Sts.
SHerwood 8-2000

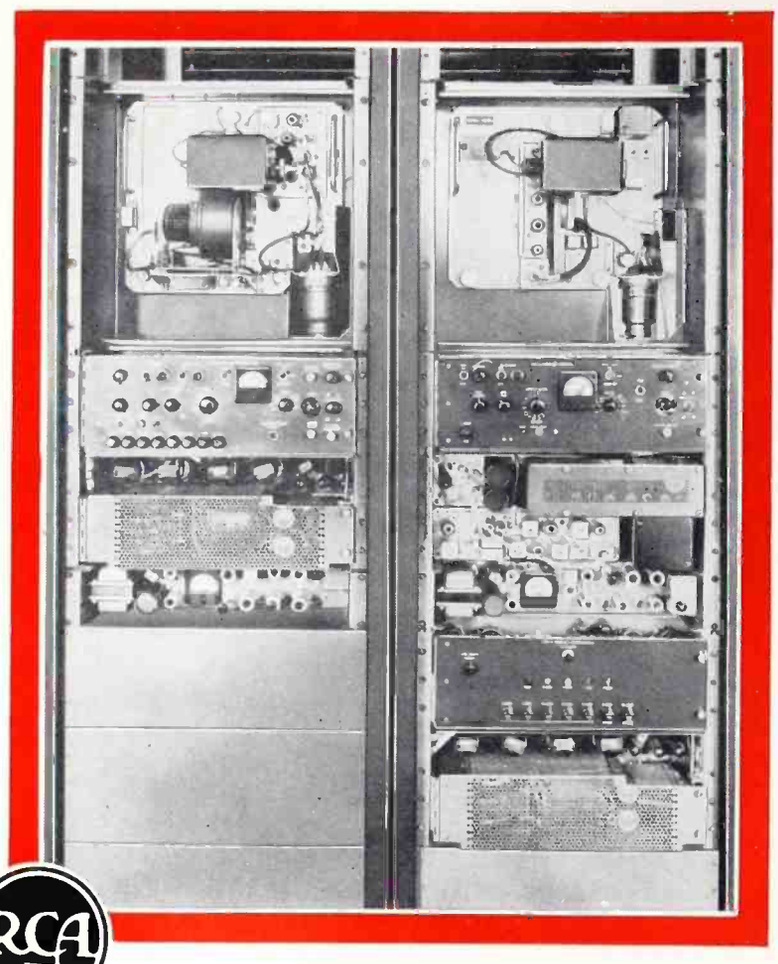
Tulsa
Hal Mott
Petroleum Bldg.
LUther 4-1769

Cleveland 15
Shelby A. McMillion
930 Kieth Bldg.
SUperiar 1-2860

Los Angeles 57
B. Wesley Olson
198 S. Alvarado St.
DUnkirk 7-4337

Dallas 1
John Sangston
909 Mercantile Securities Bldg.
RIverside 7-1732

For specific market information contact your EI Regional Sales Manager



G-V

RCA®

G-V thermal time delay relays...

protect cathodes in RCA's TV microwave relay system

When the industry required a portable microwave repeater station that behaved like a permanently installed, unattended unit, RCA developed its Television Microwave Relay Station, Type TVM-1A. In it, to protect the unit's cathodes, RCA design engineers rely on G-V thermal time delay relays to delay the application of plate voltage.

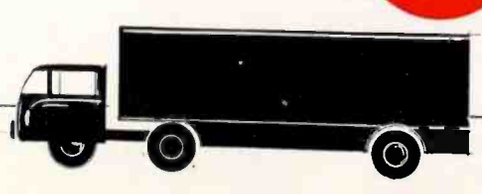
In both industrial and military equipment, G-V thermal relays are providing long, dependable, proven service in time delay applications, voltage and current sensing functions and circuit protection.

Write for extensive application data and catalog material.

G-V CONTROLS INC.

