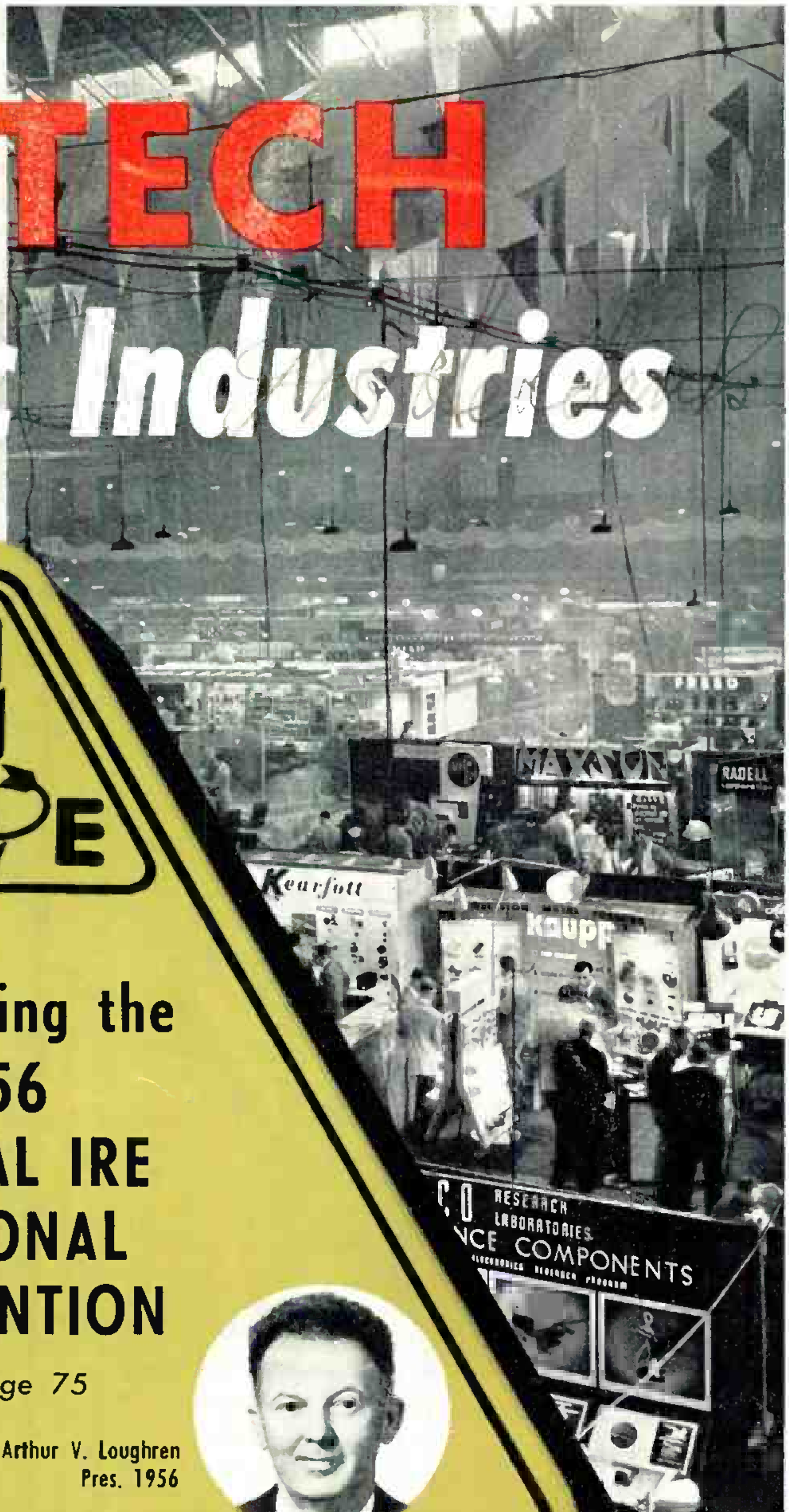
TELE-TECH & Electronic Industries



Previewing the 1956 ANNUAL IRE NATIONAL CONVENTION

See page 75

John D. Ryder
Pres. 1955

Arthur V. Loughren
Pres. 1956

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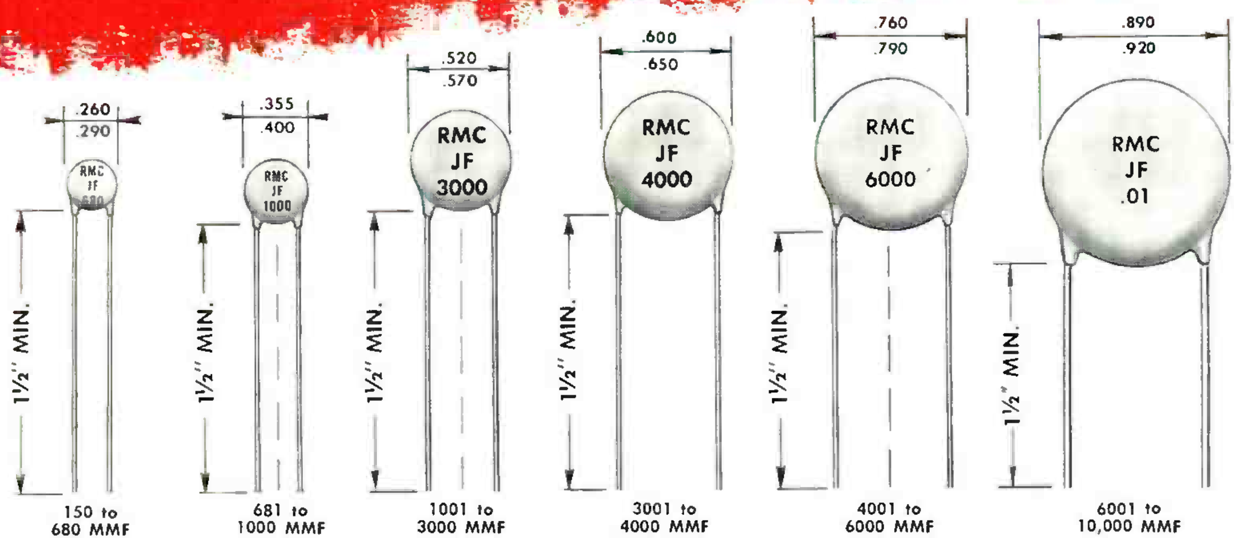
Please Route to

March • 1956

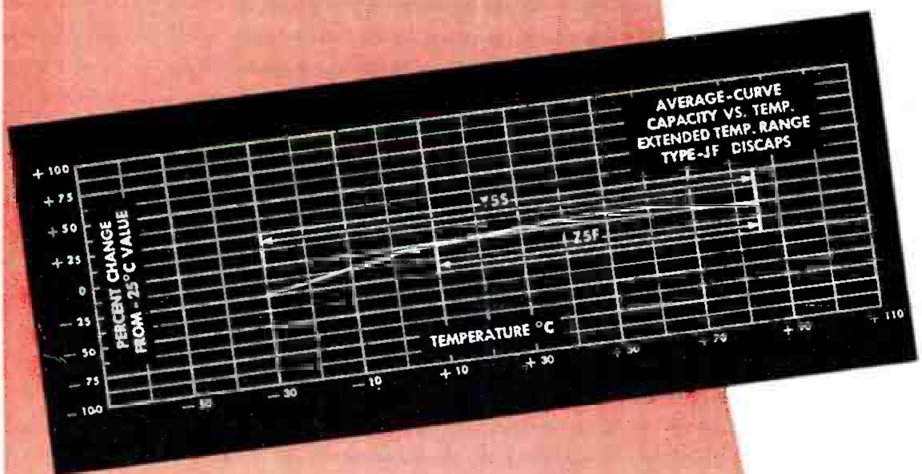
A new development from RMC

Type JF DISCAPS



SPECIFICATIONS

POWER FACTOR: 1.5% Max. @ 1 K C (initial)
POWER FACTOR: 2.5% Max. @ 1 K C, after humidity
WORKING VOLTAGE: 1000 V.D.C.
TEST VOLTAGE (FLASH): 2000 V.D.C.
LEADS: No. 22 tinned copper (.026 dia.)
INSULATION: Durez phenolic—vacuum waxed
INITIAL LEAKAGE RESISTANCE: Guaranteed higher than 7500 megohms
AFTER HUMIDITY LEAKAGE RESISTANCE: Guaranteed higher than 1000 megohms
CAPACITY TOLERANCE: ±10% ±20% at 25° C



