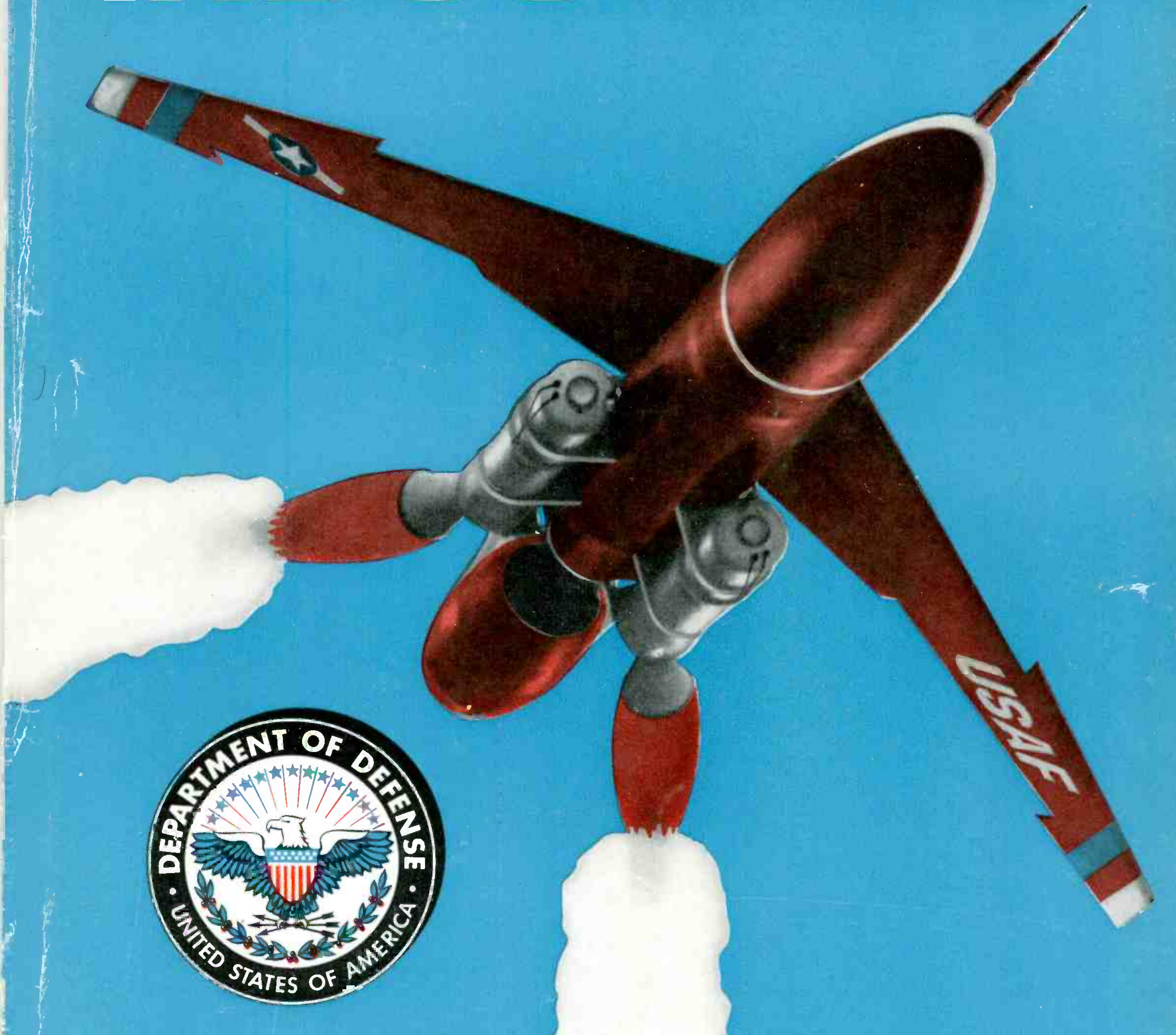
TELE-TECH &

ELECTRONIC INDUSTRIES



GUIDED MISSILE & MILITARY PROCUREMENT

See Page 81

July • 1956

A Chilton Publication

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TELE-TECH & ELECTRONIC INDUSTRIES

Vol. 15, No. 7 July, 1956

FRONT COVER: The Air Force's newest long range strategic missile, the Northrop F SM-62 "Snark," rockets off on test flight at the Air Force Missile Test Center, Patrick Air Force Base, Florida. "Snark" recently completed a highly successful controlled 1,500 mi. flight, the longest controlled flight yet made by a U.S. missile.

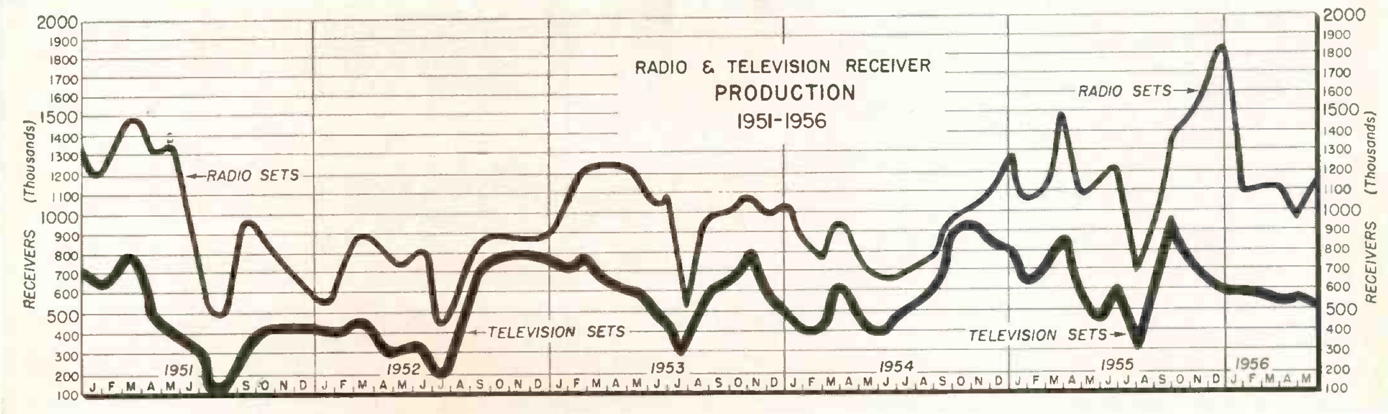
MONTHLY NEWS ROUND-UP

NEW ELECTRONIC EQUIPMENT

DEPARTMENTS

OHMITE

TOTALS



Production Capabilities of Electronic Manufacturers

The data below were assembled by the Office of Naval Materiel for the report, "Manufacturers of Electronic Equipment—Facilities Data, Ratings and Production Capabilities."

TOTALS

Company Size—Number of Employees	Planned Production 1956 Military ($000,000)	1/1/56 Total Military Backlog ($000,000)	1/1/56 Mil. Back-Log Prime-Contracts ($000,000)	1/1/56 Mil. Back-Log Sub-Contracts ($000,000)	Average Sales in 1955 per Employee $
1–50	46.6	13.0	10.5	2.5	12,700
51–100	36.1	25.3	20.1	5.2	12,519
101–200	80.6	56.3	36.8	19.5	13,033
201–500	148.4	100.5	67.4	33.1	13,193
TOTAL (Small Business)	311.7	195.1	134.8	60.3	13,032
501–1000	151.4	122.4	91.0	31.4	14,978
1001–2000	158.6	161.5	133.9	27.6	15,709
2001–5000	393.1	493.1	403.9	89.2	13,950
5001–	2735.4	3531.4	2602.6	928.8	17,588
TOTAL (Big Business)	3438.5	4308.4	3231.4	1077.0	16,925
GRAND TOTAL	3750.2	4503.5	3366.2	1137.3	16,578
Totals for Preceding Year					
Small Business	251.9	198.1	158.2	39.9	12,911
Big Business	3009.0	4328.3	3359.5	968.8	14,536
Total	3260.9	4526.4	3517.7	1008.7	14,391

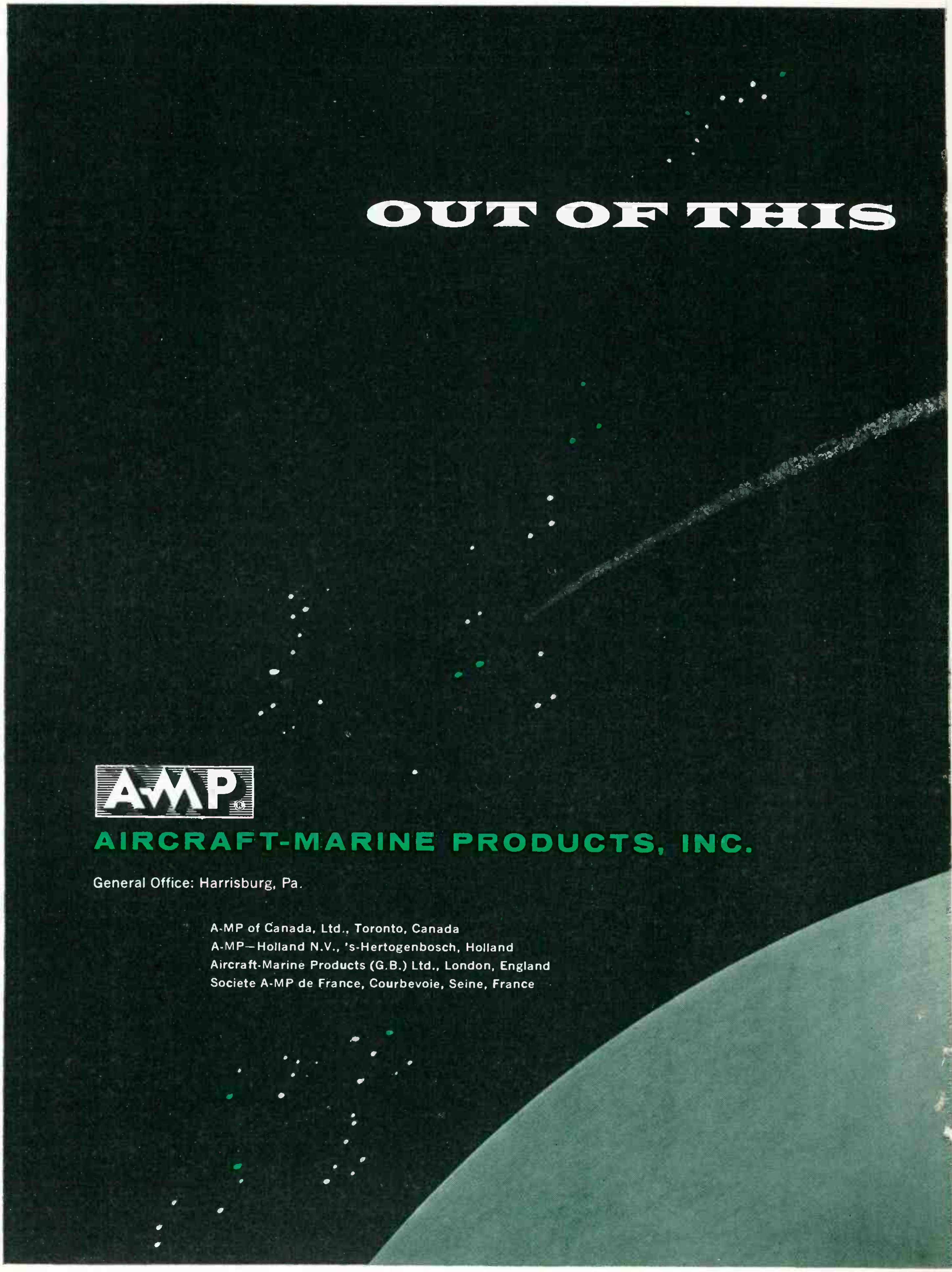
TOTALS

Company Size—Number of Employees	Number of Companies	Total Employees (1955 Average)	Max. Prod. Per Yr. 1 Shift ($000,000)	1955 Sales ($000,000)	Planned Production 1956 ($000,000)
1–50	138	3,240	157.3	41.1	57.2
51–100	76	4,963	183.0	62.1	79.0
101–200	75	8,704	368.8	113.4	130.9
201–500	104	22,389	698.0	295.4	360.4
TOTAL (Small Business)	393	39,296	1407.1	512.0	627.5
501–1000	41	18,926	499.2	283.5	327.3
1001–2000	34	23,032	701.3	361.8	385.5
2001–5000	33	47,830	1191.5	667.2	766.8
5001–	48	312,046	7430.2	5488.3	6290.1
TOTAL (Big Business)	156	401,834	9822.2	6800.8	7769.7
GRAND TOTAL	549	441,130	11229.3	7312.8	8397.2
Totals for Preceding Year					
Small Business	368	41,174	1303.9	531.6	555.5
Big Business	141	417,144	8368.4	6063.9	6486.3
Total	509	458,318	9672.3	6595.5	7041.8

GOVERNMENT ELECTRONIC CONTRACT AWARDS

This list classifies and gives the value of electronic equipment selected from contracts awarded by government agencies in May 1956.

Actuators	185,858
Amplifiers	173,562
Antennas	622,977
Batteries	5,644,133
Capacitors	384,293
Coders	60,464
Computers	16,663,084
Connectors	211,801
Controls	558,009
Converters	120,950
Converters, Frequency	5,792
Crystals	298,589
Filters, Low Pass	12,306
Generators, Signal	250,867
Headsets	670,248
Indicators	686,147
Indicators, Azimuth Range	231,147
Insulators	101,090
Kits, Avionic Modification	298,559
Kits, Radar Modification	66,949
Loudspeakers	471,227
Machmeters	456,890
Multimeters	70,005
Meters, Electrostatic	26,378
Meters, Frequency	63,449
Meters, Power	110,865
Meters, Wind Measurement	106,216
Power Supplies	324,963
Radar	3,062,688
Receiver—Transmitters	1,927,367
Receivers, Microwave	100,026
Receivers, Radio	463,595
Recorders	194,236
Rectifiers, Metallic	290,106
Relay Assemblys	56,000
Relays	157,814
Relays, Solenoid	452,623
Resistors	381,509
Stroboscopes	39,960
Switching Assemblies	642,140
Telemetering Ground Stations	175,723
Telephone Sets	170,876
Telephone Jack Assemblies	48,500
Telephone Terminals	346,385
Telephone Transmitters	109,191
Test Sets	1,709,378
Transmitters, Pressure	268,515
Transmitter, Radio	568,351
Transmitter, Rate of Fuel	831,072
Tubes, Electron	6,101,717
Wire and Cable	777,552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A-MP®
AIRCRAFT-MARINE PRODUCTS, INC.
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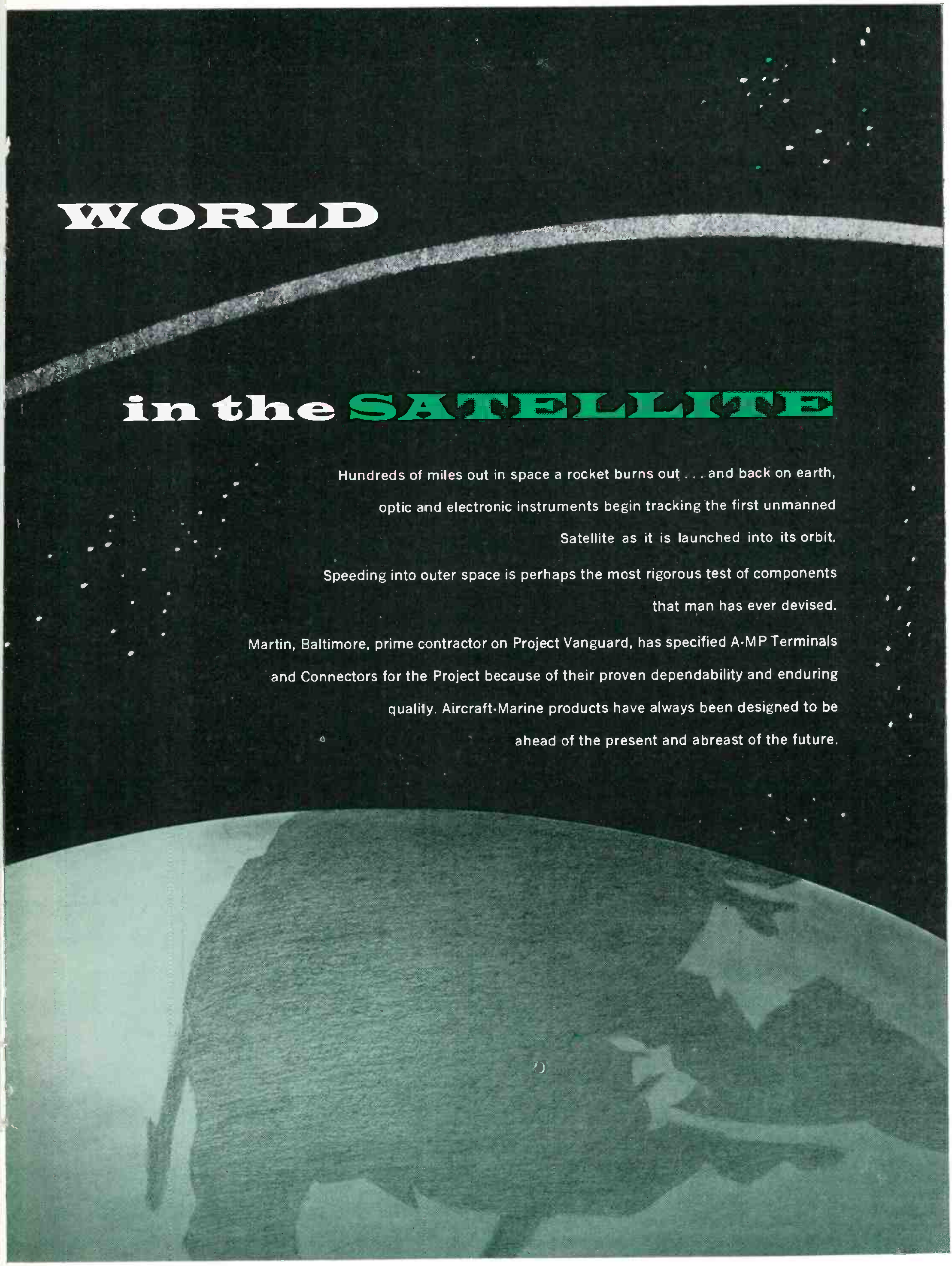
A-MP of Canada, Ltd., Toronto, Canada
A-MP—Holland N.V., 's-Hertogenbosch, Holland
Aircraft-Marine Products (G.B.) Ltd., London, England
Societe A-MP de France, Courbevoie, Seine, France



For product information, use inquiry card on last page.

TELE-TIPS

TESTING RADIOS— the hard way. Iowa radio salesman was doing 60 mph along the highway one night recently, with his samples on the seat beside him, when he plowed into the rear of a brand new Caddie parked on the road. The result: 2 cars, written off as total wrecks—1 groggy salesman —and 1 Admiral portable radio and cabinet—in perfect condition. (Which proves that the only safe place to be today is inside a portable radio.)

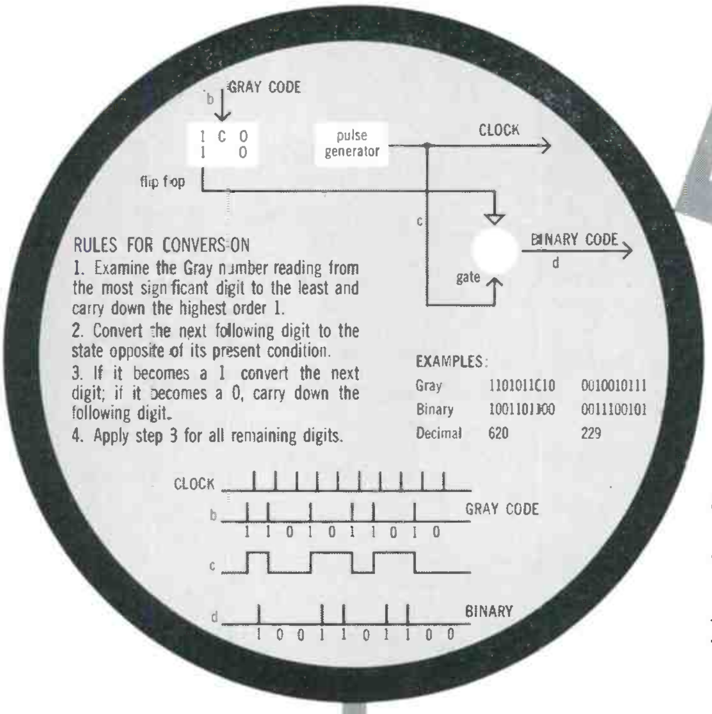
"Blessed are they who go around in circles, for they shall be known as wheels."

SUNSPOT PHENOMENA is now being explained as the migration of the sun's internal magnetic field. Theory, proposed by young physicist at the Univ. of Chicago, holds that the magnetic field is produced by the movement of churning gases in the outer, fifty-thousand-mile-thick layer of the sun. The fields float outward and, when they emerge on the sun's surface, produce the dark areas known as sunspots.

STEP DOWN. Philadelphia is considering a proposal to use closed-circuit television to spot peak-hour parking violators. The plan would use TV cameras mounted on poles or sides of buildings three blocks apart, and tied into a central control point. When an offending motorist or delivery truck pulls into the curb to stop or park, thus tying up a lane of traffic, a tow truck would be dispatched to the spot to apprehend the offender and remove the vehicle.

RADIO MOSCOW paid a left-handed (no pun intended) compliment to the West Coast area last month. By way of recognizing the importance of the area they increased their share of short-wave propaganda broadcasts from 7 to 49 hours per week.

(*Continued on page* 16)



solving logical problems with Burroughs pulse control systems

TOOLS FOR ENGINEERS

converting Gray code to binary equivalents

Here is a simple method for converting Gray code to true binary equivalents. It was put into operation in minutes just by interconnecting Burroughs Pulse Control Units in accordance with the engineer's block diagram, without detailed specifications or complicated circuit designs. With pulse control equipment at his disposal, the engineer was able to turn immediately to other important problems awaiting his attention.

The majority of engineers solving logical problems are badly in need of such tools. Most are bogged down by equipment of limited use that must be redesigned and rebuilt for every new project . . . that clutters the path to a working solution instead of clearing and shortening it.

The smallest discrete units with which such a man can work are logical concepts . . . the basic logical operations. The ideal tools for him are these same operations, packaged for convenient and immediate use by simple interconnections—like the blocks in his block diagram. Such tools are Burroughs Pulse Control Units, which bring block diagrams to life in a matter of hours rather than weeks. Wherever logical problems are being solved with pulses they have earned the title "Tools For Engineers" by eliminating intermediate steps to a proof, obsoleting the frustrations and complexities of breadboarding.

Why not lift the burden of proof from your shoulders by passing pulse problems on to us? We'll gladly show you how Burroughs Pulse Control Units can bring your logical problems closer to a neat working solution . . . at no cost. Or, write for Bulletin 236.

Burroughs

BURROUGHS CORP. • ELECTRONIC INSTRUMENTS DIV.

Department D • 1209 Vine Street • Philadelphia 7, Penna.

For product information, use inquiry card on last page.

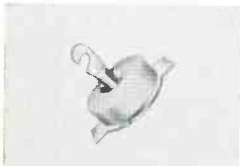
F.C.C. RADIATION INTERFERENCE LIMITS

Effective May 1, 1956 all radio receivers manufactured to operate in the range from 30 to 890 mc, including f-m and television receivers, shall not exceed the following field strength limits at 100 feet or more from the receiver:

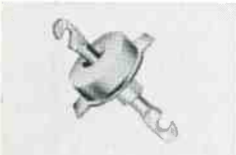
The total electromagnetic field at any point a distance of $\frac{157000}{f(kc)}$ ft. (equivalent to $\lambda/2\pi$) from the apparatus shall not exceed $15\mu v$ per meter. Radiation generated by oscillator sweep circuit must also be controlled.

COMPLY WITH F.C.C. REGULATIONS

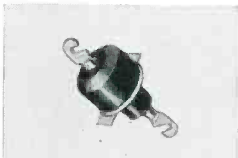
Use Allen-Bradley Feed-thru and Stand-off Capacitors



Type SO with solder tabs



Type FT with solder tabs



Type FC Ferri-Cap filter

This new F.C.C. regulation on radiation interference imposes stringent requirements on radio and TV designers. Fortunately, Allen-Bradley Types FT and SO discoidal capacitors and Ferri-Cap filters completely satisfy these requirements.

Both Type FT (feed-thru) and Type SO (stand-off) can be supplied in standard nominal capacitance values from 5 mmf to 1,000 mmf. None of these Allen-Bradley units exhibits parallel resonance effects at frequencies of 1,000 megacycles or less.

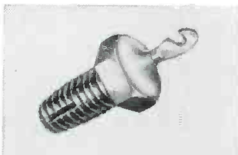
Type FT feed-thru capacitors have soldering tabs or screw-thread mounting. Type SO stand-off capacitors are available with screw-thread mounting, self-tapping threads, or solder tabs.

The rugged construction reduces breakage during assembly line handling or from contact with carelessly handled soldering irons. The terminals are specially treated for easy soldering.

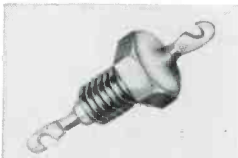
The Type FC Ferri-Cap feed-thru filter is a discoidal feed-thru capacitor in combination with ferrite material to provide internal impedances effectively in series with both ends of the feed-thru electrode of the capacitor. The Ferri-Cap filter is not susceptible to pickup, and does not require physical isolation with respect to the source of an undesired frequency.

Send for bulletin, today.

Type SO—screw mounting



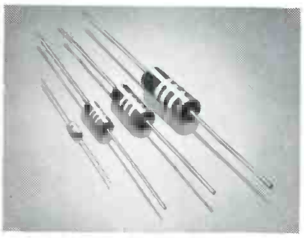
Type SO—self tap. screw



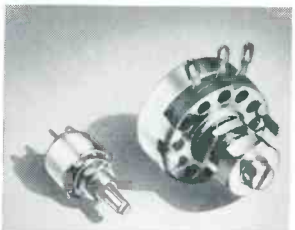
Type FT—screw mounting

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

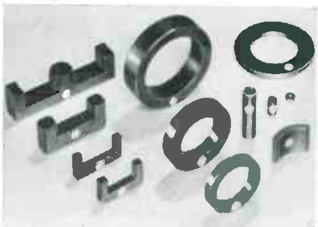
OTHER QUALITY COMPONENTS FOR RADIO, TV & ELECTRONIC APPLICATIONS



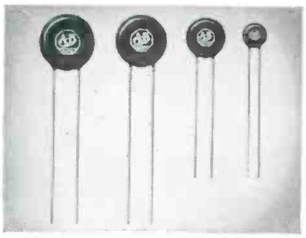
Fixed Molded Resistors
1/10, 1/2, 1 & 2 watt



Variable Molded Resistors
1/2 & 2 watt



Ferrite Components
High Efficiency

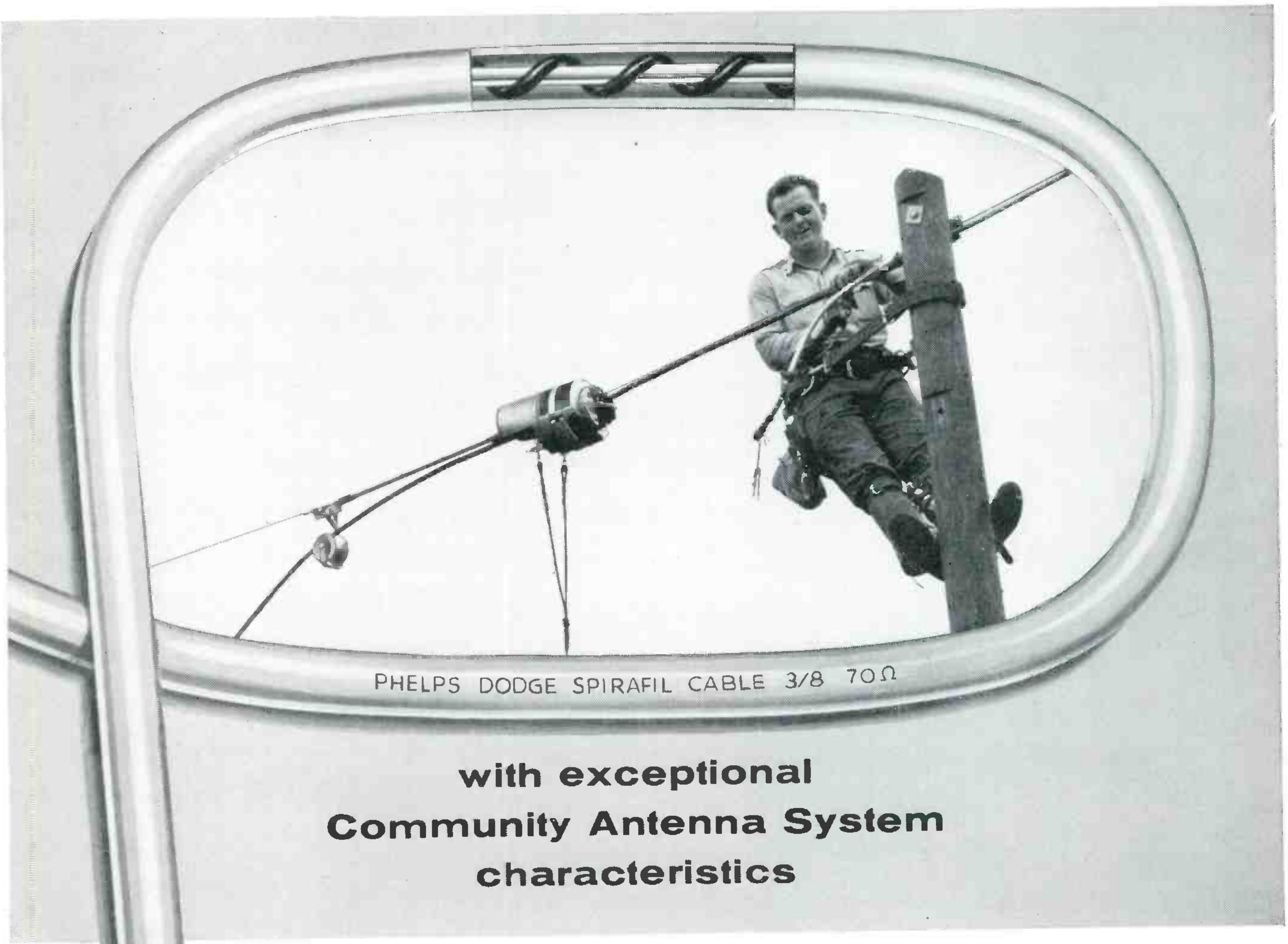


Ceramic Dielectric Capacitors
for by-pass and filtering

ALLEN-BRADLEY

RADIO, ELECTRONIC AND TELEVISION COMPONENTS

SPIRAFIL COAXIAL CABLE



Spirafil coaxial cable was developed by Phelps Dodge as a companion cable to Styroflex coaxial cable. It is particularly adaptable to use in community antenna systems. For this purpose, it has a number of outstanding features—*no radiation, low attenuation, excellent frequency response, uniform electrical properties over wide temperature variations* and *unlimited operating life.*

Spirafil is one of that select group of cables assigned the highest life expectancy rating.

These special Spirafil characteristics, together with the economical cost of the cable, also make it suitable for certain applications in VHF, UHF and microwave communications circuits.

Spirafil cable is manufactured in 1000-foot, continuous lengths without joints. A Habirlene (polyethylene) jacket is supplied for protection against corrosion when the cable is to be installed in underground ducts, under water, or buried directly in the ground.

* * *

For special bulletin describing this unique coaxial cable, or inquiries about specific applications, write Dept. HF-1.

PHELPS DODGE COPPER PRODUCTS CORPORATION MINE TO MARKET REG. U. S. PAT. OFF.

PHELPS DODGE COPPER PRODUCTS
CORPORATION

300 PARK AVENUE, NEW YORK 22, N. Y.

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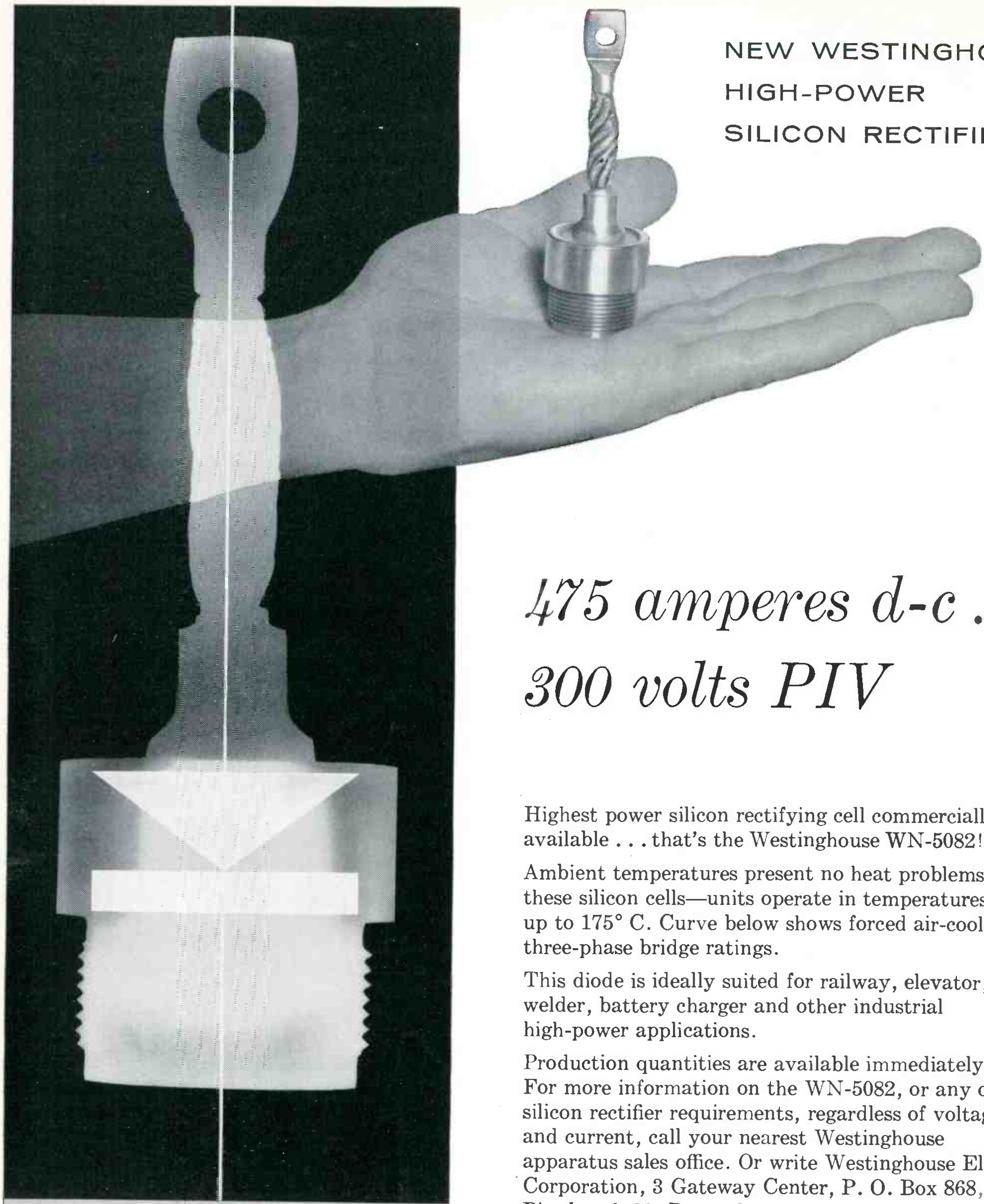


NEW WESTINGHOUSE HIGH-POWER SILICON RECTIFIER

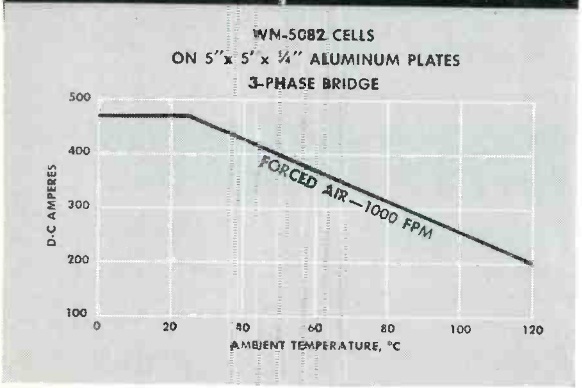
475 amperes d-c . . .
300 volts PIV

Highest power silicon rectifying cell commercially available . . . that's the Westinghouse WN-5082!

Ambient temperatures present no heat problems for these silicon cells—units operate in temperatures up to 175° C. Curve below shows forced air-cooled, three-phase bridge ratings.

This diode is ideally suited for railway, elevator, arc welder, battery charger and other industrial high-power applications.

Production quantities are available immediately. For more information on the WN-5082, or any other silicon rectifier requirements, regardless of voltage and current, call your nearest Westinghouse apparatus sales office. Or write Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-09004



WATCH WESTINGHOUSE!

*WHERE **BIG** THINGS ARE HAPPENING **TODAY!***

MAGNETIC AMPLIFIERS

Custom computer amplifiers with high stability and linearity can be designed having single or multiple inputs to your specific needs. Servo drives and relay actuators are also available. Frequency selective networks can be integrally designed to provide additional useful control functions. Proven packaging techniques insure minimum size—proven toroidal construction assures highest performance.

Typical Temperatures	−60°C. to +150°C.
Typical Line Frequencies	60cps to 6000cps

MISSILE POWER TRANSFORMERS

Recommended for supply frequencies above 400 cps and where size performance and reliability are factors. Thin nickel alloy toroidal cores reduce core losses. Toroid structure cures stray field problems.

SEALED MISSILE POWER SUPPLIES combining toroidal power transformers, toroidal filter chokes, hi temp capacitors and silicon rectifiers. These units offer multiple outputs and low ripple. Low stray field of toroidal elements obviate usual internal shielding. Mag regulation where required.

C-A-C®

MAGNETIC AMPLIFIERS & TRANSFORMERS

Our modern production and research facilities assure you of the most advanced solutions to your problems.

COMMUNICATION ACCESSORIES CO.

World's Largest Exclusive Producer of Toroidal Windings

HICKMAN MILLS, MISSOURI • PHONE KANSAS CITY, SOUTH 1-5528

A Subsidiary of Collins Radio Company

LAMINATED TRANSFORMERS AND INDUCTORS

A complete line of laminated constructed units are now available through CAC. Our highly qualified engineering staff, a well complimented laboratory, humidity controlled production facility with modern manufacturing equipment guarantees conformance with any specifications. Both power and audio transformers employing advanced techniques can be supplied either hermetically sealed or encapsulated to 150° C. ambients. Catalogs, supplied upon request, cover a wide range of standardized designs including omnirange and ILS Filters.

PRECISION RATIO COMPUTER TRANSFORMERS

Toroidal form of construction is ideal for designing precision ratio transformers since the turns of wire are applied to and adjusted on the core. Normal production procedure of zero turn accuracy, high permeability cores, low phase shift, and near unity coupling will yield laboratory quality on any production run. Advanced design and newest packaging methods provide optimum performance with minimum size and rugged construction.

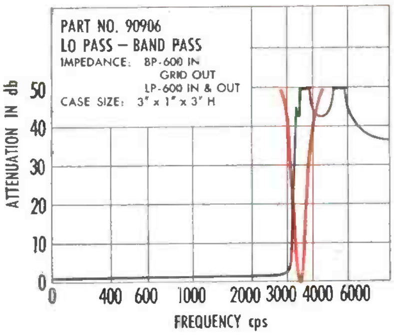
Catalogs on Individual Components are Available on Request.

L-C FILTERS

L-C filters utilizing high Q toroidal inductors and high quality capacitors are the heart of these frequency selective components. Recent developments of magnetic materials and highly stable capacitors have extended the useful frequency and temperature range of electrical wave filters. Use of impedance transformations, near unity coupling, and other applications of advanced network theory result in high performance units in small volume packages.

Low pass, high pass, band pass and band stop filters can be designed covering sub audio to over 500kc range. Line, interstage or other impedances can be specified. Filters can be designed for direct paralleling where required. High permeability cases and the closed toroidal form assure low hum pickup. Temperature stabilization on the order of 0.1% frequency can be attained through use of negative TC compensation to offset slightly positive coil and capacitor characteristics.

Depicted response curve is for an integrally packaged low pass—band pass filter employing the latest design and production procedures. This unit uses less chassis area and is an excellent example of subminiature coil usage, impedance transformations, and printed circuitry. Hermetically sealed to meet the military specifications.



LC AND MECHANICAL FILTERS

C-A-C ®

Engineering . . .

As a result of CAC's engineering developments, more end equipment manufacturers now specify CAC toroids and filters than any other supplier. You are invited to present your network problems to our engineering staff.

COMMUNICATION ACCESSORIES CO.

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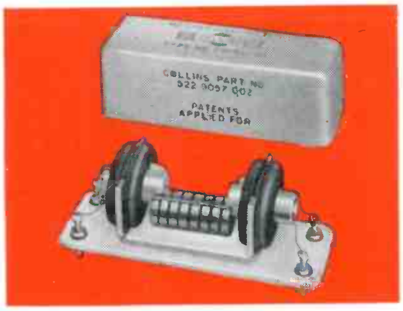
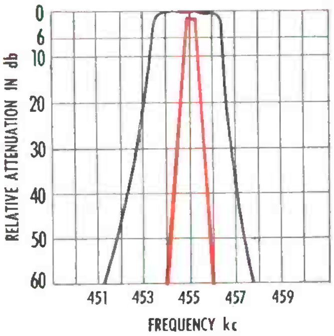


MECHANICAL FILTERS *(Developed and mfd. by Collins Radio Co.)*

The Mechanical Filter provides far better bandpass selectivity in one small sealed unit than a series of bulky conventional IF transformers. Excellent characteristics allow closer spacing of information channels, lower adjacent-channel interference and improved signal to noise ratios. These Filters have been proven in thousands of military and commercial receivers, transmitters and microwave multiplex systems.

Units are designed for center frequencies of 60 to 600kc and various 6db bandwidths from 300cps to 16kc. In general, bandwidth is limited to 10% of the center frequency. In many types, the 60db bandwidth is only twice the 6db bandwidth. Filters have a frequency shift with temperature of + 10ppm/°C. Normal insertion loss for the filters is 6 to 8db. Most types comply with Mil-E-5400 on shock and vibration.

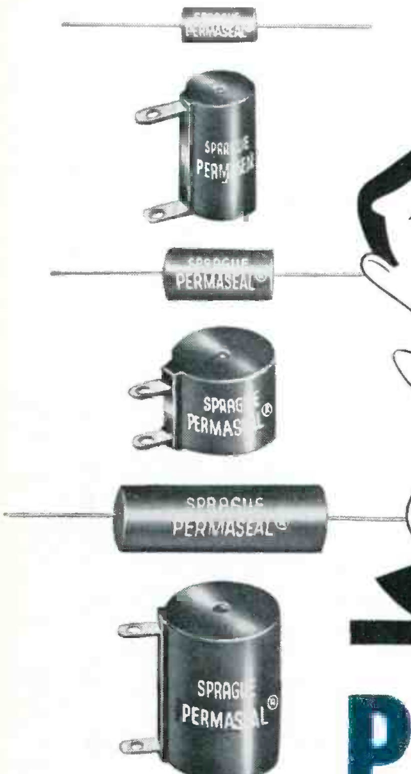
In receiver IF amplifier design the Mechanical Filter replaces one of the usual IF transformers and is fixed tuned. Preceding or following stages may be coupled with subminiature toroidal transformers using fixed tuning. Variable selectivity is obtained by using two or more Filters and switching connections.



Catalogs on Individual Components are Available on Request.

For product information, use inquiry card on last page.

A COMPLETE LINE OF DEPENDABLE ENCAPSULATED RESISTORS



PERMASEAL®

PRECISION WIREWOUND RESISTORS FOR 85C AND 125C AMBIENTS

For applications requiring accurate resistance values at 85C and 125C operating temperatures—in units of truly small physical size—select the precise resistor you want from one of the 46 standard Permaseal designs in tab or axial lead styles.

Winding forms, resistance wire and embedding material are matched and integrated, resulting in long term stability at rated wattage over the operating temperature range. The embedding material is a special plastic that extends protection well beyond the severe humidity resistance specifications of MIL-R-93A and Proposed MIL-R-9444 (USAF).

These high-accuracy units are available in close resistance tolerances down to ± 0.1%. They are carefully and properly aged by a special Sprague process so that they maintain their accuracy within the limits set by the most stringent military specifications.

SPRAGUE

FOR COMPLETE DATA WRITE FOR COPY OF SPRAGUE ENGINEERING BULLETIN NO. 122A

SPRAGUE ELECTRIC COMPANY • 233 MARSHALL ST. • NORTH ADAMS, MASS.

As We Go To Press...

Electronic Co-Pilot For U.S. Superbombers

An electronic system providing precision control during long hours of approach to distant targets has been announced by the U. S. Air Force and the Sperry Gyroscope Company. Designed by Sperry to Boeing and Air Force specifications, the A-14 "electronic co-pilot" helps the pilot control a nuclear bomber with ease and efficiency at both minimum and maximum flight operation ranges, or anywhere between. It is designed to compensate for differing control requirements at various flight speeds and altitudes, automatically determining how much or how little force should be applied to control surfaces to obtain the maneuver desired by the pilot or bombardier under varying flight conditions. The system, designed for the Stratofortress, even takes into account the flexibility limits of the giant 156-ft fuselage in establishing the degree of control required to maneuver safely and accurately.

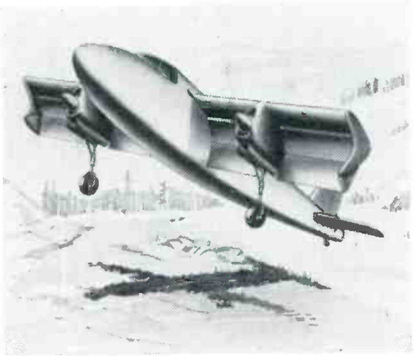
An associated bombing system, utilizing target data obtained either optically or by radar, automatically feeds steering information to the automatic flight control system as the bombardier makes the necessary commands. These versatile systems allow a bomber to take evasive action to avoid enemy aircraft and ground fire while on the bombing run, and still achieve precision bombing.

Du Mont Enters Portable TV Field

Allen B. Du Mont Laboratories will produce 14-inch and 17-inch portable TV receivers in addition to the five new AM radios and three new hi-fi units previously announced. The new TV portables will be available by fall.

Du Mont distributors had an opportunity to see the new sets at the regional meetings during June.

VERTICAL TAKE-OFF



New "Vertiplane," to be built for the Army by Ryan Aeronautical Co., achieves vertical takeoff and landing by the deflected slipstream principle, using retractable wing flaps

Ultrasonic Slicer Cuts Quartz Crystals

A new ultrasonic slicer designed by the Raytheon Manufacturing Co., that produces three times as many crystal blanks from a block of the critical mineral as a diamond wheel, is now being tested at the Signal Corps Engineering Laboratories, Fort Monmouth, N. J.

The cutter bit, resembling a closely stacked pack of razor blades, vibrates at 25,000 cps. The bit itself does not touch the quartz while cutting, though it comes microscopically close. Boron carbide flows between the slicer and the quartz. As the tool vibrates, boron particles rapidly nick out tiny flakes of the quartz. Sound-sliced wafers have been obtained as thin as twelve mils, compared to thirty-three-mil blanks produced by diamond saws.

New Fin-Tip Probe Antenna for Jets

A new type of radio antenna for high-speed aircraft has been developed and is now undergoing tests on the Boeing 707 jet transport.

The new probe antenna maintains most of the advantages of the cap type antenna without requiring any break in basic airframe structure. The probe, a slender cylinder mounted parallel to the direction of air flow, has slight parasitic drag.

Radiation patterns from this antenna are primarily due to the excitation of the airframe and are modified by the location of the probe only to the extent that this location influences the resonant modes excited on the airframe. For frequencies below that of the first airframe resonance, all probe positions produce patterns characteristic of a dipole. For wing tip probes, the patterns are due to wing excitation, while for nose and tail assembly mountings, radiation from the fuselage predominates. At high frequencies, with tail mountings, large amounts of vertical polarization occur for any location on the tail assembly due to excitation of the trailing edge of the fin. At lower frequencies, the fin-tip location is necessary to obtain vertical polarization.

More News on page 18

The new "probe" antenna is mounted on the fin tip of this Boeing 707 jet transport

TELE-TIPS

(*Continued from page 6*)

SELLING LP records by demonstrating them on $14.95 squawk boxes has always seemed a little incongruous to us. Now Gray Research & Development Co. is doing something about it. They are making available a complete hi-fi system—a Gray Viscous Damped Tone Arm, turntable, amplifier, pre-amp and speaker—to record dealers on a liberal, long term rental purchase plan.

NEW SOLDER being introduced in England by Multicore contains a small percentage of copper which is said to eliminate the need for re-surfacing and trimming soldering irons, and to increase iron life up to 10 times.

NEW GIMMICK in tube merchandising by Westinghouse. Their new "Ten Top Tubes" package contains 5 each of the most commonly used tubes, or total of 50 tubes in all. Price remains the same but a bonus $2.95 thermal picnic bag is thrown in free. The pack has a double handle built in that makes it convenient for servicemen to carry on their calls. Design was motivated by the thought that with so many new types of tubes being introduced in new sets, the servicemen might welcome an auxiliary tube caddy that would take care of most commonly used tubes, leaving their main caddy to store lower volume types. (Which could turn out to be very shrewd thinking.)

COLOR TV is making strange bedfellows. RCA Victor and Cluett Peabody and Co., manufacturers of Arrow shirts, will be collaborators on a big Fall advertising campaign. The theme will be "The Look of Compatible Color," with Cluett Peabody featuring their line of dress shirts and casual wear and RCA Victor their new line of color TV receivers.

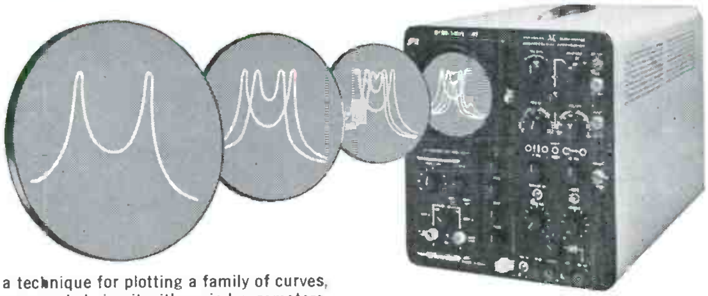
HUGHES MEMOTRON®

. . . a new concept in retaining transients

- Provides an instant and convenient permanent display of transients
- Displays traces at high brilliance indefinitely, until intentionally erased
- Permits display of successive writings
- Eliminates waste of time and film by eliminating need for taking superfluous photographs
- Can be used as a curve plotter at both high and low writing speeds.

MEMOTRON is exclusive with Hughes. It is the only cathode ray tube available which makes it possible to combine, in a single piece of equipment, the permanent writing characteristics of a pen recorder together with the high-frequency response of a cathode ray oscillograph. MEMOTRON is already incorporated into equipments serving important laboratory functions in many of the country's leading electronics research and manufacturing centers. Descriptive Product literature is available upon request.

An application of the MEMOTRON is a commercial oscilloscope manufactured by Advanced Electronics Corporation, Los Angeles. MEMOTRON has an over-all length of 18½ inches, and a neck diameter of 2¼ inches. It can replace most conventional 5-inch tubes without revision of space requirements in the equipment.



Illustrated: a technique for plotting a family of curves, representing a coupled circuit with varied parameters.

Hughes Products engineers are available for consultation on special MEMOTRON applications. For literature write to address below.

HUGHES PRODUCTS

A DIVISION OF THE HUGHES AIRCRAFT COMPANY

ELECTRON TUBES®
HUGHES PRODUCTS
Los Angeles 45, California

For product information, use inquiry card on last page.

As We Go To Press . . . (Continued)

Russian Conference Hears U.S. Scientists

Dr. Charles P. Bean, of the GE Research Laboratory, presented a paper on Domain Walls at an international conference on magnetism sponsored by the U.S.S.R. Academy of Sciences. Dr. Bean, a member of the American Physical Society, has been successful in developing new methods of measuring the thickness of "domain walls" which separate areas of differing magnetization within a piece of metal. Further measurements have been made of the energy associated with the shrinking and expansion of such walls.

Other American scientists participating in the conference were Dr. Richard M. Bozorth, physicist at Bell Telephone Laboratories, and Professor Arthur F. Kip, member of the University of California physics department.

TV Drone Aids Army Reconnaissance

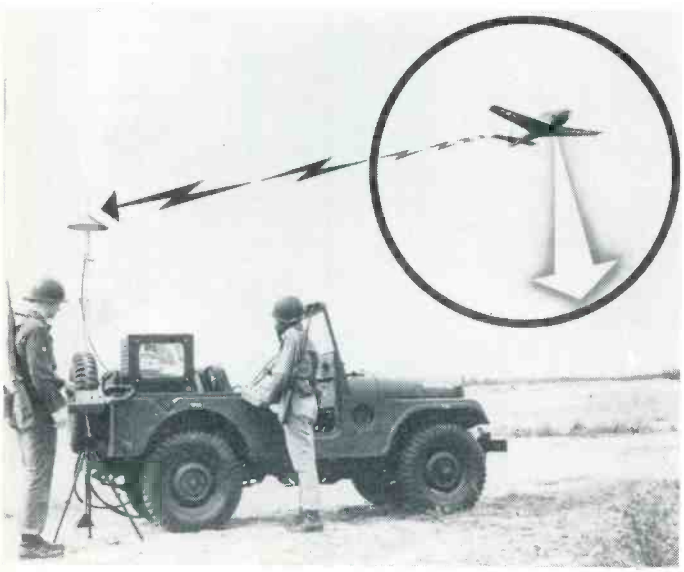
Live TV shots can be made of strategic territory by using radio controlled drone planes equipped with TV transmitters and autopilots modified for remote control by means of on-off type radio signals. A 250-pound ground station with radio links for commanding the drone completes the system.

ATMOSPHERE TESTING

Airborne instruments check "ducting" effects at Ft. Huachuca, Arizona

Inertial Guidance System for Missiles

AC Spark Plug Div. of General Motors has been awarded a contract to develop an inertial guidance system of advanced design for the Air Force. Requirements are that it must accurately guide a missile to the target without aid from radar, radio, or any ground or celestial reference. Once the correct latitude and longitude of the launching and target points have been set into the missile guidance system, the missile is on its own. Since the guidance system uses no radar or radio information it is not susceptible to enemy jamming. As it uses no star reference, the missile can be launched day or night.



Drone flashes pictures of terrain to jeep-mounted TV receiver

Tiny Vidicon Aids Flight Tests

A miniature TV camera, only 5 in. long, is being employed by Lockheed Aircraft Corp. in flight testing the new Electra propjet airliner. The result of two years of development work the new camera has already shown great versatility and usefulness.

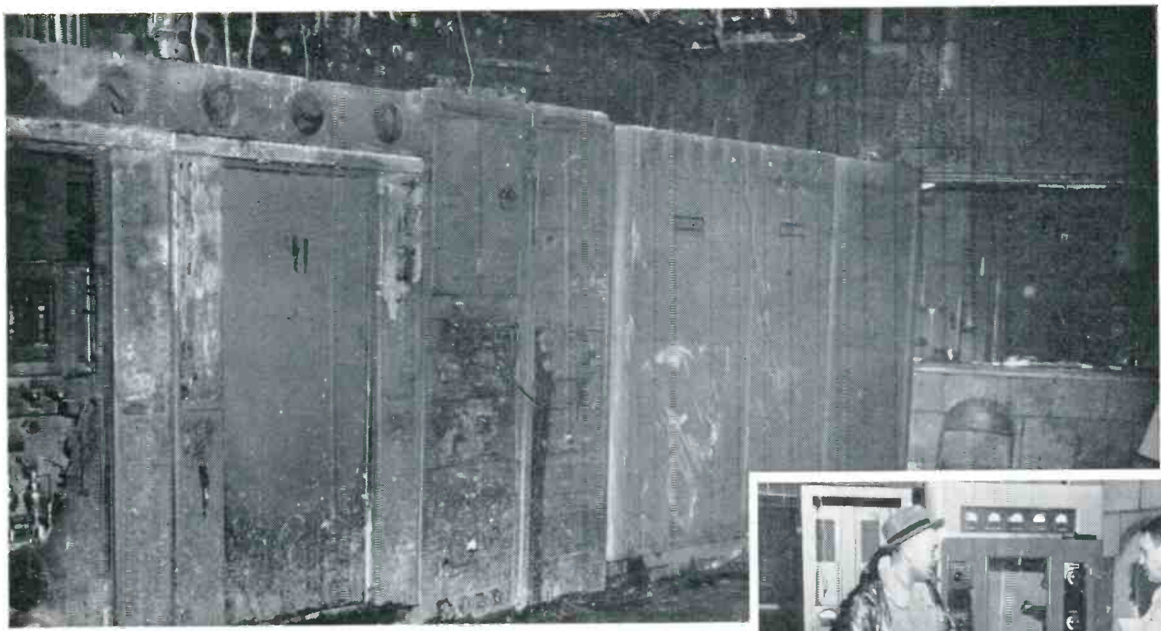
Smaller than a flashlight, the micro-miniature camera with 8 mm lens attached measures only 1¾ x 2 x 5 in. and weighs only 1½ lb. The tiny camera was designed for aerial televising, attached to flying test planes, as well as in laboratories on the ground. With it research and flight test engineers are able to observe operations which would be impossible to see without it. The camera can see into inaccessible areas. It can give a close-up view of tests a man could not watch safely. Conditioned to operate in temperatures up to 185° F, it has been ruggedized to withstand severe forces.

Camera is mounted outside aircraft

New Penna. Plant

Opening of a new, $4,000,000 plant in North Wales, Pa., has been announced by Leeds and Northrup Co., manufacturers of automatic controls and instruments. The six-acre, completely air conditioned building will be devoted to the manufacture of industrial recorders and controllers, combustion controls, and load-frequency controls.

More News on page 20



Blackened ruins of the WKRS transmitter room. Lightning started the fire in the switch panel at left.

Twenty-five hours later, WKRS resumes transmission. WKRS engineer Stanley Chadwick and Collins engineer Charles Lowder watch the Collins 20V warm up as Control Engineer Sam Kobak waits for the signal.

Lightning burns out WKRS

Complete Collins Station arrives in 15 hours

WALTER F. KEAN
CONSULTING RADIO ENGINEERS
RIVERSIDE 7-2155 • ONE RIVERSIDE ROAD
RIVERSIDE ILLINOIS

April 30, 1956

Mr. Robert Hancock
Collins Radio Company
Cedar Rapids, Iowa

Re: W K R S fire, April 27th

Dear Bob:

This is to report that fifteen hours after you had been given the order to replace the W K R S transmitting plant, totally destroyed by lightning and fire, the complete station equipment arrived at the site including the 20-V transmitter, console, racks, monitors, microphones, wire, cable and transmitter crystal. Every item ordered, arrived - nothing, not even nuts and bolts was missing.

The station staff, my own staff, and your engineer assembled the equipment during the night and found not a single failure in your equipment except one rosin joint and a couple of our own wiring errors. We got the station back on the air in time for the regular news broadcast at eight o'clock next morning, twenty-five hours after the fire was put out.

Never before in twelve years of consulting work have I seen a bill of equipment installed with so little trouble in so little time.

Sincerely,
Walter F. Kean
Walter F. Kean

WFK/abf

At 3:20 a.m., Friday, April 27, lightning struck the WKRS transmitting tower at Waukegan — sizzled through the switch panel and started a fire. The building was gutted. All broadcasting equipment in the Waukegan News-Sun station was destroyed. Damage was estimated at $100,000.

The fire was discovered at 5:15 a.m. A nearby fire department had the blaze under control in about an hour.

As soon as station management were notified, they started steps to resume transmission. Crews of men were called in to shovel out the debris as carpenters, electricians and engineers started to rebuild the station's interior.

Collins Radio Sends Equipment

Walter F. Kean, consulting radio engineer at Riverside, Illinois, was called and given the job of procuring and installing new Collins equipment. After a telephone conference with WKRS, he called Collins in Cedar Rapids and placed the order.

By 10:00 a.m. that morning, complete station equipment was loaded on a truck and on its way to Waukegan. A Collins 20V transmitter, console, and all necessary accessory equipment arrived at 9:00 p.m. that night, just 15 hours after the order had been placed.

Collins Engineer Charles Lowder met the WKRS and Walter F. Kean staffs at the burned-out building and they started installing the equipment.

Station Resumes Transmission at 8:04 a.m.

Crews worked through the night. At 8:04 a.m., WKRS signed on as announcer Brad Crandall introduced the regular Wake-Up Time show. Twenty-five hours had gone by since the fire had been put out.

Collins CREATIVE LEADER IN BROADCAST EQUIPMENT and Service COLLINS

855 35th St. N.E., Cedar Rapids, Iowa • 261 Madison Avenue, New York 16 • 1200 18th Street N.W., Washington, D.C. • 1930 Hi-Line Drive, Dallas 2 • 2700 W. Olive Avenue, Burbank • 1318 4th Avenue, Seattle • Dogwood Road, Fountain City, Knoxville • 4471 36th Street N.W., Miami Springs • 11 Bermondsey Road, Toronto 16, Ontario.

For product information, use inquiry card on last page.

As We Go To Press

NAVY SUPPLY COMPUTER

RAdm F. L. Hetter and RAdm R. J. Arnold check Navy's new IBM "702" computer newly installed at Navy Supply Office, Phila.

New Printed Circuit Assembler

An improved machine which can produce completely assembled and soldered printed circuit television or radio units, consisting of 50 to 100 component parts each at the rate of 360 units per hour has been announced by Equip-a-Matic Corp. of Riverside, Ill.