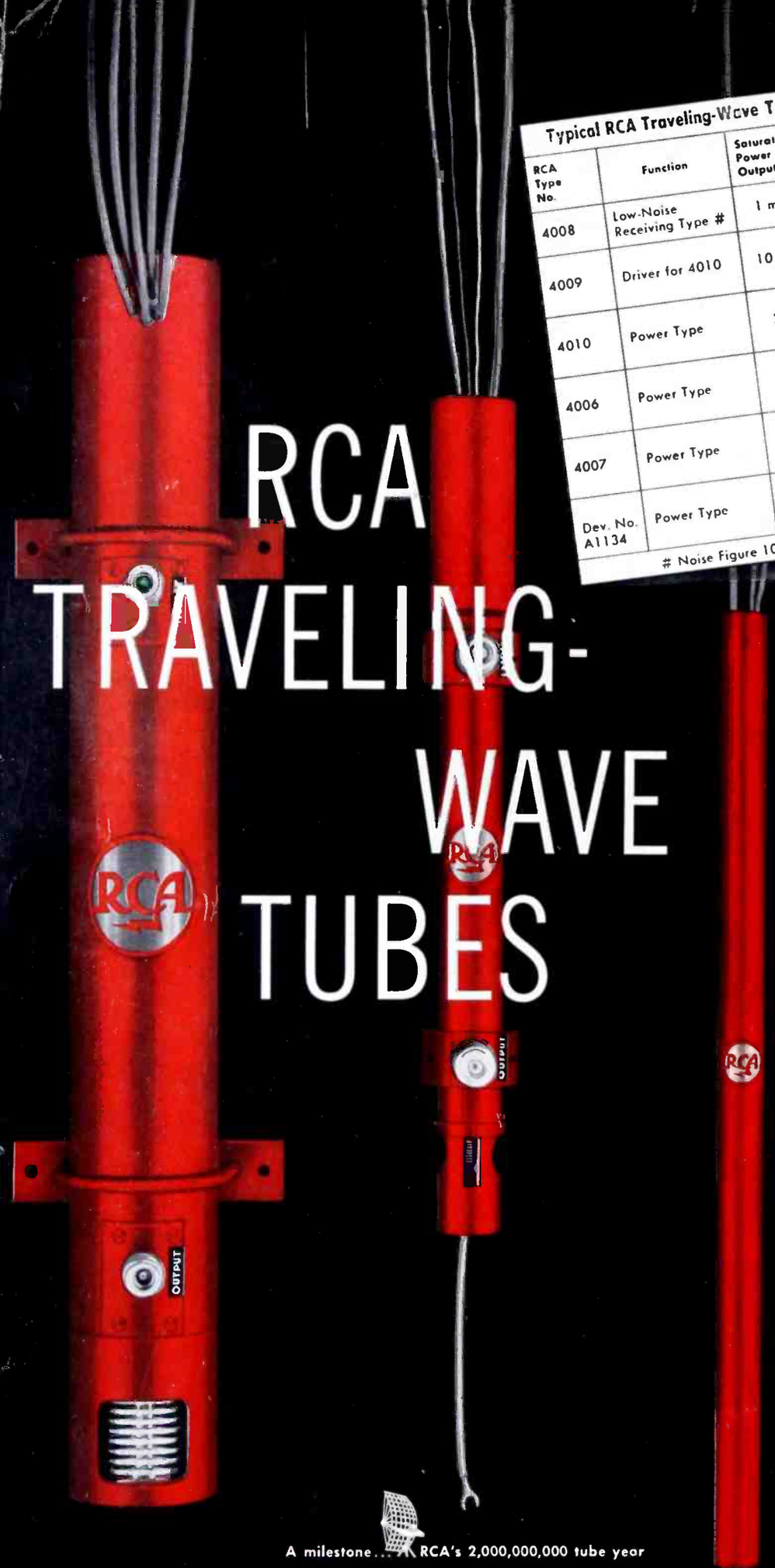
50 Hollywood Plaza, East Orange, New Jersey

G-V



Circle 38 on Inquiry Card, page 99

RCA TRAVELING-WAVE TUBES



Typical RCA Traveling-Wave Tubes for S-Band (2000 to 4000 Mc) Operation

RCA Type No.	Function	Saturated Power Output	Small Sig. Gain (db)	Focusing Method	Dia (in.)	Length (in.) Approx.	Weight (lb.)
4008	Low-Noise Receiving Type #	1 mw	20	Light-Weight Solenoid*	*2¼	*16	*10
4009	Driver for 4010	10 mw	35	Integral Periodic Permanent Magnet	1½	14	1½
4010	Power Type	2 w	35	Integral Periodic Permanent Magnet	1½	14	1½
4006	Power Type	10 w	25	Integral Periodic Permanent Magnet	1½	18½	3½
4007	Power Type	100 w (peak)	30	Integral Periodic Permanent Magnet	2½	20	12½
Dev. No. A1134	Power Type	1,000 w (peak)	30	Integral Periodic Permanent Magnet	2½	22	15

Noise Figure 10 db

* Including solenoid available separately

for every job in microwaves

Pacing the fast-moving advancements in tubes for microwaves, RCA offers designers a comprehensive line of low-noise and power traveling-wave tubes—for any application in the L, S, C, and X bands. These tubes feature a major improvement in traveling-wave tube manufacture: *high uniformity of characteristics maintained through rigid RCA quality control.*

RCA *power types* incorporate integral periodic-permanent-magnetic focusing—a design advantage that eliminates the need for solenoid power and reduces package size and weight.

RCA *low-noise receiving types* provide increased receiver sensitivity across octave bandwidths. And they are "tailored" to meet the requirements both in new equipment designs and in *modernization of existing microwave systems!*

Reflecting RCA's traditional engineering knowhow, RCA traveling-wave tubes are designed for military environments. For prompt service on your needs for traveling-wave tubes, get in touch with the RCA Sales Office nearest you.

GOVERNMENT SALES

- 415 South Fifth St., Harrison, N.J. HUmboldt 5-3900
- 224 N. Wilkinson St., Dayton 2, Ohio BAldwin 6-2366
- 1625 "K" St., N. W., Washington 6, D.C. DIstrict 7-1260

INDUSTRIAL PRODUCTS SALES

- 744 Broad St., Newark 2, N.J. HUmboldt 5-3900
- Suite 1154 Merchandise Mart Plaza Chicago 54, Illinois WHitehall 4-2900
- 6355 E. Washington Blvd., Los Angeles 22, Calif. RAymond 3-8361

A milestone... RCA's 2,000,000,000 tube year

RADIO CORPORATION OF AMERICA

® Electron Tube Division — Harrison, N. J.