Type JF DISCAPS are the result of the extensive research programs conducted in RMC's technical ceramic laboratories. These new DISCAPS extend the available capacity range of the RETMA Z5F type ceramic capacitor between + 10° and + 85° C and meet Y5S specifications between — 30° and + 85° C.

Now manufactured in capacities from 150 MMF to 10,000 MMF, type JF DISCAPS exhibit a change of only ± 7.5% over the range between + 10° to + 85° C. (See Graph). They also show a superior frequency stability over previous similar types.

Write today on your company letterhead for the answer to your questions on any type of ceramic capacitor.

VISIT BOOTH 518 I.R.E. SHOW

DISCAP CERAMIC CAPACITORS

RMC

RADIO MATERIALS CORPORATION
GENERAL OFFICE: 3325 N. California Ave., Chicago 18, Ill.
Two RMC Plants Devoted Exclusively to Ceramic Capacitors
FACTORIES AT CHICAGO, ILL. AND ATTICA, IND.

TELE-TECH
& Electronic Industries

MARCH, 1956

FRONT COVER: This symbolic cover heralds the coming of the 44th Annual Institute of Radio Engineers Show and Convention to be held March 19-22, 1956 in New York City. Pictured here within the golden "Fellow" emblem, the Institute's highest honor, are the past and present presidents of the I.R.E., John D. Ryder and Arthur V. Loughren, respectively. For details on what can be expected at the show—technical sessions, new products, etc.—turn to page 75.