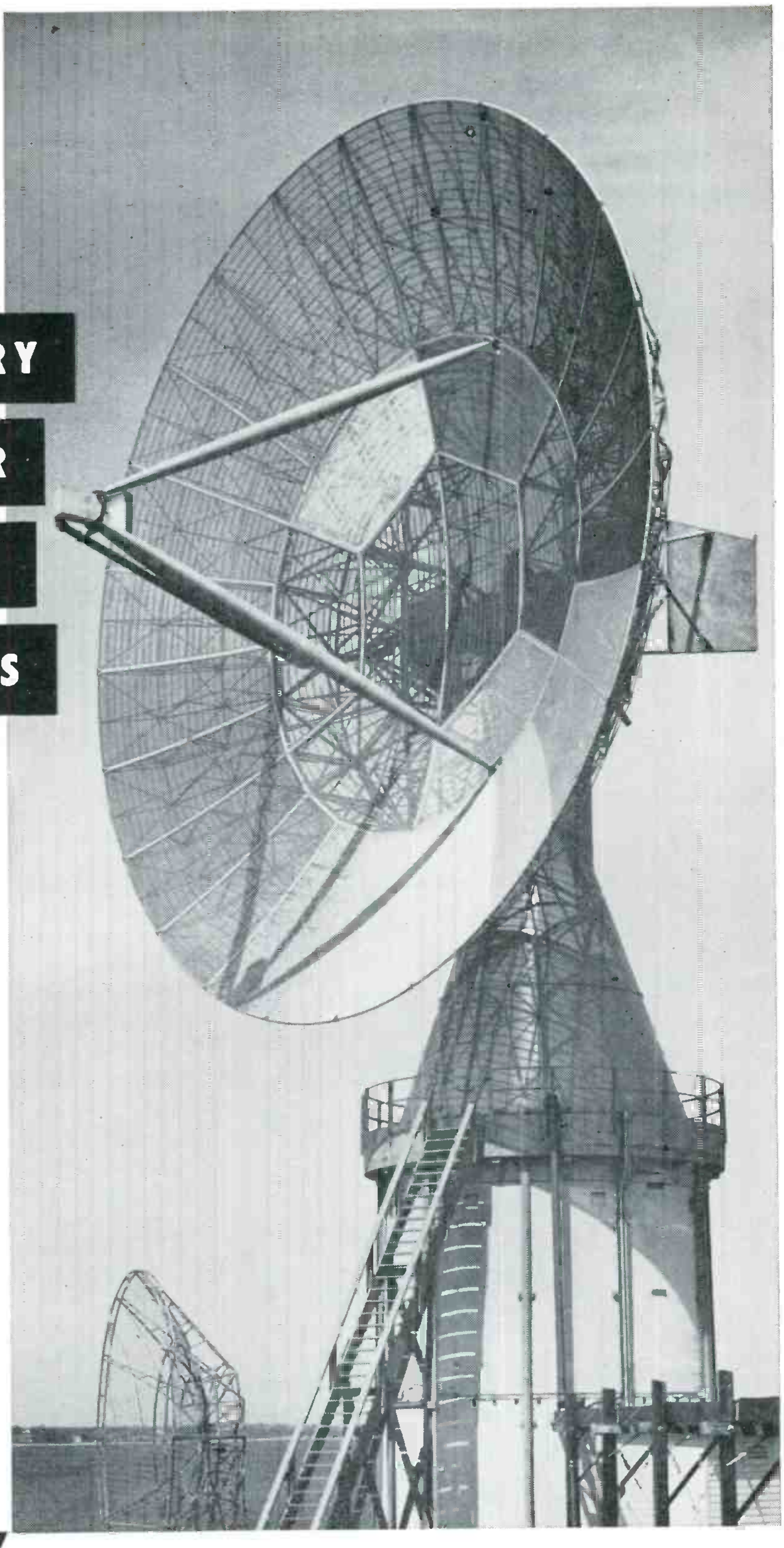
The machine is equipped with multiple parts inserters that automatically place all of each variety of part in single stations of the machine, requiring no crimping and no flux application. Inserters are so compact their vertical area dimensions are only that which the inserted part occupies on the panel, thus providing simultaneous lead forming and placement of 50 or more parts in one stroke of the inserter head. Parts placed at each succeeding station are guided down in the spaces between those components already in place using only as much of the space as the part requires on the panel.

The movement of the pallet from one station to another takes but 1.61 seconds, yet acceleration is controlled so parts merely resting on the panel surface are not tipped.

An automatic soldering method is incorporated which is said to offer many advantages over dip-soldering techniques.

More News on page 22

LINCOLN LABORATORY 50kw UHF SCATTER INSTALLATION USES EIMAC KLYSTRONS



Lincoln Laboratory uses Eimac klystrons again in its 50kw experimental tropospheric scatter installation at Round Hill. As a pioneer in this revolutionary new communication concept, Lincoln Laboratory, of the Massachusetts Institute of Technology, has been instrumental in developments leading to reliable military and commercial scatter networks.

Engineers responsible for advancing the art of tropospheric scatter set forth exacting requirements. Eimac klystrons have met these requirements through each stage of the evolution of high power.

Fourth in a series on the extensive scatter application of Eimac klystrons.

Eimac
THE POWER FOR FORWARD-SCATTER

EITEL-McCULLOUGH, INC.
SAN BRUNO, CALIFORNIA
The World's Largest Manufacturer of Transmitting Tubes

As We Go To Press

(Continued)

FM Carrier System Speeds Production

Methods engineers at the Sheffield Steel plant in Kansas City, Mo., have speeded production and increased safety by installation of an FM carrier communications system between crane-cab and floor workers. This system permits men in the pulpit station of the blooming mill to communicate directly and clearly with crane operators, eliminating the confusion of hand signals and whistles from ingot handling processes where timing is vital. An extension of this wireless communication system allows foremen to hear all communications, thus keeping in touch with operations at all times.

FM was chosen by Mine Safety Appliances Co., makers of the system, for its freedom from transmission noise and outside interference. Present equipment can be used on ten different frequencies without cross interference, and ranges up to one mile are practical.

New Missile Plant

Lockheed Aircraft Corp. has begun construction of a new Missile Systems plant at Sunnyvale, California. The new 260,000 sq. ft. plant, together with previously announced expansion of facilities, will nearly triple division space.

Scientists of the Missile Systems division are engaged in advanced research and development. Including studies in nuclear physics, high altitude research, uitrasonic aerodynamics, and heat problems.

Admiral Buys Raytheon TV & Radio Plants

Admiral Corp. has acquired the TV and radio mfg. division of Raytheon Mfg. Co., located in Chicago. The two plants will be operated as the Belmont division of Admiral Corp.

Henry F. Argento, Raytheon vice president and manager of the TV and radio operations, will join Admiral's Belmont div. in a similar capacity.

More News on page 36

Coming Events

A listing of meetings, conferences, shows, etc., occurring during the period July through October, 1956 that are of special interest to electronic engineers

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July 10-12: Western Packaging and Materials Handling Show, PanPacific Auditorium, Los Angeles, Calif.

Aug. 20-21: The National Telemetering Conference, sponsored jointly by the IRE, the AIEE, the IAS, and the ISA, in Los Angeles, Calif.

Aug. 20-24: Conference on Scientific and Technical Writing, by the Institute for Cooperative Research of the University of Penn., Philadelphia, Pa.

Aug. 21-24: WESCON Show, Pan Pacific Auditorium, Los Angeles, Calif.

Aug. 22-Sept. 1: 23rd Annual (British) National Radio Show, sponsored by the Radio and Electronic Component Manufacturers Federation, at Earls Court, London, England.

Aug. 24-26: Seventeenth Annual Summer Seminar Emporium Section of the IRE, at Emporium, Pa.

Sept. 11-12: Second RETMA Conference on Reliable Electrical Connections, at Irvine Auditorium, University of Penn., Philadelphia, Pa.

Sept. 12-14: Third National Conference on Tube Techniques, sponsored by the Working Group on Tube Techniques of the Advisory Group on Electron Tubes; in New York, N. Y.

Sept. 17-21: Symposium on radiation effects on materials, sponsored jointly by The Atomic Industrial Forum and ASTM; at ASTM Pacific Area National Meeting, Los Angeles, Calif.

Sept. 17-21: 11th Annual Instrument-Automation Conference and Exhibit, sponsored by the ISA, at the New York Coliseum, New York, N. Y.

Oct. 1-3: 12th Annual Conference of the NEC; at the Hotel Sherman, Chicago, Ill.

Oct. 8-9: Second National Symposium on Aeronautical Communications, sponsored by the IRE Prof. Gp. on Communications Systems; at the Hotel Utica, Utica, N. Y.

Oct. 9-10: Conference on Computer Applications, sponsored by Armour Research Foundation of Illinois Institute of Technology, Chicago, Ill.

Oct. 15-17: Radio Fall Meeting, sponsored jointly by the IRE and RETMA, at the Hotel Syracuse, Syracuse, N. Y.

Oct. 16-18: Conference on Magnetism and Magnetic Materials, sponsored by the Magnetics Subcommittee of the Basic Science Committee of AIEE, at the Hotel Statler, Boston, Mass.

Oct. 25-26: Annual Display of Aircraft Electrical Equipment, by the Aircraft Electrical Society, at PanPacific Auditorium, Los Angeles, Calif.

Oct. 29-30: Third Annual East Coast Conference on Aeronautical and Navigational Electronics, sponsored jointly by the Baltimore Section of IRE and the IRE Prof. Gp. on Aeronautical and Navigational Electronics; at the Fifth Regiment Armory, Baltimore, Md.

Oct. 31-Nov. 2: 20th Anniversary National Time and Motion Study and Management Clinic, sponsored by the IMS, at the Sherman Hotel, Chicago, Ill.

Abbreviations:

ASTE: American Society of Tool Engineers
ASTM: American Society for Testing Materials
AIEE: American Institute of Electrical Engineers
IAS: Inst. of Aeronautical Sciences
IMS: Industrial Management Society
IRE: Institute of Radio Engineers
ISA: Instrument Society of America
NEC: National Electronics Conference
RETMA: Radio-Electronics-TV Manufacturers Assoc.
RTCA: Radio Technical Commission for Aeronautics
WESCON: Western Electronic Show and Convention


The Most Complete Transformer Line in the World ...FROM STOCK
A quarter century of specialized experience and original research has gone into the development of UTC catalog items. Covering the range from tenth ounce units to others weighing hundreds of pounds, UTC stock items are available for virtually every application in the electronics field. Each of these items carries a plus value . . . UTC RELIABILITY, highest in the field.
UNITED TRANSFORMERS REACTORS FILTERS
The Most Reliable Transformer Products in the World
Write for your Copy of Catalog '56
PERMALLOY DUST TOROIDS
Maximum Accuracy and Stability
VARIABLE INDUCTORS
Standard and Hermetic
LOW FREQUENCY INDUCTORS and INDUCTANCE DECADES
LOW PASS, HIGH PASS and BAND PASS FILTERS . . . HERMETIC
HERMETIC
Power, Plate, Filament Transformers and Reactors
HERMETIC AUDIO COMPONENTS
for Every Application
MAGNETIC AMPLIFIERS . . . HERMETIC
PULSE TRANSFORMERS
DOTS
Transistor Transformers
Smallest Size–Highest Power
SUB and SUB-SUB OUNCER TRANSFORMERS
Audio Miniatures
OUNCER and PLUG-IN UNITS
LINEAR STANDARD SERIES
Tops in Fidelity
HIPERMALLOY and ULTRA COMPACT
High Fidelity Favorites
COMMERCIAL GRADE AUDIO and POWER COMPONENTS
for Industrial Use
SPECIAL SERIES . . . Audio and Power Components for the "Ham"
REPLACEMENT TYPES
VOLTAGE ADJUSTERS . . . STEPDOWN and ISOLATION TRANSFORMERS
PHOTOFLASH TRANSFORMERS
MIKE-CABLE TRANSFORMERS
EQUALIZERS
UNITED TRANSFORMER COMPANY
150 Varick Street, New York 13, N. Y. • EXPORT DIVISION: 13 E. 40th St., New York 16, N. Y., CABLES: "ARLAB"

RCA INTRODUCES A COMPLETELY "FAMILY" OF AUDIO

A model to "fit" every station requirement...

ALL HAVE "BUILT-IN" POWER SUPPLIES, MONITORING AMPLIFIERS AND SPEAKER RELAYS

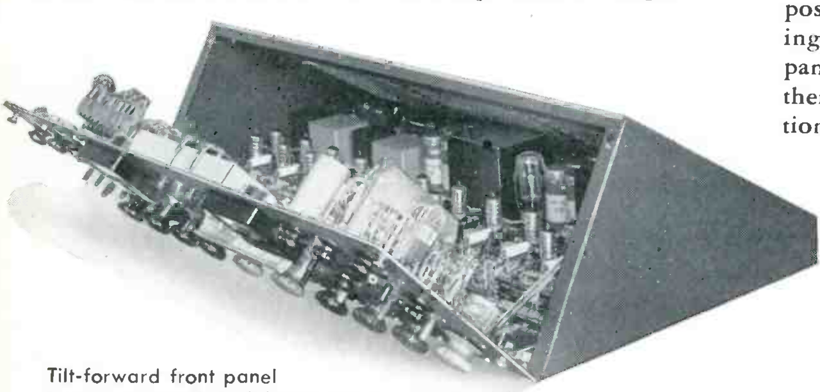
Here is a "family" of three consolettes that give you the widest choice of facilities ever offered. All have printed-wiring amplifiers in modular construction, providing the utmost in circuit uniformity and performance. Each model has its own "built-in" power supply (the BC-6A has two). Each has built-in monitoring amplifiers and speaker relays.

INSTALLATION IS QUICK, EASY...INEXPENSIVE

The "self-contained" feature of all three models makes them easy to install. There is no need for costly external wiring and "hunting" for a place to mount such items as power supplies, monitoring amplifiers and speaker relays. The reduction of external wiring minimizes the chance of stray hum pick-up greatly improving system performance.

CONVENIENT OPERATION

The low height of each consolette affords maximum studio visibility . . . no stretching to observe cues. Relaxed wrist comfort is provided by mixer controls on the right slant . . . at the right position above the desk top. RCA-developed finger-grip knobs provide convenient, positive control and are color coded for "function identity."



Tilt-forward front panel permits quick accessibility to mixer pads and spring contacts; makes maintenance easy.

EASE OF MAINTENANCE

Routine maintenance time is reduced by the quick accessibility of all components . . . easy-to-clean mixer pads, simple-to-adjust leaf-spring contacts on key and push-button switches. This is achieved by a snap-off top cover and a tilt-forward front panel, in addition to strategic placement of components.

RCA MATCHED STYLING PERMITS EXPANDABILITY

Styled with 30-degree sloping panels which match previous equipments such as the BC-2B consolette, BCM-1A mixer, and compatible among themselves, a wide range of augmented facilities is possible. Paired BC-5As provide dual channel operation and extended facilities. Addition of the BCM-1A mixer to any of these consolettes is simple and provides added microphone inputs.

THEY WORK WELL INTO CUSTOM ARRANGEMENTS

Simple functional design and "engineered" compactness makes any number of custom installation arrangements possible. A custom "U" arrangement of two BC-5As flanking a BCM-1A mixer is possible. The 30-degree front panels match the slope of video control equipment making them suitable for use in television studio custom applications as well as in radio.

Ask your RCA *Broadcast Sales Representative for detailed information*

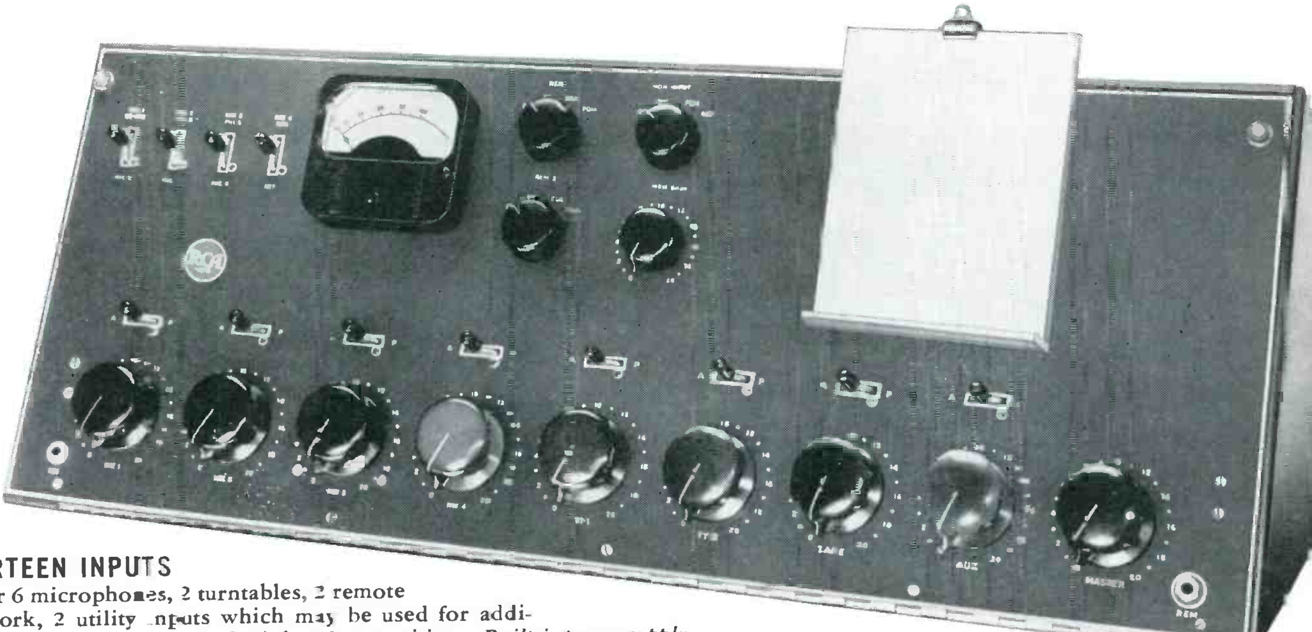
RADIO CORPORATION of AMERICA

BROADCAST AND TELEVISION EQUIPMENT • CAMDEN, N. J.

NEW CONSOLETTES

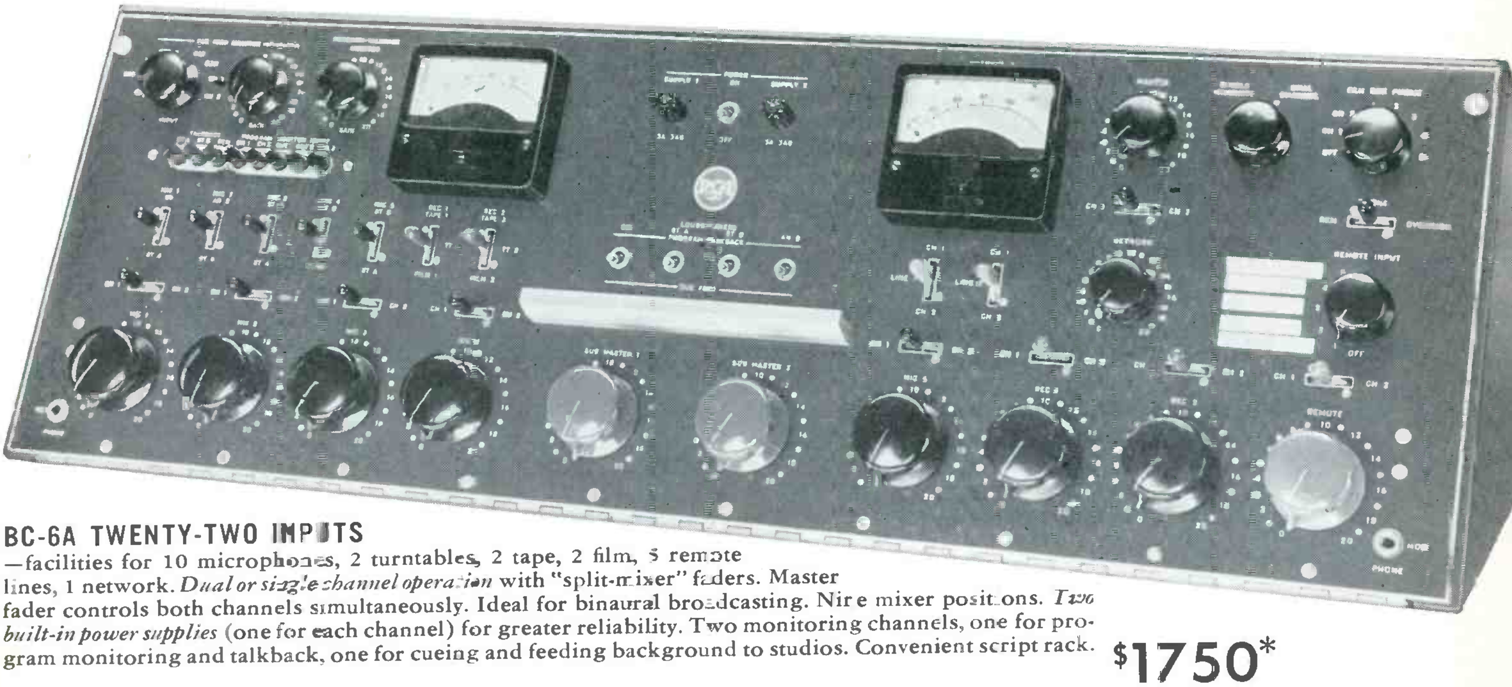
BC-5A NINE INPUTS

—facilities for 4 microphones, 2 turntables, 2 remote lines, 1 network or tape. 4 mixer positions. *Built-in power supply.* Easily expanded for dual channel use by "pairing." Block building lends "custom touch" when paired with existing BC-2B's................ $875*



BC-3B THIRTEEN INPUTS

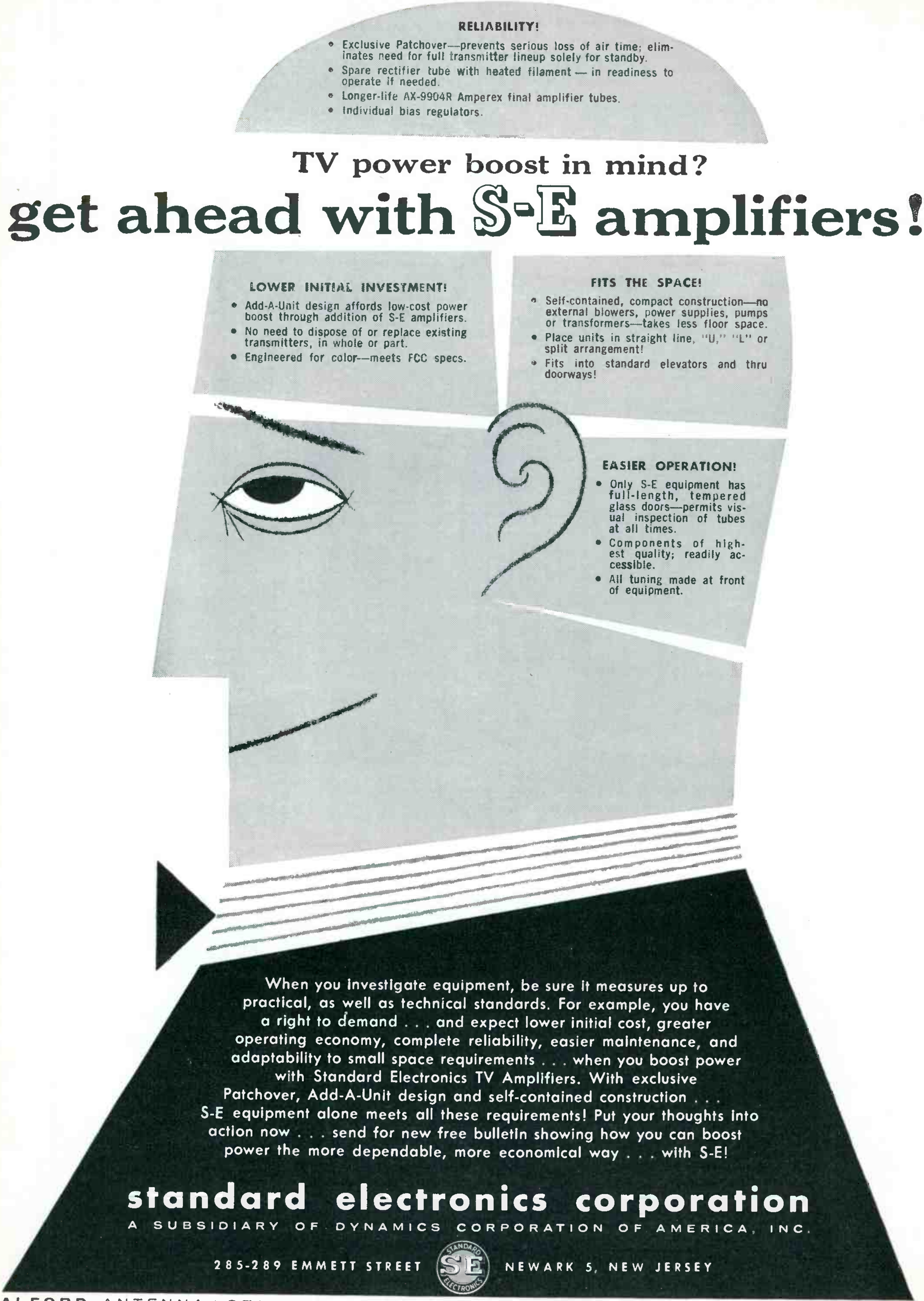
—facilities for 6 microphones, 2 turntables, 2 remote lines, 1 network, 2 utility inputs which may be used for additional turntables, tape, or as required. Eight mixer positions. *Built-in power supply.* Easily expanded for dual channel use by pairing with BC-5A. Convenient script rack. $1095*



BC-6A TWENTY-TWO INPUTS

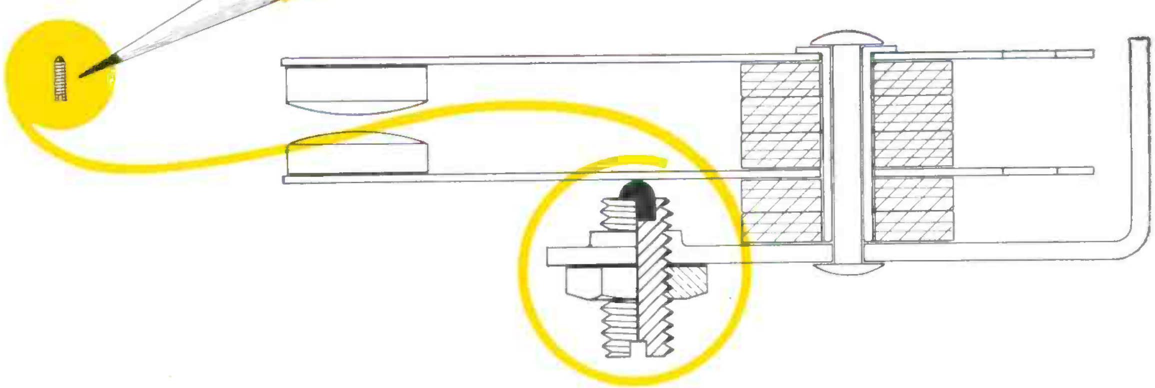
—facilities for 10 microphones, 2 turntables, 2 tape, 2 film, 5 remote lines, 1 network. *Dual or single channel operation* with "split-mixer" faders. Master fader controls both channels simultaneously. Ideal for binaural broadcasting. Nine mixer positions. *Two built-in power supplies* (one for each channel) for greater reliability. Two monitoring channels, one for program monitoring and talkback, one for cueing and feeding background to studios. Convenient script rack. $1750*

**Less Tubes—Prices subject to change without notice.*



ALFORD ANTENNA + STANDARD ELECTRONICS AMPLIFIER ≡ HIGH BAND ECONOMY

Can You Use a Glass Tipped Adjusting Screw about this Size?



If you make a relay, switch, thermostat or any component in which a metal part is adjusted by an insulated screw, please read on.

As pioneers in the field of glass-to-steel hermetic terminals, Fusite has come to grips with many problems involving the interfusion of glass with metal.

While we can only guess at the potential market for our tiny new product, we offer every assurance as to its complete practicality.

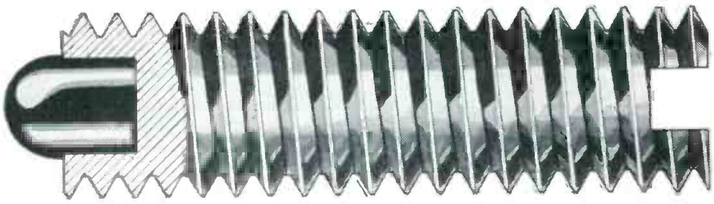
These screws, now available in standard threads one through six, have a tip of high density glass actually fused to the metal (not cemented or pressed in).

This promises perfect performance in the face of changing temperatures, humidity, friction, and corrosive chemicals.

We will be happy to send you samples without obligation.

Write Fusite Dept. U-4

INSULATE ELECTRICALLY · GLASS TO METAL · FUSITE TERMINALS PROTECT PRODUCT PERFORMANCE · SEAL HERMETICALLY



THE FUSITE CORPORATION

6028 FERNVIEW AVENUE, CINCINNATI 13, OHIO

BOOKS

Closed-Circuit and Industrial Television

By Edward M. Noll. Published 1956 by The MacMillan Co., 60 Fifth Ave., New York 11, N. Y. 230 pages, paper bound. Price $4.95.

Closed-circuit TV, whose operation this book explains, is simpler and less expensive than broadcast TV, since it consists basically of a camera, a power supply, a pulse generator, and a viewer. A relatively simple camera—camera tube, video-signal amplifiers, and camera-tube deflection stages—can be used. The power supply and pulse-generator provide the necessary operating voltages and form the various pulses needed in a TV system. The viewer may be either a standard receiver (if the scanning rate is proper) or specially made.

The purpose of this book is to present information about closed-circuit TV systems available and to suggest some of the ways in which such systems can serve modern needs. The first chapter describes operations and services that are already being performed by closed-circuit systems and illustrates many practical examples. The remainder of the book stresses the technical phases: systems, types of cameras and viewers, circuits and techniques, and installation and service. The final chapter presents sufficient details for the construction of a small, inexpensive TV camera. Illustrations are given throughout the book of commercial systems which have been developed by different electronic manufacturers.

Aircraft Production Methods

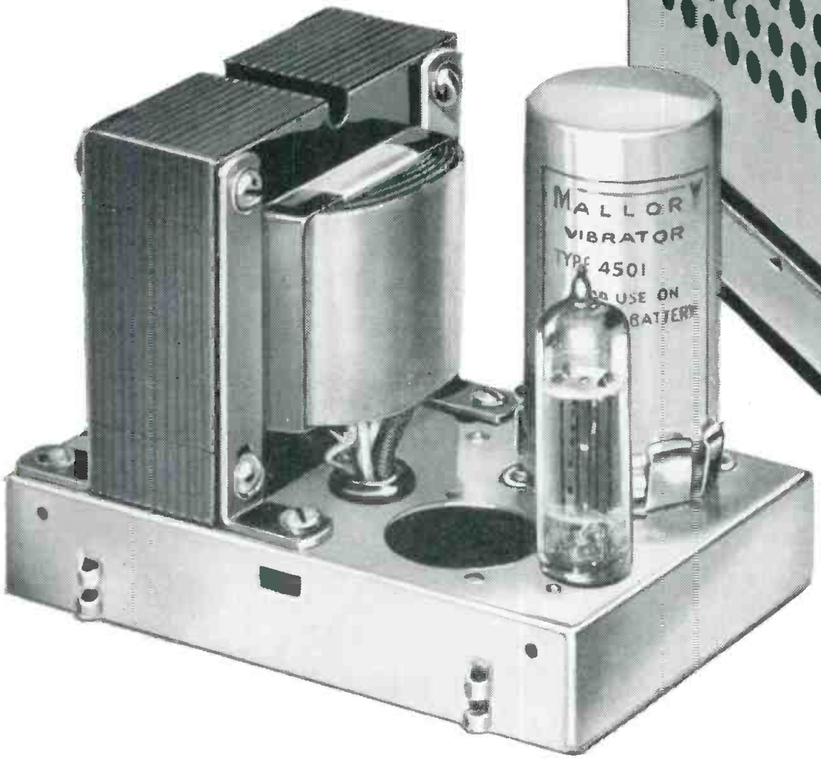
By Gordon B. Ashmead. Published 1956 by Chilton Co., Inc., Chestnut and 56th Sts., Philadelphia 39, Pa. 293 pages. Price $7.50.

This book is concerned with the developing of aircraft designs into production in industrial plants. It begins with the master plaster pattern which is a full size model of parts of the airplane and takes the reader into the foundry where the dies to form the metals are made. These dies are followed right through the shop until they meet the blanks which have been cut to suit the various forming machines. The reader stands behind the operator of a drop hammer as a nacelle section is hammered out, watches the stretch press, and sees the largest brakes and presses in the country turning sheetmetal stock into aircraft parts.

Some of the most advanced methods of heat treatment harden these parts and he learns how the surfaces of the

(*Continued on page* 30)

NEW MALLORY VIBRAPACKS®



solve your power problems in mobile equipment

WHENEVER you need a power supply for battery-operated electronic equipment . . . mobile transmitters and receivers, PA amplifiers, direction finders or similar apparatus . . . you will find the right combination of performance and economy in Mallory Vibrapacks.

A completely new series of these vibrator power supplies, incorporating improved features of design, is now available for electronic designers.

FLEXIBILITY. Vibrapacks come in a variety of ratings, capable of delivering up to 60 watts of DC power at 300 to 400 volts. Each model is adaptable to a broad range of applications.

HIGH EFFICIENCY. Circuits are designed to give minimum battery drain . . . maximum power conversion. All components are matched for peak performance.

PROVED DEPENDABILITY. Built of precision-made Mallory components, Vibrapacks have earned a reputation for reliable service in thousands of applications, under the most severe conditions of use.

ECONOMY. First cost is low. You gain the economies of Mallory standardized designs and efficient production. Maintenance costs are practically zero.

Check through the specifications for the eight standard Vibrapack models when you begin your next mobile equipment design. You will probably find the exact power supply you need. And if you need a special type, Mallory will be glad to design and produce it for you in quantity to your requirements. Write for our latest Technical Bulletin for complete data.

Parts distributors in all major cities stock Mallory standard components for your convenience.

Serving Industry with These Products:

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BOOKS

(*Continued from page* 28)

parts are prepared to withstand the elements. Various methods of final assembly are discussed and 20 different photographs in this chapter take the reader within touching distance of half a dozen different models of airplanes from midget bombers to giant transports.

Transistors I

Published 1956 by Radio Corp. of America, RCA Laboratories, Princeton, N. J. 676 pages. Price $4.50.

Within RCA, there has been such extensive research and development work on transistors, semiconductors, and their applications that scientific and engineering reports have accumulated in an unprecedented manner. Only a part of this work has appeared in the literature.

This volume contains 31 papers (496 pages) which have not appeared elsewhere and 10 papers which have appeared in various periodicals. In addition, abstracts of 46 other RCA papers on the subject of transistors are given. Semiconductor diodes, as well as transistors, are encompassed by the word "transistor."

The book is arranged in 6 sections: General; Materials and Techniques; Devices; Fluctuation Noise; Test and Measurement Equipment; and Applications.

Typical papers cover the subjects of: fabrication by the melt-quench process; thermal conversion in germanium; junction power transistors; the drift transistor; noise factor; measuring equipment; audio amplifiers; oscillators; and counters.

Books Received

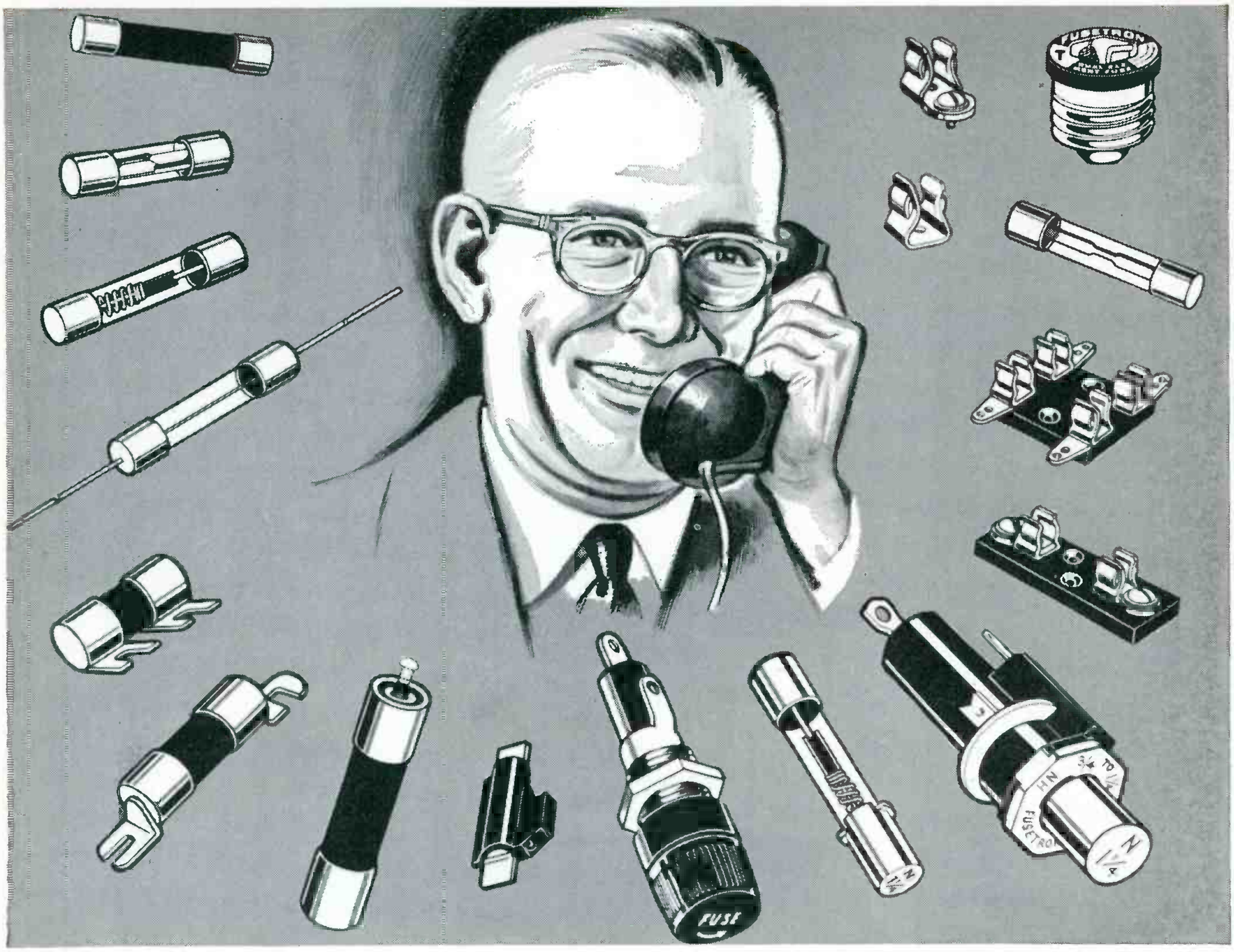
1955 Book of ASTM Standards, Part 6—Electrical Insulation, Electronic Materials, Plastics, and Rubber.

Published 1956 by American Society for Testing Materials, 1916 Race St., Philadelphia, Pa. 1776 pages, price $13.00.

Materials for electron tubes, formerly found in Part 2, have been added to this Part which includes 300 standards, 148 of which are new or have been revised since 1952.

Government-Industry Cooperation In Standardization

Published 1956 by the American Standards Association, 70 East 45th St., N. Y. 17, N. Y. 94 pages, paper bound, price $3.00. Contains 30 addresses by government and industrial leaders and military officials at the Sixth National Conference on Standards, Washington, D. C., in Oct. last year.



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To assure top quality and proper operation, — BUSS fuses are electronically tested. A sensitive device automatically rejects any fuse not correctly calibrated, properly constructed and right in all physical dimensions.

BUSS fuses, by their unfailing dependability, help safeguard the reputation of your product for quality and service.

When there is an electrical fault, BUSS fuses clear the circuit in time to prevent further damage to equipment. And just as important, BUSS fuses eliminate needless blows.

Users of your equipment get protection yet — they are not plagued with irritating, useless shutdowns caused by faulty fuses blowing needlessly.

With a complete line of "trouble-free" BUSS fuses available in all sizes and types, — it is just good business to standardize on BUSS fuses.

If your protection problem is unusual, you can save engineering time by letting the BUSS fuse engineers help you select the fuse or fuseholder best suited to your needs.

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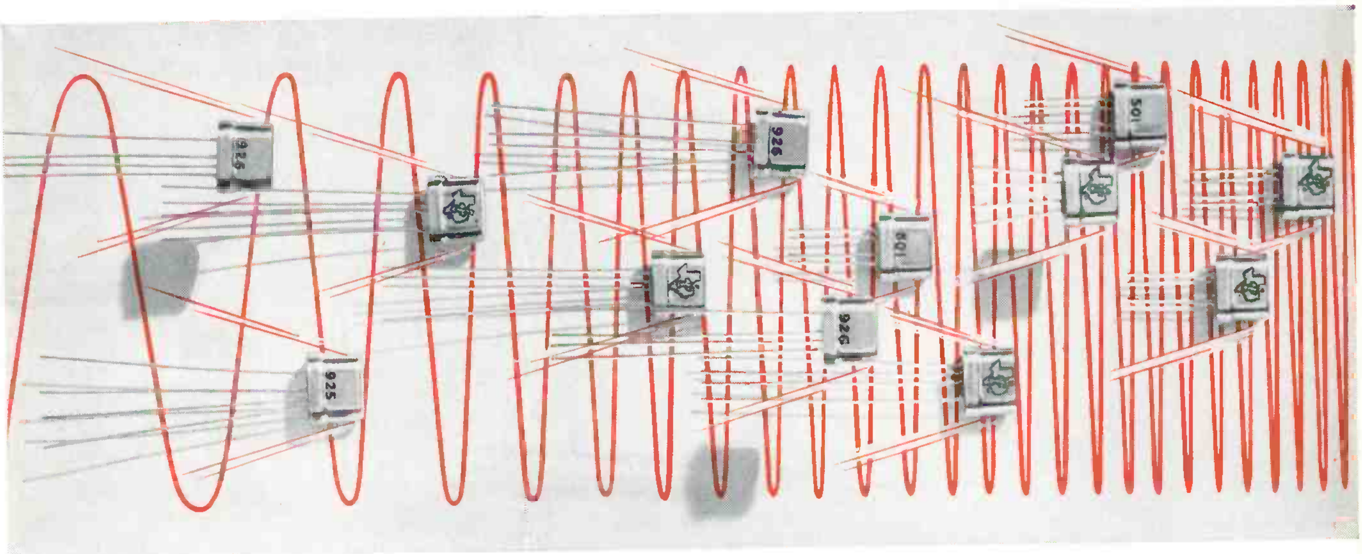
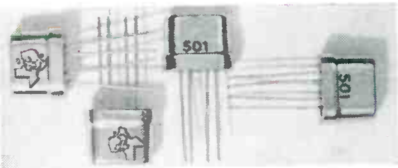
TEXAS INSTRUMENTS PROGRESS REPORT ON HIGH FREQUENCY

VHF transistors NOW!



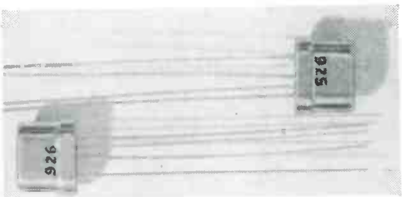
NEW 'GROWN-DIFFUSED' TYPES COMMERCIALLY AVAILABLE IN PRODUCTION QUANTITIES

HIGH GAIN VHF TRANSISTORS with usable power levels and band widths are now immediately available from Texas Instruments . . . another first for the leading producer of silicon and germanium transistors. Your design horizons are now extended to include all-transistor TV, FM, and VHF receivers . . . and transistorized amplifier, oscillator, or switching applications in communications, telemetering, or radar.



NEW VHF GERMANIUM TRANSISTOR

OSCILLATING FREQUENCY IS ABOVE 250 MEGACYCLES . . . alpha cutoff frequency is 200 mc. Typical gain is 12 db at 100 mc (unregenerative). This performance in a production transistor was unheard of prior to perfection of the "grown-diffused" method – an exclusive Texas Instruments technique.



NEW HF SILICON TRANSISTORS

FREQUENCIES TO 30 MEGACYCLES, rated 30 volts and 125° C, make these "grown-diffused" units ideal for high temperature military and commercial applications. They increase to 10 the types of silicon transistors now available from Texas Instruments, and represent the continual improvement in frequency, gain, and power made by the pioneer producer of silicon transistors.

OTHER NEW SEMICONDUCTOR DEVICES FROM TI

NEW HIGH POWER TRANSISTORS – 12-watt dissipation germanium power transistor and 8.75-watt dissipation silicon power transistor. NEW HIGH VOLTAGE RECTIFIERS – full wave and single junction half wave 1500-volt silicon units stable to 150° C. NEW HIGH CONDUCTANCE DIODES – 4 types of axial-lead silicon junction diodes with 100 ma forward currents and 0.1 μa back currents.

All these devices in production and available immediately. Write today!

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Electronic Industries News Briefs

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

EAST

AMERICAN RESEARCH CORP., Bristol, Conn., has broken ground for a new plant on U. S. Route 6 in Farmington, Conn. The new building, with 8500 sq. ft. of floor space, will include modern facilities for efficient production of altitude, temperature and humidity simulation devices.

CUSTOM HOUSE GUIDE, a 1688-page 1956 edition containing the latest U. S. rates of duty, U. S. Customs Regulations, and a complete listing of Customs Ports of Entry and their corresponding ports in Canada and Mexico, as well as other pertinent data for segments of the electronic industries interested in foreign trade, is now available at $25.00 plus postage per copy. Address: Box 7, Station P, Custom House, New York 4, N. Y.

DERIVATION AND TABULATION ASSOCIATES, INC., 67 Lawrenceville Ave., W. Orange, N. J., is a new firm organized to serve the growing need in the electronics industry for quick access to specific component data.

ALLEN B. DU MONT LABORATORIES, INC., Clifton, N. J., has received orders for 5 kw. transmitters from the Aroostook Broadcasting Corp., for WAGM-TV, Presque Isle, Me., and from the Dickinson Radio Assoc., for KDIX-TV, Dickinson, N. D.

GENERAL ELECTRIC CO., Syracuse, N. Y., has appointed Donald E. Garr as manager of the Industrial Electronics Laboratory, a new unit in the company's Laboratories Dept.

GENERAL PRECISION LABORATORY, INC., Pleasantville, N. Y., has signed a contract with the Appalachian Broadcasting Corp., for completely equipping WCYB-TV, Bristol, Va. Package includes 3 GPL Image Orthicon Camera Chains, 1 GPL 3-Vidicon Color Film Chain and a GE 35 kw. Transmitter and 3-Bay Antenna.

GENERAL ULTRASONICS CO., Hartford, Conn., has moved to a new enlarged plant at 67 Mulberry St., Hartford, Conn.

HIGH VOLTAGE ENGINEERING CORP., Cambridge, Mass., has announced that two complementary Van de Graaff supervoltage x-ray generators—one and two million volts respectively—will be used jointly in inspection of storage and pressure vessels and investigations of nuclear reactor chambers in a new facility being built in Birmingham, Ala., by Chicago Bridge and Iron Co.

IONICS, INC., Cambridge, Mass., has established a separate Nuclear Dept. under the leadership of Dr. Jack A. Marinsky, assistant director of research for Ionics.

KEYSTONE ELECTRONIC CO., Stamford, Conn., has acquired Electronic Enterprises, Inc., of Newark, N. J. Current plans call for Electronic remaining in Newark as a manufacturer of special purpose electronic tubes.

LORAL ELECTRONICS CORP., New York, N. Y., has broken ground for a new one story high and three city block long plant at Bronx River Ave. between Colgate and Story Aves.

NATIONAL ASSOCIATION OF RADIO AND TELEVISION BROADCASTERS, in testimony before the Senate Subcommittee on Labor, has proposed that the employees of radio and television stations located in communities with a population of less than 50,000, which fall outside of standard metropolitan areas, be exempt from the overtime provisions of the Fair Labor Standards Act.

SEALECTRO CORP., New Rochelle, N. Y., has opened a second plant at 610 Fayette Ave., Mamaroneck, N. Y.

SPERRY GYROSCOPE CO., Great Neck, N. Y., has announced development and delivery of precision engine control systems for advanced turbine-powered aircraft and guided missiles. Announcement of development of a wide range of advanced instrument systems for turbo and ram jet engines is expected shortly.

SQUARE D COMPANY, Detroit, Mich., is planning construction of an electrical equipment assembly plant in Atlanta, Ga., as the base of expanded operations in the southeast. Work on the 31,000 sq. ft. structure, involving an investment of $500,000, is scheduled to commence next month.

SYLVANIA ELECTRIC PRODUCTS, INC., New York, N. Y., has formed a new Applied Research Laboratory as part of the Waltham Laboratories of the company. Dr. Leonard S. Sheingold has been named manager of the new laboratory.

WESTON LABORATORIES, INC., has moved its operations from Harvard, Mass., to West Main St., Bolton, Mass. The new plant comprises a 10,000 sq. ft. building on a 47 acre tract.

MID-WEST

HARRIS-SEYBOLD CO., Cleveland, Ohio, has announced the purchase of Airtronic Research, Inc., electronics firm of Bethesda, Md.

ILLINOIS INSTITUTE OF TECHNOLOGY, Chicago, Ill., has broken ground for a classroom and laboratory building that will become the home of its depts. of electrical engineering and physics. It will be the 21st new building at the 110-acre Technology Center on Chicago's near south side.

MAGNAVOX CO., Fort Wayne, Ind., is increasing its warehouse operations throughout the country. A 20,000 sq. ft. warehouse and service building is under construction in Los Angeles, Calif., a new facility has been built in Teterboro, N. J., and additional warehouses have been built in Seattle, Wash., and in Jacksonville and Miami, Fla.

PENTRON CORP., Chicago, Ill., has acquired Ace Industries, Chicago screw machine company. The new combination is calculated to enable Pentron to expand its production capacity to meet the 30% sales increase anticipated for the balance of 1956.

PERFECTION MICA CO's. Magnetic Shield Div. has opened Plant No. 2 in Rochester, Ind. The 15,000 sq. ft. plant has new modern equipment for manufacturing Fernetic and Co-Neric shielding material.

WEST

AMPLI-VISION DIV. of International Telemeter Corp., Los Angeles, Calif., has obtained exclusive distribution rights in the U. S. of a complete line of coaxial cables, manufactured by Telcon—the Telegraph Construction & Maintenance Co., Ltd., of Great Britain.

CONVAIR DIV. of the General Dynamics Corp., San Diego, Calif., will construct a new facility at Sorrento, Calif., to be used for development and production of a guided missile system. This site was selected because of its proximity to the Air Force Test Site at Sycamore Canyon and remote enough from other San Diego defense activities to meet technical and strategic requirements. Construction of facilities and equipment will cost approx. $40 million.

ELECTROMATION CO., Burbank, Calif., has purchased patents, tooling and an inventory of co-axial switches and other microwave products, and the corporate structure including the name of the Cado Manufacturing Co., Santa Monica, Calif.

LOGISTICS RESEARCH, INC., Redondo Beach, Calif., announces that the ALWAC 800 Series Electronic Data Processing System has a speed, storage capacity, and versatility at least equal to million dollar computing systems. The new system sells for approx. $125 thousand.

MAGNETIC AMPLIFIERS, INC., New York, N. Y., has established its West Coast Div. at 136 Washington St., El Segundo, Calif. General offices will continue to be located in the New York plant.

ROBERTSHAW-FULTON CONTROLS CO. is constructing a new laboratory building at its Aeronautical Div., Anaheim, Calif., to provide increased space and facilities for apparatus suitable for guided missile applications.

WYCO METAL PRODUCTS, North Hollywood, Calif., has announced expansion of existing plant facilities and the creation of two new customer service depts. A portion of the additional space will be devoted to warehousing and the balance to manufacturing facilities.

FOREIGN

OFFICINE GALILEO di MILANO s.p.a., Milan, Italy, producer of precision devices, has been licensed to manufacture the Lear gyroscopic system for indicating the attitude of an aircraft in flight.

LENKURT ELECTRIC CO. of CANADA, LTD., has officially opened its new 15,000 sq. ft. office and factory building at Burnaby, British Columbia. The new building, twice as large as the previous Lenkurt location in Vancouver, was designed for easy addition of space to accommodate increasing production.

SUN LIFE ASSURANCE CO. of Montreal, Canada, will install, in its head office, a Univac II "giant brain" electronic computer built by the Remington Rand Univac Div. of Sperry Rand Corp. This computer, scheduled to be in operation by March, 1957, will be the first such installation by any life insurance company or other industry anywhere in Canada.

. . . for crowded panels and dashboards . . SPACE-SAVER CONTROLS

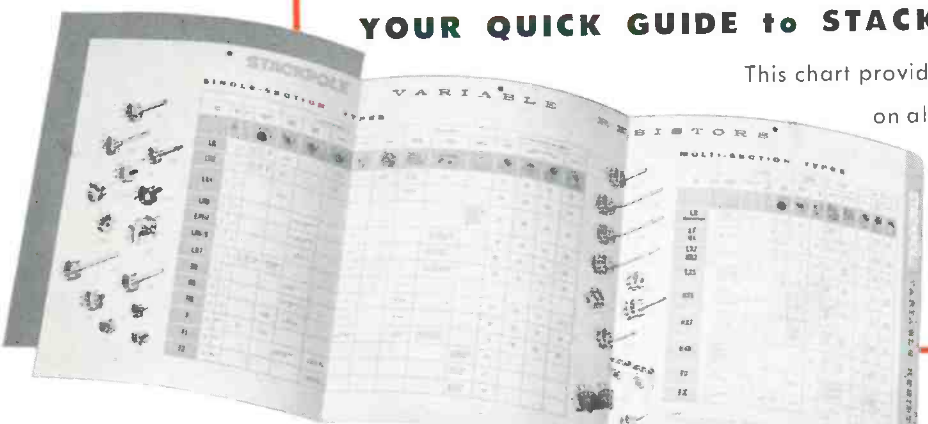
TYPES for TRANSISTORIZED SETS, too!

Similar to standard Stackpole miniature "F" Controls, but designed for low hop-off on the order of 2.0 ohm maximum, as compared to the higher values of conventional types. And they're electrically quiet!

ONLY 0.637" in diameter, Stackpole "F" controls combine quiet, dependable operation with the smaller physical size needed for automotive radios and similar equipment now undergoing miniaturization.

"F" Controls are conservatively rated at 0.3-watt for values up to 10K ohms, and at 0.2-watt for higher values. Each can be equipped with new Stackpole "B"-Series line switches for practically any switching arrangement. Standard mounting types suffice in most cases—but where they don't, suitable adaptations can be produced economically for quantity users.

ENGINEERING SAMPLES *available to quantity users . . .*
Ask the Stackpole field engineer in your locality



YOUR QUICK GUIDE to STACKPOLE CONTROLS

This chart provides essential engineering data on all standard Stackpole Variable Resistors in handiest possible form. Designed for either wall or file use. Write today for your copy.

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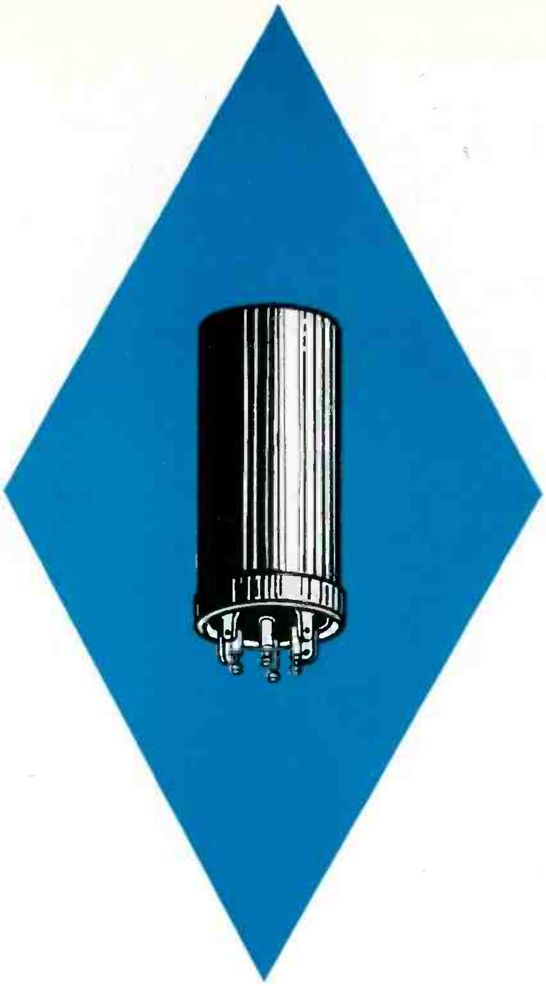

EXTENDED LIFE ELECTROLYTIC CAPACITORS

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computers
laboratory test instruments
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other electronic applications

HERE ARE CAPACITORS OF THE SAME *MAXIMUM RELIABILITY* which Sprague has long supplied to the telephone systems . . . now available for your own high reliability electronic applications.

The use of especially high purity materials . . . utmost care in manufacture, constant observation and quality control of all operations have made Sprague Extended Life Capacitors outstanding for their long life and faultless performance.

Type 17D Extended Life Electrolytics have turret terminals and twist-mounting lugs. A special vent construction is molded right into the cover, as are the numbers identifying each terminal. The aluminum cans are covered with a corrosion-resisting insulating coating.

Nineteen standard ratings, all characterized by low maximum leakage current and remarkable life test capabilities are available in the new series. Complete technical data are in Engineering Bulletin 340, available on letterhead request to the Technical Literature Section, Sprague Electric Company, 233 Marshall Street, North Adams, Massachusetts.

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TELE-TECH &

ELECTRONIC INDUSTRIES

M. CLEMENTS, Publisher ★ O. H. CALDWELL, Editorial Consultant ★ B. F. OSBAHR, Editor

The Importance of Avionics

YEAR by year, almost month by month, we see intensified specialization splitting the electronics field into more specialized groups. One of the rapidly growing groups, Aeronautical Electronics, is expanding in breadth, in numbers, in dollars and in importance. To get a true perspective we must ponder some facts.

Electronics is now a full partner with aeronautical engineering and as such must provide safety and reliability in flight with high-performance, lightweight equipment. Not an easy order to fill. There will be increased use of airborne radar and infra-red to see objects at great distances, day and night. Electronic computers, with speed and accuracy, will perform calculations humanly impossible under flying conditions. Refinements in fire control, IFF and other systems essential for military planes must not be forgotten. Automatic devices will provide new aids for the pilot.

On the ground Aviation Electronics has been making strides in communication, radar, early warning systems, air defense, navigation and traffic control to meet rapidly increasing aviation activity. All of this mounts up to a growing multibillion dollar section of the electronic industry.

The seriousness of the Soviet's challenge to us in the air and in the nuclear field is just beginning to be realized. To keep ahead we need: money, facilities, personnel. The first, money, should come both from the public coffers and investment in private industry; the second need comprises specialized research and development facilities; the last and most important refers to the large number of scientists and engineers that are needed, together with farsighted leaders who can plan, organize and manage, preferably with a minimum of duplication, our national endeavor in this important field.

From where will the scientific manpower come to fill this critical need? For the near-term, probably from other branches of electronics; for the long-term from educating present college and high school students who, alerted to the opportunities such as those in Avionics, choose engineering courses.

To maintain the momentum of this entire program, so important to our nation, our technically-minded readers must inform and influence the thinking public with the object that America continues supreme in the air.

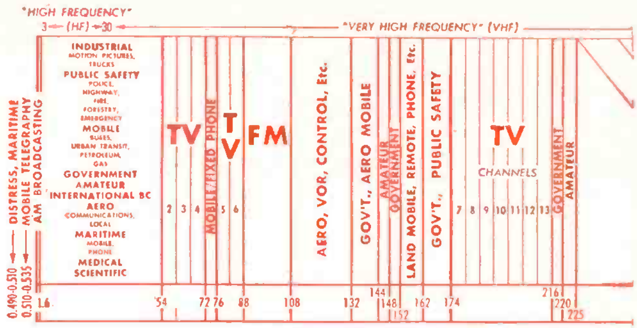
Test Equipment for Rent?

IN one of our recent field trips we noted one medium sized electronic equipment manufacturer employing engineers on a two shift basis in their research and developmental laboratories. Inquiries revealed that this procedure was being followed to avoid additional capital investment in electronic test instruments and equipment since the unit cost for such precision apparatus is quite high. Over an extended period of time, the manufacturer reports, it has proven less costly to operate in this fashion since only essential equipment is purchased and very little becomes obsolete when the work assignment has been completed.

We all realize, of course, that there are situations in research and development programs where such a policy would be unworkable. This is true particularly where measurements have to be made over an extended period of time and set-up and dismantling times are reckonable factors. But with the ever increasing growth of the electronic industries, and with the numerical predominance of small and medium sized manufacturers, we believe a test equipment rental program for electronic equipment manufacturers might prove extremely lucrative.

One test equipment manufacturer is already embarking on a program to provide a complete instrumentation service to organizations outside the electronic industries for process controls, etc. Here the buyer outlines his problems and the instrument maker develops, designs and builds a package for the job. It's but a small step for this company to broaden its base into basic test equipment repair and rental services for research and development installations. It could go even further by offering equipment for production testing and quality control. In any event, test equipment manufacturers might do well to consider such new programs in their future sales planning. We will gladly present comments and suggestions on these ideas in future columns from both the manufacturers and users of test equipment.

RADARSCOPE



Revealing important developments and trends throughout the spectrum for radio, TV and electronic research, manufacturing and operation

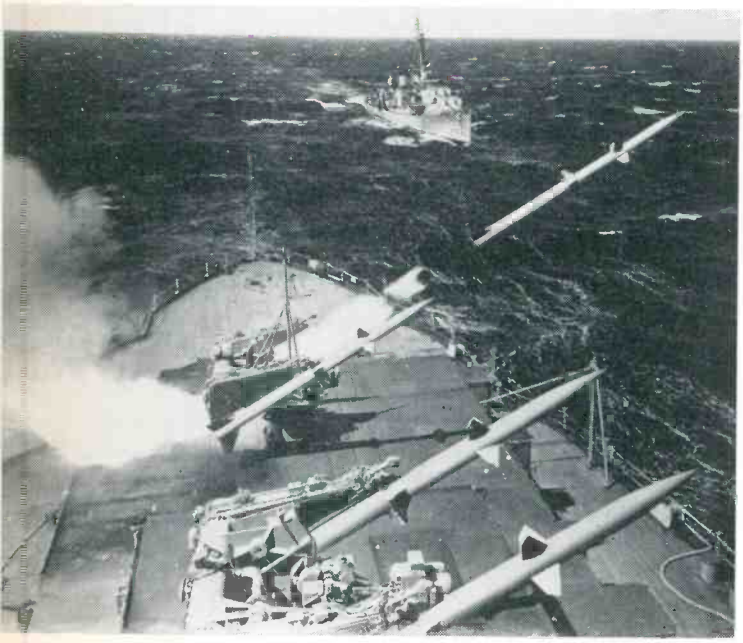
CONSENSUS of unofficial opinion is that sales of the present semi-portable TV sets should reach a sales peak of 5 million sets in 1957.