MONTHLY NEWS ROUND-UP

NEW ELECTRONIC EQUIPMENT

DEPARTMENTS

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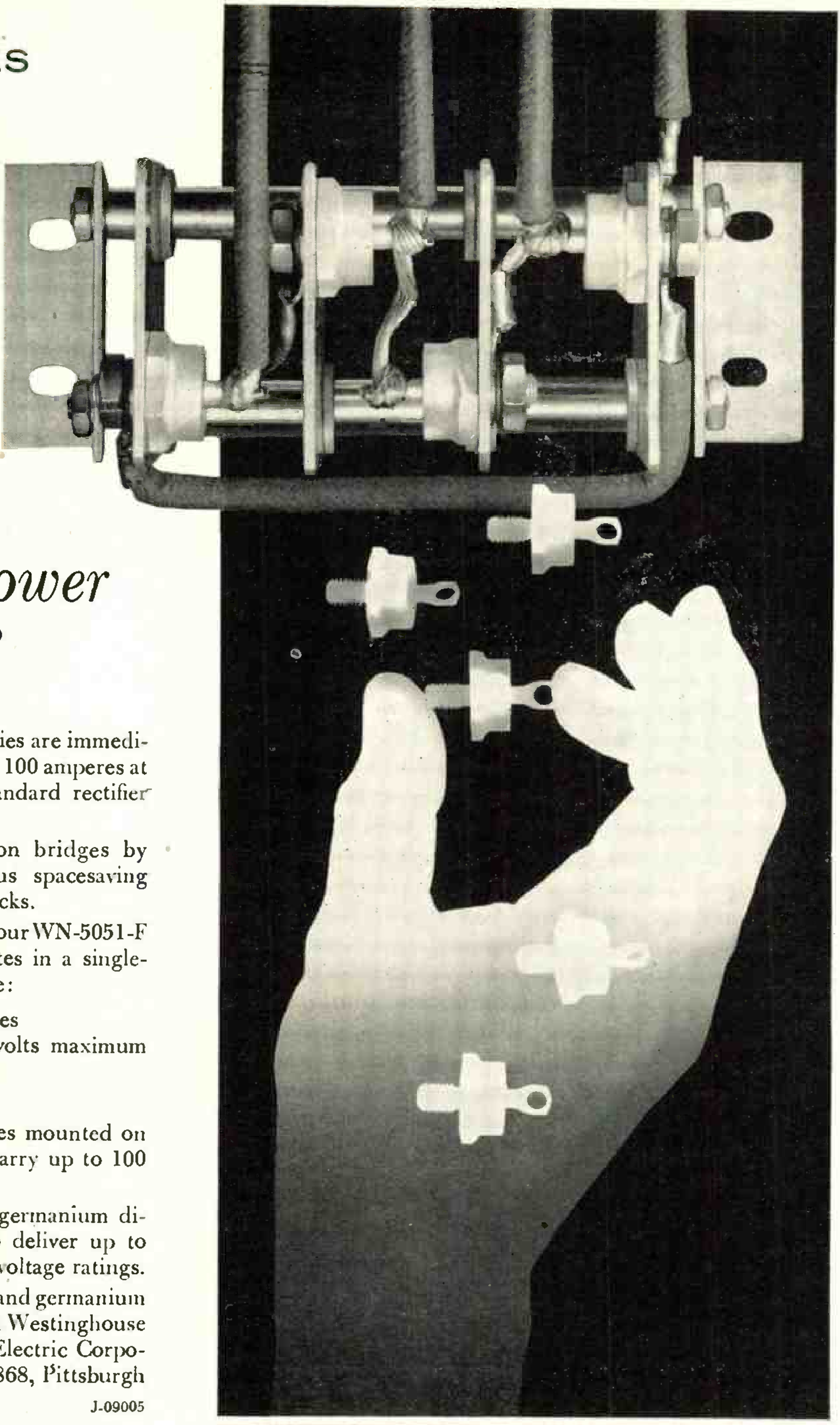
WESTINGHOUSE
SILICON BRIDGES



How much power do you need?

Westinghouse silicon bridge assemblies are immediately available with outputs from 5 to 100 amperes at 50 to 300 volts peak inverse in standard rectifier circuits.

These new pre-assembled silicon bridges by Westinghouse permit a tremendous spacesaving compared to equivalent selenium stacks.

Typical performance figures using four WN-5051-F diodes on 2″ x 2″ aluminum plates in a single-phase bridge, shown at the right, are:

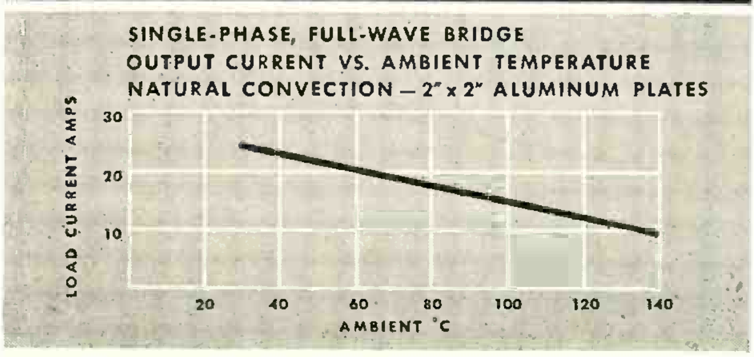
- continuous-load current 25 amperes
- leakage current <20 ma @ 300 volts maximum peak inverse
- natural convection 30° C ambient

A similar assembly with the diodes mounted on 5″ x 5″ plates with forced air can carry up to 100 amperes continuous.

Other Westinghouse silicon and germanium diodes can be mounted in bridges to deliver up to 600 amperes load current at various voltage ratings.

For detailed information on silicon and germanium bridges and diodes, contact your local Westinghouse sales office or write: Westinghouse Electric Corporation, 3 Gateway Center, P.O. Box 868, Pittsburgh 30, Pennsylvania.

J-09005

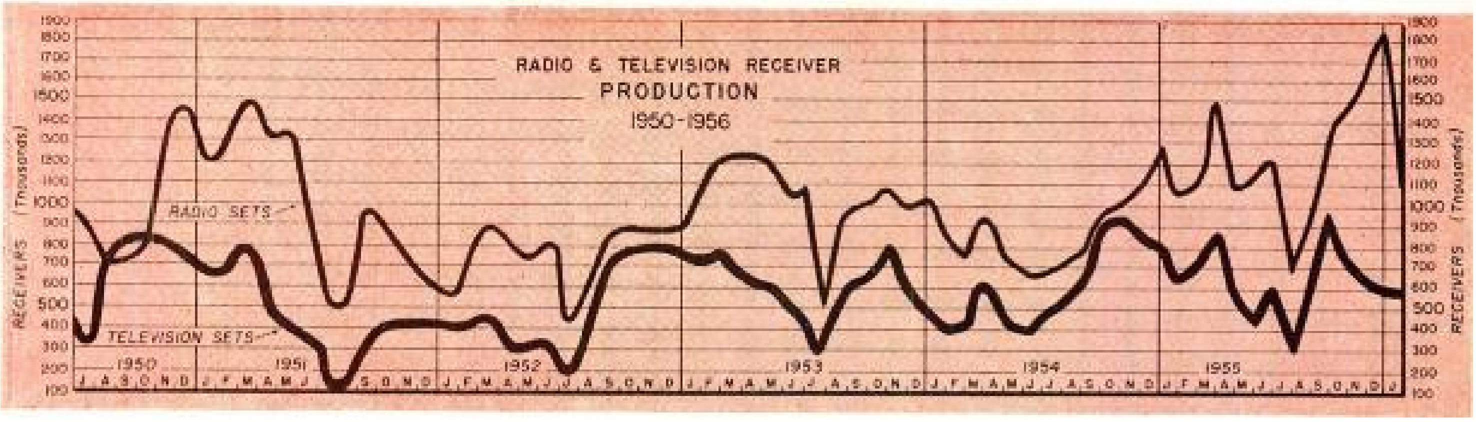


YOU CAN BE SURE...IF IT'S

Westinghouse

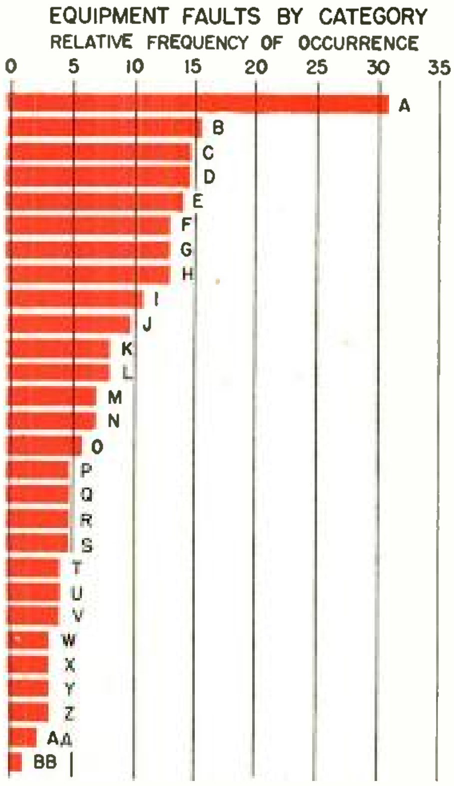
Facts and Figures Round-Up
March, 1956

ELECTRONIC INDUSTRIES TOTALS



RELIABILITY FAILURE STUDIES

Summarized below are the results from recent studies on military equipment faults and component failures. The component studies were made by Bell Telephone Laboratories and the Vitro Corp. Equipment faults by category are from the Naval Electronics Lab. Reliability Handbook.