RUSSIAN LANGUAGE TRANSLATOR will be developed for the Air Force by International Telemeter Corp. Contract awarded last month is for an information storage unit to be used for translating Russian technical journals and papers.

PRICE OF COPPER is unlikely to rise in 1956. In fact, slight price reductions are anticipated for the latter part of the year.

TREND TO AUTOMATION is emphasized by new industry estimates that more than 50% of new plant construction now under way is associated with the need to cut costs through more efficient and automatic production.

SEA-GOING MISSILES



Navy's "Terrier" guided missiles are shown being launched from the deck of the U.S.S. Mississippi. Built by Convair Div. of General Dynamic Corp., for the Navy's BuOrd, Terrier is the Service's prime surface-to-air missile, designed to intercept aircraft at longer range and higher altitudes than conventional aircraft guns

MAJOR BREAK in the transistor price structure may follow GE's announcement of a 27% cut in the price of ten new entertainment type transistors. Cuts were effective June 1. Looking beyond the price reduction per unit sufficient price reductions can also be seen for transistorized portables.

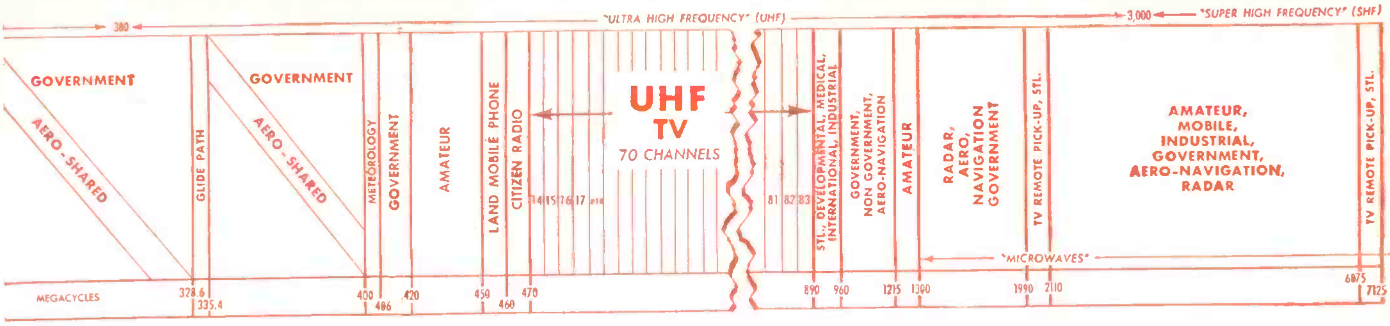
FIERCE COMPETITION developing over new portable model TV receivers, with virtually all major manufacturers now producing the light weight units. Special inducements are being employed. Admiral this month makes available a unique $12.95 full year service contract on their 10-in. portable TV receivers. Gimmick is that receiver must be delivered to an Admiral distributor's service department, and picked up when repaired—no real problem to the consumer, in view of the weight.

ELECTRONIC WATCH of the future will be run by radio impulses, according to spokesmen for the watch industry. The new time pieces, which are expected to be available within ten years, are expected to be much simpler and easier to manufacture than present models.

WEST COAST has seen a four-fold increase in population since 1915, a ten-fold increase in telephones and an almost fifty-fold increase in telephone toll circuit millage.

RESEARCH aimed at developing heat-resistant metals is turning up interesting data on the behavior of the materials commonly used in electron tubes. Scientists find that when filaments of barium oxide and strontium oxide are exposed to heat they behave in different ways. The barium oxide vaporizes as a molecule of barium oxide while the strontium oxide turns into a gas composed of separate atoms of strontium and oxygen.

THE POSSIBILITY of hundreds, perhaps even thousands, of TV translation stations that will furnish video service to villages and cross roads communities throughout the nation is afforded by the recent FCC authorization to permit the establishment of translator stations effective July 2. Translator equipment is expected to cost approximately $1,000 and the translator stations must operate without interference to any existing radio service.



LOOK FOR increased use of metal-foil type construction of inductors, transformers and capacitors. In addition to their desirable electrical properties they are also particularly suitable for production on automatic machinery. The military just recently awarded a large two-part contract to a top electronics firm and a production machinery mfr. to develop design and production methods for the new technique.

STRONG OPPOSITION will be felt to any attempts at reallocation of the 88-108 megacycle frequencies—the commercial FM band. The FM broadcasters last month formally announced the organization of a new group, "FM Broadcasters," to protect their interests at any reallocation hearings.

NEW THERMISTOR MATERIALS having large positive temperature coefficient have been developed at Bell Labs. One material reportedly has a positive temperature coefficient from about –50°C to 110°C, the coefficient reaching the value as high as 9% per degree C.

NEW EARTH SATELLITE PROGRAM is expected to provide information on atmospheric conditions that will greatly hasten the day of transatlantic TV broadcasting. O. Hugo Schuck, director of aeronautical research of Minneapolis-Honeywell, points out that the wealth of new information on the ionosphere and the magnetic disturbances caused by sun spots which will result from the project may provide a completely new approach to long range TV reception. It may be possible to bounce TV waves off atmospheric layers around the curvature of the earth, avoiding the known atmospheric disturbances.

MATERIALS

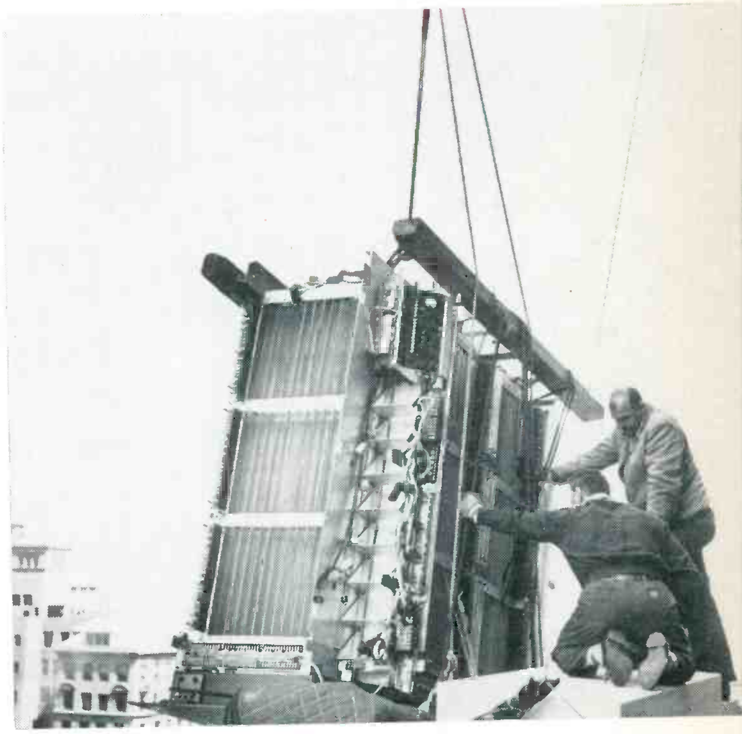
WAR TIME CONTROLS on the distribution of nickel, proposed last month, were vigorously opposed by the Office of Defense and the Commerce Department. It thus becomes unlikely that any rigid controls will be imposed on nickel in the near future, but the Commerce Department is planning a comprehensive study of the nickel situation.

NEW SHEET METAL from Zircon, resistant to hydrochloric acid and lighter than steel but slightly lighter than titanium has been developed by Krupp in Germany. It is used extensively in construction of electron tubes and nuclear reactors.

RESEARCH

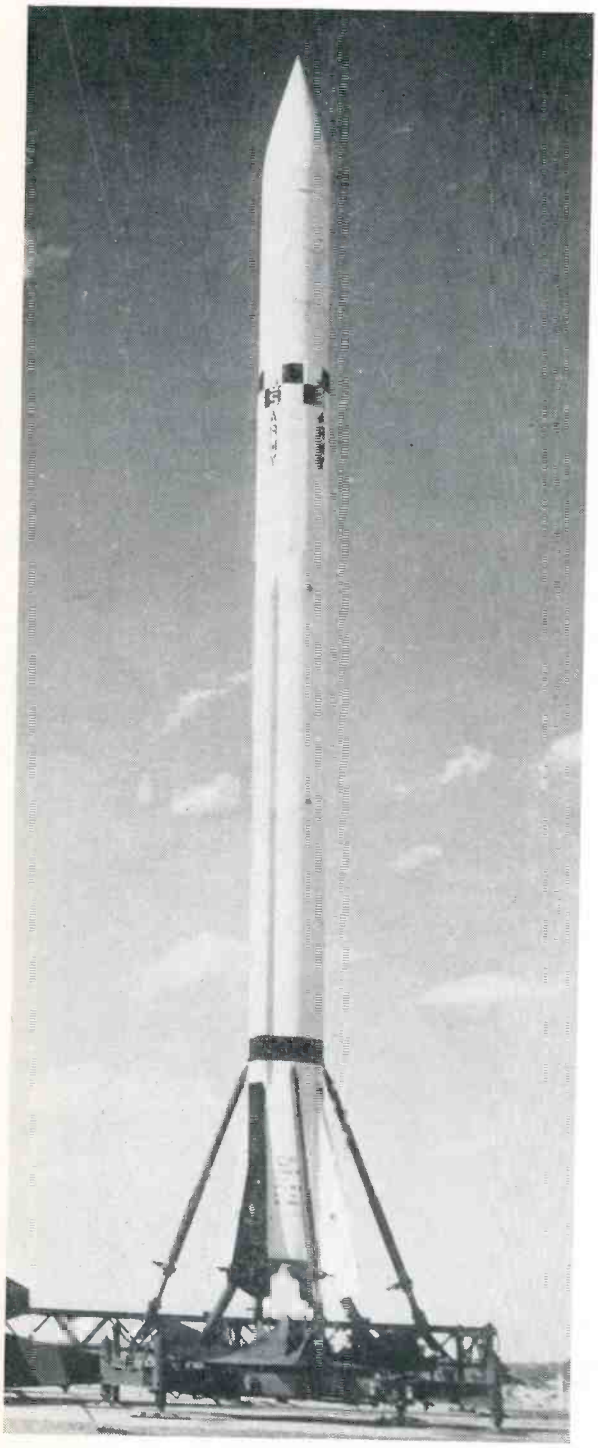
ULTRASONIC X-RAYS that provide pictures of man's internal organs is the latest tool for medical research. At present state of the art pictures taken with sound show with relative clearness outlines of such structures as skeletons, kidney and bone structures of the hand. Since they are not using reflected light rays they can work in dark places. They can be focused for certain depths and will send back only information from that depth. In operation, objects to be "X-rayed" must be submerged in water. Piezo electric parts crystals are placed, like flood lights, opposite the object to be photographed. Reflected sound waves are caught by sonic lenses. A simple transducer crystal converts the sound to an electric field whose variations duplicate the sound image being reflected from the object.

HIGH-FLYING COMPUTER



Problem of delivering the bulkier elements of a Remington Rand Univac computer to the New York office of Metropolitan Life Insurance Co. is solved by hoisting them from trucks through a 20th-floor window 273 feet above street level

High "G" Tests for Guided Missile



Corporal, long range guided missile, capable of carrying nuclear war head against surface targets

A study aimed at reducing vibrational noise in missile tubes shows improvements result from shorter tube structure, doubled mica spacers, and special cathode clamping. A test method using a 10 g accelerator and a graphic recorder of noise power vs frequency is described

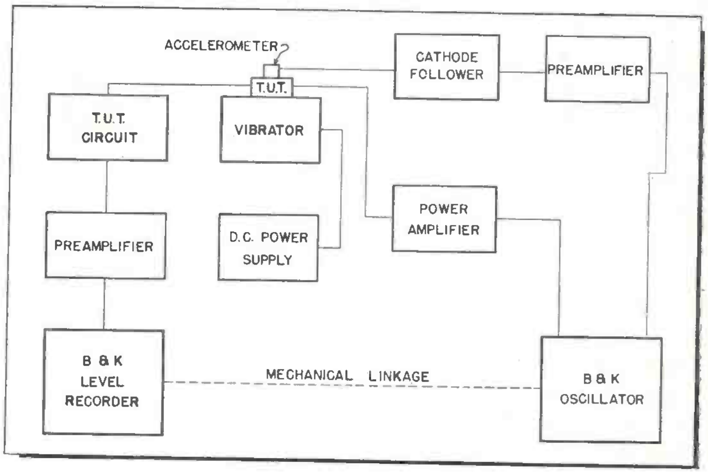
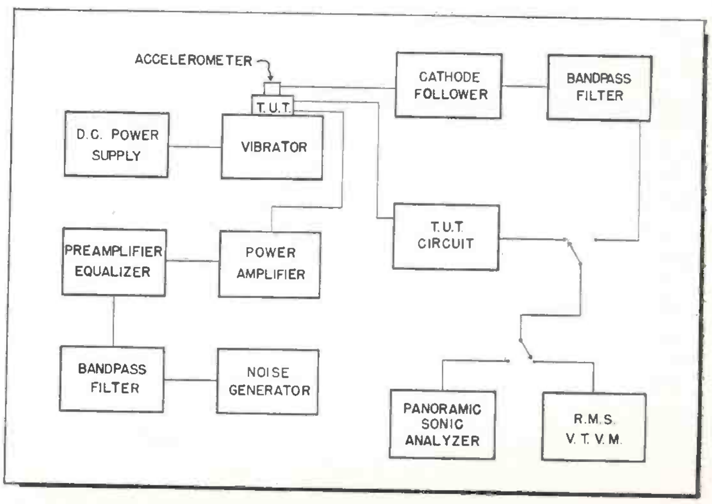


Fig. 1: "Swept frequency" test

Fig. 2: "White noise" test



Tubes

By M. F. McKEIRNAN
Divisional Quality Staff,
Sylvania Electric Products,
Emporium, Pa.

VACUUM tubes used in guided missiles must operate reliably and with low noise output despite severe vibration and shock. These conditions have been a major consideration in developing a line of guided missile tubes under Bureau of Ships Contract NObs-5359.

A survey of missile manufacturers' requirements reveals that some tubes may be exposed to accelerations of 30 to 50 g's at 100 cps and 4000 cps during motor burning. Other applications involve accelerations of 5 g's at 300 cps or 10 to 20 g's over a frequency range of 0 to 2500 cps. As an approach to vibration testing of tubes for guided missiles, a frequency range of 50 to 5,000 cps at an acceleration level of 10 g's was adopted.

Before selecting the noise measurement methods to be employed, a study was made of tube usage in available missile and telemetering applications in order to examine the effects of vibrational noise on system performance. In two missiles of interest, filtering was employed to reduce high frequency noise, therefore the low frequency noise would be of primary importance. In another missile, and in telemetering circuits reviewed, low frequency noise would also be of primary importance; but these two systems would also be responsive to higher frequency noise. In general, noise voltage peaks affect the operation of range gates, decoders, gated circuits, and commutator type telemeter. They could cause BTO jitter, excessive AGC, or limiter saturation. Noise power could affect the operation of electromechanical devices such as servos, relays, and timers. Flicker shorts induced by vibration may upset the operation of the entire electronic system.

Test Equipment

Older methods of vibration testing were inadequate, and it was necessary to develop equipment to provide the desired vibratory conditions. An electromechanical transducer was constructed that was capable of generating sine-wave vibration at 10 g's acceleration for a frequency range of 50-5,000 cps. The design, similar to one by the National Bureau of Standards, has a helical coil armature moving in a constant magnetic field. This transducer is used in two different test systems. In one system the tube is vibrated sinusoidally at essentially constant g levels as the frequency is swept across a specified bandwidth. The second system provides random vibration throughout a specific frequency spectrum. This is called the "white noise" vibration test.

For the "swept frequency" test, a Bruel and Kjaer level recorder and a beat frequency oscillator are used in conjunction with the vibrator. This combination produces a graphic record of noise power versus frequency of vibration for the tube under test. Fig. 1 shows a block diagram of the test circuit. Using batteries for heater and B+ supplies reduced background noise to 0.2 mv rms.

A "white noise" test set was assembled for the second test method. Fig. 2 shows the block diagram for the complete circuit. The noise generator uses a Type 6D4 tube as the noise source. Various peaking and clipping circuits are used to obtain a uniform, continuous noise spectrum. This noise voltage is fed to the armature coil after passing through a bandpass filter for establishing the upper and lower frequencies, through a preamplifier for shaping the spectrum, and through a power amplifier for obtaining the drive required for the desired magnitude of acceleration.

Fig. 3: Noise at 60 cps vibration

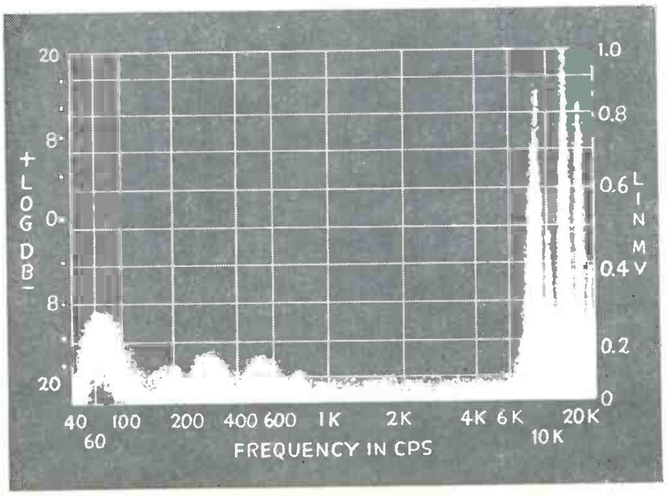
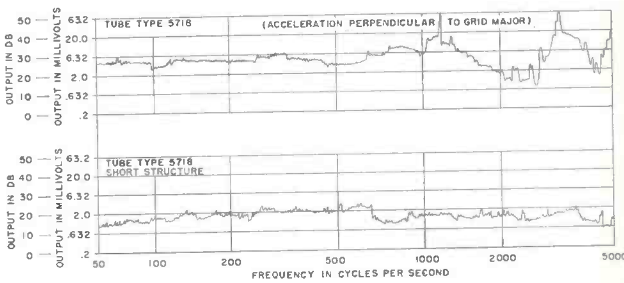


Fig. 4: Short structure cuts noise



CHARACTERISTICS

TUBE TYPE	Ib	Gm	Mu	PULSE EMISSION
5718	8 5	5800	27	536
5718 SHORT STRUCTURE	7.3	4350	32.3	425

High "G" Tests *(continued)*

For this work, the acceleration spectrum has been shaped so that vibrational energy per octave is constant. This distribution is believed to be more useful than one which has equal energy per cycle over the frequency band range of interest. This type of test is still in the experimental stage but some data of interest has been obtained. The tube noise can be measured with a vacuum tube voltmeter or it can be examined on a sonic analyzer. The meter reading is simple and easy, and there is only a single value to be appraised. This reading, however, gives no information about the frequencies of resonance or of output. The sonic analyzer clearly points out the frequencies and magnitudes of the dominant components in the noise output.

It is of importance, before proceeding further, to examine vibrational noise output in terms of frequency components and other associated parameters. This knowledge is essential in determining what type of indicating device is best suited for noise measurement purposes. Fig. 3 shows the frequency spectrum of the noise output of a tube being excited by a single fixed frequency. It can be seen that the noise output has a moderate peak at the fundamental frequency, 60 cycles, and then peaks of similar magnitude at multiples of this frequency, plus other components through the frequency range. From about 6,000 cps to 20,000 cps a rather high level of noise is indicated. In terms of noise measurement, this spectrum is of the utmost importance. The two currently favored systems of noise measurement are the rms meter and the peak-to-peak meter.

Referring back to the frequency spectrum requirements of the missile manufacturer, it was noted that 5,000 cps was a reasonable upper limit. In other words, the majority of the circuits are relatively insensitive to noise voltages whose frequency exceeds 5,000 cps. But the normal method of determining acceptable and non-acceptable tubes makes no distinction between frequencies above and below 5,000 cps. It can thus be seen that a tube having excessive low frequency noise and low high frequency noise might be adjudged acceptable even though it may be unacceptable in the field. Of course, the converse is also true. The difference between the peak-to-peak and rms meters would appear to lie in their resolution time and integrating circuits. Neither system is adaptable to this type of

(*Continued on page* 114)

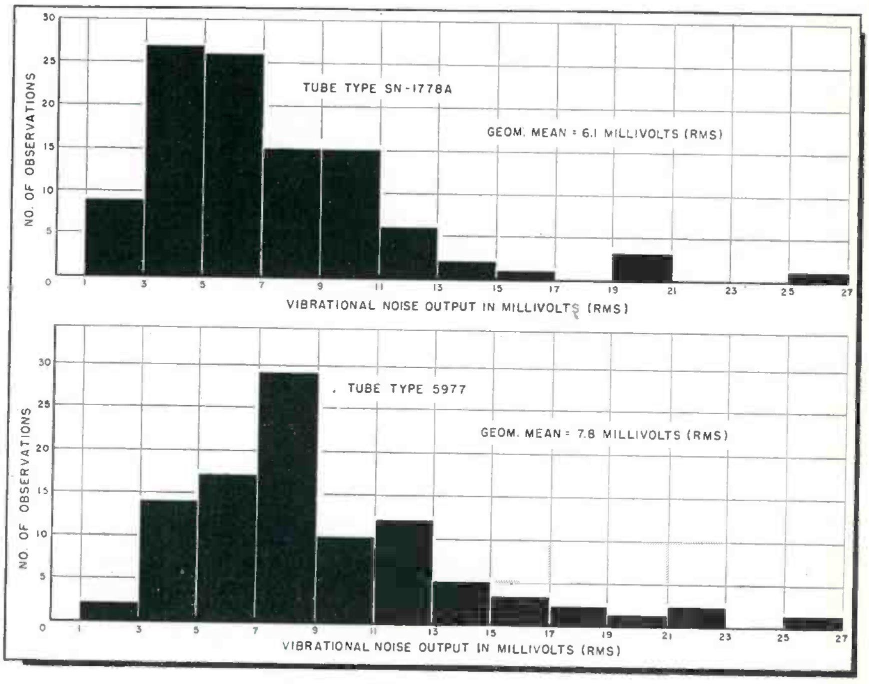


Fig. 7: "White noise" analysis

Fig. 5: SN-1778A has double micas

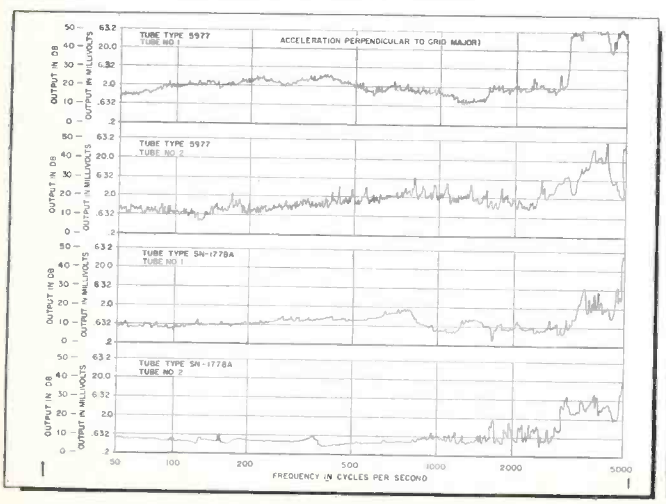
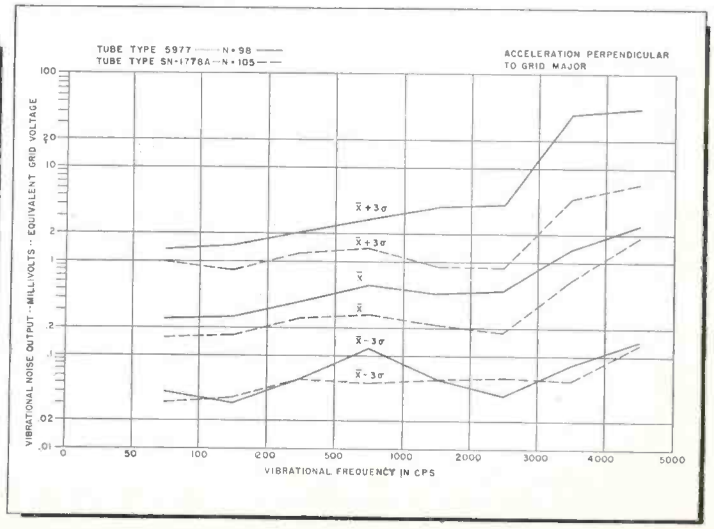


Fig. 6: "Swept frequency" analysis



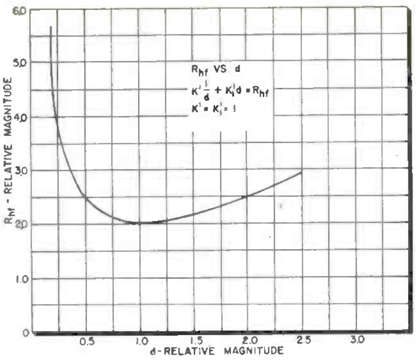
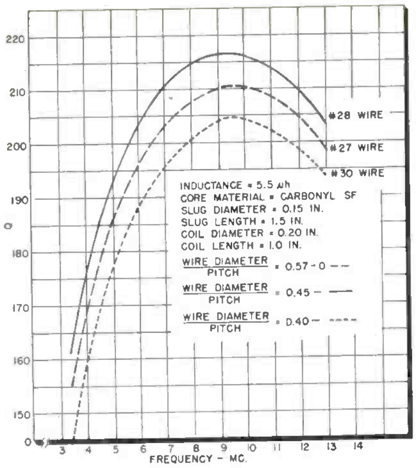
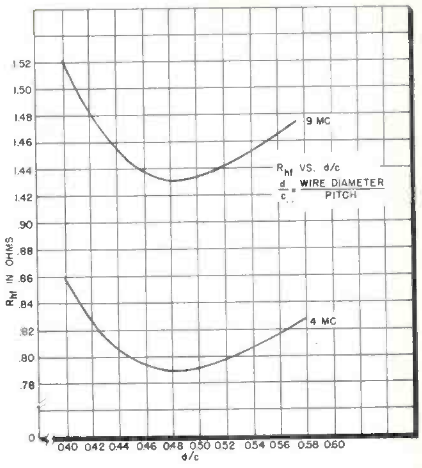


Fig. 1: Experimental curves for wire loss





"Q" Calculations for High Frequency Inductors

Equations have been developed for calculating the merit factor of h-f iron-core or air-core inductors of known dimensions and materials. Derivation of the equations is presented here, with data and examples covering all practical designs in the 5 to 60 MC range

By R. J. SCHULTE

COIL designers and r-f circuitry engineers, for some time, have felt the need of an equation whereby the merit factor of a high frequency air cored or iron cored inductor, of given dimensions and materials, could be calculated. After a great deal of reading and experimentation the author has developed an equation which works quite well for the optimum conditions of a given winding for an unshielded unit. The accuracy is within approximately 10%.

In the examples discussed here it will be assumed that the wire diameter to current depth of penetration ratio is greater than five. This takes into account almost all practical designs above 5 MC. 60 MC. is the approximate upper limit for the advantageous use of presently available powdered iron for other than a tuning means.

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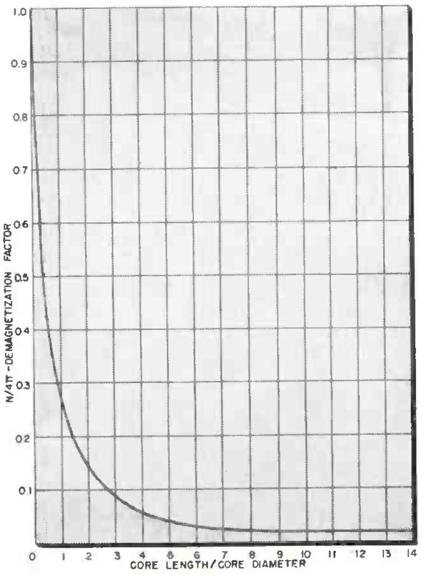
The expression for merit factor or Q is indicated below:

$$Q = \frac{2\pi f L}{R} \qquad (1)$$

Fig. 2: Demagnetization curves For iron core inductors



Where:

f = frequency in cycles per second

L = inductance in henries

R = effective resistance in ohms

Our first step will be to develop an expression for inductance. The air core inductance of a solenoid can be calculated quite accurately as long as the wire diameter to pitch ratio is greater than approximately 0.3. The expression is indicated below:

$$L = \frac{4\pi^2 N^2 r_w^2 k_n}{l} 10^{-9} \qquad (2)$$

Where:

N = Number of turns.

r_w = Mean radius of winding in Cm.

l = Length of winding in Cm.

k_n = Nagoaka constant

We are also dealing with iron cored inductors, so in this case the expression will have to be expanded to include the inductance ratio. Dr. Bozarth has shown the effects of the demagnetization factor in his book entitled "Ferromagnetism". A plot of demagnetization factor,

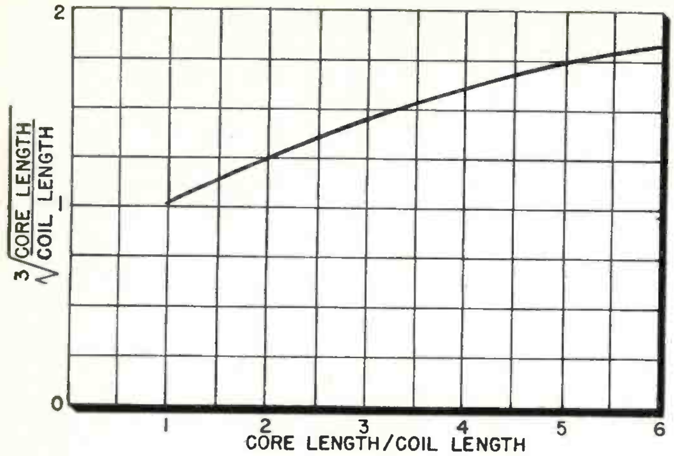
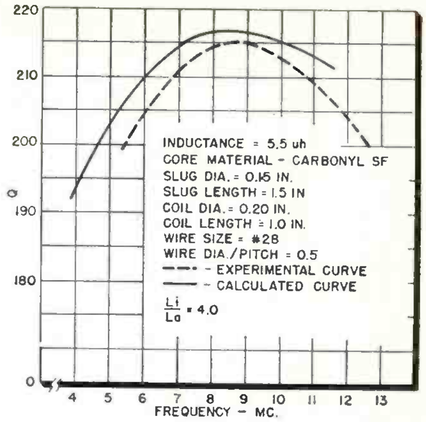


Fig. 3: (L) Calc. curve for long slugs

Fig. 5: (R) Experimental check, Q vs MC



"Q" Calculations *(continued)*

N/4π for several length to diameter ratios of cores, is shown in Fig. 2.

Dr. Bozarth has shown the effective permeability of a slug can be calculated from the following equation.

$$\frac{1}{\mu_r} = \frac{1}{\mu_e} - \frac{N}{4\pi} \qquad (3)$$

Where:

μ_r = Ring permeability of core material

μ_e = Effective permeability of slug

$N/4\pi$ = Demagnetization factor

This expression was intended for calculations of conditions of core length and winding length being equal. This may not be the case, for experiments performed by the author show the possibility of raising the Q appreciably in a good many instances by making the winding approximately 0.7 the length of the core. Observe Figs. 9 and 11. Therefore, we must have an expression for calculation of the effective permeability of a slug longer than the winding. W. J. Polydoroff and A. J. Klapperick developed the expression indicated below:

$$\mu'_e = \mu_e \sqrt[3]{L'/l} \qquad (4)$$

Where:

μ'_e = Effective permeability of slug longer than winding

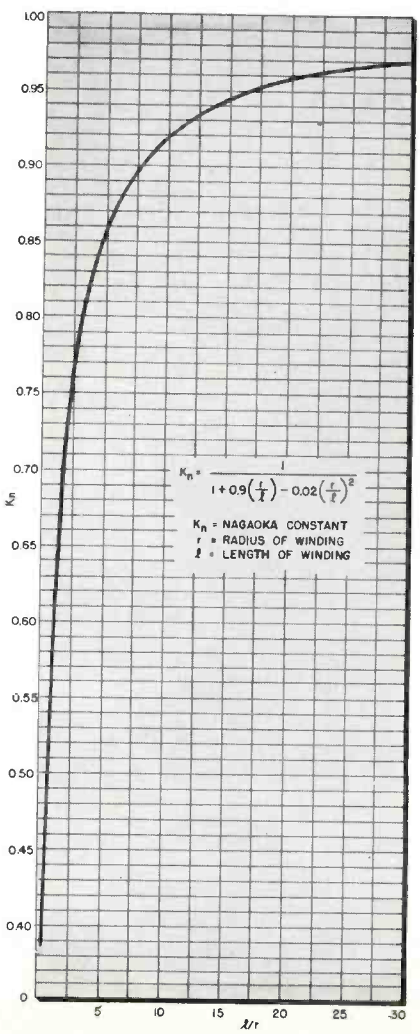
μ_e = Effective permeability of slug as long as winding

L' = Core length in cm.

For ease of calculation observe Fig. 3. Experiments included in this article and in Fig. 11 show this expression to work under the conditions described in the examples of calculations.

The cross-sectional area of the core is not equal to the cross-sectional area of the winding; therefore, this must be accounted for in the expression for the inductance ratio. The expression is indicated below:

Fig. 4: Nagoaka's constant is a function of winding length and diameter



Inductance ratio =

$$\left[1 + \left(\frac{di}{dw}\right)^2 (\mu - 1)\right] \qquad (5)$$

Where:

di = Diameter of iron slug

dw = Mean diameter of winding

$\mu = \mu_e$ or μ'_e whichever the case may be

A plot of Nagoaka's constant versus length to diameter ratio of winding is given in Fig. 4.

We now have an expression for the numerator of the Q equation. Our next step is to obtain an expression for the denominator or effective resistance. We shall make the assumption the predominate losses of our inductors are copper losses in the winding and eddy current loss in the core material. The dielectric loss should be relatively small unless the solenoid has a diameter greater than about a centimeter and the Q is approximately 175 or greater.

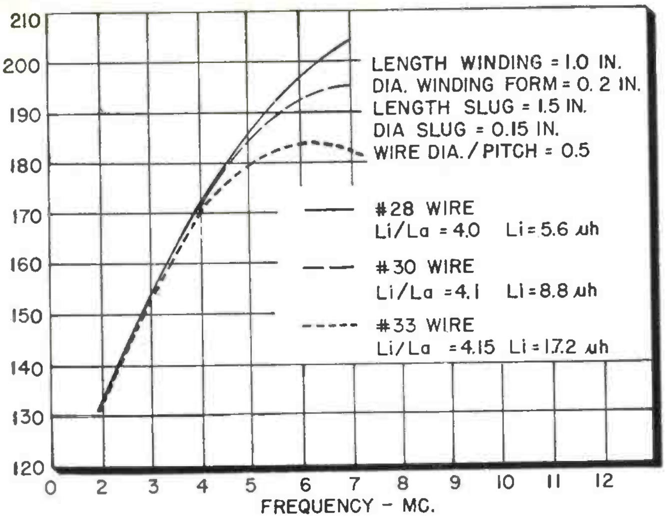
The resistance of a straight solid wire will be considered first. V.G. Welsby has shown the high frequency resistance to be nearly equal to $R_{hf} = \frac{1}{4} R_{dc} \left(\frac{d}{\delta}\right)$ (6) provided $\frac{d}{\delta}$ is greater than 5, δ for copper wire can be calculated by

$$\delta = \frac{6.6}{\sqrt{f}} \qquad (7)$$

$$R_{hf} = \frac{1}{4} \frac{\rho m}{\frac{\pi d^2}{4}} \frac{d}{\delta} = \frac{\rho m}{\pi d} \frac{1}{\delta} \qquad (8)$$

$$R_{hf} = \frac{\rho N \pi dw}{\pi d} \frac{1}{\delta} = \frac{\rho N dw}{d} \frac{1}{\delta} \qquad (9)$$

$$R_{hf} = \frac{\rho N\, dw}{d} \frac{\sqrt{f}}{6.6} \qquad (10)$$



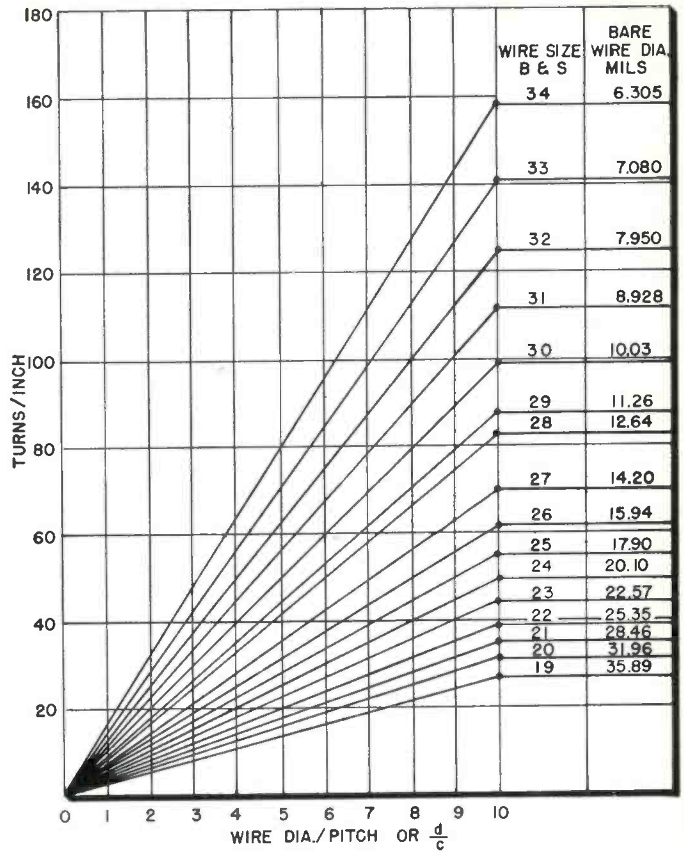


Fig. 6: (Above) Q vs MC, example No. 2

Fig. 8 (R) Data for Q calculations

Where:

R_{hf} = High frequency resistance

R_{dc} = Resistance of wire to direct current

d = Diameter of wire in Cm.

δ = Depth of current penetration in Cm.

f = Frequency in cps

m = Length of wire in Cm.

ρ = Resistance of 1 Sq. Cm. of copper 1 Cm. long 0.0172×10^{-4}

This expression will be valid for a loop of wire provided the loop diameter is large compared to the wire diameter.

Winding Loss

The winding loss will be influenced by the complex field of the solenoid. This additional loss is known as proximity loss. Butterworth has shown that the loss of a circular wire cut by a perpendicular field will have a certain amount of energy dissipated in it. The equation follows:

Wattage dissipation =

$$\frac{R_{dc}\, d^2\, H^2\, G\, 10^2}{4} \qquad (11)$$

Where:

H = rms intensity over each cycle

G = Approximately $1/8\ d/\delta$ for wire diameter/depth of current penetration greater than 5.

K, K_1, K_2, K'_1, and K' are constants.

The perpendicular field cutting the winding can be considered constant over one turn of the winding.

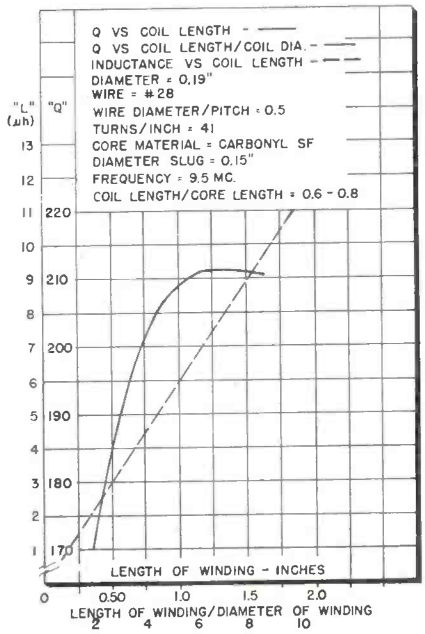
Wattage dissipation for one turn could be expressed as indicated below:

$$W.\ D. = \frac{\frac{1}{4}\ \frac{\rho\, m d^2}{\frac{\pi d^2}{4}}\ \frac{H^2 d}{8\,\delta}}{}$$

$$= \frac{\rho\, m\, H^2\, d}{\pi \cdot 8 \cdot \frac{6.6}{\sqrt{f}}} = K\, d\sqrt{f} \qquad (12)$$

$R_{hf} = K_1\, d\sqrt{f}$ ohms due to proximity effect of one turn. The loss in various turns will differ, but the total resistance due to proximity loss can be expressed as $K_2\, d\sqrt{f}$.

Fig. 7: Q for long coils



The total copper losses of the winding can be expressed as indicated below for the length of wire will remain constant for a given winding.

$$R_{hf} = K'\frac{1}{d} + K_1' d \qquad (13)$$

$$\frac{d\,R_{hf}}{d\,d} = -K' d^{-2} + K_1' \qquad (14)$$

$$\text{Let } \frac{d\,R_{hf}}{d\,d} = 0 \qquad (15)$$

$$\text{Then } K_1' = K' d^{-2} \qquad (16)$$

The differentiation shows the minimum condition occurs when the two losses are equal. The intensity of the magnetic field cutting the winding will vary for various wire diameter to pitch ratios, but the differentiation gives us a very close indication of the condition of minimum loss provided d/c is less than 0.5 or 0.6. If the optimum wire diameter to pitch ratio is used for the solenoid, the total copper loss can be obtained by calculation of the straight wire loss and multiplying this value by two. A plot of the R_{hf} as a function of d is shown in Fig. 1a. The curve shows a rather broad portion to be nearly minimum. An experimental curve is shown in Fig. 1b and 1c.

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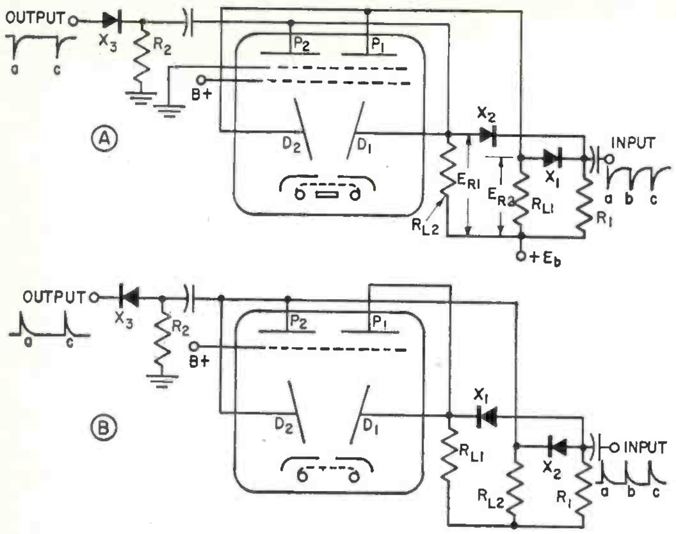


Fig. 1: Unipolar pulse binary counters using primary (A) or secondary (B) emission

Bistable operation with voltage increments as low as .66 v. is possible with a new twin target vacuum tube. The tube has use as high speed binary counter, oscillator, flip-flop and cascade dc amplifier

Low-Power Binary

BISTABLE operation with small voltage increments is one unique feature of a new twin target, electrostatic beam deflection tube. Regenerative direct coupled feedback between target elements and deflection plates provides a negative transconductance characteristic which is exhibited over a wide linear range of operation. Bistable operation is readily obtained with potential differences between "down" and "up" states as low as .66 v. The combination of regenerative direct coupled feedback and the small voltage increment between bistable points on the negative transconductance characteristic results in a unique high speed bistable memory element. The basic tube layout is shown in Fig. 1. A beam forming structure provides a focused line beam of electrons which may be positioned over the dual target assembly by action of the electrostatic deflection elements D_1 and D_2. Either primary or secondary electron emission operation of the target plates P_1 and P_2 may be utilized.

As the beam undergoes deflection, the I_{P1} and I_{P2} current curves shown in Fig. 2 are obtained. When the potential difference be-

H. J. Wolkstein

W. E. Hostetler

tween the deflection plates is zero, the beam falls equally on both target plates. If E_{P1} then goes positive, I_{P2} decreases and I_{P1} increases. Likewise, if E_{D2} goes more positive, I_{P1} decreases and I_{P2} increases. If P_2 is directly connected to D_1 and P_1 is directly connected to D_2, then

$$G_{m1} = \frac{-dI_{P2}}{dE_{D1}} \text{ and} \qquad (1)$$

$$G_{m2} = \frac{-dI_{P1}}{dE_{D2}}. \qquad (2)$$

For the connections shown in Fig. 5, and for equal load resistors, the expression for the net deflection voltage becomes,

$$E_D = (E_{D1} - E_{D2}) = (E_{P2} - E_{P1}) = -(I_{P2} - I_{P1})\, R_L. \qquad (3)$$

The expression $(I_{P2}-I_{P1})$ is represented by the composite current curve of Fig. 4 and the negative transconductance characteristic becomes evident.

Bistable Equilibrium

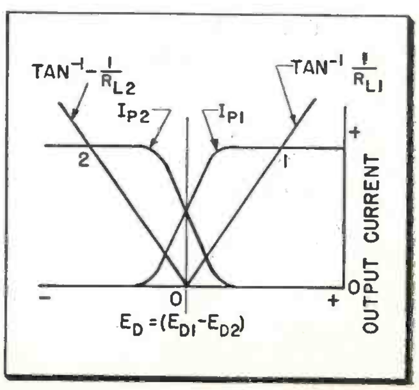
The load line for a symmetrical system such as is shown in Fig. 5 will intercept the composite voltage-current characteristic at three points, as indicated in Fig. 6 provided that:

$$-G_{MT} > \frac{-1}{R_L}. \qquad (4)$$

This relation, therefore, is the criterion for providing regenerative feedback action which results in obtaining bistable equilibrium conditions.

At points 1 and 2 of Fig. 6, the

Fig. 2: Operating characteristics



By **W. E. HOSTETLER,**
and H. J. WOLKSTEIN

W. E. HOSTETLER, Project Supervisor, Research Division, National Union Electric Corp., Orange, N. J.
and H. J. WOLKSTEIN, RCA Laboratory, Harrison, N. J.

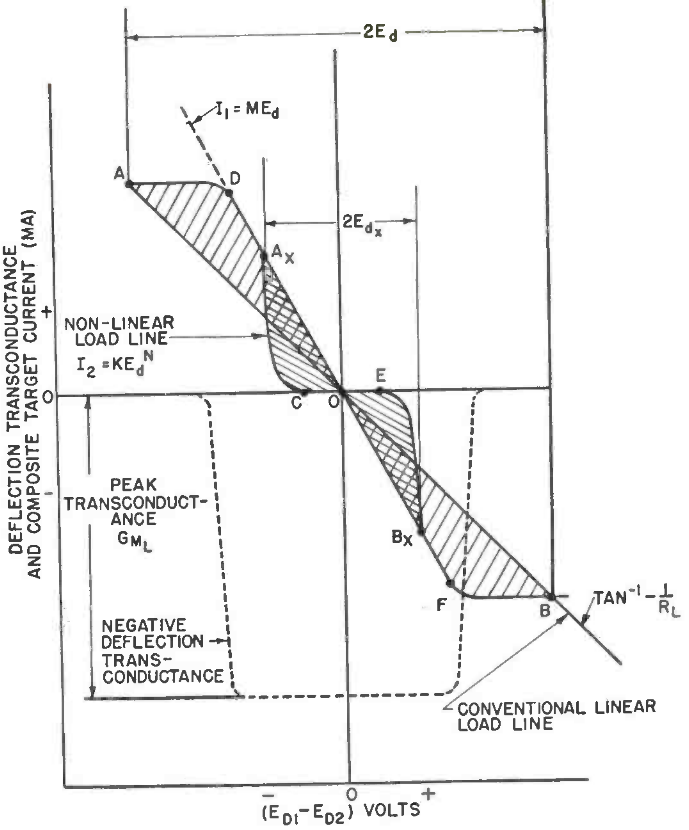


Fig. 4: Non-linear load line operation

Counter

target current flowing through the load resistor develops a deflection voltage just sufficient to hold the beam at either point. The effective loop gain at either point is unity. Any tendency for the deflection voltage to vary towards zero, from either point 1 or 2, results in more target current being available than is required to develop the decreased deflection voltage. The effective loop gain is greater than unity in this region. Therefore, the deflection voltage will be increased until points 1 or 2 are again reached. Any tendency for the deflection voltage to increase beyond point 1 or 2 results in less target current being available than is required to develop the increased deflection voltage. Since the effective loop gain in this region is less than unity, the deflection voltage will decrease until points 1 or 2 are again reached. Therefore, points 1 and 2 are points of stable equilibrium. Point O is quasi stable and will not provide any stable holding action.

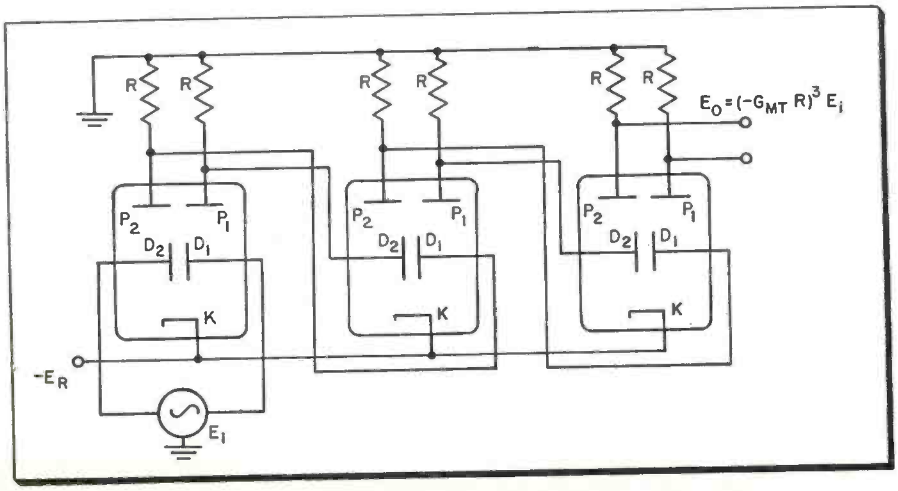
For equilibrium holding action to occur, it is necessary that,

$$(I_{P2} - I_{P1}) = \frac{-E_D}{R_L}. \qquad (5)$$

The net current available for providing equilibrium holding action is represented by the ordinate between the composite voltage-current characteristic and the load line for any given net deflection voltage.

The degree of inequality between the characteristic and the load line determines the degree of holding or current stability. The area between the characteristic and the load line is an indication of the relative holding stability.

Fig. 3: Cascade dc amp.—single B+



Non-Linear Loads

The use of non-linear loads, such as germanium or silicon diodes, selenium rectifiers, or thyrite, provides higher initial loop gains, increased holding stability, smaller increments between bistable holding points, and improved high frequency response.

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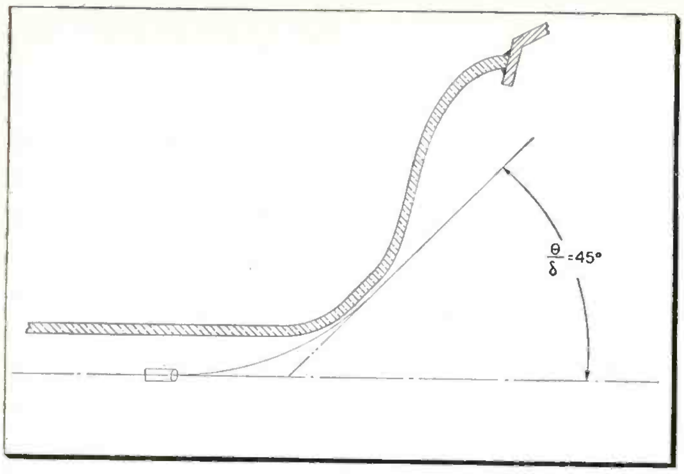


Fig. 1: Typical CRT cross-section

By B. CAHILL

Deflection Yoke Design

THERE are two methods commonly used for the deflection of an electron beam—the electrostatic and magnetic field.

The subject of this article is the latter method which depends on the theory that an electron, in cutting a magnetic line of force, is imparted a force which is normal to the instantaneous velocity of the electron.

F (Force of deflection) = e (charge) x V (velocity) x H

From this general equation the following equation can be derived.

$$\text{Sin}\,\theta = \frac{0.3\,H\,l}{\sqrt{E_b}}$$

Where H is lines of force in Gauss,

l is effective length of the deflecting field,

E_b is the second anode potential of the CRT.

From the equation it is apparent that the sine of the angle of deflection θ is proportional to the number of flux lines in the deflecting field, and to the length of the field; and is inversely proportional to the square root of the second anode voltage. Thus, if the second anode potential were quadrupled, the Sin θ function would decrease by a factor of two.

B. CAHILL, Chief Engineer, Syntronic Instruments, Inc., Addison, Ill.

The function, Sin θ, may be considered linear for angles of deflection less than 45°.

Therefore an increase of four times in second anode potential will decrease the angle of deflection by approximately two, which may be recovered by doubling the deflection current or the length of the coil.

It would appear that the simplest and easiest way to obtain deflection efficiency would be to increase the length of the deflecting field. This is true until the electron beam strikes the neck of the tube.

The practical limit to which the length of the deflecting coil can be extended is set by the inside diameter of the neck and the angle through which the beam is to be deflected. (See Fig. 1)

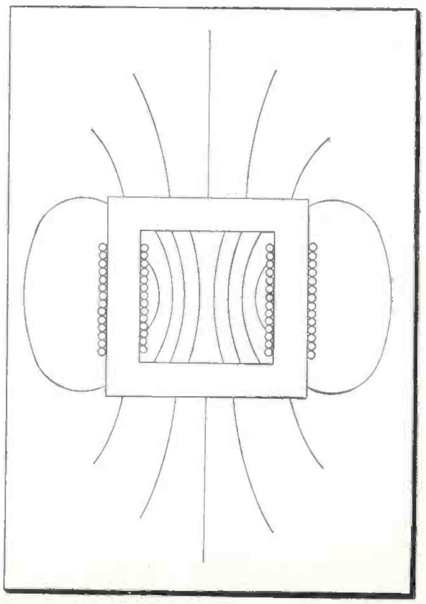
$$\text{Length} = \frac{\text{Neck radius} - \text{electron beam radius}}{\text{Tan}\,\frac{\theta}{2}}$$

The effective funnel diameter is reduced by the diameter of the electron beam which for a typical CRT is approximately 0.1 in. The calculated value of effective length should be further shortened by approximately ⅛ in. in the final design to allow for the inevitable variations in the glass funnel, the beam diameter, the beam centering, and the yoke itself. One other factor which must be kept in mind is the off centering which can result from non-linearities in the deflection system. A simple check for adequate field length safety factor can be made by moving the yoke back on the neck of the tube by approximately ⅛ in. and noting the presence or absence of neck shadow.

Deflection Efficiency

The ideal deflection yoke does not have any flux outside the neck of the CRT; and since a practical coil does have fringing and stray flux which add to the energy required, the efficiency of a deflection

Fig. 2: Parallel coils share flux



Magnetic deflection fields are affected by coil form, winding style, and external environment in the form of core, case, and other external components. The author discusses the many factors involved in deflection yoke efficiency and fast recovery time

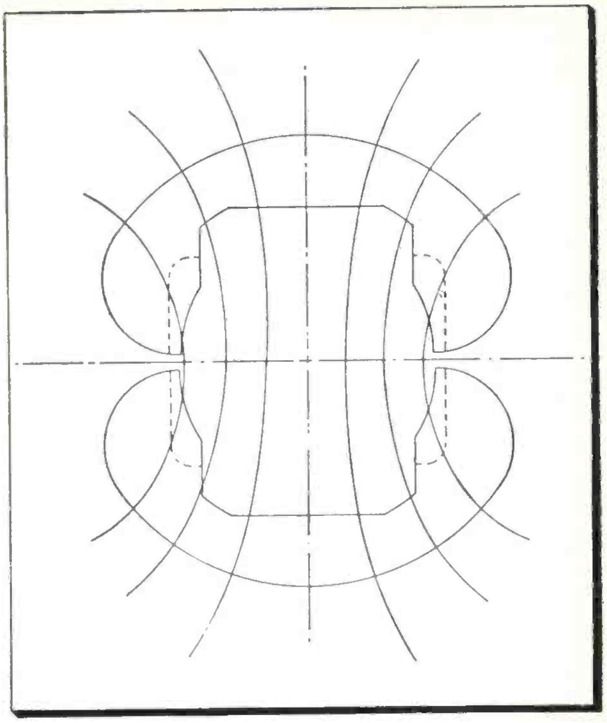


Fig. 3: Series field distribution

yoke can be defined as the ratio of the energy in the field of the ideal coil to that stored in the field of a practical yoke.

Energy in the field of the ideal coil $= \frac{a^2 \sin^2 \theta E_b}{0.72 L_o}$ ergs

Where a = radius of inside of neck of the CRT.

θ = deflection angle.

E_b = second anode potential.

L_o = length of the deflection field.

The energy in the field of a practical coil is difficult to calculate accurately; it is much easier to measure the inductance of the coil on a bridge and measure the current for the required deflection. From this the energy in the coil is $= \frac{LI^2}{2}$ joules.

Designing for a high deflection efficiency is important because the energy stored in the coil at the end of the deflection cycle must be dissipated before the start of the next cycle. The rate of decay is defined as the recovery time which is a function of the resonant frequency $f^r = \frac{1}{2 LC}$. Therefore the smaller LI^2 is for the requirements the more efficient will be the design.

The ultimate practical deflection efficiency for a particular design depends entirely upon the judicious use of the available geometry.

Since the number of turns on the coil has no effect on efficiency, the primary problem in designing a deflection coil is one of form. Once a suitable form factor has been established, the number of turns required to satisfy the voltage or current requirements can easily be found.

To have a suitable form factor a coil must meet or compromise with the following requirements:

1. Focus — The requirement of focus is a difficult one because the particular geometry of the tube enters into the problem. Focus is usually the best compatible with the pincushion allowable.

2. Pincushion — The trend toward flatter face plates makes the pincushion problem more difficult. Pincushion is more apparent to the eye than focus, therefore a small amount is easily discernible.

3. Sensitivity—Current required for a specified deflection and second anode voltage.

4. Resistance—The resistance is a substantial part of the losses in the coil and as the ear of the coil does not contribute materially to the deflection it should be kept as small as possible.

Once the form for a design has been established the following is true:

1. The inductance is proportional to turns squared.

2. The I^2R power loss is independent of the number of turns.

3. Voltage drop due to L di/dt is proportional to turns.

4. I is inversely proportional to turns.

Anything which tends to increase deflection efficiency also tends to decrease the recovery time. In those applications where fast recovery time is important an improvement can be had by increasing the efficiency at the expense of inductance by decreasing inductance without decreasing the flux in the deflecting field area or, if this factor has already been exploited to the utmost by decreasing the distributed capacity of the coil. This can be done by vertical pie winding or by using an insulating material having low dielectric constant.

The minimum recovery time for any type of scan is dependent upon the resonant frequency for the deflecting system. The minimum recovery time occurs when the yoke is critically damped. This occurs when the yoke is terminated in a resistance which is equal to one-half the characteristic impedance. By another close approximation, the minimum recovery time equals $1/f^r$ seconds. $R_d = \frac{LC}{2}$

The damping resistance which gives minimum recovery time for a particular design is larger than the theoretical resistance obtained from the equation $R_d = \frac{LC}{2}$ by a factor which is inversely proportional to the losses due to eddy cur-

(*Continued on page* 136)

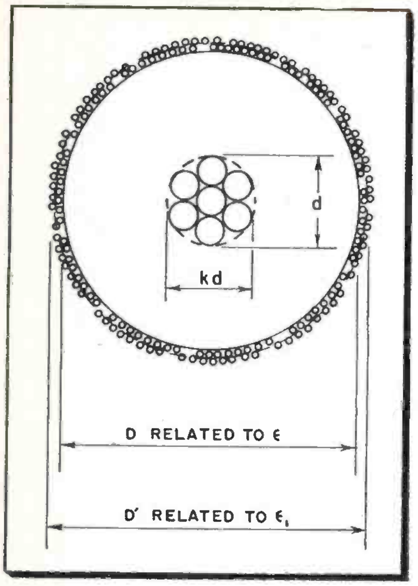


Fig. 1: Effective cable dimensions

The seven basic parameters of coaxial cable are examined and their relative importance is determined for a wide range of applications. Design data include attenuation figures and maximum operating temperatures

By C. CAMILLO and G. J. MARES

Guide To The

THE rapid development of new coaxial cables and their wide range of application has often been a source of confusion to the engineer faced with the task of making the proper selection of a suitable cable for his need. Actually, the case of only one cable being able to satisfy a set of requirements is rare. Usually, there are several cables which will meet most requirements of a particular application. However, the data which is published for these cables is, in some aspects, quite confusing and easily misunderstood. It is the purpose of this article to define and present the necessary data to enable the engineer to evaluate the cables more properly and then be able to select the most suitable cable for the expected operating conditions.

Basic Parameters

There are seven basic parameters of a coaxial cable for which values are usually published. These are:

A. Electrical Properties:
 1. Characteristic Impedance
 2. Capacitance
 3. Attenuation
 4. Velocity Ratio

B. Material Properties:
 1. Maximum Operating Voltage
 2. Temperature Limits
 3. Power Rating

If the value of each of these parameters is available, then the operation of this cable can be described under most conditions. The first four are dependent upon dimensional variations to such an extent that they must be carefully regulated and measured on samples from every production run. The last three quantities, however, are considerably less affected by any dimensional variations; they are rather functions of the over-all dimensions and type of coaxial cable. In addition, the impedance, capacitance, attenuation and velocity ratio are all interrelated while the voltage rating, temperature limits and power rating are more or less independent of each other. The actual method of determining each parameter theoretically with due consideration to practical limitations and experiences will be given in subsequent sections.