Highest Failure Components

	Component	BTL* %	Vitro** %
1.	Fixed composition resistors	17.8	17.0
2.	Connectors	not given	11.0
3.	Fixed paper capacitors	10.0	5.9
4.	Fixed mica capacitors	8.6 (silver mica)	5.5
5.	Switches	3.85	5.2
6.	Fixed wire wound resistors	6.4	4.6
7.	Transformers and inductors	8.8	3.8
8.	Variable wire wound resistors	5.3	2.0
9.	Variable composition resistors	4.3	1.8
10.	Fixed ceramic capacitors	2.7	0.9
11.	Relays	4.65	0.8
12.	Meters	not given	0.8

*Bell Telephone Labs, based on 1,700 failures.
**Vitro Corp., based on 36,000 failures. Other analyses show that for each tube there are 5.3 resistors, 3.5 capacitors, and 3.9 other components.

Data from Office of the Assistant Secretary of Defense (Applications Engineering) Advisory Group on Reliability of Electronic Equipment.

Categories of Equipment Faults

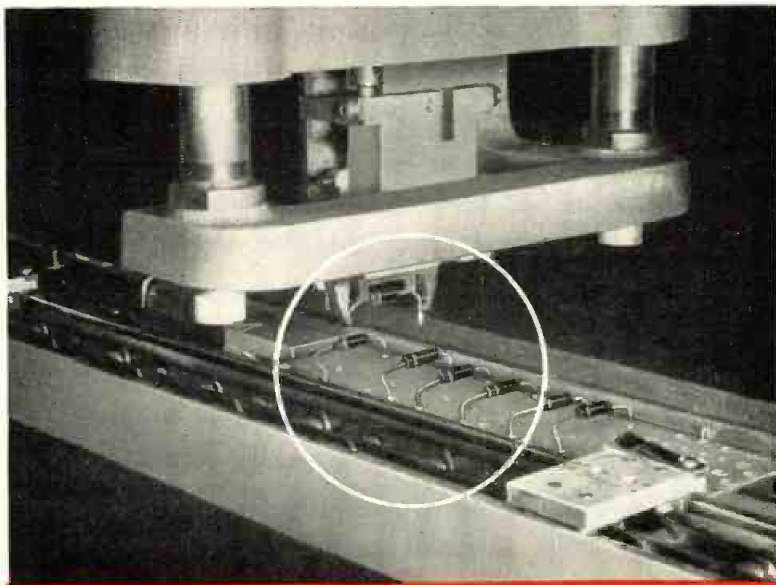
A. Inadequate Elec. Design
B. Poor Control Design
C. Inadequate Drip-proofing
D. Excessive Line-Conducted or Radiated Noise
E. Poor Performance Under Humidity and Salt Spray
F. Poor Wiring Design
G. Spurious Responses
H. Poor Shock Performance
I. Poor Parts Identification
J. Poor Vibration Performance
K. Sloppy Assembly
L. Poor Accessibility for Maintenance
M. Inadequate Instruction Books
N. Inadequate Insulation
O. Loose Fastenings
P. Poor Component Mounting
Q. Poor Welds
R. Components Used in Excess of Ratings
S. Poor Performance at Extremes of Temperature
T. Poor Performance at Extremes of Line Voltage
U. Inadequate Connecting Cables
V. Unapproved Parts Used
W. Inadequate Fusing
X. Inadequate Shielding
Y. Exceeds Specification Weight and/or Dimensions
Z. Misadjusted as Received
AA. No Wrenches
BB. Excessive Complexity of Circuits