C. CAMILLO and G. J. MARES, Amphenol Electronics Corp., 1830 S. 54th St., Chicago, Ill.

Determination of Electrical Properties

A. Characteristic Impedance

Probably the most used and discussed cable parameter is the characteristic impedance. This quantity is the direct ratio of the voltage to the current along the line and physically equals that terminating impedance which absorbs all transmitted energy. In selecting a

Fig. 2: Power input vs. freq. of polyethylene cables

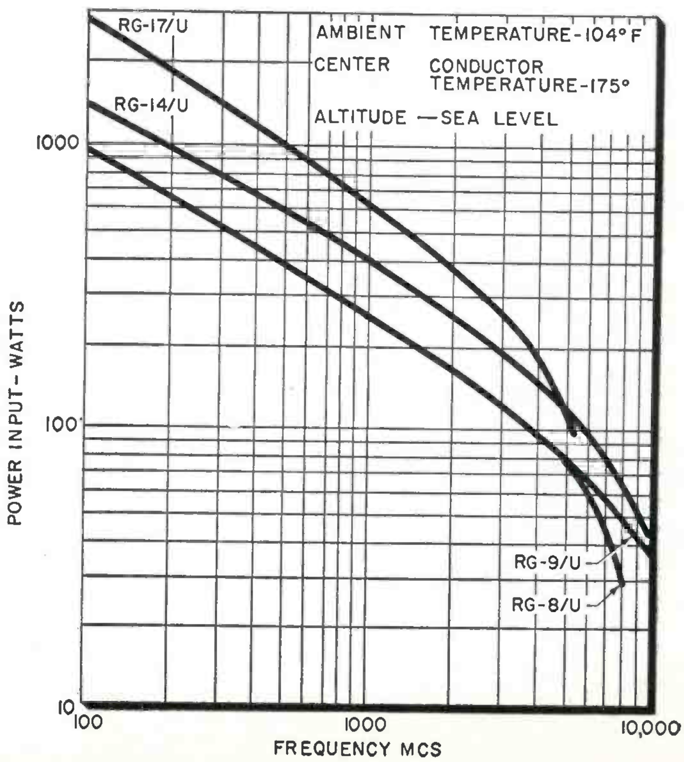


Fig. 3: Permittivity vs. diameter for polyethylene cables

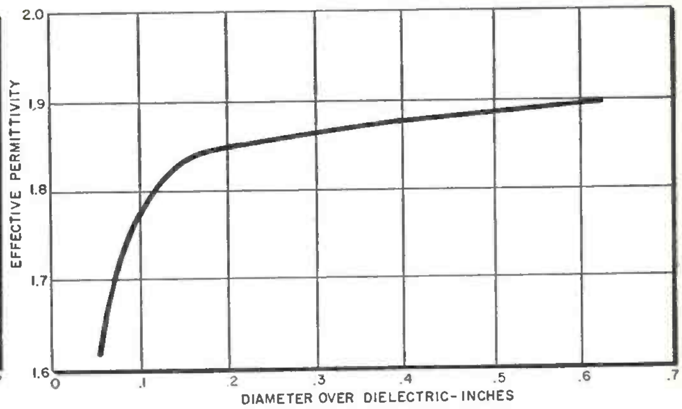


Fig. 4: Permittivity vs. diameter for teflon cables

Selection of R-F Cables

coaxial cable that will most efficiently transfer r-f energy, the engineer must use a cable that will match the signal source and the load that is being used in the installation. This impedance is usually described in terms of cable dimensions and is given by the following equation:

$$Z_o = \frac{138}{\sqrt{\epsilon}} \log_{10} \frac{D}{d} \quad (1)$$

where:

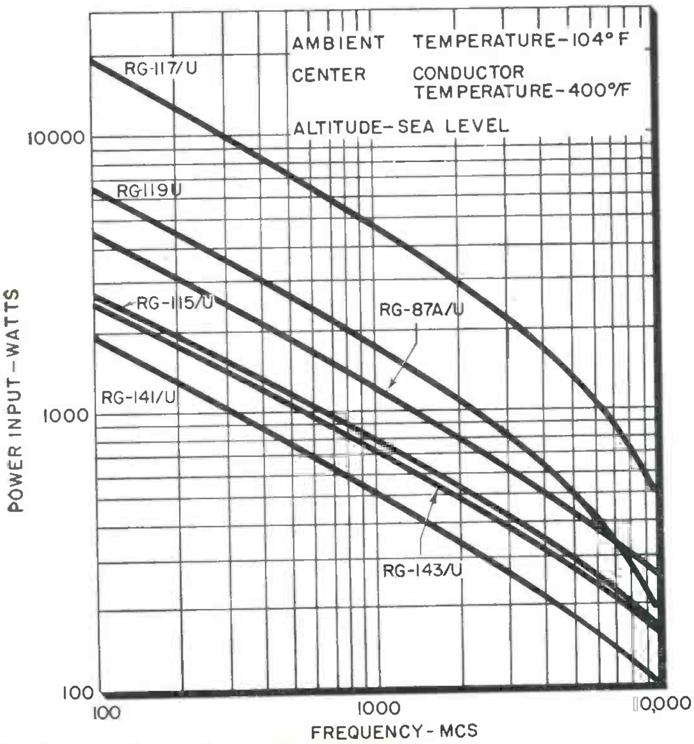
ϵ = dielectric constant

D = inner diameter of outer conductor

d = outer diameter of inner conductor

Eq. 1 is really a simplification of the rigorous equation,

Fig. 2A: Power input vs. freq. of teflon cables



$$Z_o = \sqrt{\frac{R + j\omega L}{G + j\omega C}} \quad (2)$$

where:

R = resistance per unit length in ohms

G = conductance per unit length in mhos

L = inductance per unit length in henrys

C = capacitance per unit length in farads

Z_o = characteristic impedance in ohms

At frequencies above 1 mc and with good dielectrics, it has been found that the quantities R and G can be neglected without sacrificing accuracy. Thus, Eq. 2 reduces to Eq. 1 with suitable substitutions for inductance and capacitance formulas.

Eq. 1 is exact, however, only if the center conductor is a solid wire and if the outer conductor is a continuous cylinder applied tightly over the dielectric. Such a line is not very flexible and cannot be readily used in many applications. As a consequence, the outer conductor is more commonly applied over the dielectric in the form of a braided configuration. In many instances, the center conductor is made up of stranded wire rather than solid wire for purposes of greater flexing endurance. Experiments have shown that the effective electrical diameter of a solid and a comparable stranded center conductor are not equal. Likewise, a braided outer conductor is never as tight as a cylindrical outer conductor. Thus, if one were to take the actual dimensions of a coaxial cable and substitute all quantities in Eq. 1 above, the characteristic impedance obtained would not compare to the actual measured value.

In the course of many years of accumulating such data, correction factors have been determined for the stranding of a conductor and the departure of a braided outer conductor from that of a perfect cylinder. The first factor is called the stranding factor. The second factor has been correlated to the dielectric constant of the insulation since it is found to be directly dependent upon the diameter of the insulation. This is illustrated in Fig. 1 for clarity. Eq. 1 with the appropriate corrections becomes:

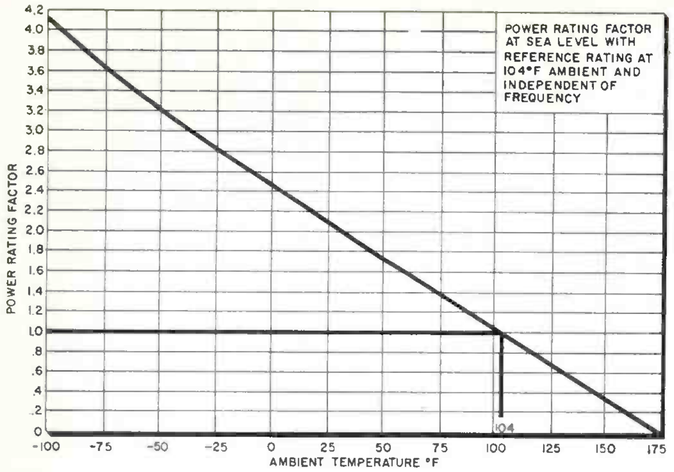


Fig. 5: Power rating vs. ambient temp. for polyethylene

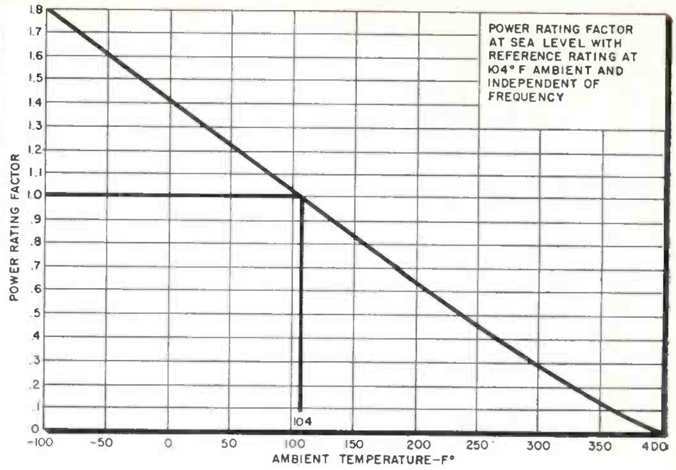


Fig. 5A: Curve for teflon. Both curves independent of freq.

R-F Cables *(continued)*

$$Z_o = \frac{138}{\sqrt{\epsilon_1}} \log_{10} \frac{D}{kd} \qquad (3)$$

where:

ϵ_1 = effective dielectric constant

k = stranding factor

The appropriate values for k based on theoretical computations have been given in the past by Mildner and are shown in Table I.

TABLE I

Value of k for Concentric Strands Only

No. of Strands	k
1	1.0
7	0.939
19	0.970
37	0.980
61	0.985
91	0.988

More recent work performed at Amphenol indicates that for a seven stranded conductor a value of 0.955 should be used for k. No further work has been done with higher strandings.

In addition, corrections for the dielectric constant must be considered. Since a braided outer conductor deviates from the ideal cylinder, it is quite evident that the dielectric will no longer be homogeneous but rather heterogeneous due to the introduction of very small air pockets at the surface of the dielectric material. Using the appropriate stranding factor along with the cable dimensions and impedance, the effective dielectric constant, ε_1 was calculated from Eq. 3 as D was varied. A plot of the ε_1 values versus cable core diameter of polyethylene cables is given in Fig. 3. It will be noted that ε_1 increases as the core diameter increases. Values of the effective dielectric constant of Teflon are presented in Fig. 4.

Although it is possible to determine the dimensions of a cable for any desired impedance, there are a number of practical limitations which must be considered. For instance, it is not possible to apply heavy insulation walls on small diameter wires. Without going into great detail on this aspect, it will suffice to point out that for solid polyethylene coaxial cables, the range of practical impedance is of the order of 15 to 80 ohms. For semi-solid dielectrics, the impedance can be as high as 185 ohms using special construction techniques.

A convenient method of measuring the characteristic impedance involves the velocity ratio and capacitance of the cable. The velocity ratio can be measured with a velocity ratio meter such as that designed by the Naval Research Lab. A capacitance bridge is used to find the capacity. The above quantities can then be combined into the following equation:

$$Z_o = \frac{101{,}600}{\text{Vel. Ratio (\%) Cap. (mmf/ft)}} \qquad (4)$$

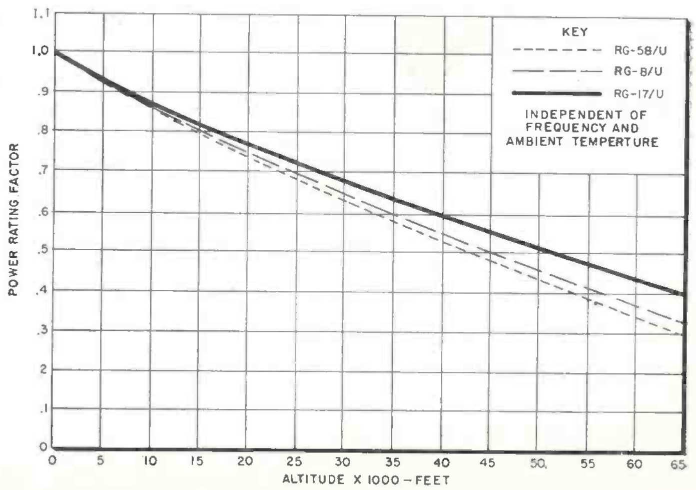
B. Capacitance

This parameter is also a dimensionally dependent quantity. It is determined by the following equation:

$$C(\text{mmf/ft}) = \frac{7.354}{\log_{10} \frac{D}{kd}} \epsilon_1 \qquad (5)$$

(*Continued on page* 127)

Fig. 6: Power rating factor vs. altitude, polyethylene



Transistor Phase-Shift Oscillator

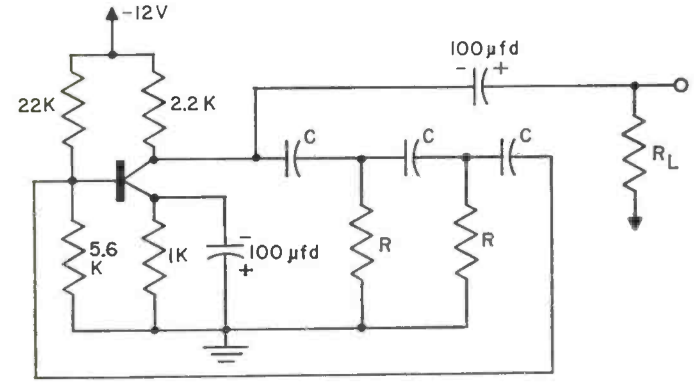


Fig. 1: The phase-shift oscillator

By W. HICKS

Engineering Dept., Raytheon Manufacturing Co., Newton, Mass.

This transistor oscillator circuit provides economy and stabilty of operation for low frequency oscillators and modulators. It needs no inductor, is compact, and draws low power at low voltage

IN applications where low frequency oscillation is required, many circuits use large inductors to obtain oscillations; other circuits, such as the wien-bridge type oscillator, employ two or more tubes or transistors. The transistor phase-shift oscillator has a definite advantage over these, since it requires only one transistor and eliminates the necessity of the large inductor. It runs on a twelve or six volt battery and can be constructed in a compact unit requiring very little power to operate.

Design

The transistor phase-shift oscillator differs from a vacuum tube phase-shift oscillator because of the transistor's low input impedance. Whereas the grid of the vacuum tube oscillator presents essentially an open circuit to the remainder of the network, this particular oscillator uses the input impedance of the transistor to provide part of the phase shift. As a consequence of this, the input and output impedances enter into the expressions for frequency of oscillation and minimum beta required for oscillation:

I.) $$\omega = \frac{1}{RC} \cdot \frac{1}{\sqrt{\frac{3R_2}{R} + 3 + \frac{3R_1}{R} + \frac{R_2 R_1}{R^2}}}$$

II.) $$\beta = \frac{R_{in} + R_b}{R_b}\left[\frac{14R_2}{R_1} + \frac{12R}{R_1} + 14 + \frac{8R_2}{R} + \frac{3R_2^2}{R_1 R} + \frac{R_2^2}{R^2} + \frac{3R_1}{R} + \frac{R_2 R_1}{R^2}\right]$$

where

$R_1 = R_L \,//\, R_o \,//\, R_{out}$

$R_2 = R_b \,//\, R_{in}$ (See Fig. 1)

R_b = Base bias resistance R_c = Collector bias resistance

R_{in} = Input impedance of Transistor R_{out} = Output impedance of Transistor

From eq. 1. it is found that the optimum value of R, that which enables the circuit to oscillate with the lowest beta possible, is approximately 2 K.

Operating Requirements

In order to obtain the maximum undistorted power output (unusually 0.5 mw) it is necessary to choose the load impedance to correspond with the beta of the unit used. (See Fig. 2.) This drawback can be overcome—or at least reduced—by using units with betas of 100 or greater. For such units a load impedance of 1 K will give the best results. The use of high beta units has further advantage in that it allows the frequency to be controlled by the R as well as the C of the phase shift network. For instance: if the beta is high enough to allow R to be 4.9 K, then oscillations of 10 cps can be obtained with C = 1.0 µf, whereas at least 2.0 µf would be needed when R = 2.2 K.

Frequency Stability

As the internal parameters of the transistor change—due to temperature fluctuations or changes in the operating point—the frequency of oscillation is apt to shift somewhat. This change is given by:

Phase-Shift Oscillator *(continued)*

III.) $\Delta \omega \approx \frac{\partial \omega}{\partial R_1} \Delta R_1 + \frac{\partial \omega}{\partial R_2} \Delta R_2$

From eq. 1 we have,

$$\frac{\partial \omega}{\partial R_1} = \frac{-1}{2 RC} \cdot \frac{\left[\frac{3}{R} + \frac{R_2}{R^2}\right]}{\left[\frac{3 R_2}{R} + 3 + \frac{3 R_1}{R} + \frac{R_1 R_2}{R^2}\right]^{3/2}}$$

or

$$\frac{\partial \omega}{\partial R_1} = \frac{-\omega}{2} \cdot \frac{\left[\frac{3}{R} + \frac{R_2}{R^2}\right]}{\left[\frac{3 R_2}{R} + 3 + \frac{3 R_1}{R} + \frac{R_1 R_2}{R^2}\right]}$$

and similarly

$$\frac{\partial \omega}{\partial R_2} = \frac{-\omega}{2} \cdot \frac{\left[\frac{3}{R} + \frac{R_1}{R^2}\right]}{\left[\frac{3 R_2}{R} + 3 + \frac{3 R_1}{R} + \frac{R_1 R^2}{R^2}\right]}$$

for illustration, we let $R = R_1 = 2$ K and $R_2 = 1.4$ K, as before, and obtain:

$$\frac{\partial \omega}{\partial R_1} = \frac{\partial \omega}{\partial R_2} = -1.2\,\omega \times 10^{-4}$$

Temperature Shift

Since the output impedance is approximately 20 K and is shunted by 2.2 K // R_L, it is apparent that R_1 will change much less with temperature than R_2.

therefore $\Delta R_1 << \Delta R_2$

and eq. 3 becomes:

IV.) $\Delta \omega \approx -1.2\,\omega \times 10^{-4} \Delta R_2$

In actual operation the average transistor was observed to shift frequency 0.25% to 1.0% max., as the temperature was raised from 25°C to 60°C. As can be seen from eq. 4, this corresponds to a change of 90 ohms in R_2, or approximately 125 ohms, in the input impedance of the transistor. This is a 6.5% change and is the most that would be expected in the temperature stabilized circuit of Fig. 1.

Stability

Better stabilization could be obtained by using a thermistor or by increasing the emitter resistor to 1.5 K. This latter approach has the effect of lowering the collector current and thereby improving the stabilization. However, this has one disadvantage—namely, that it changes the operating point such that the input impedance increases and higher beta units are required for oscillation.

Oscillator Frequency

If we assume that the input impedance of the transistor is 2 K so that $R_2 = 1.4$ K and $R = R_1 = 2$ K, the expression for the frequency of oscillation becomes:

$$f = \frac{1}{6 \pi RC} \qquad (R = 2\text{ K})$$

so that $f_l = 30$ cps for $C = 1.0\ \mu f$

Frequency Limits

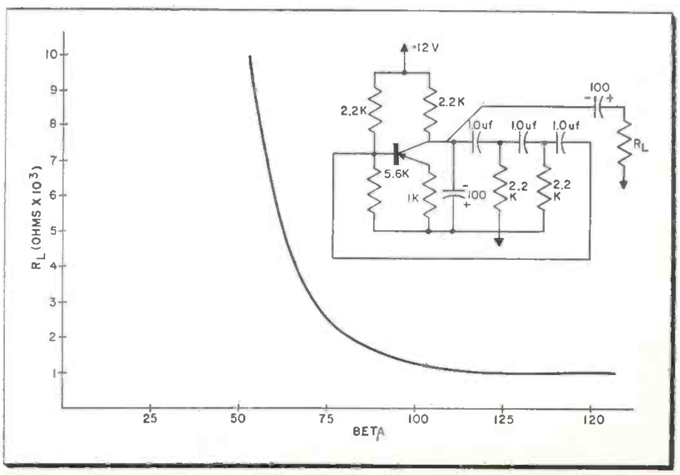
It would appear from the above equation that almost any frequency of oscillation desired could be obtained merely by changing C. This, however, is not so, due to the fact that the input impedance of the transistor is partly reactive. For instance, in an audio type transistor, there is a diffusion capacity of approximately 0.01 µf in shunt with the input impedance. Therefore, at a frequency of approximately 1 KC. (corresponding to $C \approx 0.03$ µf) the capacitance of the phase shift network is of the same order of magnitude as the diffusion capacity. This introduces an additional phase shift within the transistor and the circuit cannot be expected to function properly at this frequency. As a result, this type of oscillator appears to be inherently a low frequency oscillator.

Distortion

The circuit shown in Fig. 1 oscillates at a frequency of about 30 cps for R = 2.2 K and C = 1.0 µf. It has a maximum undistorted power output (2% distortion) of about 0.5 to 0.7 mw, and holds frequency well as the temperature is varied. (For the average transistor a frequency change of 0.25% to 1.0% is observed as the temperature is raised from 25°C to 60°C.) Frequencies as low as 10 cps are easily obtained with a 100 µfd emitter by-pass capacitor, and frequencies lower than this can be obtained by using a larger by-pass capacitor or by biasing the transistor with the emitter connected directly to ground.

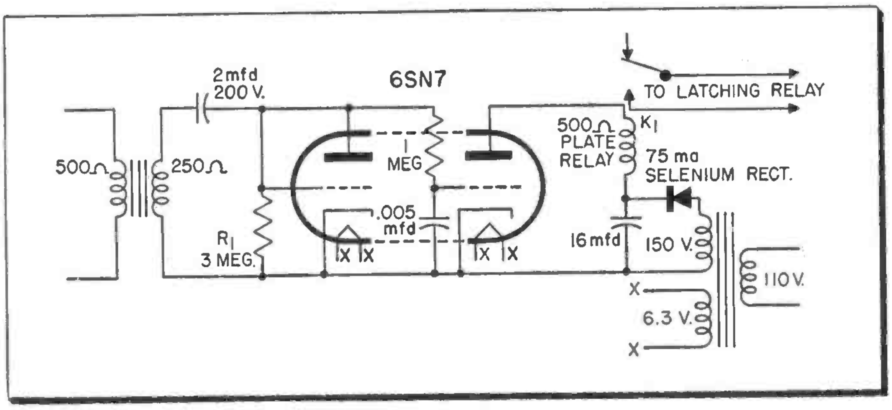
The transistor phase-shift oscillator seems to offer both economy and stability for low frequency oscillator and modulator applications.

Fig. 2: For 2% max. distortion



CUES for BROADCASTERS

Practical ways of improving station operation and efficiency



R-C time circuit discharges, thus starting recorder

Automatic Tape Starter

G. E. MADSON
KVOR, Colorado Springs, Colo.

HERE'S a solution for getting delayed network tapings started on schedule and at the same time taking some of the load off the combo man who is normally making a break and spot.

Our tape starter input is supplied with network through a spare amplifier at about zero level which holds the starter tube in a static condition. When the network breaks with 15 to 30 secs. of silence, the time constant circuit discharges and allows the tube to conduct, energizing K1 and starting recorder through the remote starting contacts on the recorder. The remote starting system is composed of a latching relay with the contacts in series with the start switch of the recorder. The latching relay is required so that the machine will remain energized when the starter returns to normal at the start of the net program. A release button for the latching relay is needed to set up for the next time the starter is to be used.

You may find it necessary to change R1 to suit different plate voltage or different input level. At any rate, the unit is designed as a voice operated slow release relay and should release the relay after a delay of approximately 10 secs.

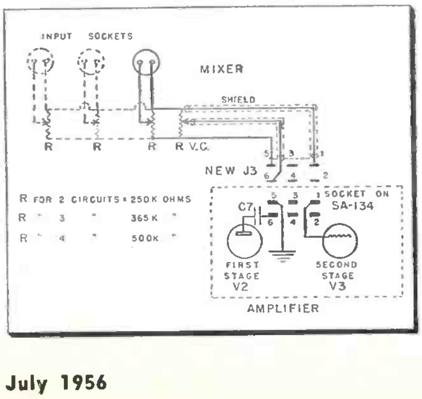
Designing A Mixer For BC Amplifiers

J. L. McFARLAND, Ch. Eng.
WAFC, Staunton, Va.

THE mixer to be described is especially applicable to the Model SA-134 audio amplifier used in Gates Transcription Players, and for remotes. Or it may be used with other amps of similar design.

Such a mixer may contain several input circuits in parallel, and affords a means for remotely controlling the gain of the amplifier to which it is attached. No changes in the amplifier are necessary in order to use the mixer. Only the jumper plug to the remote gain control need be rewired. On the SA-134 amplifier, this plug is designated as J3. (It is recommended that a separate plug like J3 be obtained and attached to the output cable of the mixer, leaving the original plug unchanged. Thus, the amplifier can be readily converted back to single channel operation by merely removing the mixer and replacing the original jumper plug). When the mixer is being used, the volume control on the amplifier becomes inoperative and the gain control on the mixer takes over.

Rewired jumper for mixing



Inexpensive Prompter

STANLEY BLITZ, Engr.
WEAT-TV, W. Palm Beach, Fla.

THE following is our idea of a low cost, easily built tele-prompter: The materials needed are two typewriter rollers and a window display motor, or a geared down phono motor (approximate speed, 15 rpm). The motor's shaft should have a pin driven through it. Typewriter rollers, when removed from their carriage, have a fixed hollow shaft on one side and a retractable shaft on the other. On the fixed hollow shafts of the rollers, a slotted groove should be made wide enough to allow free insertion of the motor shaft's pin. The motor shaft itself, must fit freely in the hollow shaft of the rollers. The chassis is made of heavy aluminum and is the same dimensions of a TV camera. The depth need only be about 3 or 4 in.

The top roller will do the driving of the gyp sheet from the bottom roller, which will be free rolling. The two rollers should be made interchangeable. The retractable shafts of the rollers should ride in a hole slightly larger than the shaft, and the hole should be deep enough to prevent slipping of the rollers. The hole should not go all the way through the chassis, to make use of the retractable feature of these rollers. The rollers are removed by retracting them to the right, and then out. A fixed shaft is used for the bottom roller to roll freely on. This shaft and the motor shaft should be made long enough to prevent slipping and short enough to allow removal of the rollers.

The gyp paper can be kept in cylinder form and can be slipped onto the bottom roller and then placed on the prompter. Bring the paper up to the top roller and attach by means of scotch tape.

A hand, on-off switch is used by the announcer to enable him to stop and start the prompter. The prompter is mounted on a stop light dolly which enables it to be positioned easily by any camera, or between cameras.

Protecting and Packaging Electronic Equipment

By W. H. HANNAHS

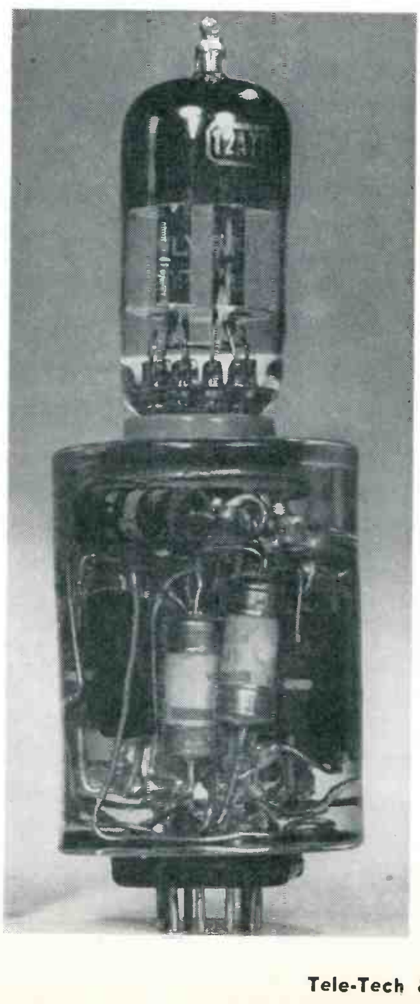
In TV sets, the presence of high voltage and the danger from implosion of picture tubes renders the enclosure problem somewhat greater.[5] Total enclosure of the picture tube is required and while the thickness of the surround varies with the size of the tube, it must be determined by actual implosion tests. An indication of strength may be gotten from the suggested value of a 7/32 in. laminated glass protection for a 19 in tube face.

Elsewhere the enclosure must not have holes exceeding 2/10 of a sq. in. in the line of flying particles and must withstand at least a 5 ft.-lb. impact from a 1.18 lb. steel sphere including the window. All picture tube assemblies are also subject to special check by underwriters with respect to X radiation. Radiation if any is very soft and easily stopped. In nearly all instances the glass implosion plate is more than adequate. From a practical standpoint this problem may be neglected except with the very largest direct view tubes or with high voltage projection tubes or in perhaps some custom installation where far less dense than ordinary housings and face plate might be employed.

When it comes to shock hazard, of course, the Achilles heel in the TV set is usually the back. An interlock should be used which works even under the handling of the foolhardy, and it might be remembered that even though the back does contain no openings larger than 2/10 in. in diameter through which no 10 in. rod might contact a live part, that a flimsy back can yet be distorted enough without disturbing the interlock to admit an inquisitive hand. Parts are generally considered to involve shock hazard if they carry more than 25 v. and upon contact will provide through a load of 500 ohms, 300 ma. after 3/10 msec., or 5 ma. after 2/10 seconds. More involved definitions[5] of shock are necessary for circuits containing high capacitance or voltages above 500 v.

W. H. HANNAHS, Automatic Production Research, 195 S. Columbus Ave., Mt. Vernon. (This article was prepared while the author was employed at Sylvania Electric Products Inc., Physics Labs., Bayside, N. Y.)

Fig. 6: Most tubes cannot be potted



Sets not employing power transformer supply isolation must be individually tested for enclosure compliance by underwriters. All of the above is of course predicated upon separate enclosure of the high voltage supply by a non-discardable enclosure. It might be noted in passing that housing requirements for any type of appliance are predicated on locating most of the fire susceptible components underneath the steel chassis. This includes, of course, those uncased power handling transformers or transformers capable of receiving appreciable quantities of current through failure of other components. Hence there is good reason for finding the transformers in the under chassis of receivers.

Wax Coating Materials

Where dielectric loss is of paramount importance, the pure hydrocarbons are undisputed leaders. This includes styrene, polyethylene and hydrocarbon waxes. Unfortunately, some of the resins having most desirable electrical properties are not easily applied as coatings to electronic equipment. Polyethylene may be flame sprayed but this is hardly suited to the purpose; styrenes form only thin coatings from solvents and must be cast about the components for maximum utility. It may be recalled that coatings in general are gelled in place by a variety of mechanisms: cooling from the hot melt, evaporation of solvents, oxidizing drying, flocculation of emulsions, polymerization.

When consideration is given to the ease of application, low loss, build, flexibility, adhesion, intrinsic hydrophobic properties and cost, it may be understood why waxes have re-

Part Two of Two Parts

Recent experiences of the military in hot, humid climates has focussed attention on the need for protecting electronic circuits against fungi and moisture, as well as mechanical shock and stress. Protective measures to accomplish this goal are described here

Fig. 7: Accessibility is essential

tained a place against a multitude of competing coatings. Waxes melting up to 275°F can be tropicallized with pentachlerophenol.

Not much detail can be given here of the wide choice available in wax compositions except to mention the principal constituents: natural paraffin (ozokerite), clear petroleum paraffins, yellow ceresine (of vegetable and mineral origin), brown cerese (a petroleum wax), brown cetyl acetamide, beeswax, hydrogenated castor oil, yellow-brown carnauba (from palm trees), hard montan, and chlorinated naphthalenes.

The latter are most familiar as capacitor impregnants. Microcrystalline waxes are highly refined petroleum paraffins with excellent electrical properties, strength and higher melting points.

The most important part of any impregnation is that the parts be dried, and also hot so as to assist penetration. Removal of entrapped air by vacuum is almost the only way to get thorough penetration and the impregnation when admitted to the chamber is driven by one or more atmospheres of pressure into the evacuated interstices.

Waxes can be compounded for softening points as high as 130°C. Not the least of their uses is as an effective moisture overseal in more porous higher-temperature coatings. This is frequently seen on ceramic disc capacitors where a coarse suspension of powdered phenolic resin has supplied the base coating. The penetrability of wax is also significant.

Wax protections may be found on some of the highest grade electronic instruments where temperature is not a problem.

Almost any of the vinyls have excellent moisture barrier characteristics, hence their use in cocoon wraps, but they soften at quite low temperatures.

Alkyd resins, while not the lowest loss materials, have excellent temperature resistance as well as the ability to form impervious films. Also they build well (the necessity of heavy layers to adequate moisture barriers having been previously mentioned), dry readily, and have excellent adhesion to metals. They are widely used in paints, varnishes and ink, and early found a place as armature dopes. They are probably most familiar as glyptals. Their best properties are brought out in baking varnishes and have found considerable usage in saturants, low frequency coil coatings, and in some multicoating transformer impregnation processes. More recently air-drying alkyds have extended their application and many familiar varnishes are blends of alkyds with other materials. 100% solid alkyd formulations are also obtainable.

Silicones, with their hydrophobic nature and high dielectric strength, provide good Class H impregnants for components, but are still limited as wire coatings because they do not have the best film forming properties. Silicones blended with good film formers such as alkyds show more promise. The art of the proper plasticization of silicones is also young. Consequently, those silicone varnishes, or any varnishes for that matter which have been extensively field proven, are much to be preferred.

The wide use of phenolic resins is creditable to their good electical properties for all except UHF, plus generally good water and chemical resistance. They release solvents and polymerize readily to tough films, and are versatile enough to be modified to a particular need by blending with drying oils or other resins. They can, for instance, be made soluble in common aliphatics like gasoline (petroleum naptha) or even suspended in alcohol. This versatility has resulted in a long list of good heat-reactive varnishes as well as other formulations for electrical use.

Insulating coatings may be evaluated by test but, according to Mathes[6], their ASTM Moisture Permeability is not a reliable index of their value as insulations. Table I, adapted from the reference, will illustrate this.

Mathes' method of testing a dip-coated wire to failure seems (results in last column) more realistic than any measurements made on panels or rods. This of course indicates susceptibility to ultimate breakdown.

(Continued on page 125)

Table I: Comparative Methods for Evaluating Magnet Wire Varnish

Type	Moisture Permeability X 10^{-8}	Dielectric Strength V./mil	Loss of D.S. after 24 hrs. in Water	Ave. time to Failure hrs.
Oil modified asphalt	0.4	1,000	65%	31
Pigmented short oil alkyd	0.8	1,000	80%	15
Oil modified phenolic	4.8	1,800	30%	10
Oil modified alkyd	2.2	1,200	45%	0.1

New Lab Equipment

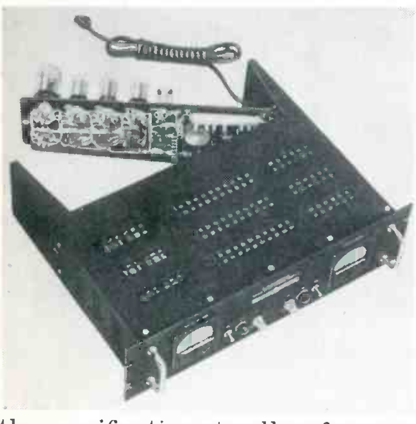
MAGNETIC AMPLIFIERS

These units are designed for use as power amplifier output stages for the control of 400 cycle 2-phase servo motors. The output is sinusoidal, variable in ampli-

tude, and phase reversible. No DC power supplies are necessary for operation of the amplifiers and their transistor or tube control circuit. Ambient temperature range: —55°C to 100°C. Standard output ratings: 3, 6, 10, 16 and 40 watts. **Timely Instruments & Controls Corp., 1645 W. 135th St., Gardena, Calif.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-192)

POWER SUPPLIES

Four new rack model regulated dc power supplies Models 281, 281M, 282 and 282M, have a panel height of only 5¼ in. Models are rated for 200 milliamps, with a range of 125-325 VDC for Models 281 and 281M, and 325-525 VDC for Models 282 and 282M. Sufficient tolerance is incorporated in



the specifications to allow for normal commercial component and tube deviations. **LAMBDA Electronics Corp., 11-11 131 Street, College Point 56,** N. Y. ELECTRONIC INDUSTRIES (7-19)

WIDE-BAND AMPLIFIER

341A is a wide-band, low distortion general purpose amplifier. Total harmonic distortion is less than 0.5% from 25 to 20,000 cps. Frequency response ± 0.5 db

from 5 to 50,000 cps. Source impedances of 30/50, 125/150, 250/300, 500/600 with #4665 plug-in transformer. Load impedances of 8, 16 ohms and 70 V. line. Output impedance less than 3.5% of nominal load impedance. Noise level 85 db below full output. **Altec Lansing Corp., Dept. TT-3, 9356 Santa Monica Blvd., Beverly Hills, Calif.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-22)

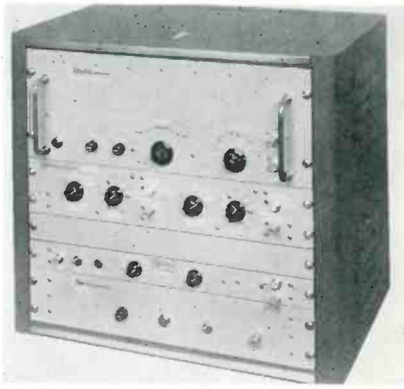
CHOPPERS

Types 175 and 300 miniature choppers with several mounting adapters are rated for a drive of 6.3 v. RMS. Series 175 choppers are for operation at 60 cps: Series 300 operates at 400 cps. They are hermetically sealed single-pole, double - throw, break-before-make units of exceptionally low noise

and long life. Two of the adapters, one for horizontal mounting, the other for vertical mounting, are shown. **Airpax Products Co., Middle River, Baltimore 20, Md.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-175)

PULSE GENERATOR

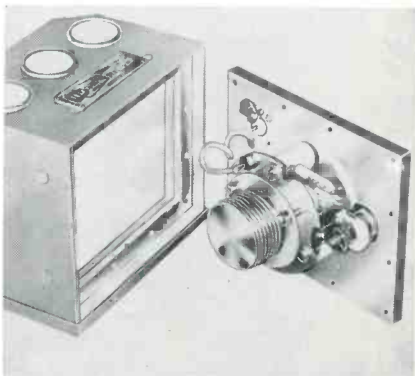
Model B-3 Pulse Generator is designed for applications involving repetition rates through one MC, delays from 0 to 10,000 usec., and fast rise time pulse output of



positive or negative polarity and widths to 10,000 usec. The main pulse can be delayed with respect to a synchronizing pulse by time intervals continuously variable in 5 ranges. The main pulse width can be continuously varied from .08 to 10,000 usec. in 5 ranges. **Rutherford Electronics Co., 3707 S. Robertson Blvd., Culver City, Calif.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-2)

RF AMPLIFIER

RF Amplifier, Model 1460 is a compact unit capable of supplying 15 w. min. of r-f power into a 50 ohm load over the frequency range of 200-250 MC. Specified output power will be obtained with no more than 2 w. of r-f input power. A filter box enclosing filters for each power input lead is provided



to minimize r-f leakage. Power Requirements: 400V DC @ 120 ma. nominal 6.3V AC or DC @ 1 amp. **Telechrome Inc., 632 Merrick Rd., Amityville, N. Y.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-185)

New Test Equipment

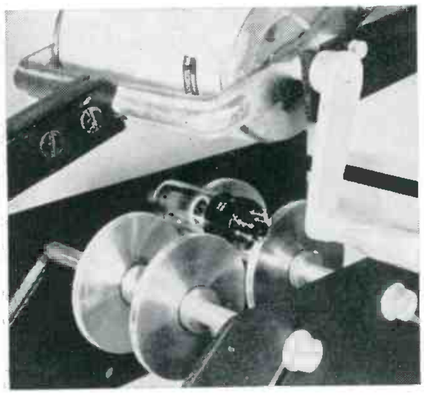
VIBRATION METER

Type 1-128, new, all-transistor vibration meter, which can be carried and used anywhere to measure the amplitude of vibrations in the 10 to 1000 cps frequency

range, uses two ordinary 22½ v. dry batteries to provide power. This all-transistor design alleviates the problem of microphonics (an important consideration in jet-engine testing where high noise levels are encountered. **Consolidated Electrodynamics Corp., 300 N. Sierra Madre Villa, Pasadena, Calif.** Tele-Tech & ELECTRONIC INDUSTRIES (7-4)

TUBE PRINTING

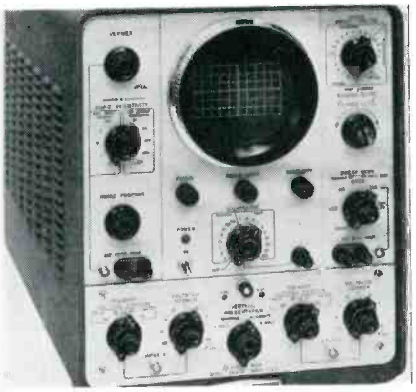
New imprinting machine can apply company names, contract numbers or any other imprint to cylindrical objects. It is designed to handle vacuum tubes with up to 12 in. diameters and is adaptable to cylinders with a max. length of 7 in. Dies used are the same conventional rubber type as used



in office stamps. Up to 400 pieces can be imprinted in 1 hr. The machine weighs 25 lb. and measures 11 x 16 x 13 in. **Murco Mfg. Co., RR No. 1, Box 5W, Delray Beach, Fla.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-160)

10 MC OSCILLOSCOPE

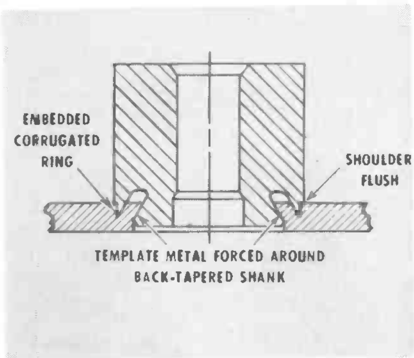
The dc to 500 kc horizontal amplifier of the Model 150A High Frequency Oscilloscope provides sweep magnifications of 1, 5, 10, 50, and 100. Full sweep range is



from .02 usec/cm to 15 sec/cm. The main vertical amplifier (pass band: dc to 10 mc) is driven by plug-in preamps. Single channel Model 151A preamp has a 5 mv/cm sensitivity. Model 152A preamp is dual channel. **Hewlett-Packard Co., 275 Page Mill Rd., Palo Alto, Calif.** Tele-Tech & ELECTRONIC INDUS. (7-16)

DRILL BUSHINGS

Line of PEM template drill bushings designed for easy installation in drill templates made from thin gauge aluminum or cold rolled steel. Only a single hole is required for each bushing. Self-clinching, bushings are compression mounted by any pneumatic or oil-hydraulic squeezer or arbor press and positively locked into position. True alignment is auto-



matic. Bushing holes are held to tolerances of drill size plus .0001 min. to drill size plus .0005 max. **Penn Engineering & Manufacturing Corp., Doylestown, Pa.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-25)

TESTING KIT

A multi-purpose magnetic shield testing kit which uses a newly developed shielding material is now available. New material is made from a special medium permeabil-

ity high saturation steel called Netic which is rolled specifically for high level attenuation and from a special high permeability steel called Co-Netic which is rolled specifically for low level attenuation only. **Magnetic Shield Div. Perfection Mica Co., 20 N. Wacker Drive, Chicago 6, Ill.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-28)

CR OSCILLOSCOPE

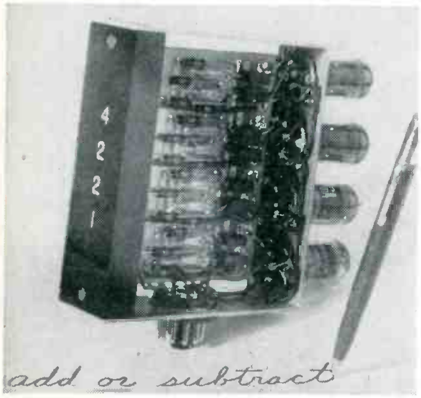
This Model 3441-A CRO permits changing polarity to vertical input amplifiers, thus keeping wave form on 5 in. CRT showing in a conventional manner. Freq. range: 10 cps to 4.5 mc. Sweep: 10 cps to 60 kc. Z axis input for intensity modulation is available. Max. sensitivity: 10 mv./in. Calibrating

meter has 2 ranges: 0-3 and 0-10 v. peak-to-peak. Phased 60 cps horizontal sweep has 160° phasing control. **Triplett Electrical Instrument Co., Bluffton, Ohio.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-14)

New Computer Components

DECADE COUNTER

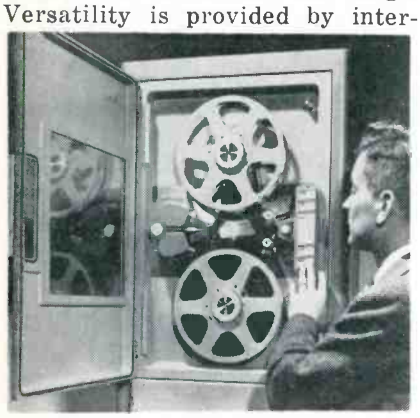
Reversible innovation of "up and down" decade counter can be electronically or manually controlled continuously by either an external flip-flop or d.c. voltages.



The internal gating is a unique circuit employing reliable long-life neon bulbs. Read-out is visual in binary coded decimal and electrical by a "staircase" voltage indicating the count. Max. continuous speed 50,000 cps. **Controller Instrument Co., 1612 Que St., N.W., Washington, D. C.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-147)

RECORDING DATA

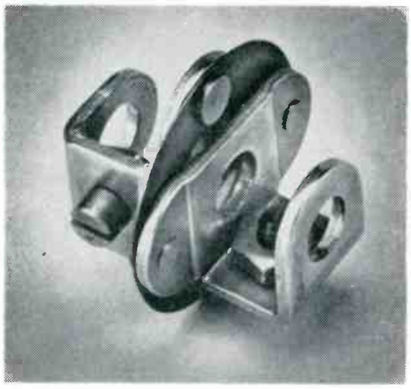
This new series of modular magnetic-recording components is for use in the fields of data acquisition, storage, handling, processing, analysis and simulation. Available in models with from 1 to 14 tracks, the FR100 Series records and reproduces scientific data in the dc to 100 KC range. Versatility is provided by inter-



changeable plug-in amplifiers for Direct, FM, and PWM types of recording and reproduction. **Instrumentation Div., Ampex Corp., 934 Charter St., Redwood City, Calif.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-7)

FLEXIBLE COUPLING

This simple and inexpensive flexible coupling unit is for mechanically joining and driving shafts which may be subject to slight misalignment. It is of



plated steel and spring brass construction and is available for connecting to ¼ in. shafts. Size: 1⅛ by 1⅛ in. Wt.: 1 oz. Useful in light mechanical assemblies requiring torques of less than 10 in.-lbs. **The Cincinnati Time Recorder Co., 1733 Central Ave., Cincinnati 14, Ohio.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-15)

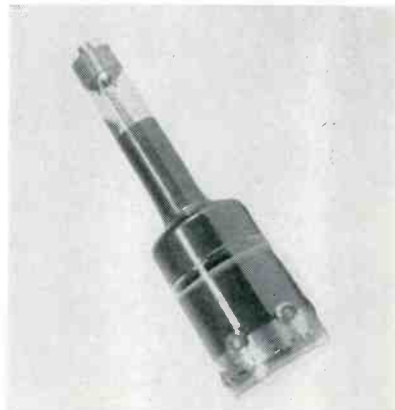
CORE HANDLER

This Core Handler Model 4010, is a completely automatic machine for high speed handling of miniature magnetic memory cores in production testing. The machine, which includes the mechanical handler, an electrical control chassis (for sequencing of the various operations), and a remote control box, takes full ad-

vantage of the magnetic properties of the core to facilitate its handling. Operating Speed: One core/sec., max. **Rese Engineering, Inc., 301 Walnut St., Phila., Pa.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-6)

MEMOTRON

The Memotron is a direct-display storage tube which has the ability to capture and retain transients on its 5 in. screen. Traces remain at high brilliance



indefinitely, until they are intentionally erased. Traces that exceed the maximum writing speed of the tube can be visibly displayed by repeated retracing at repetition rates sufficiently high to produce cumulative storage. **Hughes Products, Div. of Hughes Aircraft Co., Los Angeles, Calif.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 7-91)

SERVO

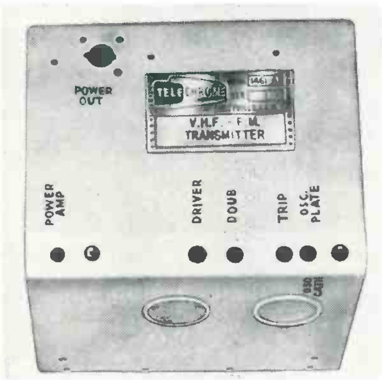
Servo, Type 2V-3362, measuring only ½ in. x 1 in., has 1/3 the torque but ½ the rotor inertia of a size 10 servo. As the torque and rotor inertia factors approx. offset each other and the remaining characteristics of the 2 motors are basically similar, an unusually high quality performance is indicated for the smaller motor. At

room temperature, the motor starts with 18v. on fixed phase and with 0.4V on control phase. **John Oster Manufacturing Co., Avionic Div., Racine, Wisc.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-27)

New Communications Equipment

VHF-FM TRANSMITTER

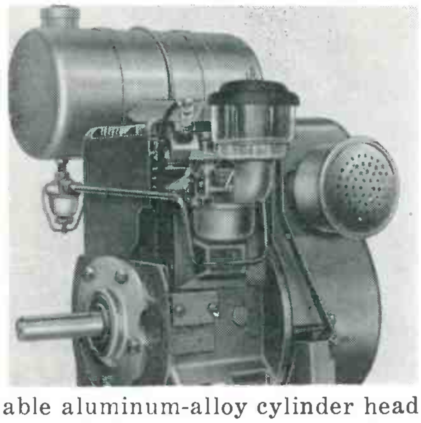
Model 1461-A VHF-FM Transmitter is a miniature unit capable of supplying 25 w. of r-f power into a 50 ohm load over the range of 215 to 235 mc. Unit is designed



for FM or PDM modulation and has a maximum deviation of 125 kc. Input impedance: 1 Meg shunted by 200 μμf. Modulation signal: 2 v. p-p will produce maximum deviation. Sine wave frequency response: 100 cps to 80 kc, ± 2 db. Sq. wave response: rise and fall times below 5 μsec. **Telechrome, Inc., 632 Merrick Rd., Amityville, N. Y.** Tele-Tech & ELECTRONIC INDUS. (7-17)

SHORT STROKE ENGINE

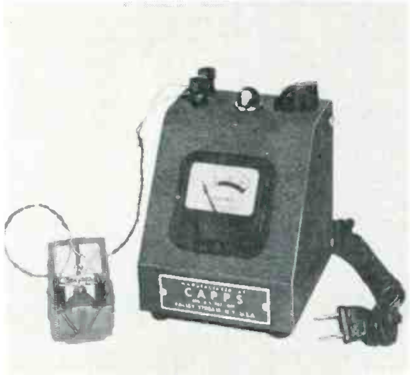
The Model AJ is a single-cylinder, air-cooled, 4-cycle, gasoline-powered engine developing 5.5 H.P. at 3600 RPM. Weighing only 86 pounds, it has a 2¾ in. bore; 2½ in. stroke; 14.9 cu. in. piston displacement and a compression ratio of 6.25:1. It has a remove-



able aluminum-alloy cylinder head and a fully counter-weighted, balanced crankshaft. The engine has high tension magneto ignition. **D. W. Onan & Sons Inc., Minneapolis 14, Minn.** Tele-Tech & ELECTRONIC INDUSTRIES (7-9)

HOT-STYLUS UNIT

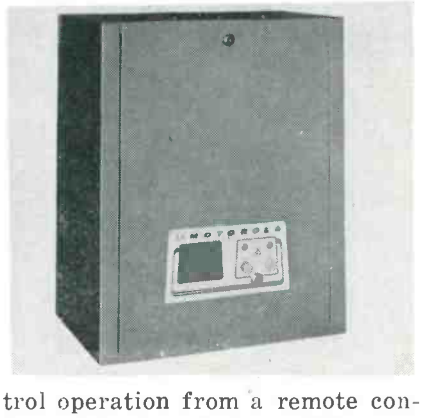
Quality of disc masters for microgroove records is greatly improved when cutting is done with a stylus heated by new hot-stylus adapter unit. The unit consists of



a small lightweight stylus terminal block which fastens to the cutting head of the recorder, and a control panel. Control panel includes stylus-heat control, pilot lamp, on-off switch, and a meter for precise heater-current indication. **Capps and Co., Inc., 20 Addison Place, Valley Stream, N. Y.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-24)

TRANSMITTER-RECEIVER

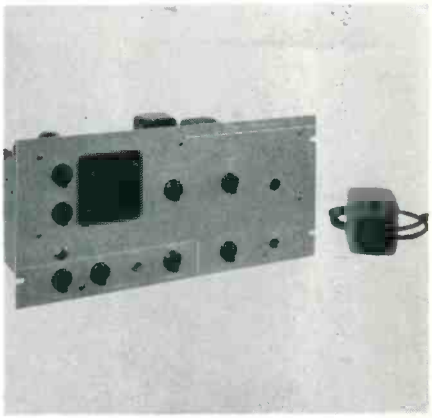
The "COMPA-STATION" transmitter-receiver is a new addition to the company's standard line of fixed FM 2-way radio equipment operating in the 25-54 or 144-174 MC band. Unit includes a 60 watt transmitter and the SENSICON "G" receiver. It is easily adapted for 2-wire or 4-wire remote con-



trol operation from a remote control console. Power: 117 vac.. Weight is approximately 100 lbs. **Motorola, Inc., 4501 W. Augusta Blvd., Chicago 51, Ill.** Tele-Tech & ELECTRONIC INDUSTRIES. (Ask for 7-5)

STATIC REJECTOR

Combining impulse-noise rejection with automatic tuning of the receiver to which it is connected, the TRAK Static Rejector is designed to improve the reliability



of code communication. An automatic frequency control system, operating a reversible motor drive on the receiver's tuning shaft, maintains accurate tuning in the presence of receiver or transmitter drift. Available for CW or for frequency-shift communication. **CGS Labs, Inc., 391 Ludlow St., Stamford, Conn.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-10)

CARBON MIKE

New carbon microphone, built for extreme ruggedness in mobile communications use, can be shielded with a special rubber boot, making it completely moistureproof. Known as the C504C, it has a Bakelite case, is 2⅛ by 1-5/16 in. in size, and weighs 9

oz. With a 40 ohms impedance, and a frequency response in the 200 to 5,000 cps range, the mike should be used as a close talking unit. **Elgin National Watch Co., Elgin, Ill.** Tele-Tech & ELECTRONIC INDUSTRIES (7-13)

New Tubes & Transistors

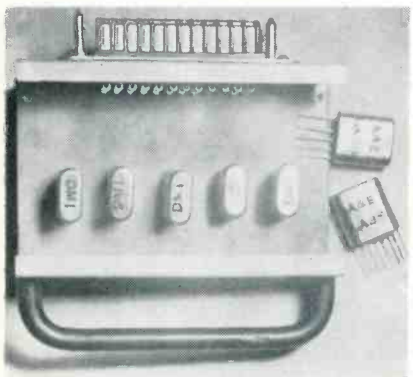
RF AMPLIFIER TUBES

Two sharp cut-off cascode RF amplifier tubes designed especially for application in TV receivers employing low B+ supplies are available. The 6BX8

employs a 6.3 v., 400 ma. heater, while the 4BX8 with its 4.5 v., 600 ma. heater, is designed for use in series heater-string receivers. Both double triodes operate with only 60 v. plate-to-cathode voltage. Transconductance is 6800 μmhos with a B+ of 125 v. **Westinghouse Electronic Tube Div., Dept. T-075, Route 17, Elmira,** N. Y. Tele-Tech & ELECTRONIC INDUSTRIES (7-3)

TRANSISTOR CIRCUITS

Potted and sealed transistor circuits, such as Flip-Flops, Multivibrators, DC Amps, Audio & RF Osc, Sawtooth Gen, Gates, Inverters, etc. are now available for use as a plug-in unit or can be soldered directly into the circuit. Units make it possible to break any ex-



isting electronic circuit into separate component stages. Average dimensions: .313 x .717 x .312. **Acoustical Electronic Laboratories, 3785 Broadway, New York 32,** N. Y. Tele-Tech & ELECTRONIC INDUSTRIES (7-176)

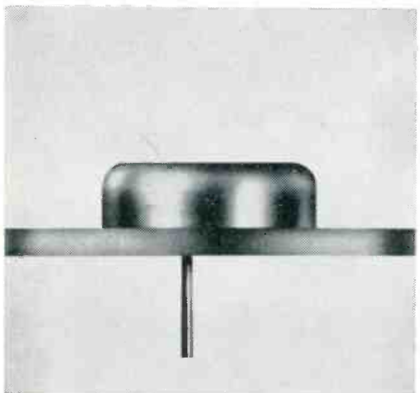
HYDROGEN THYRATRON

New hydrogen thyratron, the PL-165, has ratings intermediate between those of the 4C35 and the PL-5C22, but is no larger than the 4C35. PL-165 is designed for ap-

plications where space is limited to that occupied by the 4C35, but where the capabilities of the 4C35 are exceeded. Max. ratings of the PL-165: Peak plate voltage, 12 kv.; peak plate current, 325 a. Max. dimensions: height overall, 6.25 in.; seated height, 5.63 in.; diameter, 2.56 in. **Penta Laboratories, Inc., 312 N. Nopal St., Santa Barbara, Calif.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-58)

POWER TRANSISTOR

In a Class B audio amplifier, 2 of these power transistors will supply 4 watts with total harmonic distortion of less than 10% when operated from a 28 volt supply at an ambient temperature of 80°C, while 2 similar units, also in



Class B operation, will provide 10 watts at less than 10% distortion from a 12 volt supply at 80°C. **Motorola, Inc., 4545 Augusta Boulevard, Chicago 51, Ill.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-83)

DUAL TR SHUTTER TUBE

The BL-317, a new dual TR tube with integral shutters for X-band, is designed to give complete crystal protection over a frequency range from 8500 to 9600 mc, when

used between a balanced pair of short-slot hybrid couplers. The TR electrical characteristics of the BL-317 are identical with those of the 6334/BL-27, in addition to which the shutters, when closed, present an insertion loss considerably in excess of 40 db. **Bomac Laboratories, Inc., Salem Road, Beverly, Mass.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-30)

CERAMIC MOUNT

Compact ceramic mount improves the performance of silicon power rectifiers, electrically insulates the rectifier so as to permit its use at high potentials above ground. Heat conduction is several times more efficient than with conventional mounting methods.

Mounts can be supplied threaded to accept any standard semiconductor power diode. **Raytheon Manufacturing Company, Ceramic Sales, Waltham 54, Mass.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-29)

The CINCH-JAN Shield Insert

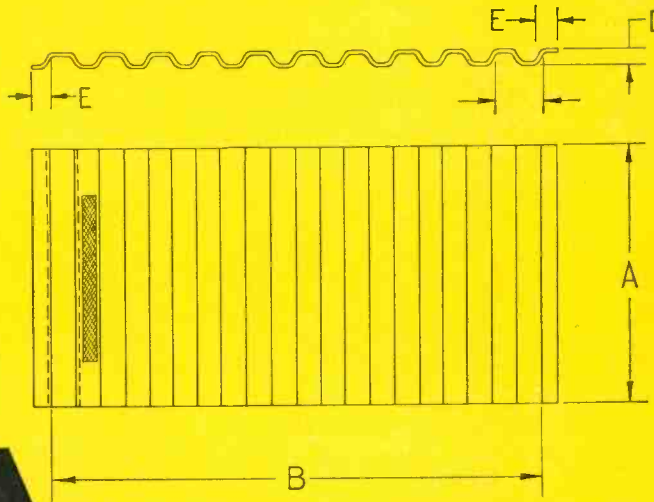
—FOR INCREASED COOLING EFFICIENCY

. . . aids in maintaining lower operating tube temperatures . . . equipments have fewer failures, greater reliability, less maintenance and tube replacement costs.

Six sizes of the corrugated inserts are necessary to fit the six sizes of miniature tubes. The seven-pin tubes require a certain corrugation height and three widths: for the small, medium, and large sizes. The nine-pin tubes require a different corrugation and three different widths: for small, medium and large tubes.

CINCH corrugated inserts are made from 0.003 inch cadmium-plated brass shim stock with black matte finish; bent into a circular shape, the ends fitted together, and then inserted into the proper shield. The insert makes contact with the glass bulb on one side and the shield on the other, distributing the hot-spot on the tube and conducting the heat to the shield with a greater radiating surface.

Part No.	Shield	B	A	D	E	For Shield Number
20K22591	7 pin Small	$2\frac{13}{32}$	.750	.049	$\frac{3}{32}$	TS 102U01
20K22592	Medium	$2\frac{13}{32}$	1.000	.049	$\frac{3}{32}$	TS 102U02
20K22593	Large	$2\frac{13}{32}$	1.500	.049	$\frac{3}{32}$	TS 102U03
20K22594	9 pin Small	$2\frac{15}{16}$	.860	.068	$\frac{1}{32}$	TS 103U01
20K22595	Medium	$2\frac{15}{16}$	1.200	.068	$\frac{1}{32}$	TS 103U02
20K22596	Large	$2\frac{15}{16}$	1.500	.068	$\frac{1}{32}$	TS 103U03



These inserts may be adapted to operating equipments presently in use with no chassis modification or additional space requirements.

Centrally located plants at Chicago, Shelbyville, Pasadena and St. Louis.