GOVERNMENT ELECTRONIC CONTRACT AWARDS

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

Actuators	220,326
Amplifiers	2,002,271
Analyzers	153,593
Antennas	48,937
Batteries	1,909,082
Cable	287,062
Choppers	95,080
Compasses, Radio	891,054
Computers	10,265,147
Connectors	100,667
Decoders, Data	132,888
Diodes	162,000
Discriminators	25,837
Fire Control Systems	12,000,000
Generators	3,111,853
Generators, Signal	190,513
Hydrophones	46,670
Indicators	3,880,246
Indicators, Altitude	5,105,100
Indicators, Azimuth	3,811,387
Indicators, Temperature	451,213
Loudspeakers	38,463
Meters, Frequency	468,549
Microphones	74,813
Microscopes, Electron	27,035
Microwave Equipment	56,740
Modulators	135,845
Motor-Generator Sets	2,472,777
Motors	134,401
Multimeters	64,351
Oscilloscopes	35,240
Panels, Control	1,756,527
Plotters	102,500
Plugs, Telephone	50,796
Power Supplies	620,397
Radar Sets	24,266,707
Radio Sets	10,655,739
Radiosondes	332,063
Receiver-Transmitters	10,850,254
Receivers	4,685,371
Recorders, Magnetic	375,100
Rectifiers	144,772
Regulators, Voltage	131,517
Relays	310,211
Resistors	257,650
Simulators, Flight	600,000
Switches	111,960
Tachometers	501,742
Transducers	31,325
Transmitters	1,337,745
Tubes, Electron	8,653,631

Unique method of anchoring IRC leads keeps them from being twisted or pulled out in automatic bending and insertion operations.



HOW TO BE <u>SURE</u> OF TERMINAL SECURITY

No matter how you assemble or solder them, IRC resistors provide the extra terminal security that prevents termination failures in the production line or in the field. Leads of IRC Type BT Resistors, for example, are uniquely anchored in the resistor body so that they won't twist or pull out. A new IRC alloy coating which overcomes copper migration also assures improved and more uniform solderability. Together, these features speed up production, cut inspection costs, and assure reliable long-range performance. For more information, send coupon today.

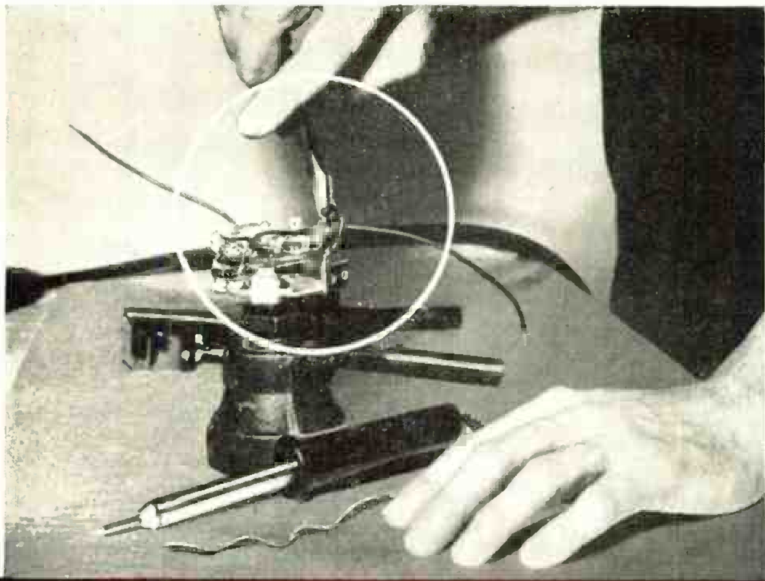
Why Leads Won't Come Loose

Leads of IRC Type BT Resistors are so securely joined to the element that even the unmolded assembly exceeds the standard 5-lb. pull requirement. For still greater strength, leads have a crimped collar which provides a tooth-and-notch effect when the assembly is molded as a unit.