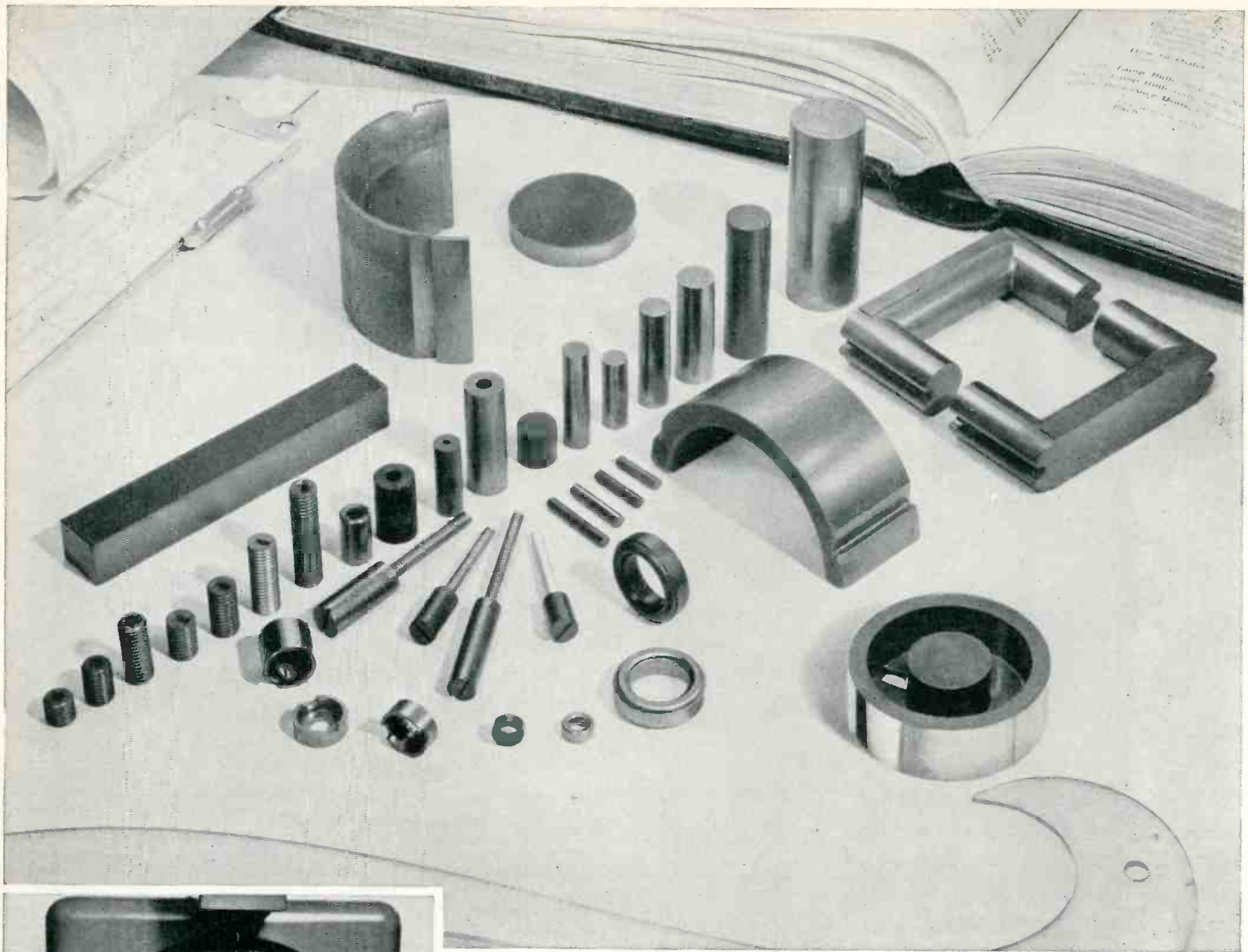
CONSULT CINCH

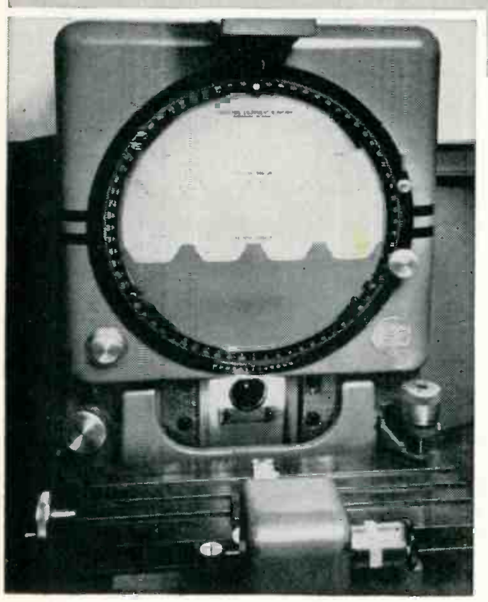
CINCH MANUFACTURING CORPORATION

1026 South Homan Ave., Chicago 24, Illinois

Subsidiary of United-Carr Fastener Corporation, Cambridge, Mass.

For product information, use inquiry card on last page.





IRON POWDER CORES

to meet your highest requirements

★ *For QUALITY*

★ *For DIMENSIONAL ACCURACY*

Here are the essential facts to keep in mind about iron powder cores—and Arnold. As illustrated above, we make a wide selection of cores, from simple cylinders to special cores of complicated design. That includes all standard types and sizes of threaded cores, cup, sleeve, slug and cylindrical insert cores you may require: for use in antenna and RF coils, oscillator coils, IF coils, perm tuning, FM coils, television RF coils, noise filter coils, induction heating and bombarder coils, and other low frequency applications. Also, a standard series of iron powder toroids is being engineered at this time, which will conform to the standard sizes proposed by the Metal Powder Association. • We'll appreciate the opportunity to supply your needs . . . *let us quote on your requirements.*

WSW 6044

COMPARATOR-CHECKED
to insure precision parts

Threaded cores are checked on an optical comparator at 100-x magnification to assure exact conformance. Arnold quality control of iron powder cores includes the maintaining of rigid electrical, physical and dimensional specifications unmatched in the industry.

Write for a copy of Bulletin PC-109

Contains essential data on processing, control methods, applications, types, sizes, suggested use frequencies, etc. of Arnold iron powder cores.

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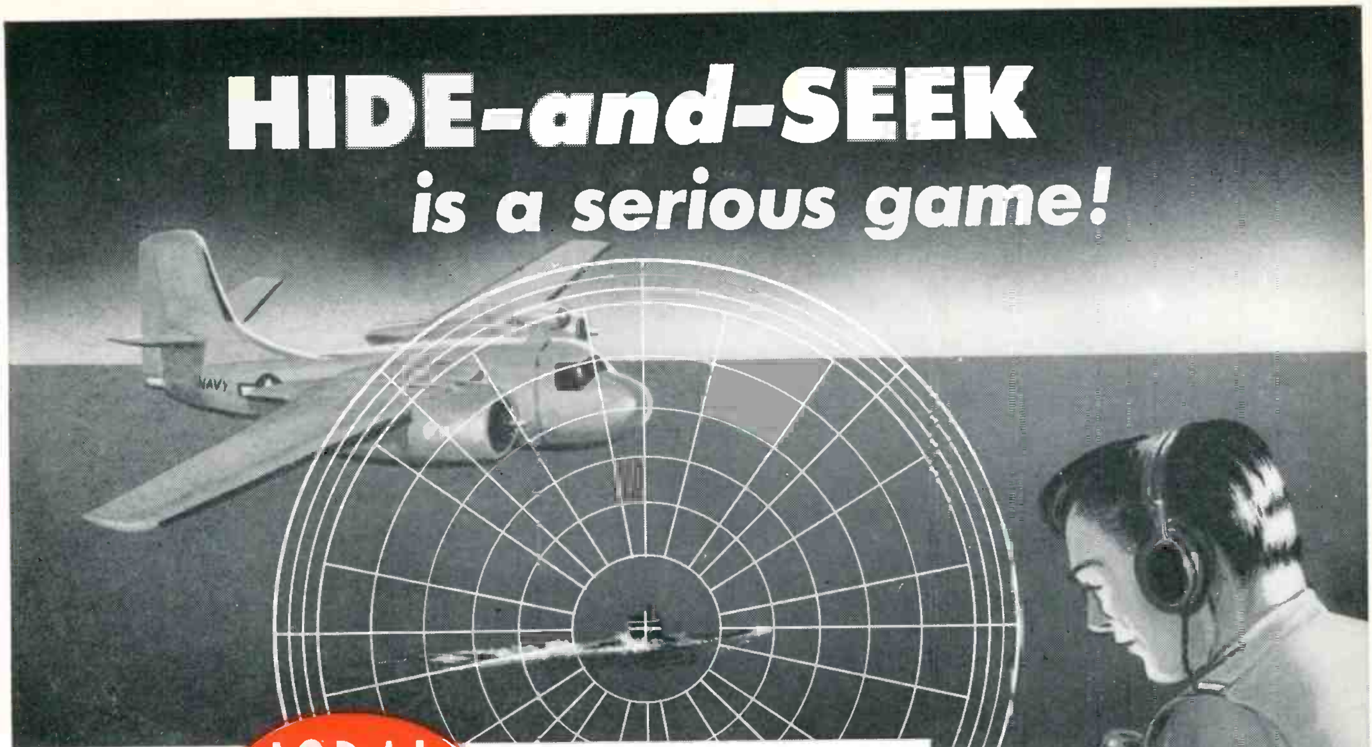
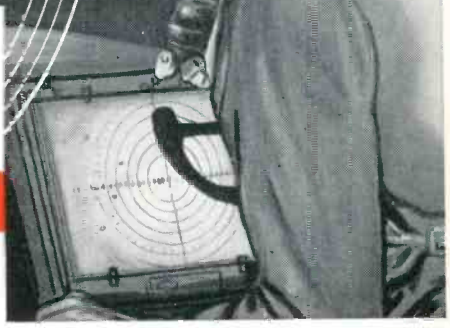


In which LORAL PLAYS ITS PART.



In the field of
ELECTRONIC COUNTERMEASURES

for
- INTERCEPT
- ANALYSIS
- LOCATING
- RECORDING

LORAL has developed extensive know-how and experience.

Current weapons system concepts in defense planning demand the optimum in creative engineering and production efficiency.

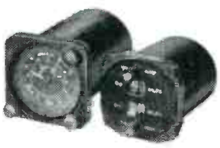
PERFORMANCE is the outstanding consideration! LORAL is an outstanding performer!

We welcome the opportunity to assist in design and development of equipment in the field of ELECTRONIC COUNTERMEASURES.

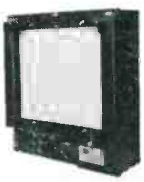
LORAL is constantly delivering NEW CONCEPTS IN AVIONICS!

Among recent developments are:

- The LORAL AIRBORNE NAVIGATIONAL COMPUTER. A compact and accurate system that computes and indicates ground displacement of aircraft.



- The LORAL Automatic Short Range GROUND POSITION INDICATOR—an 18 lb. navigational computer automatically indicating ground position.



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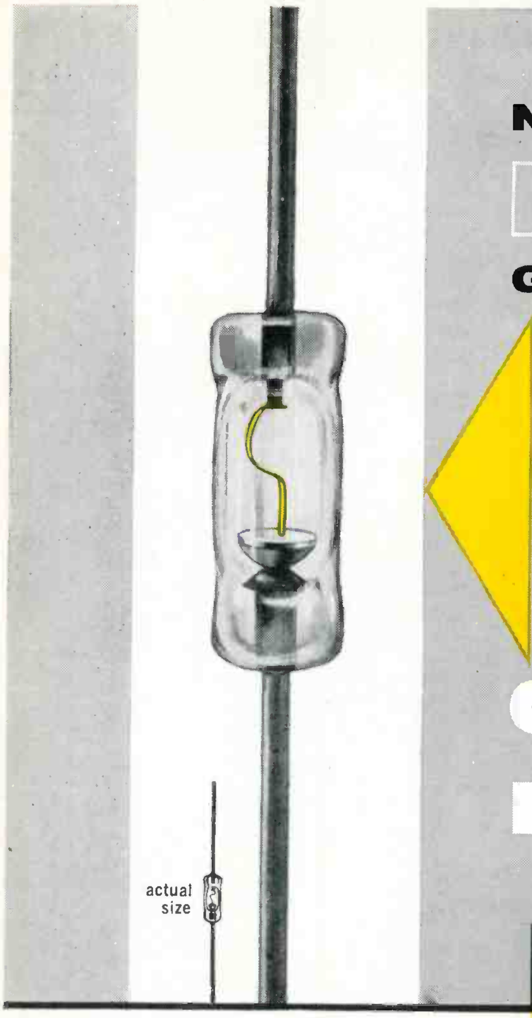

Fast recovery
High conductance
Germanium

COMPUTER DIODES *in production quantities for immediate delivery*

TYPE NO.	FORWARD CURRENT (MA)	REVERSE CURRENT§	MAX. INVERSE OPER. VOLTAGE	REVERSE RECOVERY
1N191	5 @ 1 V	400K between 10 & 50V at 55° C	60	50K in .5 usec 400K in 3.5 usec*
DR401	20 @ .5V	400K between 10 & 50V at 55° C	60	50K in .5 usec 400K in 2 usec*
DR403	20 @ .5V	500K between 10 & 50V	60	80K in .3 usec†
DR404	20 @ .5V	500K between 10 & 50V	60	50K in .3 usec†

*Switching from a forward current of 30 MA to a reverse potential of 35V.
†Switching from a forward current of 5 MA to a reverse potential of 40V.
§Test voltage is a continuous 60 cps sine wave.

Radio Receptor's "gold standard" for outstanding diode performance is met by our new group of glass computer diodes. The RRco. controlled gold bonding process produces these diodes with fast reverse recovery and high forward conductance as well as unusual reliability and long life. They are thoroughly tested, both in our factory and in actual computer service under strenuous conditions.

The performance characteristics listed above are typical of RRco. computer diodes. The complete list of types includes many others suitable for receiving equipment, transistor biasing, magnetic amplifiers, modulators, demodulators, pulse circuitry, logic circuitry, metering and varistors as well as computers.

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SELENIUM RECTIFIERS • COMMUNICATIONS, RADAR AND NAVIGATION EQUIPMENT

Lowest tube cost of any five!... Greater efficiency!

New Hi-Watter 5KW. transmitter

Here is a really new Five! So full of new features you will be sure to request the attractive brochure awaiting you. — Proposed new FCC regulations have been coped with. For example, 99% of usable sideband power is confined to the proposed stipulated bandwidth while the entire RF power amplifier/output coupling system including power tube is 100% electrically enclosed and forced air cooled. Result is spurious radiation at a new low. Ultra linear audio driver adds continued reliability in day to day low distortion.

Lowest cost tube complement and lowest primary power consumption of any Five made today. Only 3 power tube types positively means lower spare tube inventory. Each of the three cubicles is completely independent electrically and mechanically. If floor space is at a premium, place one cubicle at right angle or even opposite. Of course, independent cubicles demand independent cooling so this new Gates "Hi-Watter" Five becomes the coolest Five in all the business.

Price? — When designed right, the price is right. Gates manufacturing engineering has cut off hours and added quality — Yes—the price is very much lower—the actual meaning of Gates 'Hi-Watter", more watts per dollar investment.

GATES

GATES RADIO COMPANY • *Manufacturing Engineers Since 1922* • Quincy, Illinois, U. S. A.

Only 3 power tube types!... Less intermodulation!...100% new:

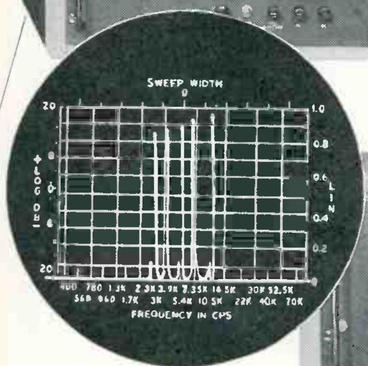
New cooling system!... Less floor space!... Designed to proposed new F.C.C. specifications!...

Lowest primary power consumption of any five!... Ultra linear audio driver!

FIND OUT

the pioneer is the leader

how these new PANORAMIC *instruments provide high speed, reliable checking of* FM/FM *telemetry systems*



Typical view of
5 adjacent channels

The Panoramic Telemetering Indicator, Model TMI-1, and Panoramic Telemetering Subcarrier Deviation and Three Point Calibrator, Model TMC-1, are designed specifically to provide a high speed yet reliable method for checking system operation and subcarrier deviation limits of FM/FM telemetry systems.

Model TMI-1 Panoramic Telemetering Indicator offers a directly read overall visual analysis of the frequency distribution and level of subcarriers oscillators from 350 cps to 85 kc. Magnified views of individual channels, or groups of adjacent channels, are readily obtained with front panel controls. This facilitates minute analysis and measurement of distortion products, noise, signal spillover and other spurious effects, down to magnitudes insufficient to disturb system operations. Cost-saving routine inspections can be made with the telemetry system in full operation.

By comparing subcarrier frequencies with precise markers generated by the TMC-1 or TMC-211, the TMI-1 also enables rapid calibration of subcarrier deviation limits well within a 1% tolerance.

USES FOR MODEL TMI-1 · Analysis and measurement of cross modulation, harmonic distortion, noise interference, hum, microphonics, etc. · High speed adjustment of subcarrier levels · Monitoring overall subcarrier spectrum · Analysis of switching transients · Calibration of subcarrier deviation limits (when used with TMC-1 or TMC-211).

Model TMC-1 Panoramic Telemetering Subcarrier Deviation and Three Point Calibrator is a source of accurate, crystal derived center, upper and lower limit frequencies for all 18 channels. Frequency accuracy is ±0.02%. Limit frequencies are ±7½% or ±15% on five optional channels. Other limit frequencies are available on request.

USES FOR MODEL TMC-1 Three point calibration of subcarrier discriminator linearity.

Model TMC-211 Panoramic Simultaneous 11-Point Calibrator is an instrument especially designed to calibrate the FM/FM Telemetering Subcarrier Discriminator linearity simultaneously, accurately, quickly and conveniently. Eleven equally spaced frequency points are provided within the ±7½% or the ±15% limits.

A TMC-211 consists of compact individual chassis, each incorporating wherever possible, two compatible subcarrier channels and a self contained power supply. A master control unit is also provided for linear mixing and simultaneous switching of all channels. By combining various subcarrier channel chassis, it is a simple matter to assemble a system to suit specific needs.

For each channel there are 11 calibrating frequencies provided which are at equal frequency differences. Calibrating frequencies are generated from frequency standards which have an inherent long-time stability of 0.002%. The linearity error is guaranteed to be not more than .002% of the total band-width for any one channel. The calibrating frequencies of all channels are controlled synchronously by solenoids provided in each rack and the synchronization can be turned off and the calibrating frequencies may be selected manually. An automatic timer is provided which can be adjusted from ¼ to 8 seconds per switching step. Warm up time is less than 5 minutes.

Makers of · Panadaptor · Panalyzor · Panoramic Sonic Analyzer · Panoramic Ultrasonic Analyzer.

THE MARK OF THE ORIGINAL · PANORAMIC

PANORAMIC RADIO PRODUCTS, INC.

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Cables: Panoramic, Mount Vernon, N. Y. State.

Write for complete information on Panoramic's new and important instruments.

All Hughes diodes resemble each other—externally. Germanium point-contact or silicon junction, they are all glass-bodied* and tiny (actual dimensions: 0.265 by 0.123 inch). But minute, meticulously controlled variations in the manufacturing process impart individual characteristics to the diodes, make them just right for specific applications. This gives you the opportunity of selecting from a line which includes literally hundreds of diode types.

So, when your circuitry requires varying combinations of such characteristics as . . . high back resistance . . . quick recovery . . . high conductance . . . or high temperature operation, *specify Hughes*. You will get a diode with mechanical and electrical stability built in. You will get a diode which was manufactured first of all for reliability.

*Nowhere else have glass packaging techniques been developed to a comparable extent, for the Hughes process has many unique aspects. They are difficult to duplicate, yet are instrumental to the manufacture of diode bodies which are completely impervious to contamination and moisture penetration. Hughes diodes have had these features—for years.

For descriptive literature please write: HUGHES SEMICONDUCTORS
HUGHES PRODUCTS
Los Angeles 45, California

HUGHES PRODUCTS
A DIVISION OF THE HUGHES AIRCRAFT COMPANY

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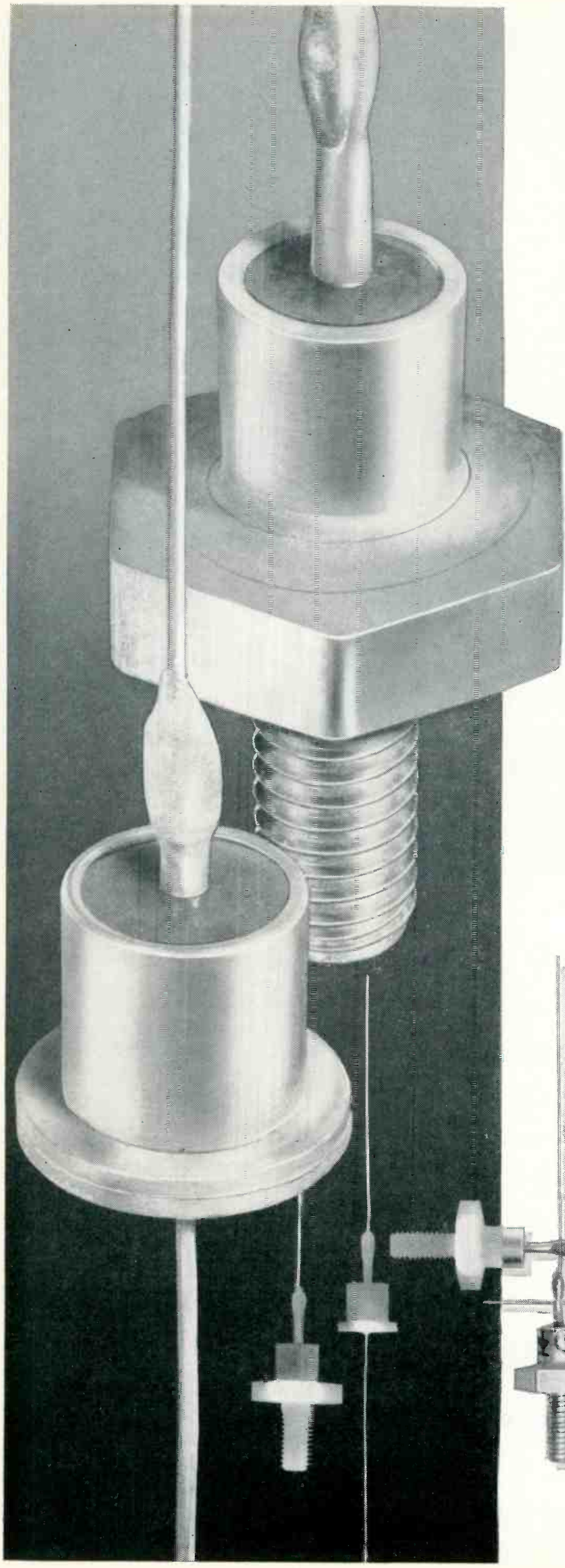


WESTINGHOUSE
SILICON DIODE

High peak inverse voltages . . . extremely low reverse current

The Westinghouse XP-5052 fused-junction silicon diode can handle 500 ma continuous d-c current at peak inverse voltages from 50 to 600 volts.

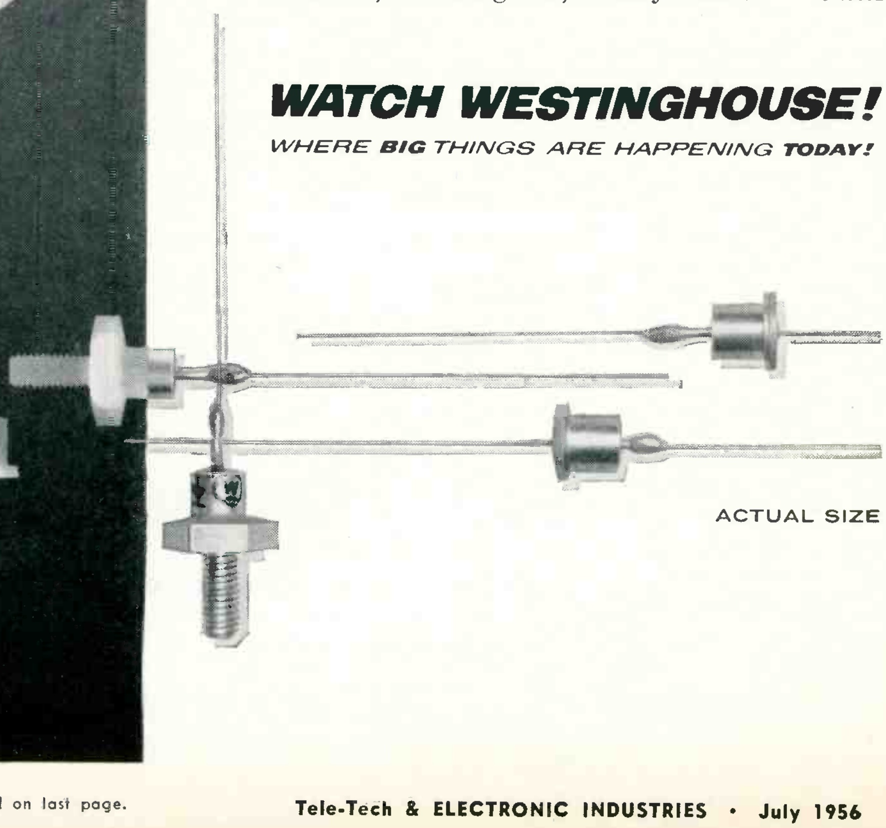
Leakage at rated voltage is extremely low . . . result is increased efficiency and temperature ranges never before attainable.

This diode is suitable for use in radio and TV, radar, aircraft, magnetic amplifiers, voltage regulators, computers, precipitators, and other industrial applications. Two case designs are immediately available . . . pigtail (XP-5052) and threaded stud (XP-5053).

For more information on the XP-5052, or any other silicon rectifier requirements, regardless of voltage and current, call your nearest Westinghouse apparatus sales office, or write Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-09001

WATCH WESTINGHOUSE!

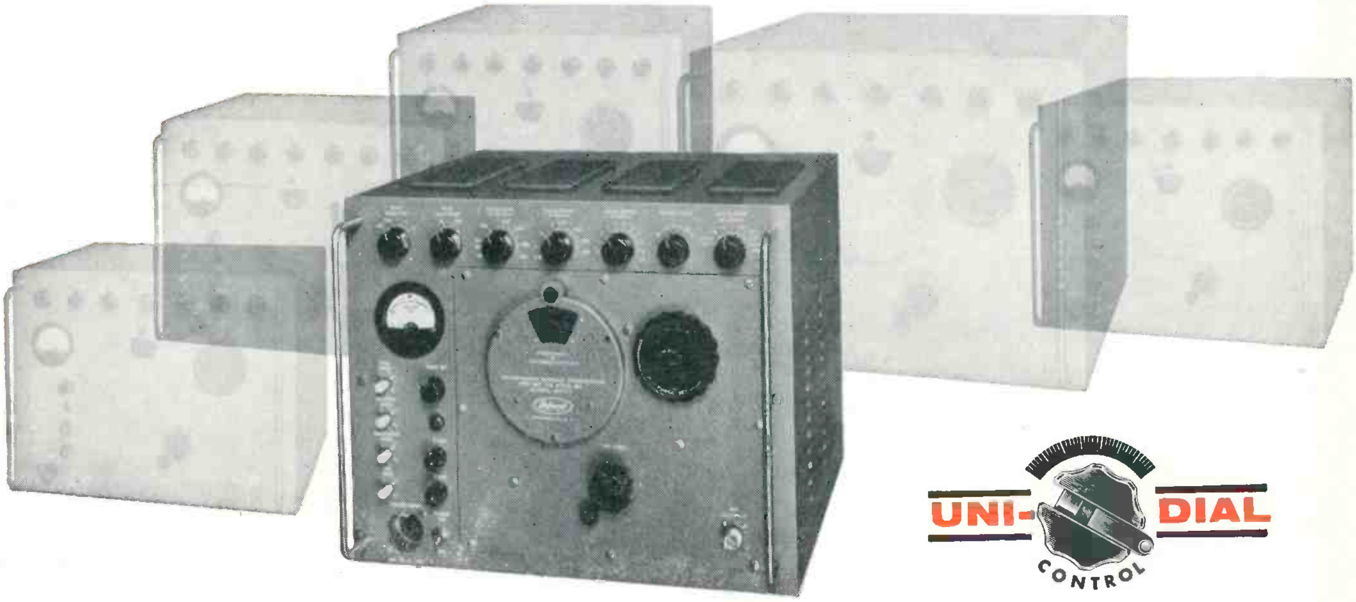
*WHERE **BIG** THINGS ARE HAPPENING **TODAY!***



ACTUAL SIZE

MICROWAVE SIGNAL GENERATORS

950 to 11,500 mc



UNI-DIAL CONTROL

JUST ONE POLARAD MICROWAVE SIGNAL GENERATOR CAN MAKE ALL THESE MEASUREMENTS

- Receiver sensitivity
- Noise figure
- Signal to noise ratio
- Image rejection
- Beacon sensitivity
- Bandwidth
- Standing wave ratio
- Antenna gain and pattern
- Conversion gain or loss
- Attenuation
- Filter characteristics
- Multi-pulsed systems, such as Beacons, DME, Tacan, etc.

Each Polarad Microwave Signal Generator (4 models cover 950-11,500 mc) is equipped with the unusually simple UNI-DIAL control that tracks reflector voltages automatically while tuning continuously. Frequency, accurate to ±1%, is read directly on the single frequency dial. There are no mode charts, no slide rule interpolations necessary.

But, most significant are the built-in features that enable use of these rugged instruments for so many applications: internal modulation, pulse and FM; internal square wave modulation; synchronization outputs, delayed and undelayed; provision for multi-pulse modulation input; provision for external modulation and synchronization; variable attenuator calibrated directly in - dbm; engineered ventilation to insure specification performance over long operating periods.

Contact your local Polarad representative or write directly to the factory for the latest detailed specifications.

SPECIFICATIONS (all models unless indicated)

Model #	Frequency Range
MSG-1	950 - 2400 mc
MSG-2	2150 - 4600 mc
MSG-3	4450 - 8000 mc
MSG-4	6950 - 10,800 mc
MSG-4A	6950 - 11,500 mc

Frequency accuracy: ±1%

Power output:
MSG-1 & 2: 1 mw
MSG-3, 4 & 4A: 0.2 mw

Attenuator range: 120 db

Attenuator Accuracy: ± 2 db

Output impedance: 50 ohms nominal

Internal pulse modulation:
Pulse width: 0.5 to 10 microseconds
Delay: 3 to 300 microseconds
Rate: 40 to 4000 pps
Synchronization: internal or external, sine wave or pulse

Internal FM:
Type: Linear sawtooth
Rate: 40 to 4000 cps
Synchronization: Internal or external, sine wave or pulse
Frequency deviation:
MSG-1 & 2: ±2.5 mcs
MSG-3, 4 & 4A: ±6 mcs

Internal square wave modulation:
40 to 4000 pps

External pulse modulation:
Polarity: Positive or negative
Rate: 40 to 4000 pps
Pulse width: 0.5 to 2500 microseconds
Pulse separation (for multiple pulses): 1 to 2500 microseconds

Output synchronizing pulses:
Polarity: Positive, delayed & undelayed
Rate: 40 to 4000 pps
Voltage: Greater than 25 volts
Rise time: Less than 1 microsecond

Price:
MSG-1, 2 ....$1,720.00
MSG-3, 4 ....$2,190.00
MSG-4A $2,450.00

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INDUSTRY NEWS

George W. Lober has been appointed sales manager of the newly-organized Microwave Electronics Div. of the Sperry Gyroscope Co., Great Neck, N. Y.

Appointment of **Frank M. Viles, Jr.**, as technical director of the Components Div. of Federal Telephone and Radio Div., Clifton, N. J., has been announced.

Perry R. Roehm, executive vice-pres. of Norden-Ketay Corp., New York, N. Y., has been elected to succeed **Morris F. Ketay** as president.

Stanley L. Rudnick has joined the National Company, Inc., of Malden and Melrose, Mass., as general sales manager of the Commercial Div.

RCA Semiconductor Div., Somerville, N. J., has announced the appointment of **Robert D. Wick** to the position of Manager, Government Sales.

The Ford Instrument Co., Div. of Sperry-Rand Corp., Long Island City, N. Y., has announced the formation of a new missile development division. Under the new organization, **Lawrence S. Brown** has been appointed manager; **Lewis J. Scheuer**, director of engineering; **Carl S. Backman**, manager of testing; **John J. Woodruff**, manager, modification center; and **Lawrence W. Farrell**, production manager.

Herbert O. Wilson has been appointed works manager of the Astatic Corp. of Conneaut, Ohio.

Bradley Laboratories, New Haven, Conn., has announced the appointment of **Harold B. Rosenberg** as production manager of its Selenium Div.

David J. Munroe has been named president of the Webster Electric Co., Racine, Wis. He succeeds **Preston G. Crewe** who was elevated to the newly-created post of vice-chairman of the Board of Directors.

Appointment of **Robert J. Jeffries** as assistant to the president of Daystrom, Inc., Elizabeth, N. J., has been announced.

Thomas B. Kalbfus has been appointed general sales manager of the television-radio div., Westinghouse Electric Corp., Metuchen, N. J.

The Board of Directors of Allen B. Du Mont Laboratories, Inc., Clifton, N. J., has announced the election of **Donovan H. Tyson** as vice-president and controller of the firm.

Robert Oakes Jordan
In the article reproduced here, just as it appeared in the May 16 issue of "Down Beat", Mr. Robert Oakes Jordan reports his completely unbiased and impartial findings on the vitally important subject of tape quality. A leading authority in the high-fidelity field, and tape recording in particular, his comments are of interest to all users of tape recording equipment, professional and amateur alike.

High Fidelity

By Robert Oakes Jordan

IT LOOKS AS though 1956 will be a year for magnetic tape recording. Perhaps it might be wise to review the subject of tape.

Looking back over the recent history of magnetic recording and its plastic tape medium, it is easy to see the progress in both.

Factors, more often than not overlooked, which are concerned with the use and storage of tape should be known and used by every person having a tape recorder.

During the last year, one of the long-term projects at our laboratory in Highland Park, Ill., has been the independent study of magnetic recording tape. We are interested in finding out just which practises in its use must be observed and how the user can best assure the safekeeping of his recorded tapes.

SEVERAL HUNDRED reels of magnetic tape from all the tape manufacturers were studied. Not more than 5 percent of this tape was submitted by manufacturers as samples. The bulk was bought by the laboratory.

In this a nontechnical report, we will tell of those factors considered most important for the tape user. It is our opinion that output consistency is the single most important factor governing the choice of any recording tape. Output consistency means that the tape must produce the same quality of sound as it is played back, month after month, year after year.

If the manufacturer has complete control of his tape production processes, then serious variation should not occur. If there are variations in the thickness of the oxide, its composition, or its method of application to the plastic base, then there will be a variation in the performance of the tape. If the user gets too little signal in playback or too much, either is a serious tape fault.

IT IS SELDOM possible for the tape user to judge the quality of the tape he uses because faults and inconsistencies identical to tape failures may be caused by poorly adjusted or maintained tape recorders. Virtually any brand of tape will provide adequate results from the majority of nonprofessional recorders now on the market. However, if you want professional results, then reel-to-reel, batch-to-batch output consistency is important.

In the tests, we found some remarkable variations in marketed tapes for consumer use. Among those faults found most often are these:

- *Nonuniformity of oxide coating*, causing signal-level variations or "dropouts" in which little or no signal was recorded.
- *Pits or pocket voids*, where air bubbles or dirt have caused very small pits in the oxide coating. In some cases the ring magnetization of the rim of these pits or holes will cause playback signal variation.
- *Nonuniformity of plastic base surface*, in which, if the plastic base has microscopic hills or valleys in its surface, the oxide coating, though perfectly smooth at the playing surface will vary in depth along the tape. This can cause that noise-behind-the-signal, perplexing to professional recording engineers as well as amateurs.
- *Uneven slitting*, in which the magnetic tape is processed and coated in wide rolls and must be slit to whatever marketable width is desired. Large roller knives must be employed in the slitting process. If these knives get dull or exhibit any heat change one to another, the tension of one slit edge of the tape varies from that of its other edge. This change of edge tension over the length of a reel of tape will cause erratic travel of the tape over the recording and playback heads.
- *Poor oxide adhesion to the plastic base.* While this fault is becoming more and more rare, it is still a factor to consider when buying "bargain" or used bulk tape. The drawbacks to good recordings are evident in the clogging effect of the loosened oxide powder.

After the tests, we chose Audio Tape Type 51, made by Audio Devices, which through two years of tests and use, proved to be the most consistent of all the major tapes.

audiotape

TRADE MARK

WINS INDEPENDENT TAPE TEST BY LEADING HI-FI AUTHORITY

. . . as reported in DOWN BEAT *magazine*

The tape test described by Mr. Jordan emphasizes two very important facts. (1) Different brands of recording tape vary widely in output uniformity. (2) Of all the leading brands tested, standard plastic-base Audiotape rated highest in consistent, uniform quality.

This outstanding Audiotape performance is the calculated result of extra care and precision in every step of the manufacturing process, from selection of raw materials to final coating, slitting and packaging. And this same uniformity extends throughout the entire Audiotape line.

Now there are 5 DIFFERENT TYPES of Audiotape, with base material and thickness to meet the exact requirements for every recording application. But whatever type you select, there's only *one* Audiotape *quality*—the very finest that can be produced. Ask your dealer for our new Bulletin No. 250, describing the newly-expanded Audiotape line. Or write to Audio Devices, Inc., 444 Madison Ave., New York 22, N. Y.

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For product information, use inquiry card on last page.

Binary Counter

(*Continued from page* 49)

The voltage-current relationship for a non-linear load may be expressed as,

$$I = K (E_D)^n. \qquad (6)$$

In Fig. 4 a typical non-linear load line of this nature is superimposed on a composite voltage-current characteristic. The non-linear load line crosses the characteristic at points A_X and B_X.

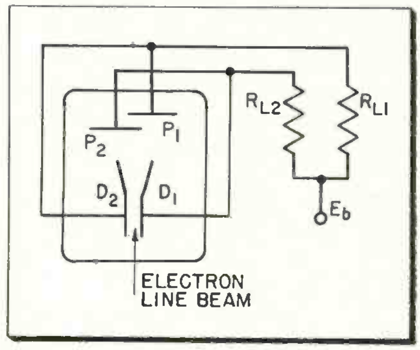
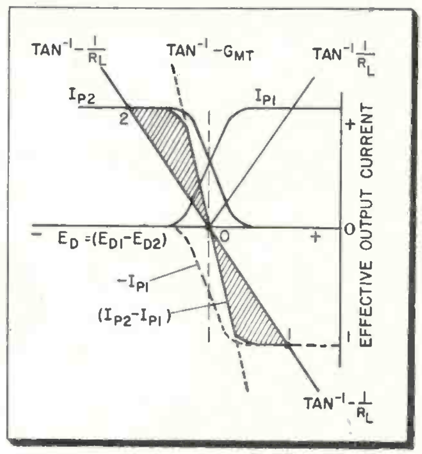


Fig. 5: Circuit shows neg. G_m

Fig. 6: Composite curve



These points, which are stable holding points, fall on the linear portion of the characteristic where a maximum and a constant negative deflection transconductance occurs. Therefore, dynamic operation for a non-linear load line takes place without a change in the deflection transconductance and an improved high frequency response is obtained. Increased holding stability is also obtained, as can be seen by a comparison of the relative ordinates between the linear and non-linear load lines and the characteristic within the areas A_XCO and B_XEO.

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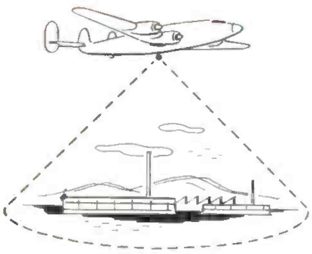

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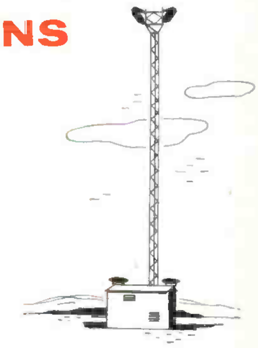

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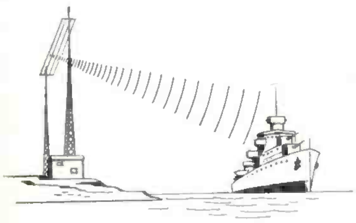

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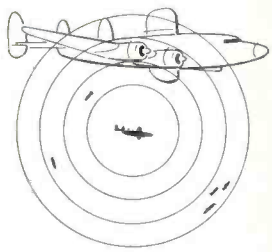

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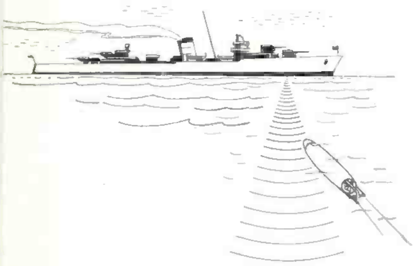

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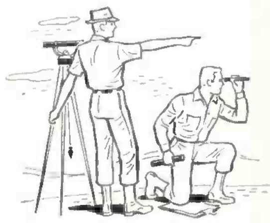

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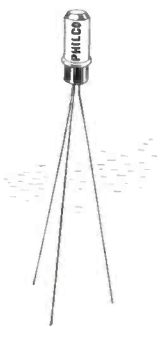

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ASST H W Walton	446
BATTERIES & TUBES Capt G L Nugent	466
ASST R E Parsons	454
COMPONENTS Capt P E Melton	478
S Anderson	273

SPECIAL PURCHASES BRANCH

CHIEF Lt Col R W Strunk	8047
ASST N Creager	8048

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DEP Col T M Hahn	X51126
EXEC OFF Lt Col T P Ross	X51144
DIR of RESEARCH Dr H A Zahl	X51136
ASST DIR of RESEARCH	
Lt Col H T Daracott	X52884
DIR of ENGINEERING S E Petrillo	X51171
ENGINEERING STAFF CHIEF	
W V Organic	X52708

OFFICE OF TECHNICAL PLANS

DEPUTY DIR H W Parmer	X52112
TECHNICAL PROGRAM CHIEF	
W L Litchfield	X51341
COMM SYSTEMS & EQUIP CHIEF	
R S Boykin	X51818

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CHIEF Col R B Tomlinson	X51191
ASST CHIEF H F Hubbard	X51191
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N K Levine	
S C SUP A (N Y) J Stromgin	
S C SUP A (CHI) O White	
FIELD OFFICES S C SUP A (PHILA)	
PROCUREMENT A Levitan	

FIELD ENGINEERING DIV

CHIEF R P Iannarone	X51253

MAINTENANCE METHODS DIV

CHIEF W C Grubb	X51552

PROCUREMENT DATA

CHIEF S Malkin	X51552

APPLICATION ENGRG DIV

CHIEF W J Laverick	X51430

LOGISTICS ENGRG DIV

STANDARDIZATION DIV H R Nooe

COMMUNICATIONS DEPT

(Formerly Coles Signal Lab)
Eatontown N J Phone EATONTOWN 3-1000
Determines requirements for wire, radio, communications, general engrg

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OFFICE OF DIRECTOR W C Brown	X52441
CHIEF ENGRG STAFF Fred B Eldridge	X52116
DEPUTY DIRECTOR	

RADIO COMM DIV

CHIEF J Hessel	X51566

TELECOMMUNICATION DIV

CHIEF B S Anderson	X51444

COMPONENTS DEPARTMENT

(Formerly Squier Lab)
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Determines requirements for components and power supplies

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DEPUTY DIRECTOR Maj O K Gardner	X52583
CHIEF ENGINEER W L Seibert	X52134
CHIEF SCIENTIST	X52582
TECHNICAL STAFF CHIEF Dr S B Levin	X52483
OPERATING SECT CHIEF D L Castellini	X52509
BRANCHES	

ELECTRONIC PARTS & MATERIALS

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POWER SOURCES

CHIEF W L Doxey	X51057

FREQUENCY CONTROL

CHIEF Dr E A Gerber	X52250

CHEMICAL PHYSICS

CHIEF Dr V F Payne	X51308

PHOTOGRAPHIC

CHIEF S Levinos	X52058

EVANS SIGNAL LABORATORY

Phone Prospect 5-3000
Determines requirements for radar, meteorological equipment, etc.

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DEP DIR Lt Col J M Raleigh	X61121
TECHNICAL ASST TO THE DIRECTOR	
W L Rehm	X61473

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DEPTY DIRECTOR Dr C N Crenshaw	X61405
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CHIEF D Deisinger	X61224

MATH & METEOROLOGY

CHIEF P J Shapiro	X61150

SPECIAL PROJECTS

ACTG CHIEF W Lonnie	X61108

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Guided Missile Instrumentation Chief	
A L Vieweger	X61249
Radar Systems Chief M M Brenner	X61322

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DEPUTY DIRECTOR	
BRANCHES	
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Countermeasures Systems Chief C B Moore	X61233

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DEPUTY DIRECTOR C K Shultes	X61455
ASSOCIATE DIRECTOR K Garoff	X61455
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497,267 sq. ft.

Plant 3
Philadelphia
304,977 sq. ft.

Plant 4
Philadelphia
98,079 sq. ft.

Plant 6
Philadelphia
157,763 sq. ft.

Plant 8
Philadelphia
81,407 sq. ft.

Plant 10
Philadelphia
659,222 sq. ft.

Plant 18
Philadelphia
147,400 sq. ft.

Plant 22
Philadelphia
43,000 sq. ft.

Plant 29
Philadelphia
152,789 sq. ft.

Plant 50
Philadelphia
668,430 sq. ft.

Other Philco Plants in:

Mt. Clemens, Michigan
235,225 sq. ft.

Croydon, Penna.
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Connersville, Indiana
1,193,823 sq. ft.

Watsontown, Penna.
528,852 sq. ft.

Sandusky, Ohio
226,183 sq. ft.

Lansdale, Penna.
314,700 sq. ft.

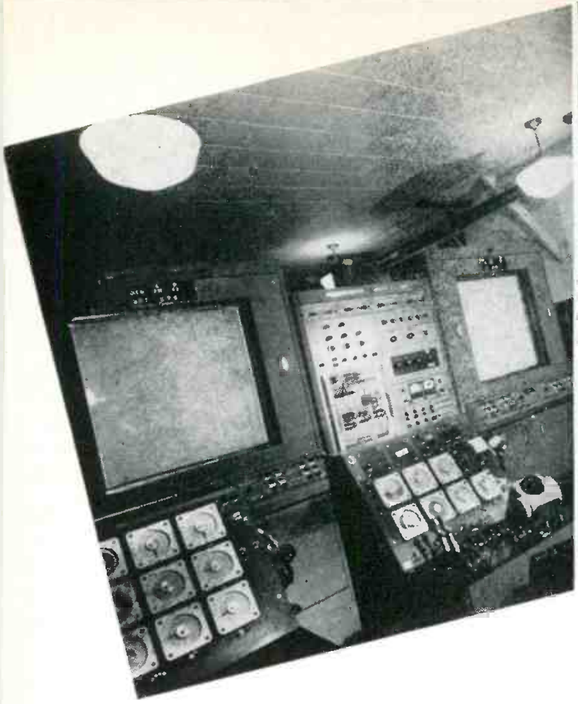
Spring City, Penna.
90,964 sq. ft.

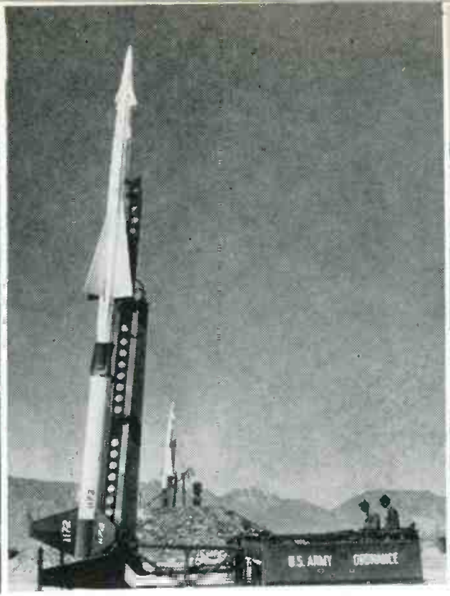
Bedford, Indiana
163,550 sq. ft.

Fairfield, Ohio
256,994 sq. ft.

Total area devoted to manufacturing...
4,789,478 sq. ft.

For product information, use inquiry card on last page.





The Army's operational missile NIKE (c) is flanked by views of the missile control panels in use at Patrick AFB, Fla.

Electronic Industries' 1956 Guided Missile Directory

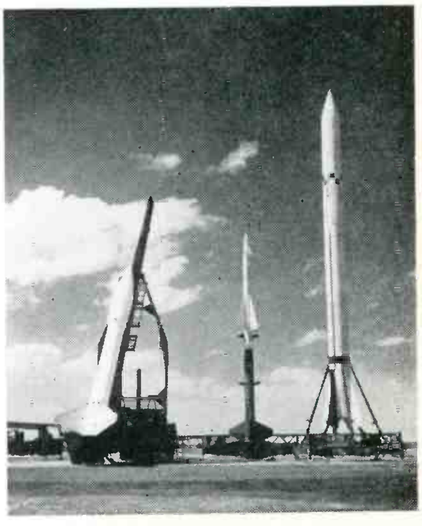
Listing the major operational and developmental guided missiles and the electronic firms and military agencies directly responsible for their design, development, testing and production. Includes personnel managers, chief engineers and military personnel involved in missile procurement.

A major stake in the government's missile program is owned by the electronic industries. More than 60% of the missile dollar is going into the guidance and control systems, and a single missile may involve as many as 900 individual manufacturers.

Presented here is the first authoritative compilation of the procurement personnel behind this vast program. For easy reference it has been divided into four parts: First, a survey of all military missiles, both operational and planned, together with the prime contractors, and a brief description of the outstanding features. Second, a listing of the most prominent electronic manufacturers, and firms incorporating electronic divisions employed on missile projects, with the names of the personnel managers and chief engineers. Third, the military agencies with responsibility for missile procurement, testing and design. The individuals and offices having prime responsibility are in red. Fourth, as mentioned above, as many as 900 manufacturers may be involved in one missile. For interested readers, there are listed in this section the major electronic firms reportedly active in missile work during the past 60 days.

U. S. ARMY ORDNANCE

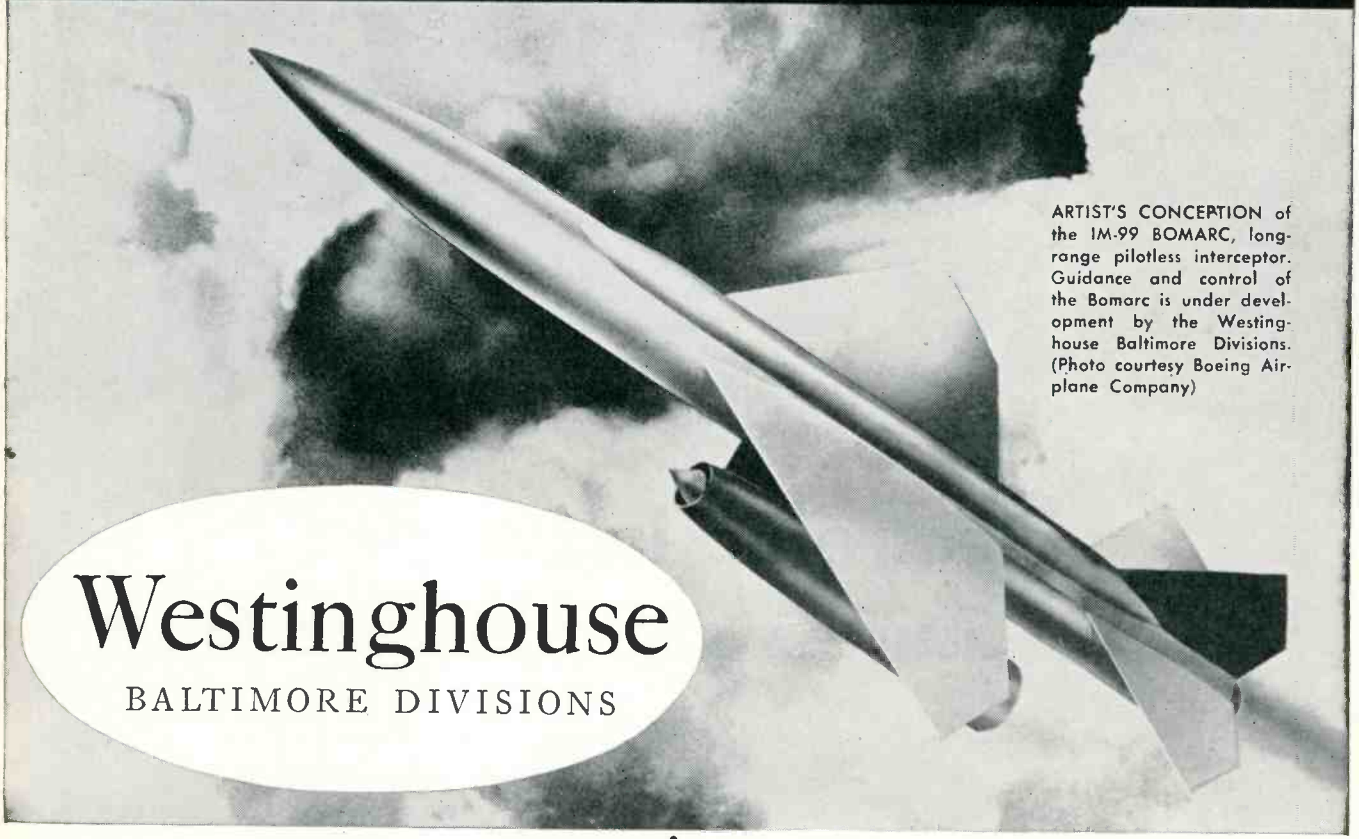
NIKE, Surface-to-air, liquid-fueled supersonic antiaircraft missile about 20 ft. long and 1 ft. in diameter, with two sets of fins for guidance and steering. Missile and booster weigh more than 1 ton. Speed, range and altitude are classified. Fired from an almost vertical position. There are eight launchers in each NIKE battery, which is operated by approximately 100 officers and men.



CORPORAL is equipped with either an atomic or conventional type warhead, and follows a ballistic trajectory. Motive power is supplied by a powerful rocket motor and speed is several times the speed of sound. A CORPORAL battalion has 250 men. There are three launchers to a battalion. CORPORAL battalions have been deployed to Europe.

REDSTONE. Largest surface-to-surface ballistic guided missile successfully fired in this country—named for its birthplace, the Army's Redstone Arsenal, Huntsville, Alabama. It is a future operational field missile and at the same time a basic "step" toward the JUPITER, the intermediate range ballistic missile capable of being launched from on land or aboard ship. REDSTONE was developed under supervision of Dr. Wernher von Braun, developer of the German V-2 Rocket.

electronics engineers:



ARTIST'S CONCEPTION of the IM-99 BOMARC, long-range pilotless interceptor. Guidance and control of the Bomarc is under development by the Westinghouse Baltimore Divisions. (Photo courtesy Boeing Airplane Company)

are active in advanced projects like **BOMARC...** are you?

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Send resume of education and experience to Technical Director, Dept. 337 Westinghouse Electric Corp., 2519 Wilkens Avenue, Baltimore 3, Maryland

BOMARC is typical of the many interesting projects "in the works" at Westinghouse. Such projects are more than a "one-shot" challenge to the engineer . . . they are the true steps forward in his career, and the broadening of knowledge that enriches his value to himself and to his profession. If you are interested in this type of project, Westinghouse is interested in you!

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U. S. NAVY

PETREL developed under technical direction of BuOrd by the National Bureau of Standards, primarily for use against enemy ships at sea. Launched by patrol aircraft well outside the range of the target's air defense. The engineering production phase was coordinated by the Naval Ordnance Experimental Unit, a field activity of the Bureau of Ordnance located at the Bureau of Standards, with the production contractor, Fairchild Engine and Airplane Corp. A number of patrol type aircraft are equipped PETREL.

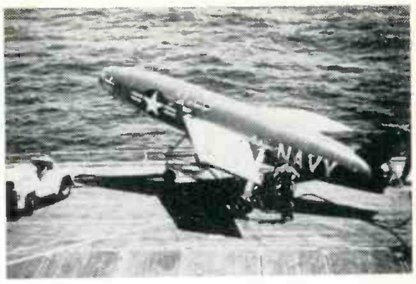
SPARROW I, a supersonic air-to-air missile, developed by BuAer, the Naval Air Missile Test Center, Point Mugu, Calif. and the Sperry Gyroscope Co. It is about 12 ft. long, weighs about 300 pounds, and is powered by a solid propellant rocket motor. Guidance signals deflect the missile's wings and direct it to intercept the target, under evasive action.

REGULUS, resembles a conventional swept-wing jet fighter. About 30 ft. long, it was developed by the Chance Vought Aircraft Co., under the sponsorship of BuAer. It is designed for launching from submarines, surface ships and shore bases.

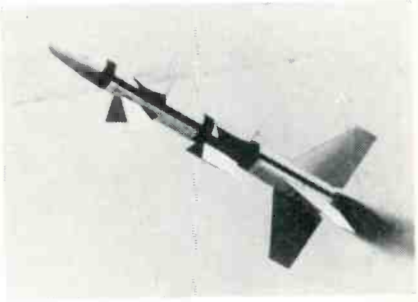
TERRIER was fired experimentally in fleet operations in November 1954 from the Navy's oldest battleship, USS MISSISSIPPI. A slim, needle-nosed supersonic missile, the TERRIER is designed to intercept aircraft at higher altitudes than conventional anti-aircraft guns. Being produced in quantity at the Naval Industrial Reserve Ordnance Plant, Pomona, Calif., operated by Convair, division of General Dynamics Corp.

TALOS, supersonic guided missile for use in the air defense, is being developed by the Johns Hopkins University Applied Physics Laboratory, Silver Spring, Md., under contract to the Navy's BuOrd, prime contractor being Bendix Aviation Corp.

TARTAR. In an open press conference on March 13, 1956, aboard the guided missile cruiser USS BOSTON, Rear Admiral John H. Sides, answering direct press queries, said: "TARTAR will be small enough to go into destroyers and the secondary batteries of large ships, yet have more performance than the original TERRIER.



Navy's REGULUS



Navy's TALOS

U. S. AIR FORCE

MATADOR (TM-61A), tactical missile of subsonic speed, manufactured by Glenn L. Martin Co. Operational since March 1954, it has a wingspan of 28.7 ft., length of 39.6 ft. Ground launched by a rocket booster from a roadable launcher, it is powered by an Allison jet engine (J-33-A-37), controlled electronically in flight by ground personnel, and is capable of delivering conventional or nuclear weapons several hundred miles. MATADOR squadrons are already stationed in Germany and Orlando, Florida.

FALCON (GAR-1), guided aircraft rocket of supersonic speed, manufactured by Hughes Aircraft Co. Operational since March, 1956. FALCON weighs slightly over 100 pounds and is approximately 6 ft. long, is powered by solid rocket propellant and electronically fired and guided. Designed for under wing or pod installation, it can be carried in quantity by interceptor aircraft.

SNARK (SN-62), long-range strategic missile manufactured by Northrop Aircraft, Inc. Recently underwent tests at the Air Force Missile Test Center, Patrick Air Force Base, Fla. It is a winged pilotless bomber powered by an Allison turbo-jet engine, and is the first U. S. long-range missile to be test flown.

NAVAHO (SM-64), long-range strategic missile, manufactured by North American Aviation, Inc., now undergoing tests at Patrick Air Force Base. Original flight tests were made at Edwards Air Force Base, Calif. A rocket-launched, air-breathing missile, it is considered to have range, accuracy and load carrying capabilities as good as ballistic missile types.

RASCAL (TAM-63), long-range guided missile under development by Bell Aircraft Corp., is a rocket-powered pilotless bomber designed to be carried by strategic bombers and released miles from objective to proceed at high speed to target.

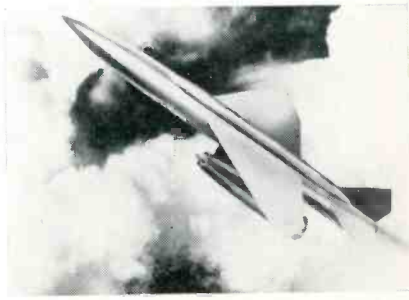
BOMARC (IM-99), long-range interceptor guided missile of supersonic speed, under development by Boeing Airplane Co. Successful experimental launchings at Patrick Air Force Base are now a regular part of the development program. A pilotless guided missile powered by Marquardt engine, it is launched from the ground.

INTERCONTINENTAL BALLISTIC MISSILES (ICBM) including the ATLAS and TITAN ICBM. Convair Division of General Dynamics Corp. received a development contract for airframe and air frame components for the ATLAS ICBM. A second development contract for airframe and air frame components for the TITAN ICBM was awarded to Glenn L. Martin Company.

INTERMEDIATE RANGE BALLISTIC MISSILE, THOR IRBM. Douglas Aircraft Co. was awarded a development contract for the THOR IRBM in December 1955. Separate contracts were awarded to prime contractors for sub-components such as guidance system, propulsion and other sub-systems.

Air Force's MATADOR

Air Force's long range SNARK



Air Force's BOMARC

in Major Guided Missile Projects

- AIR-TO-AIR
- AIR-TO-SURFACE
- SURFACE-TO-SURFACE
- SURFACE-TO-AIR

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FTL is presently extending its technical staff and facilities in the guided missile and other allied fields.

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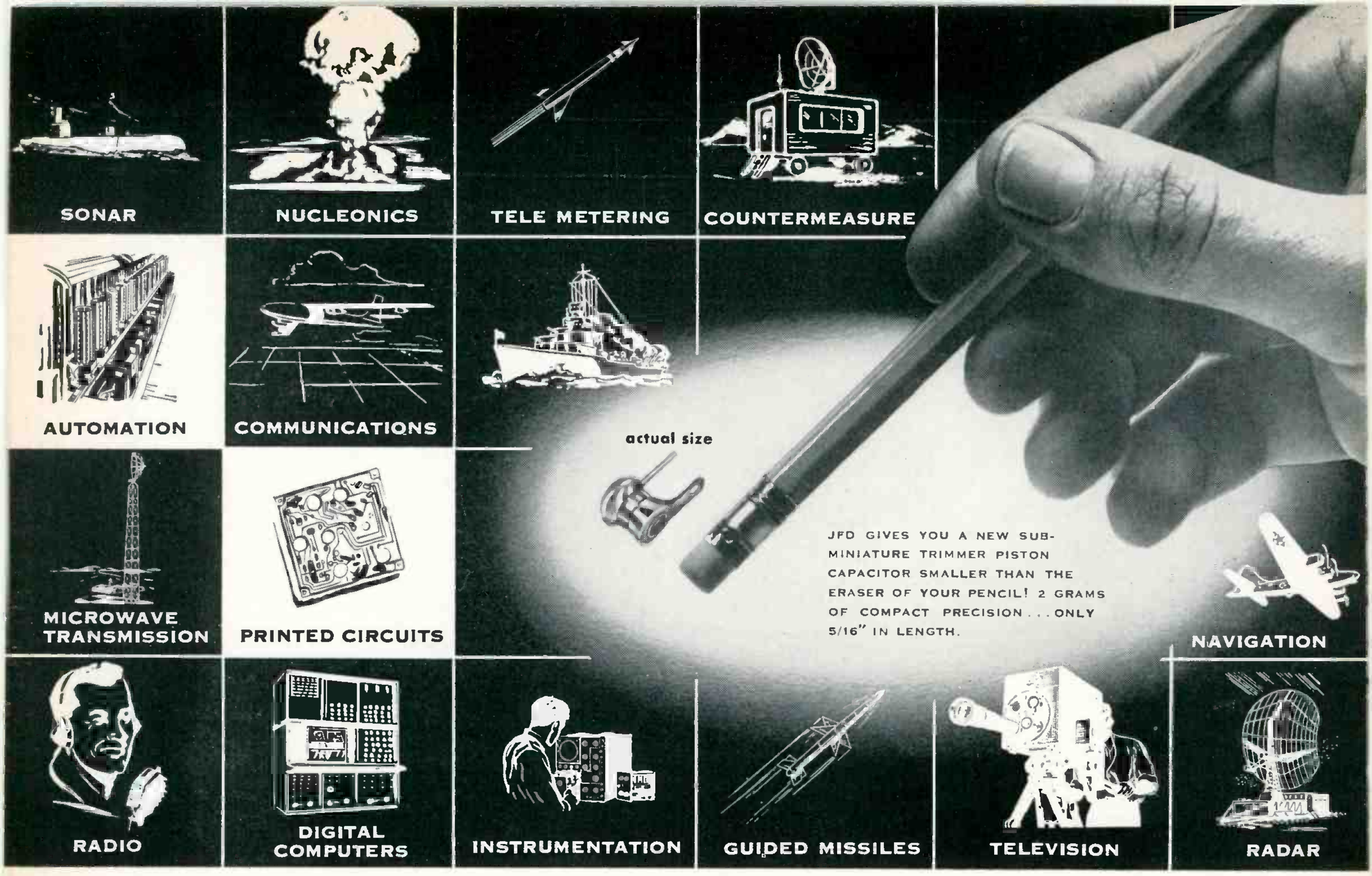
COMPANY	ENGINEERING EXECUTIVE OR CHIEF ENGINEER	PERSONNEL MANAGER
Hughes Aircraft Co. Culver City, Calif.	N. I. Hall	Scientific Staff Relations Res. & Dev. Labs.
Philco Corp. Philadelphia 44, Pa.	N. Johnson Chief Eng. "Sidewinder"	J. F. Morrissey Govt. & Ind. Div.
Sperry Gyroscope Co. Div. of Sperry-Rand Corp. Great Neck, L. I., N. Y.	L. L. Wheeler	J. W. Dwyer Mgr. for Tech. Employment
Bell Aircraft Corp. P. O. Box 1 Buffalo 5, N. Y.	T. S. Lines Chief of Missile Projects	G. E. Clock Chief Personnel Engineering Operations
Glen L. Martin Co. Baltimore 3, Md.	G. S. Trimble, Jr. V. P. Engineering	J. J. Holley
Fairchild Eng. & Airplane Corp. Wyandanch, N. Y.	A. E. Harrison Dir. of Eng.	R. B. Gulliver Personnel Mgr.
Convair Pomona, Calif.	T. A. Billings Eng. Administration	B. Dixon, Dept. 3 Personnel Employment, Div. 3
North American Aviation, Inc. Downey, Calif.	J. G. Beered, Mgr. Missile Dev. Div.	A. W. Hale Personnel Director
Chrysler Corp. Box 2628 Detroit 31, Mich.	J. P. Butterfield Chief Eng. Chrysler Corp. Missile Operations	E. Franks Personnel Placement & Salary Adm.
Chance Vought, Inc. Dallas, Texas	R. C. Blaylock, V. P. Engineering	Peter Wacks Personnel Mgr.
Northrup Aircraft, Inc. 1015 E. Broadway Hawthorn, Calif.	C. J. Dunn, Proj. Eng. Guided Missiles	Andy Aitken Dir. of Per., Eng.
Boeing Airplane Co. Seattle 14, Wash.	L. A. Wood, V. P. Pilotless Aircraft Div.	J. C. Sanders Personnel, Staff Eng.
Western Electric Co. 195 Broadway New York 7, N. Y.	F. R. Lack, V. P. Radio Div.	Personnel Director
Bendix Products Div. of Bendix Aviation Corp. South Bend, Ind.	D. M. Heller Dir. of Engr.	Missiles Emp. Mgr.
Pacific Div. Bendix Avia. Corp. 11600 Sherman Way North Hollywood, Calif.	W. S. Leitch Chief Eng., Electronics	Employment Mgr.
Raytheon Mfg. Co. P. O. Box 398 Bedford, Mass.	T. C. Wisenbaker Mgr. Bedford Labs.	L. E. Woods Director of Personnel Raytheon Mfg. Co. Waltham 54, Mass.
Douglas Aircraft Co., Inc. Santa Monica, Calif.	E. P. Wheaton Chief Missile Eng.	C. C. La Vene Personnel

PERSONNEL MANAGERS—U. S. GOVERNMENT GUIDED MISSILE PROVING GROUNDS

Proving Ground	Personnel Manager
White Sands Proving Grounds (U. S. Army) White Sands Proving Grounds, New Mexico	Milton Harris Civilian Personnel Officer
Naval Air Missile Test Center Point Mugu, Calif.	Comdr. L. L. Brannon, USN Industrial Relations Officer
RCA Service Co., Missile Test Project P. O. Box 1226, Melbourne, Fla. (Patrick AF Base)	Personnel Manager

ELECTRONIC FIRMS REPORTEDLY ACTIVE ON MISSILE PROJECTS

Aerojet-General Corp., Azusa, Calif.
Aircraft-Marine Products, Inc., Harrisburg, Pa.
Amerac, Inc., Wenham, Mass.
American Machine & Foundry Co., Alexandria, Va.
Anderson Greenwood & Company, Bellaire, Texas
Applied Science Corp. of Princeton, Princeton, N. J.
Arma, Div. American Bosch Arma Corp., Garden City, L. I., N. Y.
Avco Manufacturing Co., Crosley Div., Cincinnati, O.
Avion Div. of ACF Industries, Inc., Paramus, N. J.
Baird Associates, Inc., Cambridge, Mass.
Bell Aircraft Corp., Buffalo, N. Y.
Bell Telephone Labs., New York, N. Y.
Bendix Aviation Corp., Baltimore, Md.
Boeing Airplane Co., Wichita, Kansas
Bruno Corp., New York, N. Y.
Brush Electronics Company, Cleveland, Ohio
Burroughs, Detroit, Mich.
Chance Vought Aircraft, Inc., Dallas, Texas
Chrysler Corp., Detroit, Mich.
Collins Radio, Cedar Rapids, Iowa
Communication Accessories Co., Hickman Mills, Mo.
Craig Systems, Lawrence, Mass.
Crosley Div. Avco Manufacturing Corp., Evendale, Cincinnati, O.
Delco Radio Div., General Motors Corp., Kokomo
Eicor Inc., Chicago, Ill.
Electronics Corp. of America, Cambridge
Emerson Radio & Phono. Corp., Jersey City
Espey Manufacturing Co., New York, N. Y.
Fairchild Camera, Jamaica, L. I., N. Y.
Fairchild Guided Missiles Div., Fairchild Engine & Airplane Corp., Wyandanch, N. Y.
Farnsworth Electronics Co., Fort Wayne, Indiana
Federal Manufacturing & Engineering Corp., N. Y. C.
Federal Telecommunication Labs., Nutley, N. J.
Federal Telephone & Radio Corp., Clifton, N. J.
Filtors, Inc., Port Washington, L. I., N. Y.
Ford Instrument Co., Long Island City, N. Y.
Firestone Tire and Rubber Co., Akron, Ohio
General Dynamics, San Diego, Calif.
General Electric Co., Syracuse, N. Y.
General Precision Laboratories, Pleasantville, N. Y.
Gilfillan Brothers, Inc., Los Angeles, Calif.
Good Year Aircraft, Akron, Ohio
Hallicrafters Co., Chicago, Ill.
Harris-Seybold Co., Cleveland, Ohio
Hazeltine Electronics, Little Neck, N. Y.
Hoffman Laboratories, Inc., Los Angeles, Calif.
Hughes Aircraft Div., Culver City, Calif.
Hycon Manufacturing Co., Pasadena, Calif.
International Business Machines, New York, N. Y.
Kearfott Co., Little Falls, N. J.
Laboratory for Electronics, Boston, Mass.
Lavoie Laboratories, Morganville, N. J.
Lear, Inc., Grand Rapids, Mich.
LEL, Inc., Copiague, N. Y.
Litton Industries, San Carlos, Calif.
Lockheed Aircraft Corp., Van Nuys, Calif.
The Magnavox Co., Fort Wayne, Ind.
Magnetic Research Corp., El Segundo, Calif.
Glenn L. Martin Co., Baltimore, Md.
W. L. Maxon, Old Forge, Pa.
Melpar, Alexandria, Va.
Midwestern Instruments, Tulsa, Oklahoma
Minneapolis-Honeywell Regulator Co., Minn., Minn.
Motorola, Chicago, Ill.
Nems-Clarke Inc., Silver Spring, Md.
Norden-Ketay Corp., New York, N. Y.
North American Aviation, Inc., Downey, Calif.
Northrop Aircraft, Inc., Hawthorne, Calif.
Olympic Radio & Television, Inc., L. I., N. Y.
Packard Bell Co., Los Angeles, Calif.
Philco Corp., Philadelphia, Pa.
Radio Corporation of America, New York, N. Y.
Radioplane Co., Subsidiary of Northrop Aircraft, Inc., Van Nuys, Calif.
Ramo-Wooldridge Corp., Los Angeles, Calif.
Raytheon Manufacturing Co., Waltham, Mass.
Reeves Instruments, New York, N. Y.
Raymond Rosen Engineer Products, Philadelphia, Pa.
Ryan Aeronautical Co., San Diego, Calif.
Seeburg Corp., Chicago, Ill.
Sperry Rand, Great Neck, L. I., N. Y.
Stavid Engineering, Inc., Plainfield, N. J.
Stewart-Warner, Indianapolis, Ind.
Stromberg-Carlson Co., N. Y.
Sylvania Electric Products, Inc., Buffalo, N. Y.
Telechrome, Inc., Amityville, N. Y.
Texas Instruments, Inc., Dallas, Texas
Tung Sol Electric, Inc., Newark, N. J.
Varian Associates, Palo Alto, Calif.
Webster-Chicago, Chicago, Ill.
Weston Electrical Instrument Corp., Newark, N. J.
Wilcox Electric Corp., Kansas City, Mo.



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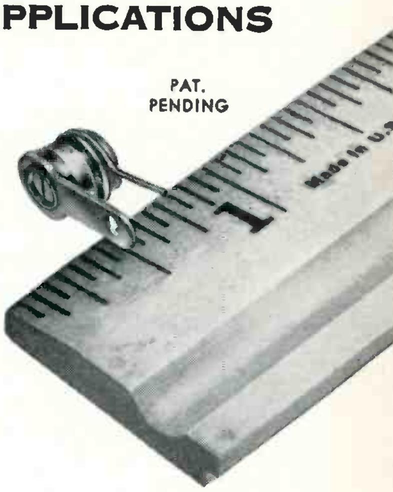

Features: Stability, approximately Zero temperature coefficient . . . End stops at either end of adjustment . . . working temperature – 55° to + 125°C . . . Anti-back lash and thread wear compensation.

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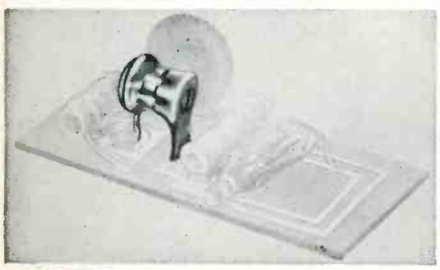

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Guided Missile Center
Redstone Arsenal
Huntsville, Alabama

GUIDED MISSILE DEVELOPMENT
Col M B Chatfield,
Chief of Research and Development

GUIDED MISSILE PROCUREMENT
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DEPUTY COMMANDER FOR WEAPONS SYSTEMS
CHIEF Maj Gen A Boyd 17

ASST GUIDED MISSILE SYSTEMS
CHIEF Brig Gen D R Ostrander 57

DEPUTY COMMANDER FOR RESEARCH AND DEVELOPMENT
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DEPUTY Brig Gen Estes 26

GUIDANCE & CONTROL DIVISION
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FIRE CONTROL BRANCH Col H C Teubmer 170
TEST INSTRUMENTATION BRANCH Lt Col W S Bradford 272

AF Missile Test Center

Patrick AF Base Cocoa Fla
Phone Cocoa Beach 2231

Responsible for testing guided missiles

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PROCUREMENT DIVISION
CHIEF Lt Col J R Byers 3-3239
T F Larkin 3-3239
DCS FOR MATERIAL Col H Rankin 3-3259

AF Flight Test Center

Edwards AFB, Edwards Calif

Responsible for flight testing research, parachute development, static rocket engine testing and experimental highspeed track testing

COMMANDER Brig Gen J S Holtoner

DIR/FLIGHT TEST & DEVELOPMENT
DIRECTOR Col H A Hanes

DCS FOR MATERIAL
DEPUTY Col B E Congleton

DCS FOR OPERATIONS
DEPUTY Col B H Harris Jr

PROCUREMENT DIVISION
CHIEF Maj J R Pugh

Holloman Air Development Center

Holloman AF Base Alamogordo New Mexico

Responsible for tests and research and development related to tests of pilotless aircraft and guided missiles.

COMMANDER Brig Gen L I Davis
DEPUTY Col H S Judy Jr

DIRECTORATE/RESEARCH & DEVELOPMENT
DIRECTOR Col J G Hemans

DIRECTORATE/AIRCRAFT MISSILE TEST
DIRECTOR Col C L Butler

DIRECTORATE/BALLISTICS MISSILE TEST
DIRECTOR Col L Baker

Arnold Engr Development Center

Tullahoma Tenn

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VICE COM Col Trotter 476

PROCUREMENT DIVISION
CHIEF J Fuqua 406

AIR MATERIEL COMMAND

Wright-Patterson Air Force Base, Dayton Ohio
Phone KENMORE 7111

COMMANDER Gen E W Rawlings 6-0333
CHIEF OF STAFF Col J Kingsley 5-6226

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Lt Gen D L Putt
Dep Chief of Staff Development
Room 4E262
Pentagon
Washington 25 D C

DEPUTY DIRECTOR/BALLISTIC MISSILES
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Phone ORCHARD 2-0171
DEPUTY DIRECTOR Brig Gen B I Funk
ASST DEPUTY DIR Col H T Morris

AIRFRAME BRANCH
CHIEF Lt Col M Seccomb
CONTRACTS W Schlerf

GUIDANCE BRANCH
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CONTRACTS E Hancock

MISSILES BRANCH
CHIEF Col H M Harlow 3-5204
DEPUTY C H Nelson 3-5204

NUCLEAR PROPULSION BRANCH
CHIEF Col L E Rymroski 3-9125
DEPUTY J K Marstiller 3-9125

U. S. NAVY

18th Street and Constitution Ave NW Wash DC
Phone Liberty 5-6700

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ASST DIR Capt R L Kibbe 63344

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ASST for SPECIAL PROJECTS
H Graf Jr 61133

PERSONAL

Dr. C. R. Burrows, former Director of Cornell University's School of Electrical Engineering, has been named vice president for engineering, in charge of all engineering, development, and research for The Ford Instrument Co., division of Sperry Rand Corp., Long Island City, N. Y.

Dr. George J. Mueller has been appointed chief engineer for the Technical Products Div. of the Packard-Bell Company, Los Angeles, Calif.

Roger S. Whitlock

Dr. George J. Mueller

Roger S. Whitlock has become manager of the Western Equipment Sales Div. for Electron Tubes of Tung-Sol Electric, Inc., Melrose Park, Ill.

S. Schneiderman has accepted a post as senior project engineer of Radio Receptor Co., Inc., Brooklyn, N. Y.

G. E. Seidel was recently appointed to the position of vice president in charge of engineering for Minneapolis-Honeywell Regulator Co.

Robert S. Butts became chief engineer of Melpar, Inc., Falls Church, Va.

Dr. C. F. Kooi, Dr. A. Dessler, and **Dr. M. Sachs** have joined the Missile Systems div. of Lockheed's Missile Systems division, Van Nuys, Calif., as senior scientists in the experimental general physics dept.

Dr. Leonard S. Sheingold is manager of the new Applied Research Laboratory of Sylvania Electric Products, Inc., Waltham, Mass.

Frank D. Langstroth, formerly Assistant General Manager of Magnavox, will now serve as field sales manager for Philco's Government & Industrial Div., Philadelphia, Pa.

Dr. Wendell B. Sell was recently named general manager of the Electronics Div. of American Machine & Foundry Co., New York, N. Y.

JULY 1956

ABSTRACTS & REVIEWS of WORLDWIDE ELECTRONIC ENGINEERING

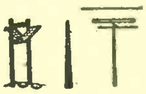
TELE-TECH & ELECTRONIC INDUSTRIES

International ELECTRONIC SOURCES

PUBLICATIONS REVIEWED IN THIS ISSUE

Abbreviation	Publication Name	Abbreviation	Publication Name	Abbreviation	Publication Name
ASTM Bul.	ASTM Bulletin	El. Eq.	Electronic Equipment	Phil. Tech.	Philips Technical Review
Auto. Con.	Automatic Control	Elek.	Elektrichestvo	Proc. IRE	Proceedings of the Institute of Radio Engineers
Avto. i Tel.	Avtomatika i Telemekhanika	Freq.	Frequenz		
Bell. J.	Bell System Technical Journal	J. BIRE	Journal of the British Institution of Radio Engineers	Radiotek	Radiotekhnika
Bul. Fr. El.	Bulletin de la Societe Francaise des Electriciens			Rev. Sci.	Review of Scientific Instruments
Con. Eng.	Control Engineering	J. ITE	Journal of The Institution of Telecommunication Engineers	T-T & El. Ind.	Tele-Tech & ELECTRONIC INDUSTRIES
El.	Electronics	Nach. Z.	Nachrichtentechnische Zeitschrift	Toute R.	Toute la Radio
El. & Comm.	Electronics and Communications	NBS J.	Journal of Research of the National Bureau of Standards	Vestnik.	Vestnik Svyazy
El. Des.	Electronic Design			Wirel. Eng.	Wireless Engineer
El. Eng.	Electronic Engineering				

Also see government reports and patents under "U. S. Government."

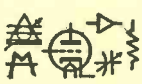


ANTENNAS, PROPAGATION

Radiation From a Vertical Antenna Over a Curved Stratified Ground, by J. R. Wait. "NBS J." April 1956. 8 pp. This paper develops the theory for propagation over a curved earth with concentric stratifications. The method of solution is a direct extension of Watson's method to obtain a solution for the electric dipole radiating over a homogeneous sphere.

Designing Dielectric Microwave Lenses, by K. Kelleher. "El." June 1956. 5 pp. Data for Maxwell, Luneberg, Eaton, Kelleher and modified types of variable index-of-radiation lenses aid antenna designers. New dielectric materials provide considerable weight reduction with slight increase in lens loss.

Reinforcing Antenna Systems for Television Networks, H. Hesselbach. "Freq." April 1956. 5 pp. The reinforcing antenna structure is designed to reinforce the signal in a region where it would be otherwise unduly attenuated, such as in a valley. It may consist of a system of suitably arranged reflectors or a receiving-transmitting antenna combination. Considerations entering the design of such antennas are presented.



CIRCUITS

Minimizing Noise in Electronic Systems, by R. L. Wendt. "T-T & El. Ind." July 1956. 4 pp. Internally generated noise is a constant problem to equipment designers. The causes of capacitive, leakage, conductive, and inductive noise pickup are discussed, and practical preventive measures described.

ATR 205, by Ph. Ramain. "Toute R." May 1956. 7 pp. A high-fidelity amplifier including a push-pull stage of two EL 84 tubes is described. In particular, detailed circuit diagrams of the power supply, the compensating preamplifier with variations, and filters are presented and component values are entered. The output circuit feeding three loud-speakers is also illustrated.

Docile Behavior of Feedback Amplifiers, by S. J. Mason. "Proc. IRE" June 1956. 7 pp. A docile amplifier is one that remains stable when connected to any passive network of a specified class. A simplified geometrical approach is used to derive the docility criteria for passive-end-loading, ideal-transformer feedback, bilateral passive feedback, and arbitrary passive feedback. A vacuum-tube amplifier problem is considered as an illustrative example.

Theory of Noisy Fourpoles, by H. Rothe, and W. Dahlke. "Proc. IRE" June 1956. 8 pp. The well-known theory of fourpoles only comprises passive fourpoles and active fourpoles with internal sources of sinusoidal currents or voltages of defined frequencies. This theory is now completed for fourpoles with internal noise sources. Simple equivalent circuits are derived for such networks. They consist of the original but noise-free fourpole cascaded with a preceding noise fourpole in which all noise-sources are concentrated. The latter contains the equivalent noise conductance G_n, the equivalent noise resistance R_n, and the complex correlation admittance Y_{cor}. The same theory is useful for mixer-circuits as well as for traveling wave tubes and transistors, as application results are given for grid controlled electron tubes.

The Impedance Concept, Its Relation to Stability and Feedback. "Wirel. Eng." 7 pp. Useful information about the properties of a network can be obtained by means of its impedance or transfer function, which can be determined by repeated application of simple algebraic laws in terms of a variable "p" closely associated with time differentiation.

Designing Low-Noise Equipment—Part IV, by W. Bennett. "El." June 1956. 4 pp. Undesirable effects of random noise on amplifier performance can be minimized by proper circuit design. The author discusses role of first stage in establishing amplifier noise figure, advantages of pentode and cascode amplifiers over triodes, and special high-frequency considerations.

Bevatron Magnet Pulse-Timing System, by W. Struven. "El." June 1956. 4 pp. Pulsing system provides means of adjusting repetition rate and length of 8,333-amp pulse flowing through magnet of 6.2 billion electron volt machine.

The Design of Low Frequency High-Pass RC Filters, by D. D. Crombie. "El. Eng." June 1956. 3 pp. The theory of a high-pass RC filter using a twin-T network is discussed. The twin-T transfer characteristics are modified by including it in a feedback amplifier having suitable phase shift. Compensating circuits and optimum filter design procedure are discussed.

Frequency Conversion With Positive Nonlinear Resistors, by C. H. Page. "NBS J." April 1956. 4 pp. A nonlinear resistor subject to an almost periodic voltage will absorb power at some frequencies, and supply power at other frequencies. Necessary and sufficient relations among these powers are developed.

Theory of an Ideal Saturable-Reactor-Type Magnetic Amplifier, by I. B. Negnevitsky and D. A. Lipman. "Elek." Jan. 1956. 9 pp. Straight-line-segment approximation to mag-

FOR MORE INFORMATION ON SUBJECTS REVIEWED HERE

Contact your nearest library subscribing to publications noted. Excellent technical periodical sections are maintained by many large public libraries, engineering universities and electronic companies.

To obtain copies of any articles or complete magazines reviewed here, contact the respective publishers directly. Names and addresses of publishers may be obtained upon request, stating publications of interest, by writing to: "Electronic Sources" Editors, Tele-Tech & ELECTRONIC INDUSTRIES, Chestnut & 56th Sts., Phila. 39, Pa. The editors can recommend translation agencies.

To obtain copies of U.S. patents, and research reports on military and government projects reviewed here, send payment indicated directly to federal agency as instructed in section entitled "U.S. Government."

netization curve serves as a basis for design. Article develops theory for simplest saturable-reactor amplifier without feedback and with series connection of ac coil and load coil for a resistive load. Resistive termination of control circuit is analyzed for even harmonics. Input-output characteristics and stability are discussed.

Design of a Magnetic Amplifier With Magnetization By Constant and Alternating Fields, by A. V. Basharin. "Elek." Jan. 1956. 4 pp. The article discusses the design of magnetic amplifiers and their transient responses on the basis of superimposing constant and alternating fields. Two sets of characteristic curves are derived: 1) the constant component of induction as a function of constant field intensity for various fixed maximum values of the alternating induction component. 2) The maximum value of the A.C. component of induction as a function of effective or average value of alternating component of magnetic field strength, for various values of the constant component of field strength.

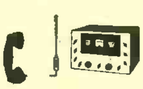
Use of Magnetic Amplifiers in an Electronic Pulse System For the Control and Protection of Power Rectifiers, by E. P. Khmelnitsky. "Vestnik." Feb. 1956. 2 pp. The article examines the application of magnetic amplifiers to specialized relay systems for the control and protection of power rectifiers. The effect of modulation upon circuit design is considered. Criteria for optimum characteristics are derived.

Concerning the Relation Between Shortened Equations and Power Balance, by S. I. Evtyanov. "Radiotek." Feb. 1956. 11 pp. The paper develops a method of composing shortened equations from a balance of real and reactive power, using harmonic oscillators as an example. The advantage of this method over others is physically obvious. Oscillators with single and double tuned circuits are examined.

Interaction of Signal and Noise in an Inertial Detector, by L. S. Gootkin. "Radiotek." Feb. 1956. 11 pp. The article examines the simultaneous detection of signal and noise by a linear inertial detector. The input resistance of the detector is determined, as well as the results of detecting unmodulated and amplitude-modulated signals. The frequency spectrum and effective value of the noise voltage are found at the output of the detector. The results are compared to those for an inertialess detector.

Concerning an Appraisal of the Selective Properties of Resonant Systems, by Ya. I. Fet. "Radiotek." Feb. 1956. 6 pp. The article examines a method for appraising the selective properties of resonant systems, which is based upon a comparison of the relative power of the noise-spectrum oscillations with the relative power of the useful-spectrum oscillations. A comparative appraisal of several resonant systems is made. It is shown that the use of other criteria leads to erroneous conclusions.

Reliable New Applications for Filamentary Subminiature Tubes. "El. Eq." June 1956. 6 pp. A description of how filamentary subminiature tubes can reduce power drain and heat dissipation, and at the same time provide increased reliability for critical circuitry.



COMMUNICATIONS

Prototype of a Tropical Receiver, by E. Dawance. "Toute R." May 1956. 6 pp. A radio receiver and phonograph for 33⅓, 45, and 78 rpm was designed to operate at a relative humidity of between 70 and 95% over a frequency range of from 40 to 12000 cps. Detailed circuit diagrams including numerical values of the components are shown and their performance as well as that of the set are discussed.

IRE Standards on Facsimile: Definitions of Terms, 1956 (56 IRE 9. S_1). "Proc. IRE" June 1956. 6 pp. This document standardizes the meanings of over one hundred engineering terms used in facsimile work.

Contribution to the Study of Disturbances by Pulse Waves on Carrier Current Equipment on High Voltage Lines, by M. F. Barrault. "Bul. Fr. El." March 1956. 20 pp. The effect of pulses on amplitude-modulated voltages transmitted over high-voltage lines is studied by considering the interaction of the respective vectors. A pulse generator for 0.5, 1, and 2 μsec pulses is schematically shown; it was used for experiments supporting the calculations.

The F.M. Section of Modern Broadcast Receivers, by H. de Quant, P. Zijp, and M. Huissoon. "Phil. Tech." June 1956. 10 pp. Nearly all European countries have a short-wave F.M. Service in operation in addition to the usual amplitude modulated transmissions. The article discusses receiver design with particular attention to sensitivity, signal-to-noise ratio, signal-interference ratio, selectivity, radiation, and antenna requirements.

Telemetering and Propagation Problems of Placing the Earth Satellite in Its Orbit, by D. G. Mazur. "Proc. IRE." June 1956. 3 pp. Telemetering will play an extremely important role in the launching of the satellite. Prior to the actual launching numerous tests will be run during which telemetering will be called upon to tell what is happening during flight and, equally important, why. Telemetering will be used also to check the performance of the internal rocket system in the moments just prior to launching, and finally, to transmit vital performance data during the actual flight of the launching vehicle. In this discussion the reader is given a general insight into the requirements which must be met and the problems encountered in telemetering the Vanguard vehicle.

Tracking the Earth Satellite, and Data Transmission by Radio, by J. T. Mengel. "Proc. IRE." June 1956. 6 pp. The earth satellite, after it is placed in its orbit, must be proved to be orbiting. The magnitude of this problem and the associated problem of measuring the orbit by optical methods is discussed, and the Minitrack system developed by the Naval Research Laboratory for acquisition and tracking of the satellite by radio techniques is described. A sub-miniature radio transmitter operating continuously for at least two weeks will be provided within the satellite to illuminate antennas at ground tracking stations. By phase-comparison techniques, these ground stations will measure the angular position of the satellite as it passes through the antenna beam, recording its "signature" automatically without the need for initial tracking information. Analysis of this signature will provide the complete angular history of the satellite passage in the form of direction cosines and time. These data will be transmitted immediately to a central computing facility for the computation and publication of ephemerides, which will be transmitted to each principal optical tracking station to provide acquisition data to them. The probable tracking accuracies and the major problems associated with the Minitrack system are described.

Multiprogram F-M Broadcast System, by W. Hershfield. "El." June 1956. 4 pp. Three additional entertainment programs sent out on subcarriers located 28, 29, and 67 kc above the main broadcast carrier. Paid programs are intercepted with special receivers.

Shipboard Telemetering for Terrier Missiles, by W. Bell and C. Schultz. "El." June 1956. 4 pp. Automatic f-m/f-m telemetering system serving both launchers on U.S.S. Mississippi provides magnetic tape recordings of internally derived data for fleet evaluation of production-type Terrier missiles without interfering with missile fire control system.

V.H.F. Communication by Ionospheric Scatter, by A. Cole. "El. Eng." June 1956. 6 pp. Ionospheric scatter is now used for communication over distances up to 1400 miles. The author reviews propagation characteristics, typical transmitters, receivers, and aerial systems.

The Intelligibility of Amplitude-Limited Speech, by H. Schneider. "Freq." April 1956. 10 pp. This first article of a survey is concerned with the effect of amplitude limiting, i.e., with an analysis of the resulting wave shapes. A comparative investigation of various amplitude-limiting systems is started.

The Overseas Transmitter "Elmshorn" of the German Federal Post Office, by Eugene Meinet. "Nach. Z." April 1956. 8 pp. The general layout of the short-wave station transmitting to South America, to the Near East, to the Far East, and to European stations, is presented. The installation includes a 20 kw SSB telephone transmitter and a 20 kw telegraphy transmitter; frequency as well as time multiplexing are involved.

Recent Developments in Receivers for Voice-Frequency Dialling, by H. Bendel. "Nach. Z." April 1956. 9 pp. The requirements of the CCIF are listed and a receiver for 3000 cycles and one for 2030 cycles are described. Elimination of interference is studied. An extensive table presents data of the receivers as well as the requirements for easy comparison.

Nonlinear Distortion in Multi-Channel Frequency-Modulation Communications Systems, by V. A. Smirnov. "Radiotek." Feb. 1956. 15 pp. This article, continuing an earlier paper by the author, derives equations for computing the nonlinear transient noise power in individual telephone channels of a multi-channel frequency-modulation communication system, which arises due to multi-beam propagation of radiowaves. The formula for computing such noises when they are produced by a mismatch of the antenna waveguide is obtained as a special case.

Geometric Derivation of a Formula for the Pass Capability of a Communication Channel Containing Noise, Which Uses a Special Receiver, by A. M. Vasilyev. "Radiotek." Feb. 1956. 3 pp. The receiver selects a signal from all those possible, such that its power differs from that of the signal at the receiver by a magnitude equal to the interference power. It is shown that the pass capability of such a channel is determined by the Shannon formula.

Construction of Amplification Equipment For Untended Repeater Points, by G. N. Stepanov. "Vestnik." Feb. 1956. 3 pp. The article examines three systems for providing reserve amplifier equipment at untended repeater points in cable mains, and compares them to each other. Data for a newly developed type of amplifier is provided.

Portable Communication Unit Using Transistor Circuits, by D. Holdsworth and S. Kagan. "El. & Comm." Apr. 1956. 2 pp. A general description of a light weight, immersion proof, emergency transmitter-receiver.

Concerning the Design of Linear Preselecting and Compensating Arrangements, by V. M. Shtein. "Radiotek." Feb. 1956. 4 pp. Design formulas are derived for linear preselecting and compensating fourpoles, which permit the average signal power at a channel input to be diminished for a given signal-to-noise ratio at the channel output. It is shown that the use of such fourpoles in telephone channels subjected to white noise, permits a 2.1-fold decrease in the average signal input power.

COMPONENTS

Magnetic Core Components for Digital Control Applications, by A. Meyerhoff. "Auto. Con." May 1956. 3 pp. Applications data on shift register loops, including discussion of the split winding loop and the inhibit loop, is given.

Q Calculations for High Frequency Inductors, by R. J. Schulte. "T-T & El. Ind." July 1956. 4 pp. Equations have been developed for calculating the merit factor of h-f iron-core or air-core inductors of known dimensions and materials. Derivation of the equations is presented, with data and examples covering all practical designs in the 5 to 60 MC range.

Deflection Yoke Design, by B. Cahill. "T-T & El. Ind." July 1956. 4 pp. Magnetic deflection fields are affected by coil form, winding style, and external environment in the form of core, case, and other external components. The author discusses the many factors involved in deflection yoke efficiency and fast recovery time.

Proposed Spec Can Improve Capacitor Reliability. "ASTM Bul." May 1956. A new specification for sulfate tissue for capacitor dielectric is soon to be published. Some of the findings and their implications are discussed in this article.

Fast Rise Pulse Generator with High Pulse Repetition Frequency, by C. Dorn. "Rev. Sci." May 1956. 1 pp. A modified telemetering mercury selector switch for use as a fast rise time pulse generator with high pulse repetition rates is described.

Simplified Radio-Frequency Ion Source, by S. Allison and E. Norbeck, Jr. "Rev. Sci." May 1956. 3 pp. A new low-voltage arc ion source for a Cockroft-Walton accelerator, or "kevatron" is described.

Negative Hydrogen Ion Source, by J. Weinman and J. Cameron. "Rev. Sci." May 1956. 5 pp. A negative hydrogen ion source is described which will yield from 25 to 30 μa of H^- ions focused on a ¼-inch diameter spot.

One-Piece Casting of Microwave Plumbing. "El. Eq." June 1956. 2 pp. A new casting process permits casting of complex microwave components in a single operation, using any nonferrous alloy including magnesium. Typical parts produced and inherent advantages of the process are described.

How to Use Thermistors, by E. M. Ullman. "El. Eq." June 1956. 4 pp. A brief history of recent developments in thermistor manufacture and design considerations regarding thermistor applications.

Pulse Circuits Fabricate Computer Code Disk, by E. Jones. "El." June 1956. 4 pp. Frequency divider, counter, gate, and wave-shaping circuits control optical circle-dividing machine to produce 16-bit pattern on photosensitive glass disk for analog-to-digital conversion.

A Laboratory Model Magnetic Drum Translator for Toll Switching Offices, by F. Buhrendorf, H. Henning, and O. Murphy. "Bell J." May 1956. 39 pp. Problems arising from the prospective use of microsecond pulse apparatus in a telephone office are studied with a laboratory model magnetic drum translator, capable of serving as a one-to-one alternative to the card translator.

A Design Method for Feedback Stabilizing Transformers, by H. B. James. "Con. Eng." June 1956. 8 pp. In industrial generator-regulator systems, where size and weight are not too important, rate transformers have been designed by cut-and-try methods. But in aircraft systems, rate transformer inductances and time delays must be maximized for any given core size, in order to reduce size and weight. This article presents an empirical method for optimizing these time delays when core size and certain other transformer parameters are given.

COMPUTERS

Low Power Binary Counter, by W. E. Hostetler and H. J. Wolkstein. "T-T & El. Ind." July 1956. 4 pp. Bistable operation with voltage increments as low as .66 v. is possible with a new twin target vacuum tube. The tube has use as high speed binary counter, oscillator, flip-flop, and cascade dc amplifier. A complete analysis of bistable operation of this tube is presented.

Where You Should Use Series or Parallel Summation, by G. Weiss and N. J. Lindner. "Con. Eng." June 1956. 7 pp. The most elementary operation in analog computers is summation. The two most common methods are series summation and parallel summation. In discussing the relative merits of these methods, the authors point out many problems and impart solutions that result in desired equipment operation.

Decade Counter Tube Circuitry, by J. Adams. "El. Des." May 15, 1956. 3 pp. Design information and circuit suggestions for decade counter (glow transfer) tubes. The principal problem is to establish and move the glow reliably, since the glow provides both visual and electrical readings.

Analog Computer for the Engineer, by J. Carroll, "El." June 1956. 8 pp. A discussion of the application of analog computers to aerodynamics, heat transfer problems, and aircraft design includes descriptions of the more common computer components.

Principles and Application of Electronic Analogue Computers (Part 4), by P. Heggs. "El. Eng." June 1956. 3 pp. Examples of computer use are given, including a discussion of methods of solving certain partial differential equations.

A New Serial Digital Decoder, by S. Soanes. "El. Eng." June 1956. 3 pp. The serial decoder described is virtually independent of the frequency of the clock timing pulses. The device is fundamentally a polynomial generator, and can thus be used in analog computers to solve certain types of polynomial equations.

An Economical Relay Operated Accumulator, by J. K. Wood. "El. Eng." June 1956. 4 pp. An apparatus is described which sums binary numbers up to a maximum capacity of about 2^{24}. The design methods are described so that a similar machine with any required capacity can be constructed.

CONTROLS

An A.C. Voltage Stabilizer, by F. A. Benson and M. S. Seaman. "El. Eng." June 1956. 6 pp. In this mains-voltage stabilizer a temperature-limited diode is used as the controlling element, being placed in one arm of a bridge circuit. The remainder of the system uses a saturable-core reactor and an auto-transformer. Stabilizer and performance are described.

Directional-Transformer Differential and Remote Relays, by A. D. Drozdov. "Elek." Jan. 1956. 9 pp. Magnetic transformer power relays with saturating core are fully analyzed. Equations are derived for various primary and secondary conditions; relay characteristics are given for all important cases.

Remote Regulation of Frequency and Power in Power Systems, by V. E. Kazansky and L. D. Sterninson. "Elek." Jan. 1956. Qualitative analysis and description of automatic regulation in power systems. Automatic frequency regulation by single and multiple aggregates. Use of static and astatic characteristics, interaction between power regulators and frequency regulation aggregates. Load distribution is discussed, and a special method is given for remote coupling between the frequency regulator and the regulating stations.

A Regulated Electric Drive With Swinging Chokes and a Magnetically-Biased D.C. Motor, by M. G. Klyuchov. "Elek." Jan. 1956. 6 pp. Design analysis for a regulated asynchronous drive. Automatic regulation properties can be improved by saturable-reactor control using D.C. current to magnetically bias the motor. Control of bias is accomplished by negative feedback of stator current, which reacts upon the excitation circuit of the biasing generator.

A New Type of Servo-Systems with Corrective Networks, by L. Fitzner. "Avto. i Tel." No. 3, 1956. 10 pp. The author gives the description and the results of the experimental analysis of a servo system designed with the cooperation of a dc analog computer.

An Electrical Servo-Mechanism with Regulated Speed, by O. Aven, E. Demidenko, S. Domanitsky, and E. Kroog. "Avto i Tel." No. 3, 1956. 12 pp. Description of a reversible servo with a 3-phase induction motor. Better utilization of the motor is achieved by using a high resistance rotor. Speed regulation is effected by 2-stage magnetic amplifiers. Magnetic amplifier with self-saturation is used as a first stage. The second (output) stage is made without feedback. As an input element of the system, a lamp which operates as a phase sensitive rectifier is used. Speed feedback is used without the use of a tachogenerator.

The Application of Magnetic Amplifiers in Servo-Systems with AC Motor, by A. Demjanchik. "Avto. i Tel." No. 3, 1956. 14 pp. The application of a half wave bridge circuit in the 3-stage servo-amplifier with an ac motor is described. A magnetic amplifier output stage which helps to get full wave output is developed. Three stages of corrective feedback are used to stabilize the system and to obtain the required dynamic characteristics. The amplifier is intended to control small power 2-phase induction motors.

The Method of Calculation of Magnetic Characteristics with Effect of DC and AC Magnetic Fields, by I. Lechtman. "Avto i Tel." No. 3, 1956. 10 pp. The method described in the author's previous paper (No. 5, 1955) is developed. The definition of the curve form of the output voltage in differential magnetic amplifiers is discussed. Reactor response to magnetization is determined and time constant is estimated.

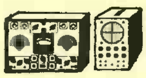
MATERIALS

Protecting and Packaging Electronic Equipment, Part II, by W. Hannahs. "T-T & El. Ind." July 1956. 4 pp. Recent experiences of the military in hot, humid climates has focussed attention on the need for protecting electronic circuits against fungi and moisture, as well as mechanical shock and stress. Protective measures used to accomplish this goal are described here.

Forming Fine Mesh Screens, by M. C. Cook. "El. Eq." June 1956. 2 pp. Photomechanically formed screens of nickel, copper, lead, and nickel-copper laminations are used as image-orthicon grids in storage tubes as well as in many other electronic discharge devices. The author describes manufacturing processes of such screens.

Materials Used in Radio and Electronic Engineering—Plastics. "J. BIRE" May 1956. 12 pp. The technical committee reviews electrical and physical properties of the more important types of plastics used in radio and electronic engineering, together with trade names and forms available from British and American manufacturers.

Electrical Resistivity of Vitreous Ternary Lithium-Sodium Silicates, by S. W. Strauss. "NBS J." April 1956. 3 pp. Resistivities of vitreous lithium disilicate, sodium disilicate, and selected ternary lithium-sodium silicates were measured in the range of 150° to 230°C. Data are given as log resistivity-composition isotherms. Resistivities of the glasses were interpreted in terms of the structures of glass.



MEASURING & TESTING

High "G" Tests for Guided Missile Tubes, by M. F. McKeirnan. "T-T & El. Ind." July 1956. 5 pp. A study aimed at reducing vibrational noise in missile tubes shows improvements result from shorter tube structure, doubled mica spacers, and special cathode clamping. A test method using a 10 g accelerator and a graphic recorder of noise power vs frequency is described. Noise responses of type 5977 tubes and a redesigned version, type SN-1778A, are compared.

New Inverse Pulse Recovery Test Method, by N. DeWolf. "El. Des." May 15, 1956. 2 pp. A new test circuit gives more accurate testing of clamping and logic matrix transient characteristics. Previous circuits introduced large, variable errors.

Transistor Modulator for Airborne Recording, by J. Upham, Jr., and A. Dranetz. "El." June 1956. 4 pp. Differential-transformer transducer feeds transistorized network employing phase and pulse time modulation for airborne type recording of accelerations up to 180 g and 500 cps.

Programmed Checker Plots Transducer Calibration Error, by M. Miller. "Con. Eng." June 1956. 2 pp. Penumatic and electric circuit changes are programmed automatically to record errors in total resistance and resistance function in two-potentiometer pressure transducers.

Surge Voltage Breakdown of Air in a Nonuniform Field, by J. H. Park and H. N. Cones. "NBS J." April 1956. 24 pp. The discharge and breakdown phenomena in air when a surge voltage is applied to sphere-plane electrodes were investigated. A steeply rising surge of 145 kilovolts peak value was applied to the plane placed 86 cm above the laboratory floor. An attempt is made to explain how the initial streamers form and how the channels leading to breakdown develop.

The Scientific Value of the Earth Satellite Program, by J. A. Van Allen. "Proc. IRE." June 1956, 4 pp. The Satellite can be useful to us in two ways: first, as an inert sphere, the position and movement of which can be accurately measured from earth by optical means to yield valuable information about the geodetic figure of the earth and the density of the upper atmosphere; and secondly, as a carrier of instruments and telemetering equipment for obtaining data concerning cosmic and solar radiations, atmospheric phenomena, and geophysical conditions. The highest "flight-priority" has been assigned to the following: a) the monitoring of the intensity of the solar ultraviolet; b) the monitoring of cosmic ray intensity and the measurement of its latitude, longitude, and altitude dependence; c) the measurement of the size spectrum and the number density of interplanetary dust; and d) the measurement of the earth's optical albedo over large areas.

A Receiver for the Radio Waves from Interstellar Hydrogen (Part II—Design of the Receiver), by C. A. Muller. "Phil. Tech." June 1956. 11 pp. Extensive observations are being made of the 21 cm radiation emitted by interstellar hydrogen. This radiation, which has the character of noise, is extremely weak and special measures are required to be able to distinguish it from the much stronger noise inherent in the receiver. The article describes the receiver circuits employed.

The Exploration of Outer Space with an Earth Satellite, by J. P. Hagen. "Proc. IRE." June 1956. 4 pp. Experiments conducted in an artificial earth satellite circling the earth in the outer tenuous region of our atmosphere can greatly increase our knowledge of the atmosphere—its structure, its constituents, and the powerful radiations both electromagnetic and corpuscular that impinge upon it—and help determine its state. Work is in progress not only on the vehicles, but on the experiments to be done in the satellite.

A Note on Bandwidth, by A. Nathan. "Proc. IRE" June 1956. 3 pp. The concept of "bandwidth" is commonly used as a measure of the range of frequencies over which a network has an approximately constant gain. In this note the notion of bandwidth is extended to networks with arbitrary transfer characteristics. It is defined in terms of the maximum allowable variance of the output of a network (to within a multiplicative constant) from that of an "ideal" network, the input being a band-limited signal. The maximum bandwidth of such an input signal is termed the bandwidth of the network under consideration.

Measurement of Microwave Dielectric Constants and Tensor Permeabilities of Ferrite Spheres, by E. G. Spencer, R. C. LeCraw, and F. Reggia. "Proc. IRE" June 1956. 11 pp. The Bethe-Schwinger cavity perturbation theory is applied to measurements of the microwave dielectric constants and tensor permeabilities of small spherical samples of ferrites. For the dielectric constant measurements, a cavity opened at a position of minimum transverse wall currents is used. A frequency-shift method is used for measuring the real part of the dielectric constant and a cavity-transmission method is used for measurement of the loss tangent. Circularly-polarized cavity methods yield effective scalar permeabilities of which the real and the imaginary parts are measured in a manner similar to the dielectric measurements. These scalar permeabilities yield sufficient information to describe completely the tensor components. Experimental data are given for a polycrystalline magnesium-manganese ferrite, to illustrate the techniques described.

Measurement of Equivalent-Circuit Values of High-Q Resonators, by Eberhard Frisch. "Nach. Z." April 1956. 4 pp. Equivalent circuit for a ferrite resonator and a piezoelectric resonator are studied, and a method for the evaluation of the observed data is developed. A diagram of the measuring circuit is included and a numerical example presented. A short survey of other methods is given.

Development of a Vibrating-Coil Magnetometer, by D. Smith. "Rev. Sci." May 1956. 8 pp. The author describes a means of obtaining continuous measurements of a dipole field and recording on a chart as a function of time, temperature, crystallographic orientation, or magnetizing field.

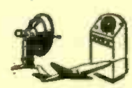
Electronic Wattmeter with Wide Frequency Range, by T. Schultz. "Rev. Sci." May 1956. 2 pp. A description is given of a device to provide accurate indication of the average product of two electrical signals in the audio range.

A Portable Digital Frequency Meter, by M. I. Forsyth-Grant. "El. Eng." June 1956. 4 pp. The meter described will operate at frequencies up to 100 kc showing the last four figures in discrete digits on an illuminated escutcheon. Overall accuracy is the order of five parts in 10^5.

Detection of Charged Particles with Gas Scintillation Counters, by R. Nobles. "Rev. Sci." May 1956. 4 pp. The author describes a gas scintillation counter using a wavelength shifter to match the scintillation light spectrum to the response characteristics of the photomultiplier.

Test Methods for Measuring Energy in a Gas Discharge, by S. I. Reynolds. "ASTM Bul." May 1956. 3 pp. The methods described show that energy increases linearly with applied voltage, and that certain organic insulations placed in the discharge in a closed system with pure oxygen, degrade at a rate proportional to the measured power.

Effects of Corona on Plastic Laminates, by A. Rufolo and R. R. Winans. "ASTM Bul." May 1956. 4 pp. A method of corona exposure, and exposure effects on various properties of materials are presented as a basic approach to the problem of corona deterioration in electrical equipment.



RADAR, NAVIGATION

Placing the Satellite in Its Orbit, by M. W. Rosen. "Proc. IRE." June 1956. 4 pp. The Vanguard satellite launching vehicle is a three-stage rocket of which the first two stages are guided and the third stage is maintained in a fixed orientation while it is firing. The first stage, an improved Viking, serves primarily to raise the remaining stages to altitude. The second stage, another liquid-propellant rocket, contains the guidance for the three-stage vehicle and, in addition, supplies some of the propulsive energy. The third stage, a solid-propellant rocket, is ejected from the second stage at orbital altitude and provides about half of the required orbital velocity. The Vanguard launching vehicle system was chosen from a number of possible two- and three-stage vehicle combinations. It represents the smallest satellite launching vehicle consistent with the present state of rocket development.

The Effect of AGC on Radar Tracking Noise, by R. H. Delano and I. Pfeffer. "Proc. IRE" June 1956. 10 pp. Radar angle tracking noise, such as that due to angular and amplitude scintillation of the target echo, is increased by the response of the receiver agc to the low frequency components of the fading of the echo envelope. An increase in angle tracking noise spectral density by a factor of two to three is representative of what can happen when the radar echo envelope is approximately Rayleigh distributed. This phenomenon has been investigated by analog simulation of the agc, both for an ordinary linear filter in the feedback path and for a nonlinear filter with quick attack and slow release in the loop.

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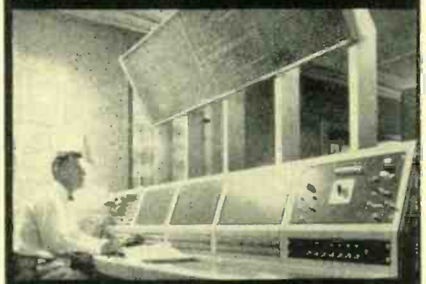

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Since the increase in tracking noise decreases monotonically with increasing agc time constant, an analysis is presented to describe a particular basic problem which requires the agc time constant to be kept short, namely, the transient rise in average signal strength encountered by a radar when closing rapidly on a target.

Personal Microwave Search Receiver, by E. Herman. "El." June 1956. 2 pp. Crystal detector with slab-line resonant circuit picks up microwave energy and feeds it to hearing-aid amplifier. Result is personal portable for 1.000 to 10,000 mc with sensitivity from —35 to —40 dbm.

Variable Delay Line Simulates Radar Targets, by S. Gitlin. "El." June 1956. 3 pp. Two quartz transducers and movable corner reflector in 3½-foot water-filled copper tank give time delays ranging from 72 to 1,400 microseconds for simulating moving targets during tests of new radar.

A Directional Attenuator with a Delay Line and a Ferrite Body at Around 4000 MC, by W. Eichin. "Nach. Z." April 1956. 5 pp. The attenuation of the field in a traveling-wave tube having a delay coil and a ferrite attenuator to which a magnetic field is applied is experimentally investigated. The different values of the attenuation for the forward and backward traveling wave are measured and plotted for different coil parameters, ferrites inside and outside the coil, magentic field strength, and wave length. The circularly polarized magnetic field component, responsible for the effect, is considered in the neighborhood of the ferrite body.

Concerning the Problem of the Relation Between the Observability of an Object and the Number of "Illuminating" Pulses, by G. N. Bystrov. "Radiotek." Feb. 1956. 3 pp. The article examines the probability of detecting an object against the background or fluctuating noise, as a function of the number of pulses of high-frequency energy falling on it. The statistical properties of the fluctuating noise are considered, and the probability of detecting the object is determined as an addendum which allows the probability of the appearance of fluctuating ejections at the observed point to attain a value of unity. The appendix gives the relation between the probability of detecting the object and the distance, receiver sensitivity and transmitter power.

Some Investigations at Microwave Frequencies, by S. Chatterjee. "J. ITE." Mar. 1956. 20 pp. A brief review of investigations at 3 cm. wavelength, including theoretical investigations of microwave cavities, perturbation effects in a cavity resonator, and interaction of modes. Report of investigation into propagation through a cylindrical metallic guide filled with two concentric dielectrics.

Waveguide Filters, by M. Potok. "Wirel. Eng." 4 pp. High-Q, low insertion-loss waveguide filters can be made by inserting into the guide a number of suitably spaced, quarter-wave long, dielectric sections.

Clutter on Radar Displays, by J. Croney. "Wirel. Eng." 13 pp. An analysis is developed of an idealized logarithmic receiver followed by a differentiating circuit with respect to inherent receiver noise, sea-clutter, and rain-clutter echoes. Results are given of experiments with logarithmic receivers on both S and X band radars.

SEMICONDUCTORS

Transistor Phase-Shift Oscillator, by W. Hicks. "T-T & El. Ind." July 1956. 2 pp. The transistor phase-shift oscillator, has a definite advantage over conventional oscillators, since it requires only one transistor and eliminates the necessity of a large inductor. Design equations are presented, and a practical oscillator described.

Chemical Interactions Among Defects in Germanium and Silicon, by H. Reiss, C. Fuller, and F. Morin. "Bell J." May 1956. 102 pp. The solid solutions involved bear a strong resemblance to aqueous solutions insofar as they represent media for chemical reactions. Acid-base neutralization, complex ion formation, and ion pairing all take place. The article describes developments in this field during the past few years.

Single Crystals of Exceptional Perfection and Uniformity by Zone Leveling, by D. Bennett and B. Sawyer. "Bell J." May 1956. 24 pp. The zone-leveling process has been developed into a simple and effective tool, capable of growing large single crystals having high lattice perfection and containing an essentially uniform distribution of one or more desired impurities.

Diffused p-n Junction Silicon Rectifiers, by M. Prince. "Bell J." May 1956. 24 pp. Diffused p-n junction silicon rectifiers are made by diffusion of impurities into thin wafers of high-resistivity silicon. Development models having current ratings from 0 to 100 amperes with inverse peak voltages greater than 200 volts are described.

Calculation of the Gain Coefficient and the Basic Characteristics of an Amplification Stage Containing a Transistor, by G. S. Tsykin. "Radiotek." Feb. 1956. 4 pp. The article proves that the equivalent circuit of a transistor may be represented in the form commonly used for an electronic tube. Expressions are given for calculating the equivalent circuit parameters for various transistor connections, examples of parameter design are given for typical cases, and indications are given concerning the calculation of the frequency and phase characteristics for both single and multi-stage amplifiers.

The Forward Characteristic of the PIN Diode, by D. Kleinman. "Bell J." May 1956. 22 pp. A theory is given for the forward current-voltage characteristic of the PIN diffused junction silicon diode. The theory predicts that the device should obey a simple PN diode characteristic until the current density approaches 200 amp/cm^2.

Contribution to the Mathematical and Engineering Treatment of the Transistor as a Linear Four-Terminal Network, by Titus Scheler and Hans-Werner Becke. "Freq." April 1956. 10 pp. It is proposed to measure the open and shorted input and output impedances of a transistor and the input-output voltage ratio with open output, the emitter being grounded. Measuring circuits are included. A system of matrices and equations to derive from these figures pertinent transistor characteristics is presented.

A Semiconductor as Converter of Solar Energy, by A. Haehnlein. "Nach. Z." April 1956. 6 pp. The absorption mechanism of solar energy in a semi-conductor is studied with a view to maximum efficiency for the generation of electric energy. Optimum spacing of the semiconductor absorption band is derived. The silicon cells developed by Bell Labs. are discussed.

TELEVISION

Some Remarks on the Radio-Frequency Phase and Amplitude Characteristics of Television Receivers, by A. van Weel. "J. BIRE." May 1956. 10 pp. Picture quality is considered with reference to steady state characteristics of the receiver r-f section.

Chrominance Circuits for Color Television Receivers, by B. W. Osborne. "El. Eng." June 1956. 7 pp. This article is a brief review of circuit techniques applicable to the chrominance section of a color television receiver designed to receive an N.T.S.C. type signal.

The 21 MC System for Local Television Transmission, by H. J. Schmidt. "Nach. Z." April 1956. 5 pp. Coaxial cables are used to transmit television signals from studios or other program sources to local transmitters. In particular, details of the modulators (push-pull modulators and beam-deflection modulator), amplifier (7 stages, 15 mc to 27 mc) to correctly compensate the frequency-dependent attenuation in the cable, and 21 mc demodulator are presented.

Television Sweep Generation with Resonant Networks and Lines, by K. Schlesinger. "Proc. IRE" June 1956. 8 pp. The synthesis of a current sawtooth from a limited number of first harmonics has been studied. It was found that good linearity is easier to obtain than a fast retrace. Scan distortion may be held below 5% over 80% of scan, by adding only 4 harmonics in a "least square" proportion. Fast flyback, on the other hand, requires 8 harmonics to be usable for commercial television. Several practical systems for resonant sweep have been tested. All circuits used shock excitation of multiresonant networks by pulses of current. Both pentodes and small hydrogen thyratrons were used successfully. The best multiresonator for synthetic sweep is a delay-line, 3% shorter than a half-wave long and shorted at the far end. To minimize dispersion, a "slanting wafer" type of construction has been developed which permits control of mutual without effect on self-inductance.

TRANSMISSION LINES

Guide to the Selection of R-F Cables, by C. Camillo and G. J. Mares. "T-T & El. Ind." July 1956. 4 pp. The seven basic parameters of coaxial cable are examined and their relative importance is determined for a wide range of applications. Design data including attenuation figures and maximum operating temperatures are presented.

On the Theory of the Exponential Transmission Line, by B. P. Afanasyev. "Radiotek." Feb. 1956. 14 pp. Equations are obtained for the complex voltage and current amplitudes of a lossless exponential line, loaded in any manner and operating in either a wave or a non-wave regime. The wave impedance is shown to be complex. The concept of a "reactive traveling-wave" regime is introduced. Formulas are derived for the traveling-wave coefficient, the input impedance, the reflection coefficient and the amplitude-distribution for specific cases of loading.

The Discharge of a Capacitor onto an Infinite Line Having Uniform Resistance and Capacitance, by Friedrich Boettcher. "Freq." April 1956. 6 pp. Discharge equations for a capacitor connected through a resistor to an infinite uniform line are set up and solved for different conditions. The problem is compared to one involving temperature changes and another one involving diffusion of a gas.

TUBES

On the Theory of a Deflectron, by A. M. Strashkevich. "Radiotek." Feb. 1956. 6 pp. The article examines the general properties of

axially-asymmetrical fields which may be used in a deflectron; the boundary conditions for which this occurs are indicated. General formulas are derived for the given class of fields. The condition is indicated for which the central region of the axially-asymmetrical field permits attainment of equal sensitivities of the electron beam in two mutually-perpendicular directions.

Technique of Manufacture and Control of Reliable Electron Tubes, by M. Jean Brasier. "Bul. Fr. El." March 1956. 10 pp. The steps taken in manufacture to produce reliable tubes, required by STEA E in France for aviation purposes, are set forth. The material to be used, the manufacture of grid and cathode, of metal pieces and glass pieces are discussed as well as soldering, closing, and pumping steps.

Corona Discharge Tubes Provide Voltage Tubes, "El. Eq." June 1956. 2 pp. This article outlines the operation of corona-discharge tubes and describes their application as voltage regulators.

U. S. GOVERNMENT

Research reports designated (LC) after the price are available from the Library of Congress. They are photostat (pho) or microfilm (mic), 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.

When an agency other than LC or OTS is the source, use the full address included in the abstract of the report. Make check or money order payable to that agency.

Symposium on Electronics Maintenance, 3-5 Aug 1955 (PB 111841). Dept. of Defense. Aug. 1955. 214 pp. $1. (OTS) 18 papers on such topics as selection of electronics personnel, role of the operator in electronics maintenance, development of proficiency measures for electronics technicians, etc.

VHF Extra-Diffraction Propagation Bandwidth at 200 Miles (PB 119468), by L. Ames, P. Newman, and T. Rogers, USAF. June 1955. 25 pp. Mic $2.70, pho $4.80. (LC) Photographs of TV station WATV's test pattern were made throughout the first quarter of 1955 and signal amplitudes were simultaneously recorded. Appendix A calculates the diffraction field and Appendix B estimates the signal-to-noise ratio.

VHF Tropospheric Overwater Measurements Far Beyond the Radio Horizon (PB 119469), by L. Ames, P. Newman, and T. Rogers, USAF. June 1955. 31 pp. Mic $3, pho $6.30. (LC) Using a high power radar type transmitter near Boston, Mass., point-to-point measurements have been made at a frequency of 200 MC on 200 and 400 statute mile overwater paths extending along the east coast. Correlaion between the shorter path field strength data and sea echo back-scatter near the transmitter site are indicated. Measurements 400 miles out across the Atlantic Ocean also have been made.

Weather Effects of Radar (PB 119619), by D. Atlas, V. Plank, W. Paulsen, A. Chmela, J. Marshall, T. East, K. Gunn, and W. Hitschfeld, USAF. Dec. 1952. 110 pp. Mic $5.70, pho $16.80. (LC) Microwave properties of precipitation particles, atmospheric attenuation of the short microwaves, oxygen absorption, and calculated sensitivity of airborne weather radars.

Analysis of the Diode Mixer Consisting of Non-Linear Capacitance and Conductance and Ohmic Spreading Resistance (PB 111786), by A. Macpherson, NRL. Feb. 1956. 16 pp. 50¢. (OTS)

75 KC/S High Power Pulse Transmitter (PB 119453), by E. Blatt, D. Chaffee, and C. Volz, Penn. State U. Oct. 1955. 68 pp. Mic $3.90, pho $10.80. (LC) This report attempts to describe in some detail the conversion involved in changing the frequency of a long-wave pulse transmitter from 150 KC to 75 KC.

Some Network Theorems and Their Applications to Wideband Transistor Amplifier Design (PB 119470), by G. Matthael and G. Plotnikoff, Calif. U. Feb. 1955. 66 pp. Design of transistor amplifiers, design of wideband amplifiers, and network theory.

Studies of Backward Wave Magnetron Interaction (PB 119596), by J. Kluver, Calif. U. Aug. 1955. 66 pp. Mic $3.90, pho $10.80. (LC) Study is related to beam-type magnetron tubes employing crossed dc electric and magnetic fields. A short description of the physical process by which gain is obtained with a negative circuit is given. Two slow wave circuits are discussed: the zigzag line and the interdigital line.

Final Engineering Report on Ultrasonic Propagation in Solid Materials (PB111809), Anderson Laboratories, Inc. for U. S. Air Force. June 1955. 8 pp. 50¢. (OTS) Contains an analysis of the many factors which determine the performance of delay lines. Designs with delays ranging from 300 to 400 msec have been compiled and it is now possible to fabricate these lines for any delay within these limits, with a minimum of further engineering time involved. A delay and cancellation system for moving target indication radar was designed and developed. The unit takes video in, delays and subtracts, and gives cancelled video out.

Video-Presentation Analyzer, 50 KC to 10 MC (PB111852), by F. T. Griffin, Naval Research Laboratory. Mar. 1956. 30 pp. 75¢. (OTS) Video frequency spectra data, from the modulating source as well as the incorporated amplifier, of an electronic countermeasures equipment are often required in determining the equipment's effectiveness. Previous facilities utilized for video analysis were characterized by slow operational point-to-point sampling procedures, and by uncertainty of resolution figure due to possible "Q" variation of each of the multiple-tune circuits used in the analyzer. A quasi-instantaneous video analyzer developed principally for the rapid analysis of modulation spectra is described. It presents the frequency analysis of a complex voltage visually, with an alternative provision for instrumental analysis by manual control. It is essentially a double-conversion superheterodyne receiver without preselection. A magnetically controlled local oscillator is used as a sweep for visually displaying the complete spectrum from 50 kc to 10 mc on a cathode-ray tube. A manually tuned local oscillator is used in conjunction with a thermistor bridge indicator for a point-by-point analysis.

A Wide-Band Differential Amplifier Oscilloscope Attachment (PB111953), by A. W. Carlson, Air Force Cambridge Research Center. June 1955. 17 pp. 50¢. (OTS) A differential amplifier having a single-ended output is described. The amplifier is useful in converting a single-channel oscilloscope into a differential oscilloscope. The circuit has many of the advantages of the cathode follower, such as wide bandwidth and low output impedance.

Development of Capacitor, Variable, Hermetically Sealed, Three Sections (PB111961), Sprague Electric Co. June 1955. 139 pp. $3.50. (OTS) Although mechanical tolerances necessary to obtain the required performance prevented achievement of the ultimate goal, the report presents data believed to have substantial value to those working with fixed capacitors, air dielectric concentric trimmers, and ceramic dielectric capacitors.

Electroforming of Copper for High-Vacuum Applications (PB111960), by L. LaForge, Jr., W. W. Hansen Laboratories, Stanford U. Feb. 1955. 23 pp. 75¢. (OTS) The electroforming process, used in typemaking and phonograph record reproduction, is now applied to the fabrication of vacuum tube envelopes, waveguides, linear-accelerator sections. The compositions and operation of the various solutions are given in detail, with many of the significant variables.

Cermets (CTR-319), The Transistor (revised) (CTR-310), Magnetic Amplifiers (CTR-244). April 1956. 10¢ each. (OTS) All applicable research reports in the OTS collection of over 250,000 documents are abstracted in the catalogs. Technical reports available from OTS are primarily the results of research done by the Government or by private laboratories with Government sponsorship, but also include German technical papers captured by the Allies in World War II. The reports listed are available now either from OTS or the Library of Congress.

Measurement of the Microwave Properties of Ferrites at High Power Levels (PB111826), Signal Corps Engineering Laboratories. April 1955. 21 pp. 75¢. (OTS) All the samples tested and discussed in the report are flat-ended, right-circular cylinders which were checked when mounted in the center of a circular waveguide. Data have been accumulated relative to the insertion loss and Faraday rotation characteristics of samples of different chemical compositions, and samples fabricated under different manufacturing processes. Although several refinements in test techniques have been made in the course of the research, additional work must still be done alone these lines.

Ferrite Components for 8.7-MM Wavelength (PB111813), Naval Research Laboratory. August 1955. 10 pp. 50¢. (OTS) The importance of ferrite components in X-band and S-band propagation prompted the investigation of applicability to 8.7 mm wavelength, as, for example, in radiometer measurements. An 8.7 mm ferrite isolator and a gyrator were designed and constructed. The isolator is capable of about 33 db isolation at an average VSWR of 1.07 and an average insertion loss of 0.8 db over the range of 8.58 to 8.80 mm wavelength. The design procedure and critical dimensions are given in the report, and an electronic switch using a gyrator is described.

Proceedings on the Conference on Atmospheric Electricity (PB121004), Air Force Cambridge Research Center. Nov. 1955. 225 pp. $4. (OTS) An appraisal of the current status of the science, arts, and techniques related to atmospheric electricity; proceedings, papers, reports, and discussions of the conference held in May 1954 at Wentworth-by-the-Sea, Portsmouth, N. H.

Transcendental Function Analog Computation with Magnetic Cores (PB111900), by D. Schaefer and R. Van Allen, Naval Research Laboratory. Feb. 1956. 11 pp. 50¢. (OTS) A rugged, fast, static method of performing analog computations utilizing a square loop magnetic core in conjunction with switching transistors. The basic circuit is capable of performing a variety of analogue computations, the waveshape of various input voltages determining the particular computation to be performed.

An Instantaneous Sound Spectrograph (PB-111864), by R. Misner, Naval Research Labora-

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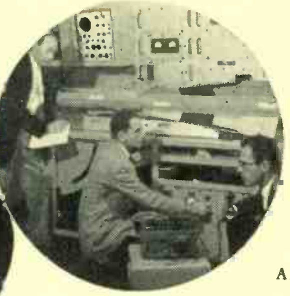

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Engineering writers work with research and development engineers during formation stages of new equipment to produce clear, concise technical manuals, for use in maintenance and training, as well as specialized handbooks for USAF aircrews.

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A completely staffed and equipped school is operated to train qualified military and company personnel in maintaining Hughes equipment. Instructors are graduate engineers or physicists with backgrounds in development work or university instruction.

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Engineers are assigned to manufacturers whose aircraft employ Hughes fire control systems, and are responsible for pre-installation testing of the systems. They work with airframe designers in cases where their operational knowledge bears on equipment installation problems.

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Hughes policy is not only to get reliable equipment into the field promptly and in sufficient amount, but to modify and develop this as soon as field information and test data become available. Engineers correlate information from the field and indicate engineering changes to the Research and Development Divisions.

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Hughes Aircraft Company
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tory. Jan. 1956. 35 pp. $1. (OTS) A new sound spectrograph presents an instantaneous plot of the energy of an audio signal, with time dimension plotted along the length of the paper, frequency plotted across the width, and energy of individual frequency components indicated by the density of recorded marks. The spectral analysis is performed by a group of 42 comb-type bandpass filters.

Ground Calibration of the VOR (PB121012), CAA Technical Development and Evaluation Center. Oct. 1955. 18 pp. 75¢ (OTS) This report describes a simple and accurate method of calibrating VOR stations with a portable detector mounted on the edge of the counterpoise. The ground-calibration method provides a means for readily determining the calibration curve without interrupting service at the station.

Design of Millimeter Wavelength Components, (PB 111968), by R. G. Fellers and J. A. Kaiser, Naval Research Laboratory. Mar. 1956. 27 pp 75¢. (OTS). Naval Research Laboratory has designed a series of waveguide components and test equipment covering the portion of the millimeter wavelength range from four millimeters to about one centimeter. Items covered in the report include connectors, standing-wave indicators, wavemeters, attenuators, directional couplers, switches, hybrid junctions, adjustable shorts, crystal mounts, power meters, power supplies, terminations, bends, horns, tees, and tapers.

Electromechanical Properties of Barium Titanate Prepared by a Fusion Method (PB 111811), by E. J. Brajer, The Brush Laboratories Co. Nov. 1954. 25 pp. 75¢. (OTS). A fusion method and a sintering method were investigatetd in an effort to improve the uniformity and reproducibility of barium titanate in regard to electromechanical properties. Test discs were matured, electroded, polarized, and tested to evaluate each material. Ceramics made of fused barium titanate batches have electromechanical and dielectric properties similar to those of ceramics made of sintered barium titanate of the same composition.

Piezoelectric Titanate Ceramics With Low Temperature Coefficients (PB 111812), by D. Berlincourt, The Brush Laboratories Co. Nov. 1954. 36 pp. $1. (OTS). The properties of barium titanate compositions containing substantial amounts of calcium titanate are reviewed. These compositions have improved temperature dependence of resonant frequency, electromechanical coupling, and dielectric constant as well as higher mechanical Q. The piezoelectric, dielectric, and elastic properties of these compositions are reviewed, and typical aging data are shown.

Instantaneous Sound Spectrograph (PB 111864), by R. Misner, NRL. Jan. 1956. 35 pp. $1. (OTS) Given are the first model and plans for a second model sound spectrograph which presents an instantaneous plot of an audio signal in the frequency and time domains.

Precision Determination of Lattice Constants with a Geiger-Counter X-Ray Diffractometer (PB 119464), by A. Smakula and J. Kalnajs, MIT. Feb. 1955. 30 pp. Mic $2.70, pho $4.80. (LC) Method is described. Limiting factor in the accuracy of measurement is not in the error of the diffractometer, but in the X-ray wavelength.

Speech Analyzer for a Formant-Coding Compression System (PB 119473), by J. Flanagan, MIT. May 1955. 124 pp. Mic $6.30, pho $19.80. (LC) Electronic analyzer for extracting formant and vocal information from continuous speech is designed for use in a bandwidth compression system operating on formant-coding principles. Speech is coded in the form of narrow bandwidth control signals which are transmitted to a synthesizer that is, in effect, a terminal analog of the human vocal mechanism. The synthesizer recreates the speech at the receiver.

Transcendental Function Analog Computation With Magnetic Cores (PB 111900), by D. Schaefer and R. Van Allen, NRL. Feb. 1956. 11 pp. 50¢. (OTS) Rugged, fast, static method of performing analog computations has been evolved which utilizes a square loop magnetic core in conjunction with switching transistors. Output voltages proportional to 2 input voltages, to trigonometric functions, and to powers and roots have been obtained.

Electroforming of Copper for High Vacuum Applications (PB 111960), by L. LaForge, Jr., Stanford U. Feb. 1955. 23 pp. 75¢ (OTS) Waveguides and similar microwave components were formed to a thickness of 0.150 in. on stainless-steel mandrels in an acid copper bath at room temperatures with current density of 10 amp/sq. ft. after suitable cleaning of the mandrel. Linear-accelerator sections were also formed.

Auroral Zone Absorption of Radio Waves Transmitted via the Ionosphere. Final Report for the Period Mar 1, 1954-Feb 28, 1955 Under Contract No. DA-36-039-sc-56739 (PB 119549), by K. Bowles, C. Little, and R. Dyce, Alaska U. Feb. 1955. 93 pp. Mic $4.80, pho $15.30. (LC) Investigation on scattering from the aurora, E clouds, and meteors.

Preliminary Analysis of the Half-Wave Bridge Magnetic Amplifier (PB 119519), by H. Woodson, NOL. Feb. 1954. 74 pp. Mic $4.50, pho $12.30. (LC) Two half-wave bridge magnetic amplifiers, one with parallel reset circuits, the other with series reset circuits, are analyzed using only linear circuit theory and Faraday's Law. Some design criteria are established and theoretically justified.

Progress Report Under Contract N7 onr-41906 (PB 119688), by Z. Bay and N. Grisamore, George Washington U. Feb. 1955. 29 pp. Mic $2.70, pho $4.80. (LC) Discusses: National Union Electric Corporation's 7-stage grid-controlled multiplier tube; pulse generator using the Phillips EFP-60 tube; and high speed counting circuits.

Intensity Spectra After Half-Wave Detection of Signals in Noise, Harvard U. Feb. 1955. Order separate parts described below from LC, giving PB number of each part. **I: Theoretical Discussion** (PB 119641), by G. Fellows and D. Middleton. 34 pp. Mic $3, pho $6.30. (LC) When narrow band noise centered about a frequency f_0 and an unmodulated carrier of frequency f_0 are added and passed through a nonlinear device, the intensity spectrum of the output wave consists of zones centered about harmonics of the frequency f_0. The theoretical aspects of this problem are presented, along with a number of computed results.

PATENTS

Complete copies of the selected patents described below may be obtained for $.25 each from the Commissioner of Patents, Washington 25, D. C.

Electronic Amplifier, #2,742,588. A. V. Hollenberg. Assigned Bell Tel. Labs., Inc. Issued April 17, 1956. The electron beam in a traveling wave tube is shaped as a hollow tubular beam. An electrode in the form of a helically wound conductor extends inside of and coaxial with the beam; wave propagation velocity along the electrode being less than along the propagating helix. A dc potential is applied between the electrode helix and the propagating helix.

Solid State Amplifier, #2,743,322. Inv. J. R. Pierce. Assigned Bell Tel. Labs., Inc. Issued April 24, 1956. Electromagnetic waves are propagated axially through a piece of material which exhibits a large Hall effect and a dc field is applied in the same direction. Under these conditions, the dc field in combination with the magnetic field of the electromagnetic waves result in a Hall effect field which tends to amplify the electric field associated with the electromagnetic waves.

Wide-Band High Frequency Pre-Amplifier Circuits, #2,743,323. Inv. S. Wlasuk. Assigned R.C.A. Issued April 24, 1956. An amplifier circuit adapted to simultaneously amplify a band of relatively high-frequency signals and a band of relatively low-frequency signals has a common input and output. Two electron tubes adapted for high-frequency amplification and connected in series across a power supply and two electron tubes adapted for low-frequency amplification and connected in series across the same power supply transmit the signals from the common input to the common output.

Automatic Frequency Control, #2,743,362. Inv. D. Leed. Assigned Bell Tel. Labs., Inc. Issued April 24, 1956. The difference frequency between a standard frequency and the controlled frequency is derived and any deviation from a predetermined difference is converted into a first dc voltage. Further a phase discriminator generates a second dc voltage which increases as long as the error persists. The controlled oscillation is generated by mixing the output of a mechanically-tuned variable oscillator and a reactance tube oscillator. The frequency of the latter oscillator is controlled by the combined dc voltages, while for the control of the first oscillator these combined voltages are first converted into a suitable ac signal affecting the speed of a 2-phase induction motor which in turn tunes the oscillator.

Television Circuit, #2,743,389. Inv. J. Guiffrida. Assigned C.B.S. Issued April 24, 1956. Three electromagnets for converging the three electron beams in a color television picture tube of the aperture mask type are provided. Each electromagnet is adjustably mounted. The magnets are energized by transistor circuits to cause the corresponding electron beam to converge at a greater distance from its source as the deflection of the electron beam from its central position increases.

Impulse Excited Magnetic Deflection System, #2,743,392. Inv. A. W. Friend. Assigned R.C.A. Issued April 24, 1956. In this sawtooth wave generator, a capacitor, a rectifier or electron tube, and an inductance are connected in series across a dc supply. A second capacitor and a second tube are connected in parallel to the first tube and the first capacitor, a synchronizing signal being applied to the grid of this second tube. An inductance connects the tube-capacitor points in each circuit.

Information Storage Device, #2,743,430. Inv. M. L. Schultz and G. A. Morton. Assigned RCA. Issued April 24, 1956. The storage device is in the form of a cell composed of a photoconductive material in electrical contact with a photovoltaic material which changes the direction of its photocurrent output when the applied current changes its polarity, for instance a lead sulfide film. A reversing switch or other current reversing circuitry supplies the information to be stored.

Antenna System, #2,743,441. Inv. C.-E. Granqvist. Assigned Hazeltine Research, Inc. Issued April 24, 1956. The talking radio beacon consists of a first antenna array having a radiation pattern in the form of a pair of sharply concentrated beams extending in opposite directions and having a common axis and a second antenna array having a figure eight radiation pattern with an axis perpendicular to the axis of the beams. Both arrays are simultaneously rotatable.

Color or Monochrome Television Receiving System, #2,744,155. Inv. H. Kihn. Assigned RCA. Issued May 1, 1956. The receiver re-

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ceives a color component signal including several signals each representative of a color and a control component signal. The color signal has a given color recurrence frequency, each color signal having a different phase, and the control signal has a burst of several cycles of a wave having the color recurrence frequency. The control signal is used to produce a wave having said color recurrence frequency which wave is effective in separating the several color signals.

Audiometer, #2,744,158. Inv. W. Grandjot. Issued May 1, 1956. A tone generator adjustable in frequency and intensity over the audible range is provided for measuring the hearing loss. An arm automatically moves with the manually controlled frequency and intensity settings and the threshold at any desired frequency is plotted on a card on which the hearing loss values for a normal person are plotted for comparison.

Pulse Amplifier, #2,744,169. Inv. Chs. Reed Deming. Assigned Hughes Aircraft Co. Issued May 1, 1956. The high-impedance plate-output circuit of a first amplifier is fed to a second amplifier which has a low-impedance cathode-output circuit. A diode is connected between the two output circuits and it is poled so that current flows when signals in the cathode output circuit are more positive than in the plate output circuit, whereby signals of widely varying dynamic range are greatly amplified without substantial distortion.

Post-Pulse Clipping Circuit for Pulse Modulators, #2,744,195. Inv. P. Winokur. Assigned Philco Corp. Issued May 1, 1956. A gas discharge tube in series with a load resistor is connected across the pulse source and in parallel with the primary winding of an output transformer. A trigger winding associated with the output transformer primary supplies a positive signal during the peak value of each pulse over a suitable circuit to the grid of the gas tube effectively clipping the pulse signal.

Frequency Stabilization, #2,744,197. Inv. R. Marshall Gogolick and J. G. Tabler. Assigned Globe-Union Inc. Issued May 1, 1956. The frequency stabilizer is a body made of an electron compound metal alloy having a low internal damping of mechanical vibrations. This body is mounted for vibration and two electrodes are arranged to form two capacitors, respectively with the body; constant potential is applied to both capacitors. One capacitor is connected in the output circuit of an oscillator, thereby driving the body to mechanical oscillations at its resonance frequency, while the other capacitor is connected to the oscillator input supplying a frequency-stabilizing voltage.

What Good Are Patents, by R. Miles. "El. Des." May 15, 1956. 2 pp. A business approach rather than a legal approach to the value of patents. The author points out the limitations of patents as an investment, as well as their value.

Speed Indicating Device, #2,740,108. Inv. L. W. Plympton and H. C. Jones. Assigned New England Helicopter Service. Issued March 27, 1956. An alternator is driven by the shaft the rotational speed of which is to be checked. The alternator output frequencies are proportional to the angular shaft velocity; they are fed to a band pass filter which consists of two coils coupled by at least one frequency sensitive reed. The band pass output controls an electronic switch which in turn actuates a tone generator.

Thermionic Valve Feeding Circuit for Piezo-electric Transducer, #2,740,906. Inv. E. A. Newman and D. O. Clayden. Assigned National Research Development Corp. Issued April 3, 1956. Rectangular, high-frequency, pulse-modulated signals are fed into an acoustic delay line fitted with a piezo-electric transducer by a step-down transformer secondary. The primary is in the plate circuit of an electron tube biased to operate near cut-off. One transformer winding is coupled to the piezo-electric transducer to form a circuit resonant at the resonant frequency of the transducer. At least part of the transformer secondary is connected into the cathode circuit providing negative feedback.

Television Intercarrier-Sound Detector, #2,-741,660. Inv. W. K. Squires. Assigned Sylvania Electric Prod., Inc. Issued April 10, 1956. The detector for the sound carrier in a television system comprises an infinite-impedance detector. The video-signal output load impedance is connected to both the input and output circuit of the detector, while the sound-signal output load is connected to the output circuit of the detector only.

Electron-Discharge Device, #2,741,721. Inv. Robert Adler. Assigned Zenith Radio Corp. Issued April 10, 1956. A pair of controllector electrodes is arranged on opposite sides of an electron beam. Each controllector electrode consists of a control section and an electron-impervious collector section electrically connected to the control section and intercepting the electron beam path. An apertured electrode cooperates with the collector electrodes to form an electrostatic electron lens for focusing the electron beam at its interception with the collector electrodes.

Cavity-Backed Slot Antenna, #2,741,763. Inv. J. R. Ashwell, S. Hershfield, and D. B. Kleason. Assigned The Glenn L. Martin Co. Issued April 10, 1956. A dielectric spacer is arranged in an elongated metallic cavity having one side open. The spacer is of even thickness and centrally located in the cavity. Two metal members of substantially U-shaped cross-section are arranged with one leg secured to the spacer and with the other leg secured to a parallel wall of the cavity, whereby a cavity-backed, T-ended slot antenna is formed.

Color Television, #2,742,522. Inv. R. R. Law. Assigned RCA. Issued April 17, 1956. The signal-modulated electron beam successively impinges on different-color phosphors on the target in synchronism with the signal color. A device for producing color balance interrupts the flow of electrons towards the target in between each separate color signal and varies the duration of the period during which the electrons impinge upon the different phosphors.

Field Identification Apparatus, #2,742,523. Inv. J. O. Preisig and A. A. Barco. Assigned RCA. Issued April 17, 1956. The field sensing apparatus distinguishes two interlaced sets of field scanning operations having different time intervals between vertical blanking period timing and field starting timing. A first set of pulses is derived during each vertical blanking interval and a second set during alternate blanking intervals. These two sets of pulses control a bi-stable device which produces a signal to distinguish the successive fields being scanned.

Transistor Trigger Circuits, #2,744,198. Inv. G. Raisbeck. Assigned Bell Tel. Labs., Inc. Issued May 1, 1956. In the trigger circuit for generating output waves of symmetrical shape, two transistors being connected in series with their common electrodes grounded. The two transistors have the same shape voltage-current characteristics, however, the characteristics are of opposite sign. In this circuit one of the transistors will be at cut-off when the other is at saturation.

Electronic Thickness Gage, #2,744,238. Inv. G. J. C. Andersen. Assigned Goodyear Tire and Rubber Co. Issued May 1, 1956. The dielectric property of a material is tested by placing it close to a single probe electrode of the gage. The control grid of a triode oscillator is capacitively coupled to this probe electrode. This grid is further coupled to the grid of another triode, the output current of which is an indication of the dielectric properties of the material.

Wave Guide Delay Line, #2,744,242. Inv. S. B. Cohn. Assigned Sperry Rand Corp. Issued May 1, 1956. A series of parallel very thin flat conductive plates extends between the side walls of a rectangular wave guide reaching to one of the wide walls while being spaced from the opposing wide wall. A circular rod is secured to the free edge of each of the conductive plates to increase their loading capacity and inductance while reducing voltage breakdown.

Means for Improving Television Interlace Control, #2,744,956. Inv. G. L. Haugen and G. D. Wofford. Assigned Bendix Aviation Corp. Issued May 8, 1956. The vertical deflection oscillator, which is controlled by an incoming synchronizing signal also supplies an output over a resistor-capacitor network generating a voltage pulse of selected duration. This voltage pulse is used to render the vertical deflection oscillator insensitive to external signals, such as synchronizing signals, for the duration of the voltage pulse.

Receiver for Two Amplitude-Modulated Waves, #2,744,961. Inv. 2,744,961. Inv. J. J. Alphonsus Peek. Assigned Hartford National Bank and Trust Co. Issued May 8, 1956. The receiver is adapted to simultaneously receive two amplitude-modulated carriers having a predetermined frequency displacement. The demodulated signal is amplified in two channels having the same amplification factor, the two channels being triggered to be alternatively operative at a frequency equal to the frequency displacement. The outputs of the two channels are added and subtracted and their sum and difference applied to two loudspeakers.

Semiconductor Signal Translating Devices, #2,744,970. Inv. W. Shockley. Assigned Bell Tel. Labs., Inc. Issued May 8, 1956. The device comprises a semiconductive body having a first zone of one conductivity type and an adjacent second zone of the opposite conductivity type to form a rectifying junction. A drain and a source connection are made to the first zone and a gate connection to the second zone. Input signal and biasing source are connected between the source and the gate, while a load circuit and a biasing source are connected between the drain and the gate.

Photo Device Amplifier Circuit, #2,745,021. Inv. J. Kurshan. Assigned RCA. Issued May 8, 1956. A photo conductive device, having a non-linear resistance decreasing in response to an increase of the applied voltage, is inserted between the base electrode of a transistor and a grounded voltage source, the emitter electrode of the transistor being grounded. The output circuit is connected to the collector electrode which is negatively biased. The collector current will decrease when the photo conductive device is illuminated.

Direct Reading Time Measuring Device, #2,-745,058. Inv. T. Frankel. Assigned General Dynamics Corp. Issued May 8, 1956. A current indicator is used which requires a longer time interval to reach its maximum indication than the time interval to be measured. Current is applied to the indicator by a relay having a make and break contact; the contacts are made and interrupted at the beginning and end of the time interval to be measured.

Microwave Magnetized Ferrite Attenuator, #2,745,069. Inv. W. H. Hewitt. Assigned Bell Tel. Labs., Inc. Issued May 8, 1956. An elongated solid body containing ferrite is longitudinally arranged in a wave guide and extends over only a portion of the wave guide cross-section. If a linearly polarized wave is propagated in the wave guide and a magnetic field parallel to the direction of polarization is applied to the ferrite body, attenuation will take place.

Circularly Polarizing Directional Antenna System, #2,745,100. Inv. J. G. McCann, F. M. Weil, and R. E. Stein. Assigned Gilfillan Bros. A linearly polarized radiation, collimated axially but divergent transversely thereto, is reflected to be collimated in both directions. A grid positioned to intercept only the primary radiation transforms it to be circularly polarized.

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- Multi-Stable Work Horse: By employing a non-linear load, new circuit permits two transistors to do the work of ten. IBM Bulletin No. 200.
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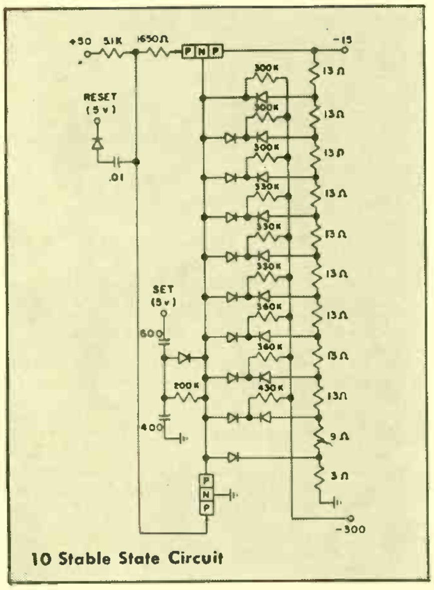
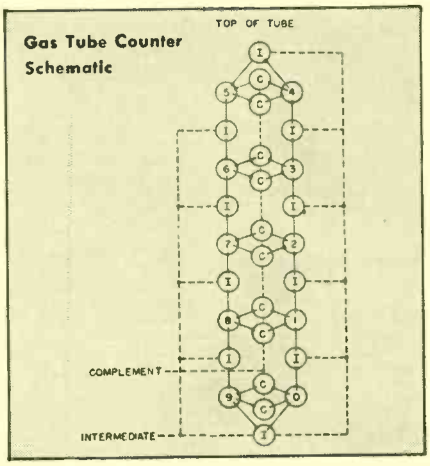


10 Stable State Circuit

A full report on this new idea from IBM contains eight full-page circuit diagrams in addition to mathematical analyses of the operation of the circuit. Write for your copy of IBM Bulletin No. 200.



Gas Tube Counter Schematic

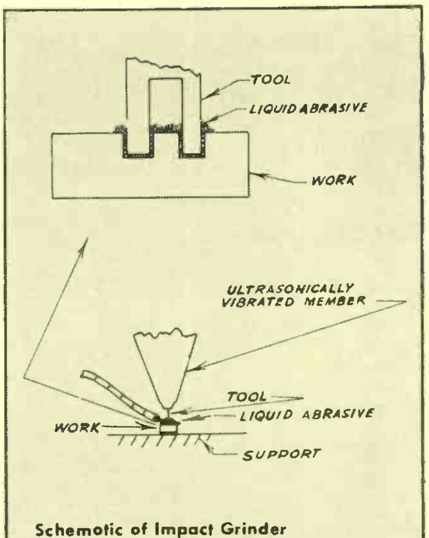
Self-Complementary

Accounting machines these days must be able to do everything—even make decisions. In order to get a machine to do more in a day's time with little or no increase in operating cost, IBM Component Research people studied the idea of using a multi-cathode gas tube. It's good news that they came up with an attractive approach, which Robert Koehler, of our Device Development Group, then reduced to practice; it operates faster than its electro-mechanical predecessor and, furthermore, with simple circuitry, can subtract by adding. It can read out in true number form both positive and negative balances. This is possible because a number stored in the tube may be transposed to its 9's complement (i.e., value subtracted from nine) by a single electrical pulse.

If you'd like more information on the basic principle, physical arrangement of parts, and typical problems solved, write for IBM Bulletin No. 201. If you are fascinated by the theory of numbers, we recommend this Bulletin.

The Soft Touch

In some of our studies of new components, at the IBM Research Laboratories at Poughkeepsie, it is necessary to make many different, small and intricately shaped parts from brittle materials. Following the conventional approach, each of these parts would require laborious and costly machining and fabrication. We turned to ultrasonic cutting; with this tool we can make any shape or size component in approximately a minute—with an accuracy five times greater than previously possible! The ultrasonic cutter has helped us progress faster in our development of new devices. RESEARCH at IBM means IDEAS at work.



Schematic of Impact Grinder

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New Tech Data for Engineers

Resumes of New Catalogs and Bulletins Offered This Month by Manufacturers to Interested Readers

Drill Bushings

A new bulletin giving complete information on the Doylestown, Pa., Penn Engineering Mfg. Corporation's self-clinching drill hushings has been published. Bulletin includes adequate diagrams and specifications showing how PEM bushings give faster, easier template assembly. (Ask for B-7-26)

Encapsor

The advantages of the Alcorite Encapsor are displayed in the newest literature issued by the Alcor Electronics Corp., 180 Lafayette St., New York, N. Y. (Ask for B-7-27)

Relays

Features, applications and specifications for eight different types of relays for electrical, electronic and industrial use are set forth in a well-illustrated, 18-page book presented by Kurman Electric Co., 35-18 37th St., Long Island City, N. Y. (Ask for B-7-28)

Sub-Miniature Connectors

Cannon Electric, 2308 Humbolt St., Los Angeles, Calif., has issued an 8-page engineering bulletin on Type "D" sub-miniature connectors. It contains actual size photographs of D miniatures; dimensional data, soldering, mounting and shell deviations; standard assemblies and application photos. (Ask for B-7-1)

TV Picture Tubes

A revised reference guide for TV picture tubes, Bulletin PA-2, is being offered by CBS-Hytron, Salem, Mass. Pertinent data for 258 magnetically deflected picture tubes, regardless of make, is provided. (Ask for B-7-2)

Servo Motors

Four catalog pages, illustrating and fully describing a type of low inertia servo motor, are available from John Oster Manufacturing Co., Avionic Div., Racine, Wis. Each sheet includes graphs, dimensional drawings, average characteristics and complete electrical data. (Ask for B-7-3)

Magnetic Tapes

Physical and magnetic properties of 12 "Scotch" brand magnetic tapes and films are covered in a new technical data booklet available from Minnesota Mining and Manufacturing Co., Dept. A6-114, St. Paul, Minn. (Ask for B-7-5)

Magnetic Shielding

Perfection Mica Co., 20 N. Wacker Dr., Chicago 6, Ill., has released data describing the protection of tape recordings from various low and high intensity magnetic fields by storing or carrying in Fernetic and Co-Netic protective cans. (Ask for B-7-6)

Controls

Clarostat Mfg. Co., Inc., Dover, N. H., lists almost every type and size control or resistor for the usual run of applications in their Catalog No. 56. Among the listings are composition-element and wire wound controls in several sizes. (Ask for B-7-8)

Contact Connectors

4-page brochure, from Alden Products Co., Brockton, Mass., shows a whole new series of compact single and multi-contact connectors. Illustrations and applications of the company's "IMI" connectors and unit cables are shown. (Ask for B-7-12)

Portable Tube Tester

Seco Manufacturing Co., 5015 Penn Ave. S., Minneapolis, Minn., offers literature describing their portable model grid circuit tube tester, as well as information about the Seco signal tracer and intermittent localizer. (Ask for B-7-30)

Meter-Relays

A new 40-page catalog, issued by Assembly Products Inc., Chesterland, Ohio, details all features, specifications and prices of the company's meter-relays. Plentifully illustrated throughout, it contains many diagrams. (Ask for B-7-23)

Silicon Rectifiers

Transitron Electronic Corp., Melrose, Mass., manufacturers of silicon rectifiers, as well as transistors and diodes, has recently published new tech. bulletins including descriptions, ratings and complete specifications on their products. (Ask for B-7-24)

Engine Analyzer

Allen B. DuMont Labs., Inc., Clifton, N. J., has issued a bulletin on their new Dynamic Engine Analyzer, the newest electronic device of interest to all motor mechanics. The new device is a shortcut to fast, sure and complete engine analysis. (Ask for B-7-25)

Transistors

Lafayette Radio, 100 Sixth Ave., N. Y. 13, N. Y., has released a 32-page Transistor Brochure featuring a complete line of miniaturized parts available and listing practically every transistor on the market. Whole pages are devoted to transistor specs. (Ask for B-7-13)

EJC Report

Discussion of the Reserve Forces Act of 1955, and the findings of the Hoover Commission, of interest to all engineers are highlights of 68-page pamphlet "Proceedings—Second General Assembly" available from Engineers Joint Council, 29 W. 39th St., N. Y., N. Y., at $1.00 per copy. (Ask for B-7-14)

Encoders

Baldwin Piano Co., 1835 Gilbert Ave., Cincinnati, Ohio, has published an 8-page bulletin describing new 13-digit and 16-digit optical-type analog to digital angular position encoders. Bulletin gives detailed information on operation and construction. (Ask for B-7-15)

Printed Circuit Tolerances

2-page Technical Bulletin P-9 is a comprehensive set of standard printed circuit tolerances published by The Kotula Co., 400 Madison Ave., N. Y. 17, N. Y. Included are such items as diameter tolerances of unplated and plated holds, location tolerances between holes, etc. (Ask for B-7-16)

Cabinets

A 38-page catalog of electronic components and sheet metal cabinets has been published by Bud Radio Corp., Cleveland 3, Ohio. It is complete with descriptions, specifications, illustrations, and diagrams. (Ask for B-7-19)

Semiconductors

The Semiconductor Products Div. of Texas Instruments, Inc., 6000 Lemmon Ave., Dallas, Texas, has issued data sheets containing detailed characteristics and prices of their new silicon rectifiers and diodes. (Ask for B-7-20)

Connectors

American Phenolic Corp., 1830 S 54th Ave., Chicago, Ill., has produced a new 12-page catalog presenting complete information on Amphenol rack and panel connectors, as well as pin and socket, princir, and many special types of connectors. (Ask for B-7-21)

DC Power Supplies

Lambda Electronics Corp., College Point, New York, offers a new 6-page supplement to their catalog 55, describing the new "200 MA" series of compact, regulated DC power supplies. (Ask for B-7-9)

Testing Information

The GE Radiation Digest, published quarterly by the X-ray department of the General Electric Company, Milwaukee, Wis., contains material of interest to all engaged in various phases of nondestructive testing. (Ask for B-7-10)

Testing Instruments

80 different devices are covered in a 40-page "Testing Instruments Reference Book" published by General Electric, Instrument Dept., Schenectady 5, N. Y. (Ask for B-7-17)

Microphones

Elgin National Watch Co., Elgin, Ill., has released a 20-page catalog of the company's line of American microphones and phonograph cartridges. Catalog lists prices, specs., and characteristics of each item, and contains a section devoted to the ceramic "turnover" and single-needle phono. cartridges. (Ask for B-7-18)

Magnetic Cores

New 4-page folder describing the development, characteristics, applications, and services available in connection with tape-wound magnetic bobbin cores is available from Burroughs Corp., Electronic Inst. Div., 1209 Vine St., Philadelphia, Pa. (Ask for B-7-34)

Tri-Film Processor

PSC Applied Research, Ltd., 1500 O'Conner Dr., Toronto, Canada, has issued several new information releases concerning a transportable tri-film processor, an instrumentation camera designed for automatic recording on 35mm film, and microwave plumbing. Complete data included in each. (Ask for B-7-32)

Precision Resistors

International Resistance Co., 401 N. Broad St., Philadelphia, Pa., has issued a new catalog data bulletin containing comprehensive information on winding technique, testing, tolerance, inductance, insulation, terminals, temperature coefficient, plus charts and graphs. (Ask for B-7-31)

Microwave Components

A wide range of standard and custom-engineered microwave components and complex mechanical assemblies are featured in an illustrated technical catalog available from J-V-M Engineering Co., 8846 W 47th St., Brookfield, Ill. (Ask for B-7-29)

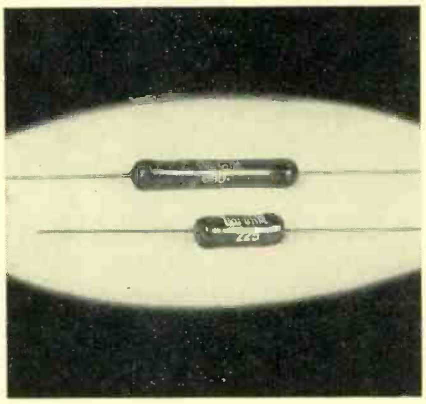
Electronic Circuitry

4-page bulletin, "Ideas, Techniques, Designs," from Alden Products Co., Brockton, Mass., gives practical information on how design, layout and construction time can be reduced by using a standard system of plug-in unit construction. (Ask for B-7-22)

New Circuit Components

RESISTORS

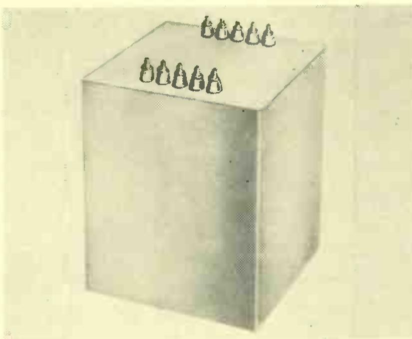
New vitreous axial lead resistors are capable of dissipating the same amount of power as their larger counterparts. Core assembly is wound to the proper resis-



tance; the junction of the resistance element is silver brazed and then coated with vitreous enamel which is then fired at high temp. This unit is capable of continuous operation at 300° C. They are offered in 3, 5 and 10 watt sizes. **Tru-Ohm Products Div. of Model Engineering & Mfg. Co., 2800 N. Milwaukee Ave., Chicago, Ill.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-148)

PLATE TRANSFORMERS

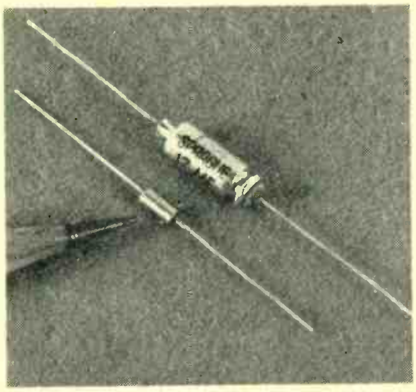
New UTC series of hermetic plate transformers surpass MIL-T-27 requirements. In addition to the primaries being tapped for 105/115/210/220 v. service, the



secondary windings are tapped to provide either of two dc output voltages. Eight standard types cover the range from 365 v. dc at 275 ma to 2550 volts dc at 1 a. Larger size plate transformers have terminals opposite studs for typical rack type equipments. **United Transformer Co., 150 Varick St., N. Y. 13, N. Y.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-21)

CONDENSER

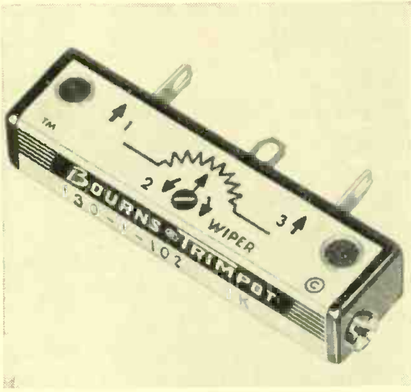
The pencil points to a new "solid electrolytic" condenser for use in guided missiles and other applications where reliable transsistorized electronic circuits are



required. In its smallest version shown here, it is only 1/8 in. in diameter by 1/4 in. long. It occupies 1/10 the volume of the miniature aluminum electrolytic condenser shown behind it. It will find immediate use in the most severe military electronic applications. **Sprague Electric Co., North Adams, Mass.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-11)

TRIMMER POT

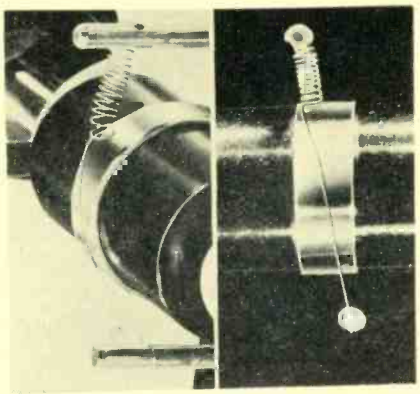
This subminiature trimming potentiometer, designated the Trimpot Model 130, is available in 11 standard resistances from 10 to 20,000 ohms. The unit is screwdriver adjusted over 25 turns and has excellent shock, vibration, and acceleration characteristics.



Solder-lug terminals are used instead of the usual wire leads. Resolution ranges from 2.0 to .02%. **Bourns Laboratories, 6135 Magnolia Ave., Riverside, Calif.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-85)

SLIP RING PICKOFF

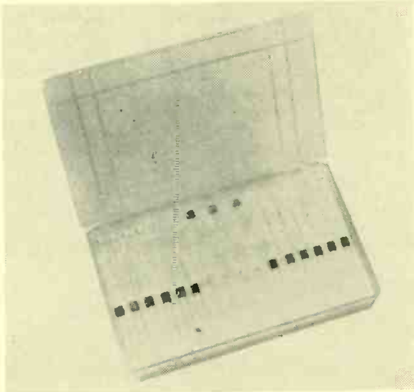
Recently completed test data of a new concept of slip ring brush design has shown life better than 100 million revolutions at low electrical noise level. Arrangement consists of a self-contained spring and wire which contacts the slip ring over a sector of ap-



prox. 180°. Wire used was .004-.006 diameter, and wear at the end of test was less than 1/2 the diameter. **J. M. Ney Company, 80 Elm St., Hartford 1, Conn.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-23)

THERMISTOR TEST KITS

This new series of thermistor test kits will enable design engineers to investigate and evaluate the potentialities of employing these versatile semiconductor ceramic units in the latest circuit designs. The kits, available in 3 sizes priced from $9.95 to $39.95,



include representative units in a wide range of resistances, temperature coefficients, and sizes. **Thermistor Corp. of America, Metuchen, N. J.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-89)

WASHINGTON

News Letter

Latest Radio and Communication News, from The National Capital, and Previews of Things to Come

NEW FCC COMMISSIONER—Retired Navy Commander T. A. M. Craven, who served as a Commissioner from 1937 to 1944 and as FCC Chief Engineer from 1935 to 1937, takes over again on the Commission as this publication reaches its readers. Engineer-Commissioner Craven, who succeeds the veteran Commodore E. M. Webster, also an engineer, brings to the Commission expert experience and knowledge in its most difficult field—allocations.

NETWORKS PRESENT SIDE—The two major television networks, National Broadcasting Co. and Columbia Broadcasting System, last month presented strong replies to the allegations and criticism of some Senators and spokesmen for a few non-network stations to the Senate Interstate and Foreign Commerce Committee. NBC President Robert W. Sarnoff and CBS President Frank Stanton testified before the Senate body in mid-June hearings. Mr. Sarnoff brought out that NBC television programs were viewed by 80 per cent of the nation's population—some 37 million homes—and there has been little criticism from the public TV audience of the networks' operations and service. Dr. Stanton stressed that the legislation, proposed by Senator Bricker of Ohio, ranking Committee Republican, would place networks in a strait-jacket of public utility regulation and this would "suppress and possibly destroy" networks and their important public services to the nation.

NICKEL EXPANSION—Aimed at providing a U. S. annual supply of 440 million lbs. of the metal by 1961, a revised expansion goal for nickel—vitally important to the communications and electronics industries—has been promulgated by Defense Mobilizer Arthur S. Flemming. At the new objective level, the available nickel supply for civilian and defense use, including the national stockpile, would be 140,000,000 lbs. above the present annual supply and 60 million lbs. over the previous goal. Increasing concern had been expressed prior to the ODM chieftain's announcement that it was becoming difficult to meet even current demands as well as necessary expansion in communications-electronics production, both for military requirements and civilian demands in an expanding economy.

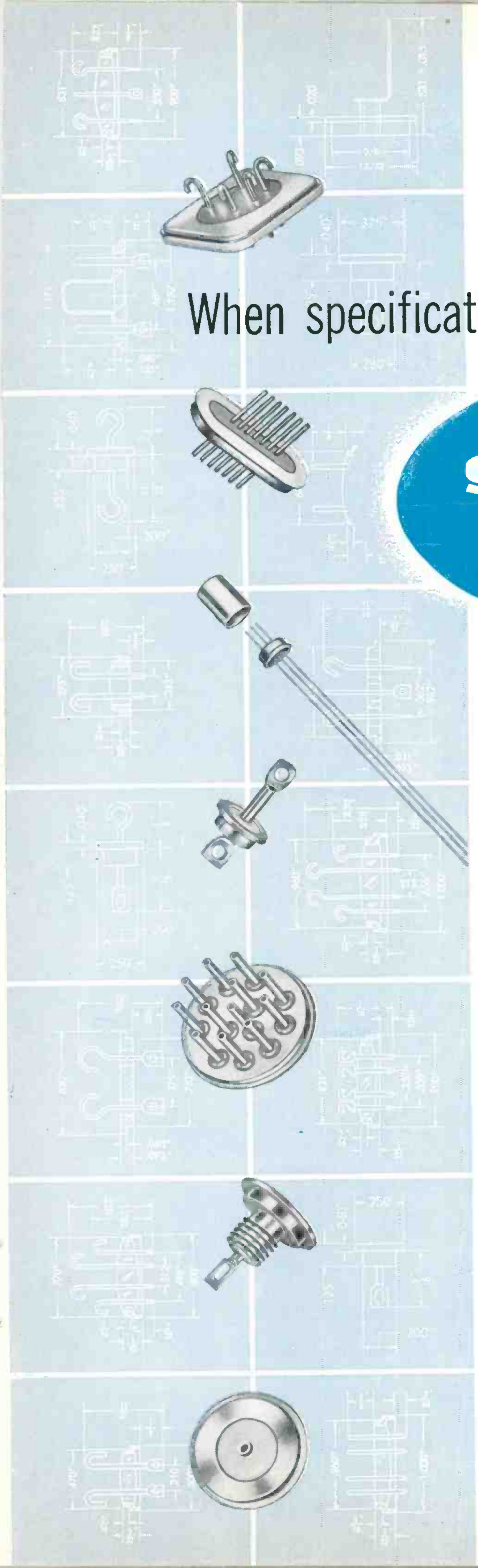
SHORTAGE PROBLEM—Dr. C. B. Jolliffe, Vice-President and Technical Director of the Radio Corporation of America, in a recent address in Washington warned that the total of around 25,000 scientists and engineers who graduated last June from the nation's universities and colleges is only half the number required to fill positions in industry alone. He stated that "this relative drying up of the flow of scientific and engineering skills is undermining our ability as a nation to prosper in a technological age." A most important problem, he cited, was the shortage of scientific and technical teachers at the high school level. For solution of this shortage he declared one of the most challenging proposals is the suggested establishment of a national educational reserve of industry scientists and engineers taking over teaching assignments which has been made by RCA Board Chairman David Sarnoff.

AIR TRAFFIC CONTROL—Characterized as "the first step in the government's efforts to develop a comprehensive plan for meeting the requirements of the jet aircraft age," the White House awarded a $300,000 contract for an extensive research study of the nation's air traffic control needs, including electronic navigation aids and communications, for the next 20 years. The research survey will be carried out by the Airborne Instruments Laboratory of Mineola, N. Y., in cooperation with the Cornell Aeronautical Laboratory of Buffalo and the Aeronautical Research Foundation of Boston. The survey which is regarded as a significant step in the coordination of government and industry aviation planning will be under the general supervision of Edward P. Curtis, special assistant for aviation facilities planning to President Eisenhower.

MULTI-BILLION DOLLAR BUSINESS—The increasing reliance being placed by the U. S. Air Force on communications and electronics is reflected in the fact that in 1954 total costs of personnel, facilities and equipment for these items took up 12% of the Air Force budget, while in 1957 the percentage will be up to 17%, it was disclosed recently by Dr. H. Guyford Stever, chief scientist of the Air Force. "If one adds the aeronautical electronic budgets of the other armed services and those agencies which have non-military uses of aeronautical electronics," said Dr. Stever, "it is clear that this business is a healthy multi-billion dollar business."

National Press Building
Washington, D. C.

ROLAND C. DAVIES
Washington Editor



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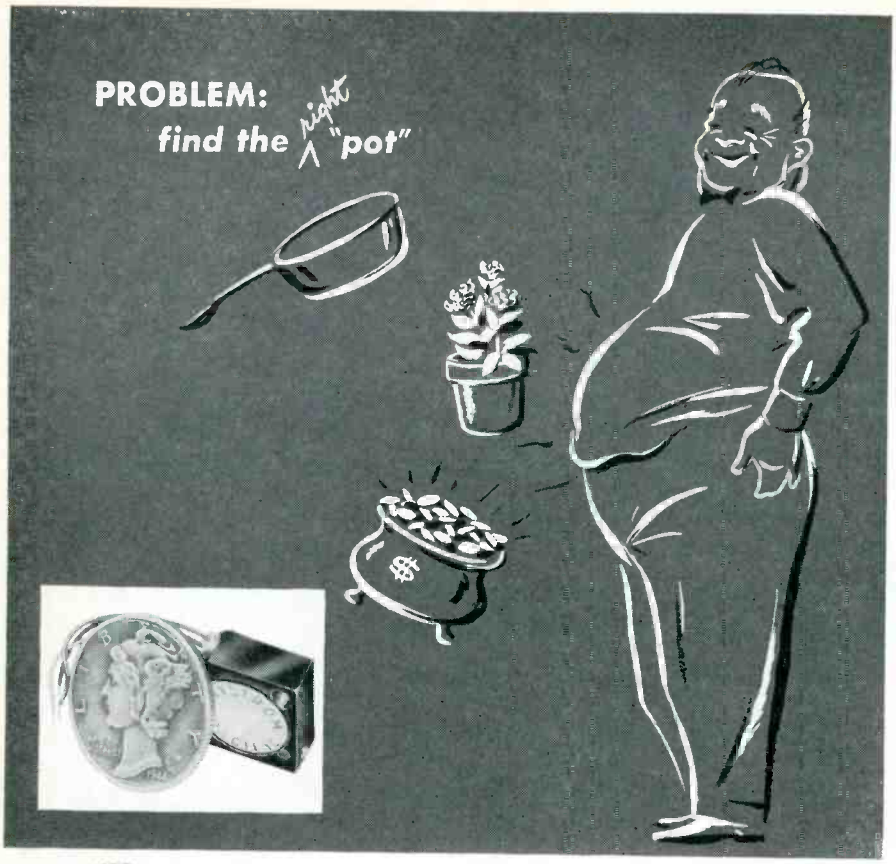


High "G" Tests

(*Continued from page* 44)

measurement on an absolute basis since the complicated waveforms present in noise voltages do not conform to the definitions necessary for the proper calibration of these two instruments. It has often been noted that good correlation between vibration noise measurement and field results are difficult to acquire. Some reasons for this are now apparent.

In addition, the Bruel and Kjaer level recorder used to record the output of the swept frequency vibration, is also an integrating method and the output recorded will depend upon the resolution time of the system as well as upon the bandpass characteristics of the unit. In this particular model the bandpass characteristics are such that frequencies up to 40,000 cps will be included. This test system also uses a sine wave input and is therefore incapable of showing the noise output that would be produced by acceleration of a complex waveform. Each component represented in such a wave can produce numerous noise harmonics, as shown in Fig. 3. The waveform and magnitude of the noise output depend on how these harmonics combine and are therefore not easily determinable from swept frequency results.

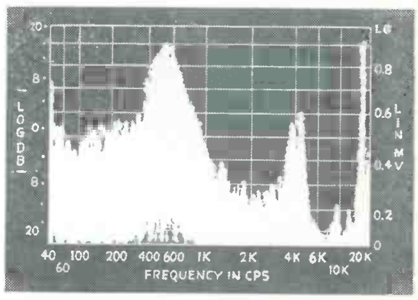
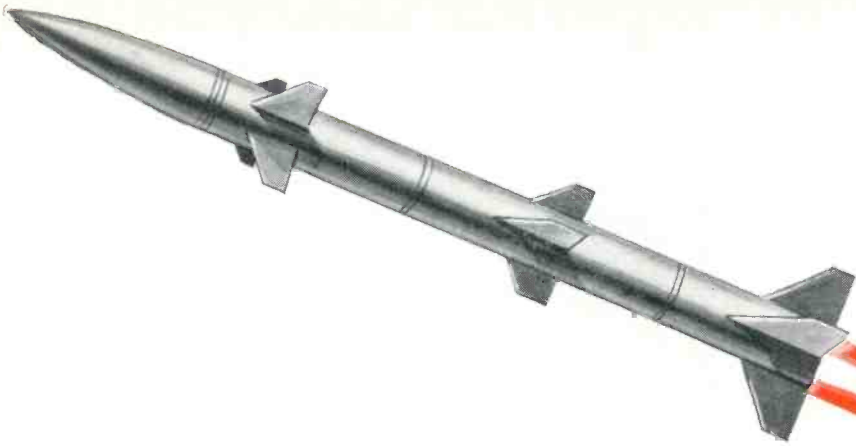
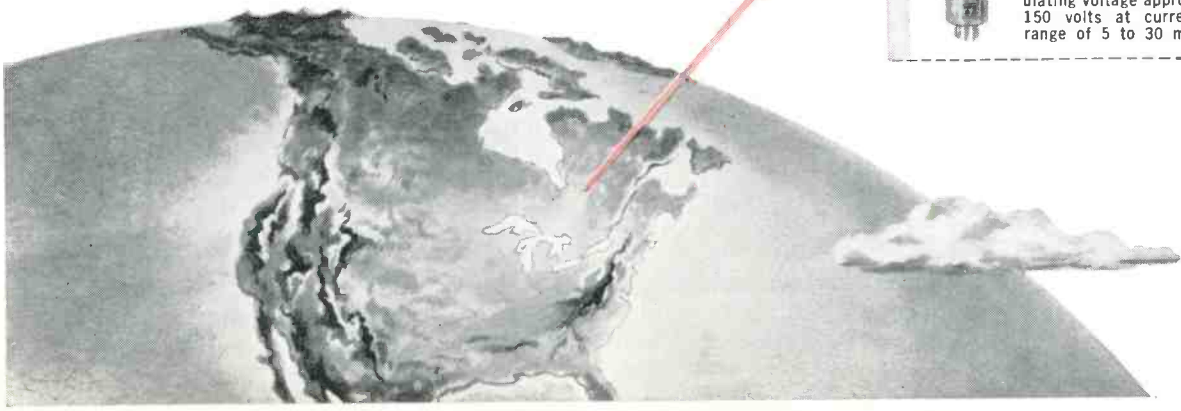


Fig. 8: "White noise" panorama, 5977

It can be seen that no system alone is adequate for determining the relative merits of two tubes and that some compromise is necessary for production and quality testing. In any event, extreme caution should be used in making comparisons between tubes unless all of the details concerning the method of test are known.

Eliminating or reducing vibrational noise output in vacuum tubes as required for guided missile use





For product information, use inquiry card on last page.

High "G" Tests

(*Continued from page* 114)

leads to the examination of the following:

(a) The effect of shortening the mount structure,

(b) The importance of mica to cathode fit, and the ultimate range of fit which will hold the cathode firmly without breaking or shaling mica or distorting the cathode,

(c) The effect on vibrational output of holding the cathode by other means such as a strap or exceedingly heavy cathode tab,

(d) The change in vibrational output and structure resonance by strapping grid siderods and tying to rivets in mica,

(e) The relative importance of grid siderod mass, diameter and strength on vibrational output and structure resonance.

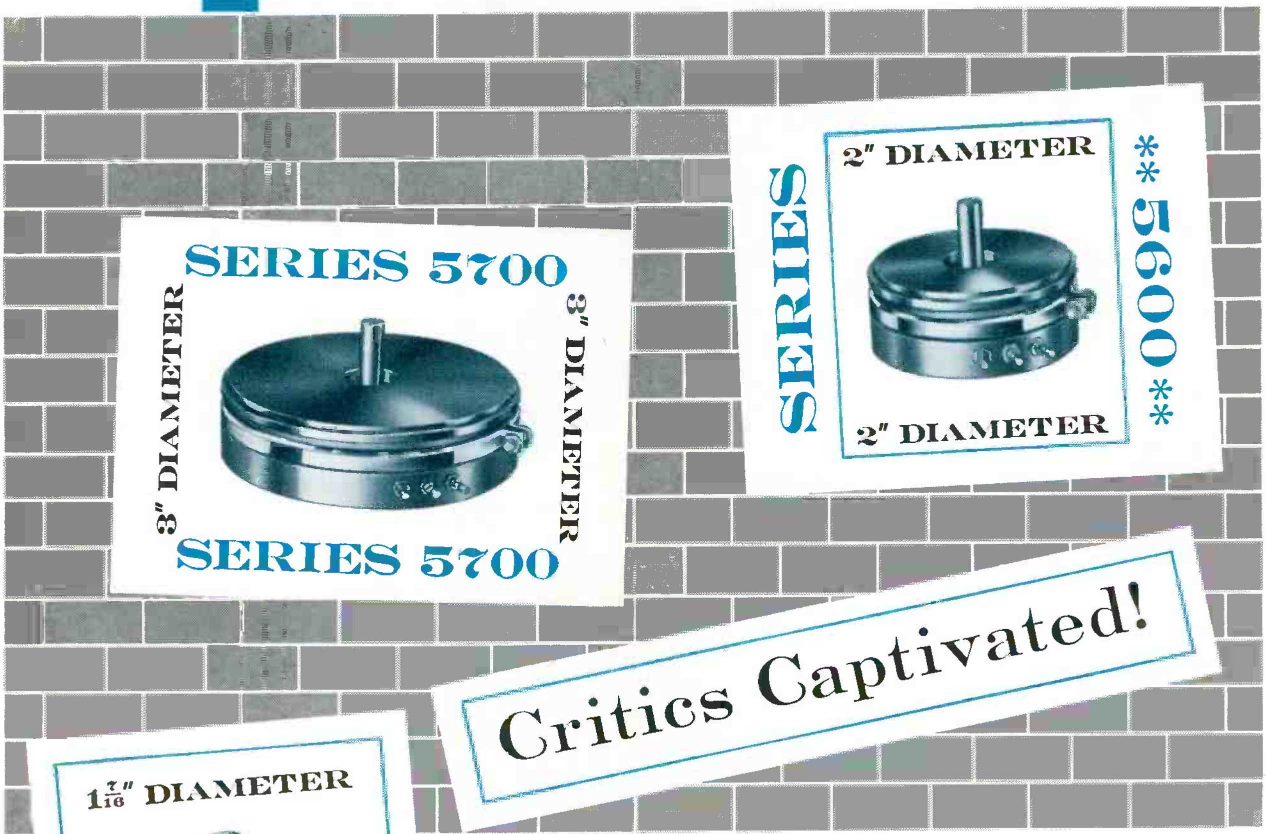
Tube Structure

The determination of the effect of structure changes is a very difficult task because statistical analysis must be used, resulting in rather large tests and considerable data; but, the main difficulty lies in the determination of the effect of mechanical tolerances of the parts used. A difference of half a thousandth of an inch in the size of the grid hole in a mica will have a profound effect upon vibrational output. Unfortunately, the methods of measuring mica holes and cathode and grid dimensions entail errors which approach the magnitude of tolerances required.

The first approach to the problem was to determine how much reduction in vibrational noise output could be achieved by shortening the structures. From the standpoint of vibrational output and shock resistance, it is obvious that a short structure has many merits. The problem then becomes one of determining how short the structure may be without excessive lowering of the tube characteristics.

The Type 5718 mount was shortened from .340 in. to .240 in. with no other changes. It can be seen from the data in Fig. 4 that considerable reduction in vibrational noise output was achieved and could be directly attributed to the short mount length since this was the

Another product surprise from Helipot!



Discriminating engineers, the world's toughest critics, applaud the brilliant performance of Helipot's brand new trio - - series 5400, 5600 and 5700 single-turn precision potentiometers.

According to the program notes, these three virtuosi come in a choice of five mounting-and-bearing combinations. A one-piece, dimensionally-stable plastic housing eliminates a separate rear lid. There are tighter tolerances on linearity and mechanical run-out.

A new rotor design reduces mass . . . permits lower contact pressure . . . results in decreased coil wear, more reliable operation, greater life expectancy. Incidentally, torque is lower.

They're a quiet trio, too. Maximum noise, at 100 rpm, with 1 milliamp of slider current, is 100 millivolts.

Sweet music to any electronic designer's ear !

For complete information and specifications on these three new HELIPOT* precision potentiometers, write for data file 704.

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High "G" Tests

(*Continued from page* 116)

only change. The tube characteristics that are direct functions of cathode area, such as pulse emission, plate current and mutual conductance, were compared as shown in Fig. 4. The results indicated that it would be possible to run a structure as short as .240 in. without incurring an intolerable reduction in tube characteristics. Subsequent recentering of mu raised g_m and I_b to more satisfactory values.

Another approach to lower vibrational noise output was the use of double micas to investigate the effects of greater mica bearing surface. Results indicated a general lowering of vibrational output, but structure resonances remained unchanged.

Numerous tests were run to make the mount as rigid as possible by locking the cathodes and grids in the top micas by means of special straps. A general improvement nearly always resulted from a reduction of tolerances on mica holes. Direct connections between stem pins and electrodes and decreasing the mount to header distance also help lower vibrational output.

In one test the cathode was inserted into the mica, then the cathode tab was welded into place to form a device which locked the

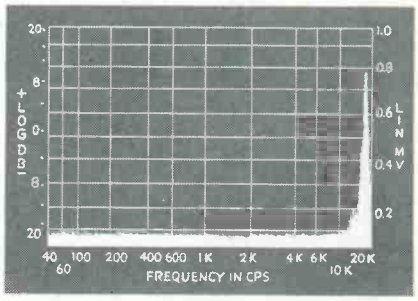
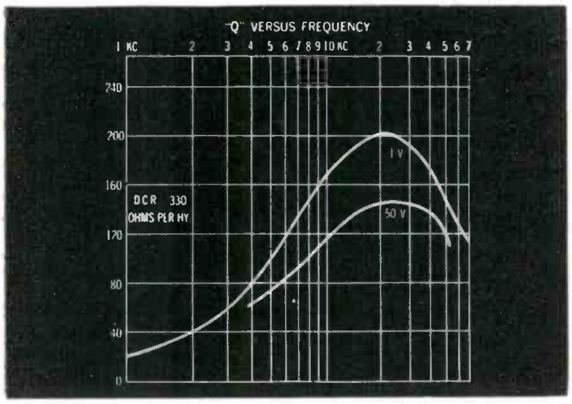


Fig. 9: "White noise" panorama, SN-1778A

cathode to the mica. This particular test showed a considerable reduction of vibrational noise output for some of the longer structures, but when used with the short structure the noise output was not reduced enough to warrant such a technique.

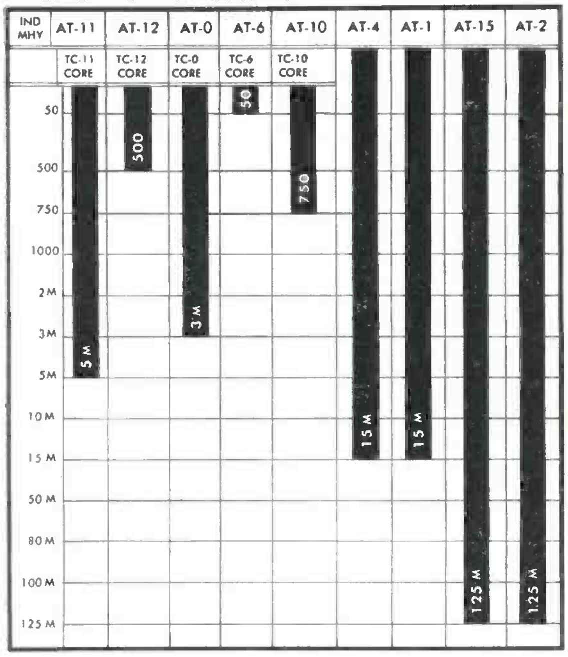
The particular tube design improvements which were derived from this study were: (1) the shifting of structure resonances to higher frequencies by shortening the structure, (2) the lowering of

variable "L" by BURNELL



Typical Q vs. frequency characteristics of Adjustoroids.

RANGE OF NORMAL INDUCTANCES FOR STOCK ADJUSTOROIDS



For nominal D. C. R. values refer to Burnell catalog No. 103.

COMPLETE TECHNICAL INFORMATION UPON REQUEST
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The Adjustoroid, a low cost adjustable toroid, exclusively developed by Burnell & Company, Inc., contains an actual complete toroid with all the excellent characteristics of the non-adjustable types. Adjustment is obtained by a completely stepless function with magnetic biasing.

The nominal inductance value for an Adjustoroid is the **maximum** value, and the inductance range is the nominal value minus approximately 10%.

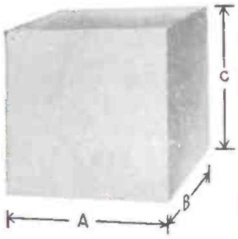
Hermetically sealed to meet Government MIL specifications. Many types of networks in tuned circuits are being produced which employ the Adjustoroid in completely hermetically sealed packages.

Intermediate inductance values as well as special taps and extra windings available on special order with minimum delay.

For additional technical data on Adjustoroids, refer to equivalent toroid in catalog.

AT-0, AT-6, AT-10, AT-4

AT-1, AT-2, AT-11, AT-12



ADJUSTOROID & VARIABLE INDUCTOR DIMENSION CHART

	A—LENGTH	B—WIDTH	C—HEIGHT
AT-O, AT-6	1-1/16"		1"
AT-10, AT-4	1 19/64"		1-1/4"
AT-15	1-31/32"		1-7/8"
AT-11, AT-12	45/64"	45/64"	3/4"
AT-1	1-3/4"	1-3/4"	1-1/4"
AT-2	2-3/4"	2-3/4"	2-1/4"
AF-51, AF-52	1-19/64"		2"

and now . . .

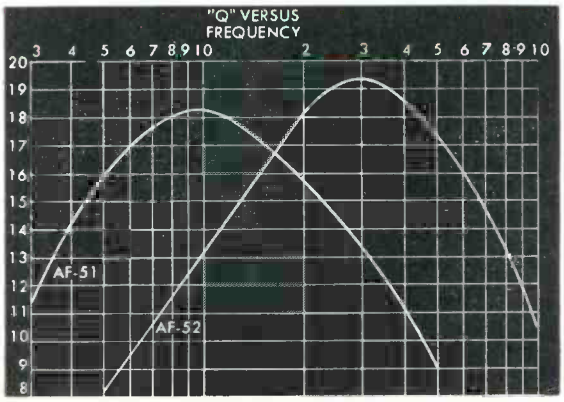
VARIABLE INDUCTORS

AF-51 AF-52

AF-51 (20-500 cycles)
Maximum Q at 100 cycles

AF-52 (50-1000 cycles)
Maximum Q at 250 cycles

Burnell Variable Inductors have the similar characteristics to the Adjustoroid except they are especially designed for low frequency applications or for conditions where high inductance values are required. Variable Inductors are available in all inductance values up to 1000 Hys.



Typical Q vs. frequency characteristics of Variable Inductors.

BURNELL & CO., INC.
YONKERS 2, NEW YORK Teletype: Yonkers, N. Y. 3633
Pacific Division: 720 Mission St., S. Pasadena, Calif.

High "G" Tests

(*Continued from page* 118)

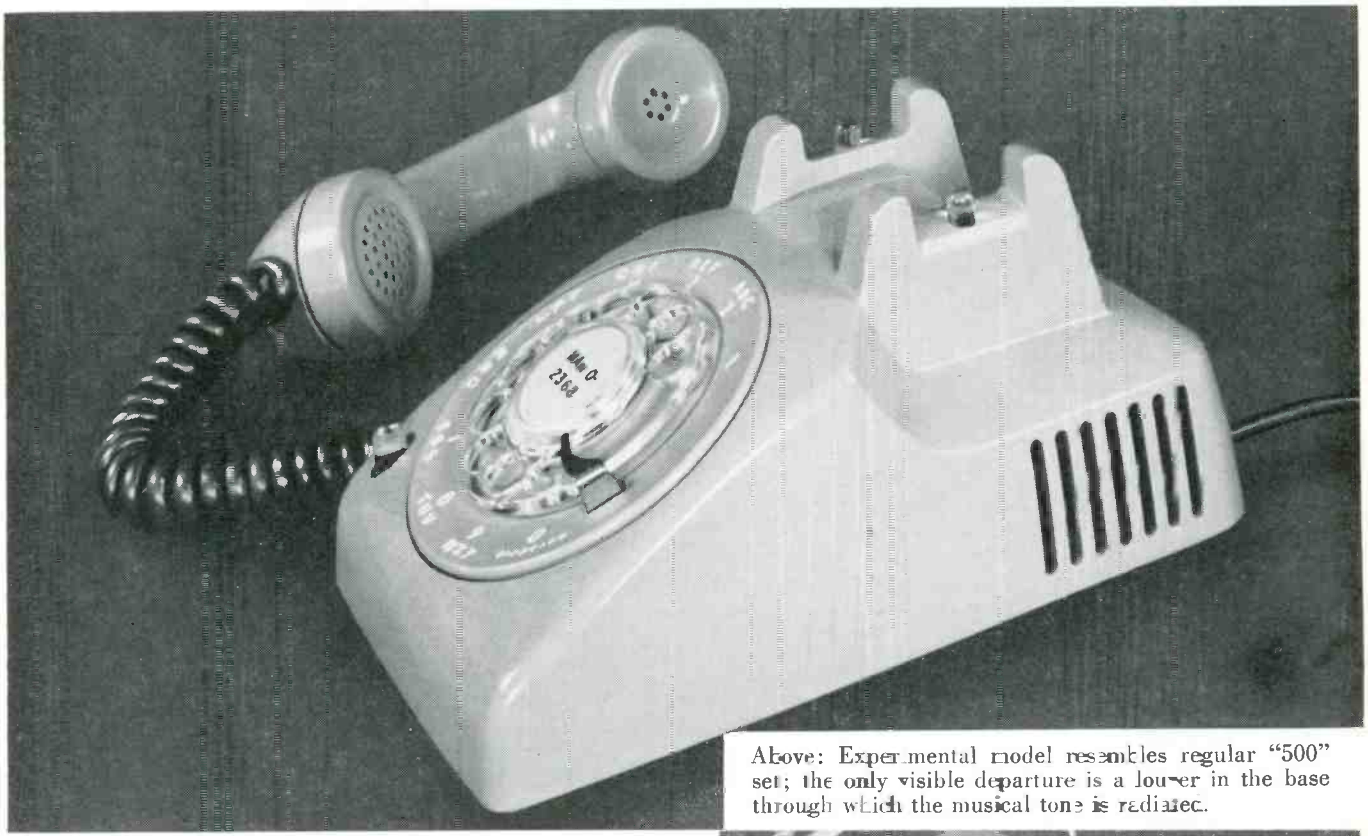
vibrational output by the use of double micas and by mounting the active structure nearer the header.

Results

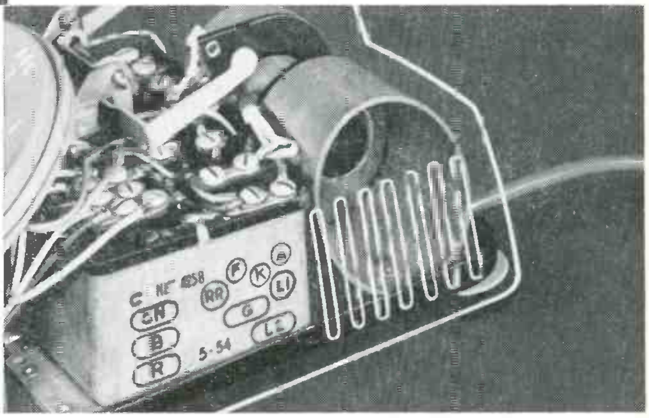
The design features that were found to reduce noise output were incorporated in a developmental triode, Type SN-1778A. This tube type has electrical characteristics similar to those of Type 5977. The two types were compared for vibration performance. A sample of one hundred tubes of Type SN-1778A and a sample of one hundred tubes of Type 5977 were vibrated using the two vibration test systems.

Fig. 5 illustrates typical curves of vibrational output as obtained on the swept frequency test. These tubes were vibrated at a constant acceleration of 10 g's through a frequency range of 50 to 5,000 cps. The vibrational noise output is recorded in db above a .2 mv reference level and is converted into millivolts. It can be noted that the missile Type SN-1778A has a lower and more uniform output over the entire range than the prototype 5977, particularly at the higher frequencies. For the purpose of analysis each curve obtained was divided into octaves, and the peak value in each octave was read off with data reduction equipment. The peak readings at each octave appeared to have a normal distribution when expressed in log values and a conversion chart was utilized to determine individual means and standard deviations. Comparisons indicated that a significant difference existed between the peak output levels of Type SN-1778A and Type 5977 at almost every octave. Fig. 6 shows a graph of $\overline{X}$ and $\overline{X} \pm 3\sigma$ limit curves of peak output values, calculated on a log basis, where X, the ordinate, is vibrational noise output expressed in equivalent grid voltage to allow direct comparison between the two tube types. The circuit gain for the Type 5977 is approximately 10, whereas the circuit gain for the missile Type SN-1778A is approximately 12. It may be noted that the curves for average and upper 3σ limit are lower for the experimental type

Transistorized telephone summons you with a musical tone



Above: Experimental model resembles regular "500" set; the only visible departure is a louver in the base through which the musical tone is radiated.



Bell scientists have developed a new musical tone device which may some day replace the telephone bell, if it meets technical standards and customers' approvals.

Because the musical tone equipment uses transistors, the tones will be transmitted with the same amount of power required to transmit a telephone conversation — considerably less than is needed to make a telephone bell ring.

The experimental telephone sets resemble the current "500" sets; the only external difference is a louver at the side of the base through which the tone is radiated by a small loudspeaker mounted inside the telephone's base.

Tests have shown that the musical tone can be heard at great distances. It stands out above general room noise and can be distinguished from such sounds as ringing of doorbells, alarm clocks, and home fire alarms.

This new low-power signaling technique is expected to play an important part in the electronic switching system now under development at Bell Laboratories.

Above: Bell ringer has been displaced by a small loudspeaker in transistorized telephone. Left: L. A. Meacham heads the team of engineers that developed the musical tone ringer. Mr. Meacham holds a B.S. in Electrical Engineering from the University of Washington, Class of '29. He became affiliated with Bell Labs a year after his graduation. In 1939 Mr. Meacham won the "Outstanding Young Electrical Engineer" award of Eta Kappa Nu.

BELL TELEPHONE LABORATORIES

World center of communications research and development

High "G" Tests

(*Continued from page* 120)

than they are for Type 5977. There is less difference between the X —3σ limit curves partly because these are approaching the background noise level.

These same two samples of a hundred tubes each were also vibrated on the white noise test. The tubes were vibrated with random noise having a bandwidth of 50 to 10,000 cps at an acceleration level of approximately 3 g's rms per octave. The rms values of the vibrational noise output appeared to have a normal distribution when expressed in log values. A conversion chart was utilized to determine the geometric means and standard deviations on each type. Fig. 7 shows histograms with rms values of noise for each type. Comparisons indicate a statistically significant difference existing between the geometric mean of white noise readings on Type SN-1778A (6.1 mv rms) and the geometric mean of white noise readings on Type 5977 (7.8 mv rms).

The tube noise outputs of tubes subjected to white noise vibration were also observed with a panoramic display type of sonic analyzer. Fig. 8 is a photograph of the tube noise output for a typical Type 5977 tube. Sixty sweeps were used. The vertical scale is logarithmic. Note that noise power is distributed throughout the frequency spectrum under consideration but much of it is in lower part of the spectrum. Major concentrations occur at about 500 and 4,000 cps.

Fig. 9 is a photograph showing noise output for a Type SN-1778A tube subjected to the same test conditions as for the previous figure. The rms value of noise was approximately the same as for the tube in the previous figure, but observe that the frequency components have been shifted to the high end of the band. There is virtually no noise below 10,000 cycles while there is a distinct peak at about 20,000 cps. Compared to the tube represented by Fig. 8, this tube will obviously be much better in the applications earlier described as being relatively insensitive to noise voltages whose frequencies exceed 5,000 cps.

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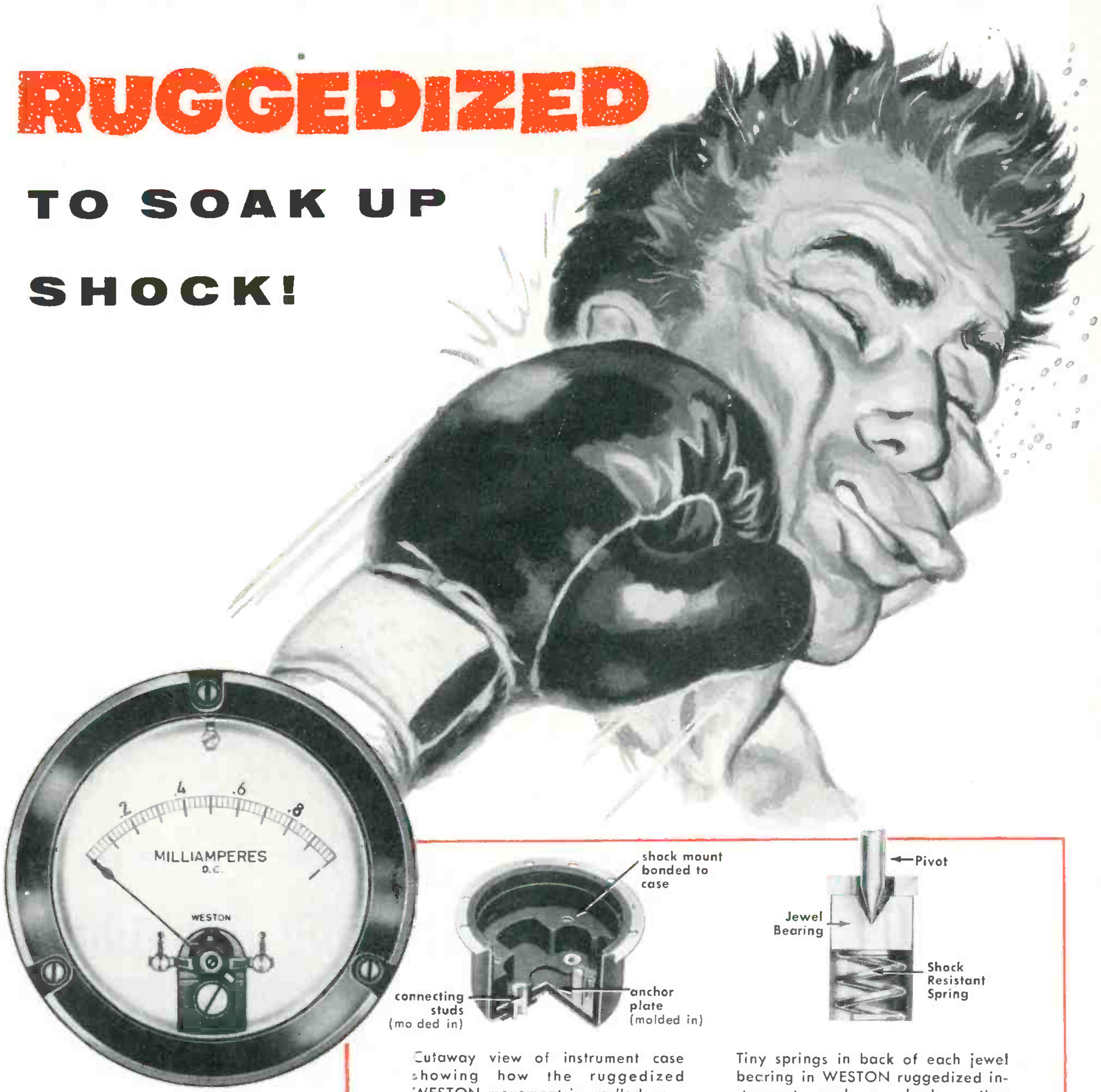

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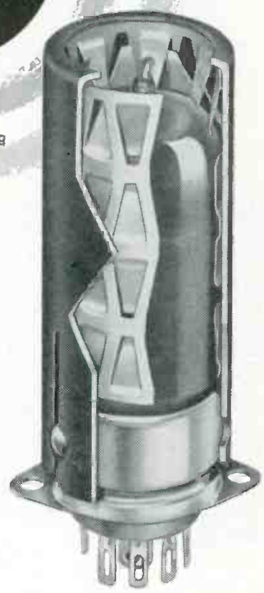

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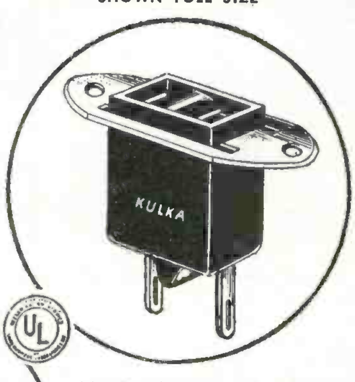

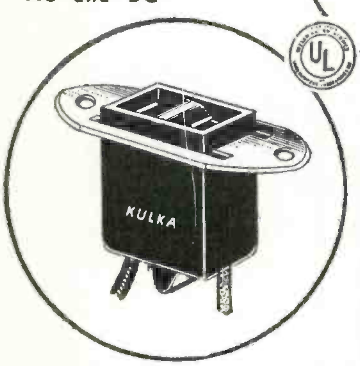

No. 221 (above) with soldering terminals and steel bracket with # 6 clearance mounting holes. Also No. 222 with 6-32 tapped mounting holes. No. 223 (left) with 8" #14 or #16 plastic wire leads and steel bracket with #6 clearance mounting holes. Also No. 224 with 6-32 tapped mounting holes.

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Packaging

(*Continued from page* 59)

Other investigators have also shown that large moisture absorption does not always mean poor power factor; (cellulose) acetate butyrate furnishes an outstanding example.

Probably the most realistic test proposed to date, particularly for harness overimpregnation, is the measurement of insulation resistance after 7 days of 97% R.H. at 30°C per MIL-V-173A.[7] Limiting values should, of course, be appropriately chosen as the 10 meg lower level specified is for a terminal pair spaced 9/64 in. on laminate plus attached wires. With the conditions above, excepting the limit, and the resistance to be measured between conductors in a twisted pair, a test may be suggested more near to usage for either primary insulation or overimpregnations.

In making such measurements it should be remembered that the temperature coefficient of (applied) insulation resistance is generally large and negative, the measured currents deriving partly from leakage through the body of insulation and largely from current flow in the surface film.

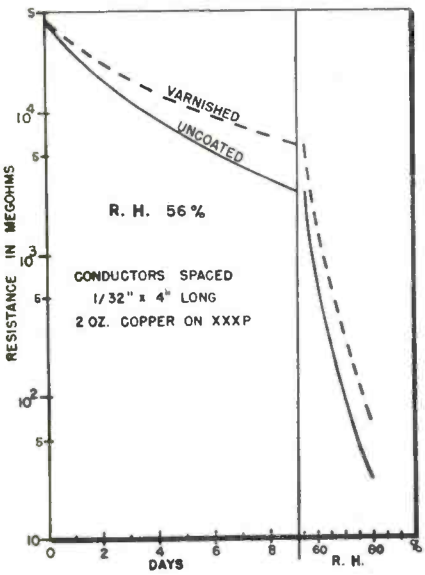

Fig. 8: Surface conductivity

Grade 1 Class B Sealing

Undoubtedly the best seal is afforded transformers and most other components by ceramic or glass hermetic sealing.

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Packaging

(*Continued from page* 125)

The ceramic lead-in has a strong rival in the fluorinated resin and silicone rubber molded feed-throughs which, of course, are resilient. There seems to be no reason except custom why these cannot be used elsewhere in outer enclosures for equipment.

Grade 1 Class A Sealing

Under the most moisture resistant classification of MIL-T-27 for transformers, which coincides with hermetic seals except for temperature, there has also been admitted several proprietary types of plastic enclosures such as Flexseal, Form-Flex, Fosterite, Permafil and others.

Life at Various Temperatures
for Class A, Class B and Class H Insulation

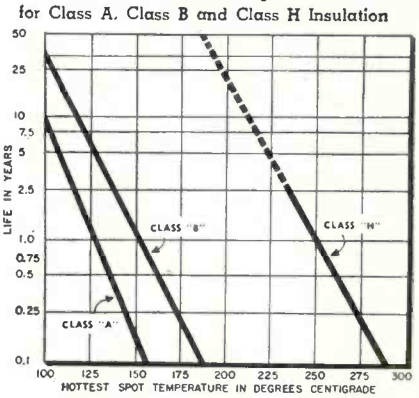

Fig. 9: Temperature ratings

Precautions for Cast Embedment

1. The presence of copper inhibits some polymerizations and the manufacturer should be checked on this. Thin lacquer coatings can be used to seal over copper parts.

2. In the monomer state many potting compounds are excellent solvents and may attack other insulations with the result of bleeding colors.

3. Fast polymerization is generally suspect; even though the casting holds together, a high residual strain may later cause deformations. Strain relief is possible with annealing just as with glass.

4. Residual salts, which may be left from catalysts, can cause electrolysis.

5. Air entrapped in components is a frequent cause of faulty castings and if the potting is done without vacuum, air bubbles may be removed by sonic agitation in the early stages of polymerization.

According to MIL-STD-108 definition,[9] an enclosure assumes the following functions: 1. Provides mechanical, electrical and other protection to the enclosed items; 2. Protects personnel and objects outside the enclosure from those items within; 3. Provides for ventilation; 4. May provide for cooling; 5. Provides for external mounting; 6. Provides interior support for assemblies and parts.

STD-108 forcefully reminds by its classification that enclosures for gun directors and the like may be required to resist deformation of three different levels of muzzle blast and that various portions of a radar ground station could be protected against 5 grades of precipitation less than watertight:

1. drip-proof; 2. drip-proof protected; 3. splashproof; 4. fogproof (against mist); 5. spraytight.

Navy Shipboard Equipment Enclosures[10] are specifically designated under MIL-E-2036A, but items of gear generally may be called upon to be: Watertight at 3 ft. for 2 hrs.; or undergo one of 3 degrees of submersion: submersible to 15 ft. for 1 hr.; submersible to 50 ft. for 1 hr.; submersible to 1200 ft. for 24 hrs.

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R-F Cables

(Continued from page 54)

where k, D, d, and ε_1 have the same significance as in Eq. 3. It is to be noted that ε_1 and the ratio of D/d appear in both Eqs. 3 and 5. Because of this interdependence, choosing a ratio of D/d and ε_1 fixes both the characteristic impedance and the capacitance of the cable.

Thus, for all 50 ohm solid polyethylene cables, the nominal capacitance is 30 mmf/ft and for 75 ohm cables it is 20 mmf/ft.

If a low capacity cable is desired, the core of the cable can be changed from a solid to a semi-solid dielectric construction. By introducing these air spaces into the dielectric, the capacity of the cable can be decreased to values as low as 6.5 to 14 mmf/ft. Another low capacity cable that retains the rigidity of solid coaxial cables is the foamed polyethylene core. For the polyfoam cables, the capacitance range will vary from 12 to 50 mmf/ft.

C. Attenuation

As a signal proceeds from the signal source along the line to the load, it can be shown that the signal traveling toward the load decreases in magnitude since all cables are not lossless. This decrease in signal magnitude is termed the attenuation constant and is given by the equation below.

$$\alpha(\text{db/ft}) = \frac{2.39 \times 10^{-5}\sqrt{\epsilon_1 \rho f}}{\log_{10}\frac{D}{kd}}\left(\frac{K_s}{d} + \frac{K_b}{D}\right) + 2.77 \times 10^{-8}\sqrt{\epsilon_1}\, f \tan\delta \quad (6)$$

where:

ϵ_1 = effective dielectric constant
D = inner diameter of outer conductor—inches
d = outer diameter of inner conductor—inches
k = stranding factor
f = frequency—cycles/sec.
ρ = resistivity of inner conductor—ohm-inches
tan δ = loss tangent of dielectric
K_s = inner conductor resistance factor
K_b = outer conductor resistance factor

The two components of the first part of Eq. 6 represent the copper loss due to the center and outer conductors respectively, while the second term represents the loss due to the dielectric material. Attenuation calculations made at 100 MC show that the conductor losses are about 6 times greater than the dielectric losses while at a frequency of 10,000 MC, the dielectric losses are about twice as great as the conductor losses. An inspection of the first term of Eq. 6 will indicate that the configuration of the inner and outer conductor will affect the attenuation. When K_s and K_b are greater than 1, where 1 is the value for perfect cylinders, the attenuation will be increased. For a typical 7 strand copper inner conductor K_s is equal to 1.3 while for a braided copper wire outer conductor K_b varies from 2 to 5 as the cable core diameter is increased from .250 to 1.50 inches. At frequencies above 3,000 MC, it is desirable to use silver coated wire to minimize the high values of resistance. Therefore, the core size of the cable should be such that the value of attenuation is not excessive.

The second term of Eq. 6 represents the loss due to the dielectric material used in a coaxial cable. The quantity tan δ is called the loss tangent and its value at any frequency is dependent on the molecular configuration of the material.

Therefore, if a dielectric with a high-loss tangent is used, the attenuation of the cable will in turn be increased. When choosing a material to be used for the cable dielectric, the loss tangent versus frequency characteristics should be investigated. The material with the lowest value of loss tangent over the intended frequency range is to be preferred.

The attenuation is also affected by the dielectric constant of the insulating material. A material which has a high dielectric constant will likewise increase the attenuation constant of the cable. If such a material is used, the conductor size and spacing would have to be altered to keep the impedance constant which means that the size of the completed cable would be large, maybe too large for convenient fabrication. From a fabrication cost and operating efficiency viewpoint, it is recommended that the standard type cables be utilized whenever feasible. A characteristic impedance of 50 ohms was chosen

TABLE II

Attenuation of Coaxial Cables

Cable	Dielec-tric	D.O.D. (in.)	Inner Con-ductor	Attenuation at 1000 Mc (db/100 ft.)
RG-58A/U	Poly	.116	19/.0068	24
RG-8/U	Poly	.285	7/21	8.0
RG-17/U	Poly	.680	.188	3.3
RG-21/U	Poly	.185	16 N	46.0
RG-141/U	Teflon	.116	19 SCW	14.0
RG-87A/U	Teflon	.280	7/20 S	7.6
RG-117/U	Teflon	.620	.188	3.5
RG-126/U	Teflon	.180	7/24 K	72.0

SCW = Silvered Copperweld; S = Silvered Copper
N = Nichrome; K = Karma

For product information, use inquiry card on last page.

R-F Cables

(*Continued from page* 129)

since the attenuation is a minimum value at this impedance.

As an example of the range of attenuation obtainable, the values for the several 50 ohm cables have been selected as representing the maximum, intermediate and minimum attenuation attainable in the standard sizes. These are given in Table II.

RG-21/U and RG-126/U use high resistance wire for the center conductor and are high attenuation cables. These type cables are used as attenuation pads and loads for instrumentation applications.

D. Velocity Ratio

This property is defined as the ratio of the velocity of propagation of plane waves in a cable to the velocity of propagation in free space. The velocity of radio frequency waves is given by:

$$v = \lambda f \qquad (7)$$

where:

v = velocity of signal
λ = wave length of the signal
f = frequency of signal

and then from the following equation, the velocity ratio can be determined:

$$V.R. = \frac{v\ (cable)}{v\ (air)} \qquad (8)$$

For cables which use a dielectric different than air, the velocity of the wave will be less by a factor of

$$\frac{1}{\sqrt{\epsilon}}$$

It must be pointed out that ε rather than ε_1, the effective dielectric constant, appears in this relationship. This ratio can be directly measured by using a velocity ratio meter as developed by the Naval Research Lab. This meter operates on the principle of resonant circuits when using a specific length of cable over a specific frequency range. Resonance of the test cable is indicated by a VTVM. A calibrated dial then indicates the velocity ratio. This method yields values of accuracy better than 1%.

Determination of Material Properties

A. Maximum Operating Voltage

One of the most confusing ratings published for coaxial cables is the maximum operating voltage. The value given is based upon the measurement of the 60 cycle corona extinction voltage and has very little relationship to the short time dielectric strength test. This is where the confusion arises since many users mistake this rating for the actual breakdown voltage.

In coaxial cables, corona manifests itself in the form of random radio noise pulses. The test procedure consists of capacitively coupling a radio receiver or similar detector to the center conductor of the cable. Then a 60 cycle high voltage source is also connected to the cable center conductor and outer conductor. The voltage is increased at the approximate rate of 500 v./sec. until radio noise can be heard. The voltage is then decreased to the point of cessation of radio noise and this voltage is called the corona extinction voltage. On the other hand, the dielectric strength is determined by subjecting the finished cable to a 60 cycle potential between shield and center conductor and increasing this potential at the rate of 500 v./sec. until failure occurs. This property is used as a quality control check on the dielectric material to insure uniformity of product.

Operation of the cable below the corona extinction voltage results in considerable increase in service life. Although polyethylene has a good resistance to corona and ozone under the combined influence of mechanical stress, the cable will break down in a relatively short time compared to operation below corona extention voltage. However, for certain applications of short duration, it may be necessary to exceed the corona voltage. In these special cases, it would be well to check the dielectric strength test voltage given in the applicable military specification.

In addition, there are many other applications such as pulse transmission, super-imposed direct current with pulses and so forth. All cases cannot be rated from the published maximum operating voltage. However, several cases can be worked out with the aid of the following rules which have been found from experience:

(1) For direct current applications, the given 60 cycle RMS voltage can be multiplied by a factor of

R-F Cables

(*Continued from page* 131)

11 for polyethylene. For Teflon, there is still some question but a factor of 5 should be considered a safe value.

(2) For pulse transmission, the peak pulse voltage the cable can handle is determined by multiplying the 60 cycle RMS voltage given as the maximum operating value by a factor of 2.6 to 2.8. This represents the ratio of the RMS to peak to peak voltage of a sine wave. This applies to polyethylene and Teflon dielectrics alike.

It should also be pointed out that care must be exercised in applying voltage ratings since this may not be the cable's limiting factor. Thus, if radio frequency pulses are being transmitted in the X band, the power rating of the cable is usually far exceeded before the maximum operating voltage is reached. That is, all ratings must be checked carefully with all aspects of the intended operation of the cable.

B. Temperature Limits

The upper and lower temperature limits of a coaxial cable are determined by the materials used in the cable construction. At the present time several combinations of materials are in prevalent use. These are:

1. Polyethylene dielectric and polyethylene jacket
2. Polyethylene dielectric and vinyl jacket
3. Teflon dielectric and polyfluoron jacket
4. Teflon dielectric and fiberglass jacket

Recent developments indicate that a fifth combination, Teflon dielectric and Teflon jacket, may be added in the smaller cable sizes.

Under steady state conditions and a condition of zero input power, an upper ambient temperature of 185°F has been established as the limiting temperature for polyethylene cables. This temperature should not be exceeded since upon continuous exposure, the polyethylene will begin to soften, thus increasing the chances of center conductor migration or dielectric degradation. For Teflon dielectric coaxial cables, which use a varnish impregnated fiberglass jacket, at zero input power or up to milliwatt power levels, the safe ambient temperature is 400°F. If the cable is subjected to higher temperatures, the varnish begins to melt and becomes quite tacky. In addition, at temperatures above 480°F the Teflon begins to liberate small amounts of toxic fumes.

TABLE III

OPERATING TEMPERATURES OF COAXIAL CABLES
Power Input—Milliwatt Range or Less

Jacket Material	Low Temp.	High Temp.	Dielectric
Type I (MIL-C-17B) Contaminating Vinyl	—40°C (—40°F)	+ 85°C (+185°F)	Polyethylene
Type II (MIL-C-17B) Non-Contaminating Vinyl	—25°C (—13°F)	+ 85°C (+185°F)	Polyethylene
Type IIa (MIL-C-17B) Non-Contaminating Vinyl	—40°C (—40°F)	+ 85°C (+185°F)	Polyethylene
Type I (Special) Contaminating Vinyl	—60°C (—76°F)	+ 85°C (+185°F)	Polyethylene
Polyethylene (Brown or Black)	—60°C (—76°F)	+ 85°C (+185°F)	Polyethylene
Polyfluoron	—40°C (—40°F)	+150°C (+302°F)	Teflon
Fiberglass Braid-Silicone Varnish Impregnated (MIL-C-17B)	—55°C (—67°F)	+200°C (+394°F)	Teflon

The lower temperature limit for polyethylene dielectric cables is limited by the jacket material available. Depending upon the jacket material, if the vinyl jacket is a low temperature Type I or Type IIa, then the low limit would be —40°F while a cable using a Type II vinyl jacket would safely withstand a temperature of —25°F.

In the case of Teflon dielectric cables, a lower temperature limit has been set at —55°F. Although the flexibility of a Teflon cable at —55°F is small, the fiberglass jacket does not crack and the cable is still mechanically stable. The selection of a particular coaxial cable is dependent upon many variables and these variables should be carefully considered before making a selec-

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The KP-80 is the first ion deflection thyratron. It is a triple control coincidence tube for use in circuits: (1) where two positive coincident signals are required to produce conduction, (2) as a quick-firing single signal pulse thyratron, (3) where negative signals should cause conduction. In addition to the customary shield, there are two symmetrical control electrodes which have equal sensitivity. A signal on only one grid (up to and exceeding plus 40v) will not fire the tube, but small (4.5v) simultaneous signals on both grids cause conduction. The KP-80 has a 6.3v, 150 mA heater cathode, with an anode operating voltage of 150v. The KP-80 makes possible coincident circuit designs eliminating over a dozen circuit components. This tube is also made in the small (T-2) size subminiature (KP-106).

For details on this and other special purpose electron tubes, write:

KIP ELECTRONICS CORPORATION
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Incidentally, those of you who have recently sent us a change of address notice must please be patient with us if the requested change is not made immediately.

The Circulation Department has just moved from New York to Philadelphia and a complete revision is under way in the method used for the placing of your name on the mailing wrapper. Your kind patience will be most appreciated.

R-F Cables

(Continued from page 133)

tion. The cable should be chosen based on the worst expected conditions and, if this is done, one can be quite certain the cable will operate satisfactorily. To further clarify the various available operating temperature limits, see Table III.

C. Power Rating

Of major importance in the selection of a coaxial cable for the transmission of r-f power, is the ability of the cable to safely carry the anticipated power. If the heat generated by electrical losses occurring in the center conductor, outer conductor, and dielectric material causes excessive softening, deterioration or eventual breakdown, such a cable is inadequate for carrying that amount of power. The power rating of coaxial cables resolves itself into a problem of efficient heat transfer from the coaxial cable surface to the surrounding environment, and the maximum temperatures which the materials can withstand. Therefore, power rating is defined as the input power which will produce a maximum safe center conductor temperature under steady state conditions and terminated by a matched load.

In the case of polyethylene dielectric coaxial cables, a temperature of 175°F has been established as the maximum safe operating center conductor temperature, rather than 185°F for reasons of adding a safety factor. For Teflon dielectric coaxial cables, 400°F is the safe operating center conductor temperature. Previously, a center conductor temperature of 482°F was used for Teflon cables but subsequent investigation has shown that at this temperature, the Teflon will slowly start to decompose and liberate toxic fumes.

1. Power Rating Vs. Frequency

Since the power rating value at one frequency is inversely proportional to the total attenuation at that frequency, providing the ambient and center conductor temperatures remain the same, ratings at other frequencies can be calculated according to the following relationship:

$$P_x = P_1 \frac{\alpha_x}{\alpha_1} \qquad (9)$$

where:

P_1 = power at test frequency

P_x = power at new frequency

α_1 = total attenuation at test frequency

α_x = total attenuation at new frequency

The power input vs. frequency relationship for polyethylene and Teflon dielectric cables at sea level and an ambient temperature of 104°F are presented in Figs. 2 and 2a. It will be noted that these power ratings have been given at an ambient temperature of 104°F. This temperature has been selected as the normal ambient temperature for cable installations in tropical climates.

2. Power Rating Vs. Ambient Temperature

The power rating at various ambient temperatures, other than those given, can be determined from a power rating factor curve vs. ambient temperature. Figs. 5 and 5a present these curves of the power rating factor vs. ambient temperature of polyethylene and Teflon cables, respectively. It should be noted that these curves are independent of frequency. If the power rating of a cable is desired at 1,000 MC at an ambient temperature of 150°F, the new power rating value can be determined by multiplying the value of the power at 104°F by the power rating factor at 150°F as given in Figs. 5 and 5a. Since this new ambient temperature is higher than the reference temperature of 104°F the new power rating value of the cable will be smaller, and if a temperature lower than 104°F is used, the same procedure is followed and an increase in power rating will then be obtained.

3. Power Rating Vs. Altitude

The foregoing discussion dealt with various ambient temperatures at sea level. Inasmuch as coaxial cables will be used at other altitudes, power rating factors vs. altitude have also been determined. By applying the principle of similarity to the complicated case of heat convection from a cylinder suspended in air, a dimensionless correlation of heat transfer from the surface of a coaxial cable to the surrounding environment can be obtained.

Figure 6 shows the power rating factor vs. altitude of polyethylene and Teflon dielectric cables from sea level to an altitude of 65,000 ft. In the case of the polyethylene and Teflon cables, it should be noted that the graphs are shown for the small and very large sizes cables in order to cover the range of the cable sizes in common use. In each case, the power rating factor increases slightly as the cable diameter increases. It should be noted that the power rating factor curves are independent of frequency and ambient temperature.

4. Power Rating Vs. VSWR

The exact effect of the standing wave ratio upon the heating of the coaxial cable is not accurately known. It is known, however, that an increase in the standing wave ratio results in an increase of temperature of the coaxial cable which will limit the maximum amount of power which the cable can safely handle. Considering that the radial transfer of heat from the inner conductor to the atmosphere predominates, the power rating at other than unity standing wave ratio will be changed by a factor equal to one over the new VSWR. It follows then that, if a cable has a power handling capacity of 1,000 watts at a specified frequency for a VSWR of 1 to 1, the power rating of a VSWR of 2 to 1 would be 500 watts at that same frequency. It is recommended, therefore, that whenever a cable is under consideration in a particular installation, the power rating should be selected considering the highest VSWR to be encountered. A VSWR of 1 to 1 should prevail if at all possible. The above relationship is conservative, and in the light of the available data concerning power rating and VSWR, this will prove to yield a safe operating power level.

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Presented at the 1956 Annual Conference on Aeronautical Electronics, Dayton, O.

Deflection Yoke

(Continued from page 51)

rents in the core, case, and associated environment at the frequency of the yoke. These losses along with the damping R are in shunt across the yoke inductance. The magnitude of these losses may be obtained by applying a step function of current to the yoke and damping it experimentally for minimum recovery time. Then knowing L, F_r, and the value of the added shunt resistance, the magnitude of the equivalent loss resistance may be found by solving for it in the equation. $R_d = \frac{R_s \times R_e}{R_s + R_e}$

Where $R_d = \frac{LC}{2}$

R_s = losses due to eddy currents
R_e = added shunt damping resistance

There are two basic methods of generating a suitable magnetic field for deflecting an electron beam; parallel and series magnetic fields.

These terms derive their name from the manner in which the field is shared by the coils and has no reference to the way in which the electrical connections are made to the coils, or the direction in which the current flows through the coils. In the parallel field yoke the flux is not common to both coils; in the series field yoke the flux is common to both coils. (See Figs. 2 and 3.)

The recovery time of the parallel field, square core construction depends upon a large number of factors: the primary time constant $\frac{LC}{2}$, the core time constant, the case time constant, the focus coil (if one is used), and the mount, including any shields or braces in the mounting members.

The primary time constant for a high speed yoke can be of any duration up to approximately 1 µsec., and consists of the inductance and capacity of the deflection coil.

The core time constant is derived from flux linking the core and the resistance of the shorted turn which is the core. The inductance is that of a single turn and the resistance is very low.

The case time constant is derived from large amounts of stray flux which cuts the case. The resulting emf and the very low resistance of a heavy case can provide a time constant in the order of 1000 to 2000 µsec., the amplitude of which can be in the order of 2.5 to 3.0%. Because the case time is a long one, it also requires a sweep of long duration to energize it.

The focus coil time constant is of the same derivation as that of aluminum case and is slightly lower in amplitude.

The mount and it's structural bracing can be a source of annoying time constant. The magnitude is low because only a small percentage of the total yoke ever gets out as far as the mount. However,

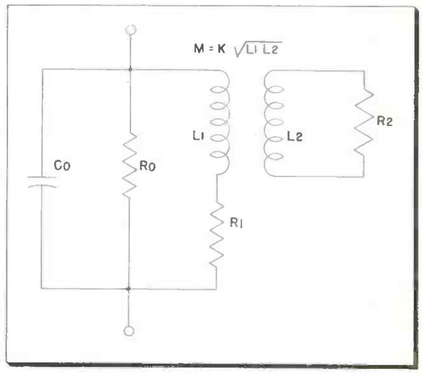

Fig. 4: Eddy losses shunt yoke

in unshielded coils the mount has to be taken into consideration because the attenuating effect of a shield is missing and the amount of flux cutting the mount is correspondingly larger.

These extraneous time constants can be easily overlooked in the evaluation of a design because each must be isolated by the use of the proper length of sweep. The primary time constant due to the inductance and capacity of the coil must be small with respect to the secondary time constant to be evaluated or it will be masked so that it cannot be seen. However, where the LC time constant is long, in the neighborhood of 200 µsec., any time constants shorter than this will be masked and are usually of no concern. The case, case mounts, and focus coil effects will still be noticeable and counter-measures may be necessary.

Reduction of these time constants may be accomplished by compensating the yoke for its fringing field effects. When the field of a deflection yoke cuts a non-magnetic conducting material, such as brass or aluminum, eddy currents are generated which in turn generate a flux opposing the originating field. This shorted turn effect on the stray flux of the yoke causes a reduction in the inductance of the coil much the same as a shorted turn in a transformer will cause a reduction in the over-all inductance. However, in the case of a yoke this is beneficial because the shorted turn of the case does not affect the magnitude of the flux in the deflecting area. This results in an increase in deflection efficiency. This increase in deflection efficiency is not without payment, because the shield is frequency sensitive and for those frequencies whose period is longer than the time of the shield there is little shielding effect.

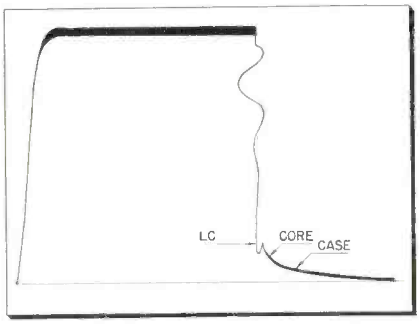

Fig. 5: Recovery time components

If the yoke is to operate with constant sweep speed and duty ratio, the circuit may be compensated by altering the shape of the drive voltage waveform or by means of a passive network. However, if the yoke is to be operated over a wide range of duty cycle and sweep speeds it must be compensated.

The core time constant can best be investigated with a coil that has a primary recovery time less than 10μsec. Twenty-nine Gage silicon steel of the Audio A variety exhibits a time constant in the order of 100 μsec. whereas Mu-Metal has time constant in the order of 25 to 30 μsec. The effect of these time constants may be easily removed from the output by an RC time constant in the amplifier itself.

Cores which are fabricated from powdered iron of ferrite do not exhibit this time constant because their resistivity is high and their eddy current losses are low.

Phenomena such as line splitting or curved raster can sometimes be traced to the mount or the focus coil, and operating the yoke too close to its resonant frequency can cause very serious distortion.

TV Yoke Design

The series field, round core yoke is the most efficient and has the least problems due to core time constant.

The efficiency factor in favor of this type as compared with the parallel field type occurs in two important aspects:

1. The energy contained in the magnetic field is less by the ratio of the enclosed volumes. The inscribed circle has 0.7856 the area of the square, which represents an improvement of 21.44%.

2. The amount of copper required to gain a given flux density in the deflection area is less.

Method of Construction

The horizontal coils are formed to the contour of the tube neck and mounted as close to the tube neck as is practical. This is done because the closer coil has the higher deflection efficiency. The coils are dimensioned so that the vertical coils interlace the horizontal coils to form a circle around which is placed the core and binding strap.

The vertical coil is usually heavily damped both by resistance across each of the coils and by a low impedance driving circuit. However, each of the coils can resonate within its own distributed capacity and inductance and it is this resonance which, when excited by the energy released during the horizontal retrace, causes the wiggle. Proof of this can be obtained by noting the frequency of the wiggle and calculating the natural resonance of each of the vertical coils.

The range of impedances at which the horizontal coil can be operated is determined primarily by the 8 μsec. retrace period. Too high an impedance causes the resonant frequency of the yoke to be too low, which in turn means that the secondary inductance of the driver transformer must be low in order to keep the resonant frequency above 70 kc. The ratio of driver transformer inductance to yoke inductance should be in the order of 10 to 1 or the magnetizing current in the transformer will be excessive.

For product information, use inquiry card on last page.

News of MANUFACTURERS' REPS

REPS WANTED

Manufacturer of ultra sub-miniature and metal can type electrolytic capacitors seeks reps for export to Mexico and South America. (Ask for R-7-1.)

At a Chicago, Ill., meeting of the Chicagoland Chapter of "The Representatives," the following were elected officers for the 1956-7 term: **Joe Rose**, of the J. K. Rose & Co., president; **Walter Sparf**, first vice-president; **William J. Doyle**, second vice-president; **Ringland Krueger**, secretary; and **Claude Booth**, treasurer.

The Rockbar Corp., sales rep, has moved to expanded quarters at 650 Halstead Ave., Mamaroneck, N. Y.

Art Foosner of the Quam-Nichols Co., Chicago, Ill., has been appointed rep in the Chicago area by Condenser Manufacturers, Inc., Nashville, Tenn. The company has also announced the appointment of **Harry P. Woodit**, Yonkers, N. Y., to handle the New York City area.

Kaelber & Mack, Manhasset, N. Y., have been appointed sales reps for Carling Electric Co., West Hartford, Conn.

Frank A. Emmet Co., Los Angeles, Calif., is now representing Brilhart Plastics Sales Corp., Mineola, N. Y., in southern Nev., Ariz., southern Calif., and N. M.

Frank J. Perna Assoc., Philadelphia, Pa., has been appointed distributor rep by the Ampli-Vision Div. of International Telemeter Corp., Los Angeles, Calif.

The Hewson Co., Newark, N. J., has appointed the following three additional reps: The **D. S. Mayo Co.**, Houston, Tex.; **Charles J. Kemp**, Dallas, Tex.; and **Torman Co.**, Milwaukee, Wis.

William Sullivan has joined the sales engineering staff of Haggerty-Ludwig Co., Ferndale, Mich.

Mitchell & Morris, Indianapolis, Ind., manufacturer's agent, has been appointed factory sales rep for Regency Div., I.D.E.A., Inc., Indianapolis, Ind.

Jackson Edwards of the Jackson Edwards Co., Los Angeles, Calif., has recently returned from a five week tour of electronic plants in Italy, France, and England.

Leo Nurmi and **John Sheffs** have been selected to represent The Gamewell Co. of Newton, Mass. in the northern Ohio and western Pa. areas. On the West Coast, Gamewell Precision Potentiometers will be handled by **Luscombe Engineering Co.** of Pasadena, Calif.

Gene Piety, Honolulu, Hawaii, rep, has announced the addition of Don Walsh to the staff as sales engineer.

William Richter Corp., industrial sales rep of Rochester, N. Y., has appointed Charles V. Hinxman to manage the firm's new office in Syracuse, N. Y.

Gerald B. Miller Co., Hollywood, Calif., has recently established two new field offices; one in Las Cruces, N. M., and the other in Denver, Colo.

Marion Electrical Instrument Co., Grenier Field, Manchester, N. H., has appointed six new sales reps. Firms and their areas are: **Robert F. Lamb Co.** of Buffalo, N. Y., west of Elmira; **J. F. Wulfetange, Jr.**, of Syracuse, N. Y., east of Elmira; George **Podeyn** Inc. of Wood-Ridge, N. J., north of Trenton; **Grady Duckett Sales Co.** of Atlanta, Ga., Ala., Ga., Tenn., Miss., N. C., and S. C.; **Hyde Sales Co.** of Denver, Colo., will cover Colo., Utah, Idaho, Wyo., and Mont.; **Koehler-Pasmore** of Detroit, Mich. will represent Marion in that state.

R. P. Kennedy Co., Rochester, N. Y., has been named exclusive sales engineering rep in N. Y. by **L. L. Constantin & Co.**, Lodi, N. J.

John J. Heavey, Jr. Belmont, Mass., has been appointed Instrument Division sales rep in the New England area for Tracerlab, Inc.

Hytronic Measurement Associates, Denver, Colo., has been appointed technical rep for Feedback Controls, Inc., in Wyoming, Nebraska, Colorado, Utah, and eastern Montana and Idaho.

Gus Jose, North Miami Beach, Fla., has been appointed Florida rep for Components Corp., Denville, N. J.

Instruments, Inc., Tulsa, Okla., has been appointed Tulsa rep for Wheelco Industrial Instruments.

C. S. Shotwell, manufacturers' rep of 602 Levering Ave., Los Angeles 24, Calif., is interested in representing manufacturers of electronic equipment and components in the southern Calif. area.

Q Calculations

(*Continued from page 47*)

Experiments conducted by the author indicate the value of H is influenced by the eddy current shielding and non-symmetrical current distribution about the axis of the conductor for values of wire diameter to pitch ratios greater than approximately 0.5 or 0.6. All the iron cored units considered here have an optimum between approximately 0.4 and 0.55. The air core unit will be considered to have an optimum of 0.6, very long solenoids have a greater optimum than this but the practical difference between Q values will be negligible. Medhurst has shown the value of R_{hf} of an air core coil working in the

$$\frac{d}{\delta} > 5$$

region is nearly twice the value of R_{hf} of the same wire when straight, provided the length to diameter ratio is greater than 1 and the wire diameter to pitch is 0.6. For ratios of length to diameter less than this, the value of R_{hf} will be less than in the previous instance. This fact will be used in the development of the Q equation for the air core condition.

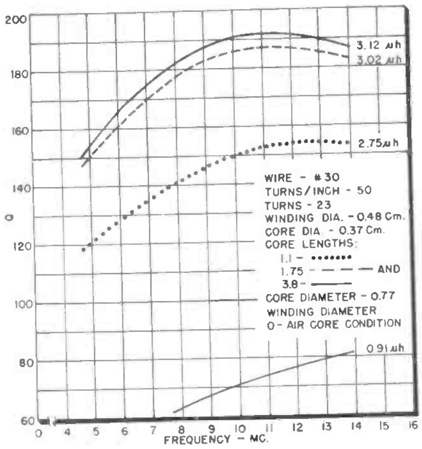

Fig. 9: Q vs frequency

Optimum Ratio

The optimum wire diameter to pitch ratio is approximately 0.4 for core length equal to coil length and material ring permeability between 7 and 5. If the core is considerably

"Q" Calculations

(Continued from page 139)

longer than coil, the optimum is approximately 0.5. For ring permeabilities between 3 and 4 the optimum for all conditions is approximately 0.55. For ease of calculation observe Fig. 8. These ratios are for $1/d_w$ between 1 and 5.

It is interesting to notice the effective resistance is decreased by lengthening the core beyond the ends of the winding. This point is illustrated in Fig. 10.

A good value of winding diameter to core diameter is 0.75. The use of this value permits small increases of distributed capacity due to the presence of the core and the realization of a great portion of possible value of inductance ratio. All this work has been done using this ratio or a ratio quite near this value. Almost all practical designs use a value near the suggested value.

Core Loss

Let us now consider the core loss. The predominant loss of powdered iron at these frequencies is eddy current loss. The loss will be treated as the loss for a toroid. This is making the assumption the flux is uniform throughout the core material within the winding. The assumption will also be made the flux is not of sufficient magnitude in the portions of the core protruding beyond the ends of the winding to produce a significant loss. Observe the graphs of effective resistance of inductors on Fig. 10. It can be observed the losses due to the core ends, protruding beyond the ends of the winding, do not add appreciably to the core loss. The value of effective resistance is lower for the longer cored units, but this is due to the lowered winding loss. The permeability of the slug will be increased by the extra length, but the volume of the core contributing to the loss will be considered to remain the same. The iron used in coils operating at the frequencies in question has relatively low permeability, this may account for the negligible effect of the added volume of core material.

Legg's equation for eddy current loss is indicated below:

$$R_e = e\,\mu\,f^2\,L \qquad (17)$$

Where:

R_e = Effective resistance in ohms
e = a constant for the core material in use
f = Frequency in cycles per second
L = Inductance in henries
μ = Effective permeability

The core diameter will not be equal to the winding diameter. The loss equation is derived on the assumption the core diameter is equal to the winding diameter. The iron loss equation for the Q equation must therefore be compensated for this inequality. The iron loss equation is indicated below.

$$R_e = \frac{4\pi^2 N^2 \mu^2 r_1^2 e f^2}{l} 10^{-9} \qquad (18)$$

Where:

r_1 = radius of core in Cm.
l = length of winding in Cm.

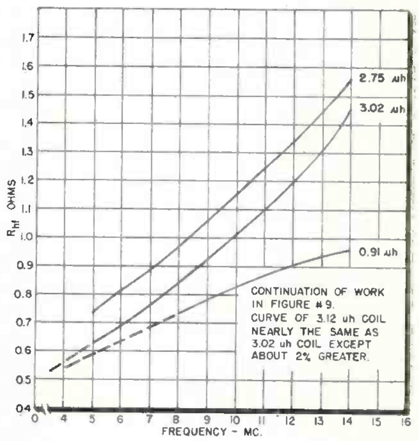

Fig. 10: Coil impedance curves

The Q equations are:

$$Q = \frac{8\pi^3 N^2 r_w^2 f K_n \left[1 + \left(\frac{di}{dw}\right)^2 (\mu - 1)\right] 10^{-9}/l}{\frac{0.303\,\rho\,N\,dw\sqrt{f}}{d} + \frac{4\pi^2 N^2 \mu^2 r_i^2 e f^2 10^{-9}}{l}} \qquad (19)$$

for the iron core case and

$$Q = \frac{8\pi^3 N^2 r_w^2 f K_n 10^{-9}/l}{\frac{0.303\,\rho\,N\,dw\sqrt{f}}{d}} = \frac{0.239\,N\,r_w\sqrt{f}\,K_n\,d}{l} \qquad (20)$$

for the air core case where wire diameter to pitch equals 0.6 and l/dw is between 0.75 and 10 it can be used with quite good accuracy with an l/dw less than 0.75 but the Q value will be slightly higher than indicated by the formula. An inductor having an l/dw greater than

10 will have a slightly smaller value of Q than indicated by the formula.

The Q equation for an iron cored inductor operating under the given conditions may be expressed as follows:

$$Q = \frac{K_4 f}{K_5 \sqrt{f} + K_6 f^2} \qquad (21)$$

where K_4, K_5 and K_6 are constants for the given inductor

The frequency of maximum Q can be determined by differentiation and the resulting expression is indicated below.

$$f_m = \left(\frac{K_5}{2 K_6}\right)^{2/3} \qquad (22)$$

Where f_m = frequency of maximum Q

Examples of Calculations

The information on the inductor is included in Fig. 5. The permeability will first be calculated.

$$L_i/L_a = 4.0 = 1 + \left(\frac{di}{dw}\right)^2 (\mu - 1)$$

$$= 1 + (0.75)^2 (\mu'_e - 1) \qquad (23)$$

$$\mu_e' = 6.3$$

$$\mu'_e = \mu_e \sqrt[3]{\text{Core length/Coil length}} \qquad (24)$$

$$6.3 = \mu_e \sqrt[3]{1.5}$$

$$\mu_e = \underline{5.5}$$

$$\frac{1}{\mu_r} = \frac{1}{\mu_e} - N/4\pi$$

$$\frac{1}{6.3} = \frac{1}{\mu_e} - 0.02$$

$$\mu_e = \underline{5.6}$$

Where:

L_i = Inductance iron core condition

L_a = Inductance air core condition

It can be seen the two values of μ_e agree very well even if the method of calculation is quite different. Let us take a longer core than 1.5 in., say 3 in.

$$\mu_e'' = 5.6 \sqrt[3]{3} = \underline{8}$$

Inductance ratio =

$$1 + (0.562)(8) - 0.562 = 4.92$$

The experimental value is 4.16.

Inductance ratio =

$$4.16 = 1 + (0.562)(\mu_e'') - 0.562$$

$$\mu_e = 6.6$$

The μ_e' expression has limitation, but as long as the ratio of L'/l is within the range of 1 to 1.5 and the calculated μ_e' value hasn't reached a value greater than the μ_r value of the material it proves quite satisfactory.

"Q" Calculations

(*Continued from page 141*)

Now let us proceed with the solution of Q at 9 Mc.

$$Q = \frac{\dfrac{8\cdot\pi^3\cdot 40^2\cdot 0.254^2\cdot 9\cdot 10^6\cdot 0.915\cdot 4.0/2.54}{0.303\cdot 1.72\cdot 10^{-6}\cdot 40\cdot 5.09\cdot 10^{-1}\cdot 3\cdot 10^3}}{3.215\cdot 10^{-2}} + \frac{4\cdot\pi^2\cdot 40^2\cdot 6.3^2\cdot 0.15^2\cdot 2.54^2\cdot 0.19\cdot 10^{-9}\cdot 81\cdot 10^{12}\cdot 10^{-9}}{4\cdot 2.54} \quad (25)$$

$$Q = 216$$

$$Q = \frac{36.9\cdot 10^{-6}\cdot f}{0.327\cdot 10^{-3}\cdot\sqrt{f} + 0.68\cdot 10^{-14}\cdot f^2} \quad (26)$$

$$Q \text{ at } 4 \text{ MC.} = 192$$

$$Q \text{ at } 6 \text{ MC.} = 211$$

$$Q \text{ at } 11 \text{ MC.} = 214$$

Example No. 2

The Q equation can be expressed as follows:

$$Q = \frac{\dfrac{8\cdot\pi^3\cdot N^2\cdot r_w^2\cdot f\cdot K_n}{\left[1+\left(\dfrac{di}{dw}\right)^2(\mu-1)\right]/l}}{\dfrac{2\,\rho\,N\,d_w}{\dfrac{d}{C}\cdot\dfrac{l}{N}\cdot\delta}} + \frac{4\,\pi^2\,\mu^2\,N^2\,r_i^2\,e\,f^2\,10^{-9}}{l} \quad (27)$$

Where C = pitch of winding

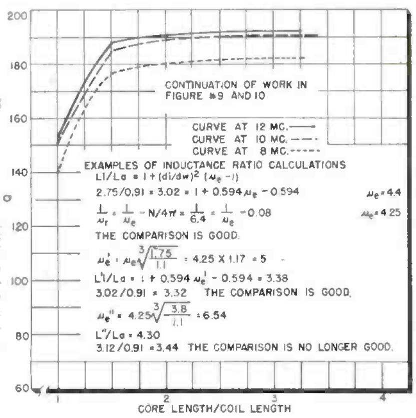

Fig. 11: Experimental check

Obviously for a given geometrical configuration the Q is independent of N^2/l. However, it must be kept in mind the dimensions of the coil change as the diameter of wire wound on the same form is varied, but reasonable changes of N/l should not affect it too much. Fig. 6 shows 3 such coils. The Q meter readings were not corrected for the effects of distributed ca-

(*Continued on page 144*)

Tele-Tech & ELECTRONIC INDUSTRIES Advertisers—July, 1956

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.

"Q" Calculations

(*Continued from page 142*)

pacity, therefore they do not agree too well at the higher frequencies.

Example No. 3

The Q equation can also be expressed as indicated below if inductance, frequency, and geometrical configuration are constant but volume is a variable. K_5, K_6, and K_7 are constants.

$$Q = \frac{K_5}{K_6 \frac{1}{r_w} + K_7} \quad (28)$$

Two coils were wound having dimensions in the ratio of 1 to 1.6. The first two measurements are at 8 MC., the second two are at 6.5 MC.

$$Q = \frac{K_5}{K_6 + K_7} = \frac{202}{K_6 + K_7} = 117 \quad (29)$$

$$Q = \frac{K_5}{\frac{K_6}{1.6} + K_7} = \frac{202}{\frac{K_6}{1.6} + K_7} = 175 \quad (30)$$

So $K_6 = 1.48$ and $K_7 = 0.24$

$$Q = \frac{K_5'}{K_6' + K_7'} = \frac{163}{K_6' + K_7'} = 108 \quad (31)$$

$$Q = \frac{K_5'}{\frac{K_6'}{1.6} + K_7'} = \frac{163}{\frac{K_6'}{1.6} + K_7'} = 164$$

So $K_6' = 1.34$ and $K_7' = 0.16$

$$\sqrt{\frac{f}{f_1}} = \sqrt{\frac{8}{6.5}} = 1.11$$

$$\left(\frac{f}{f'}\right)^2 = \left(\frac{8}{6.5}\right)^2 = 1.52$$

$$\frac{K_6}{K_6'} = \frac{1.48}{1.34} = 1.10$$

$$\frac{K_7}{K_7'} = \frac{0.24}{0.16} = 1.50$$

It must be realized as the coil volume becomes large capacitive losses become appreciable. The last equation can be derived by another means in which fewer assumptions have been made.

Example No. 4

The Q equation indicates the Q value should rise as an iron cored inductor is made longer but eventually level off and remain constant. Observe Fig. 7.

References

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