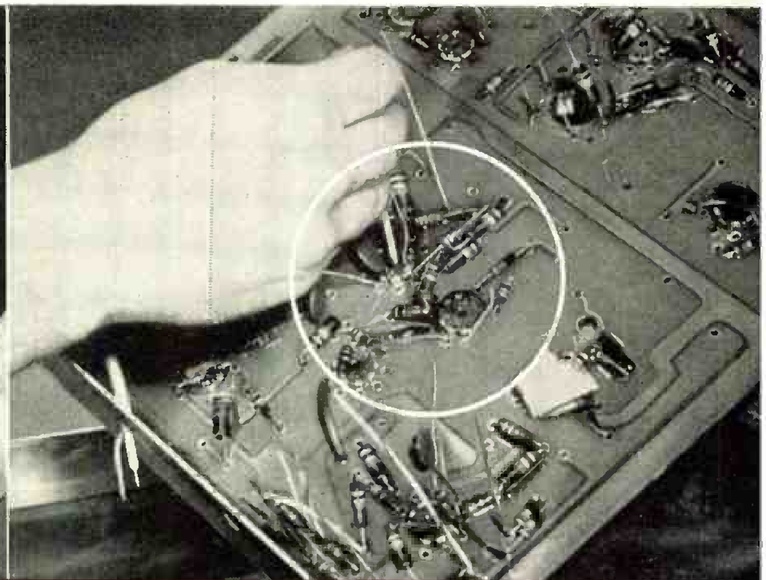
Straight Leads Speed Automation

The IRC Automation Package assures you of consistently straight leads suitable for automatic feed. This permits automatic, trouble-free feed to holding devices or into inserting heads of printed wiring lines.

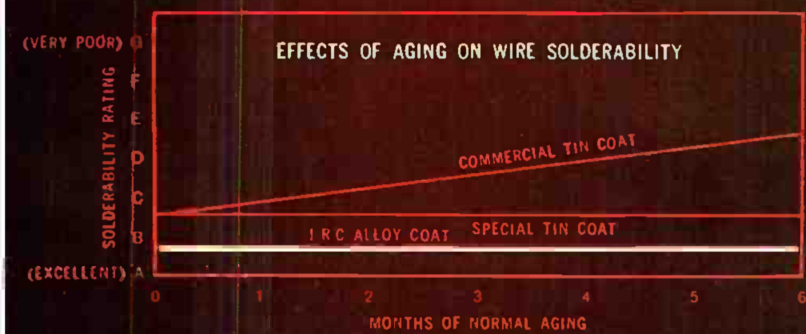
Because they can be bent up to resistor body, IRC leads solve special "fit" problems and simplify production and soldering operations.

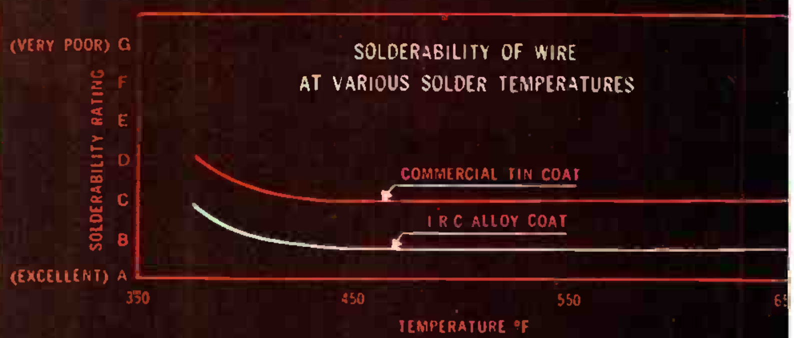


New alloy surface on leads overcomes tendency of copper to migrate toward coating. This assures superior solderability by any method, with low or varying temperatures.



here's how much IRC's new alloy coating improves solderability





EXTRA TERMINAL SECURITY ALSO FEATURES OTHER IRC RESISTORS

Be sure to visit IRC at the I.R.E. show, Booth 553-555 Components Ave.

Deposited and Boron-Carbon Resistors

The metal used in terminations passes ASTM tests for season cracking. In addition, terminations are automatically assembled for uniform strain strength.

Wire Wound Low Wattage Resistors

Through machine assembly, the element, terminal clips, and leads are assembled simultaneously. No other method assures such uniformly high resistance to twisting or pulling.

Wire Wound Precision and Power Resistors

Lugs can't turn or twist and break the fine resistor wire. This also eliminates any "strain gauge" effect which would change the resistance value.

IRC Subsidiary Companies also invite you to visit their I.R.E. exhibits

HYCOR Division of International Resistance Co., Booth 369, Microwave Ave. CIRCUIT Instruments Inc., Booth 555 Components Ave.

Voltmeter Multipliers • Boron & Deposited Carbon Precistors • Insulated Composition Resistors • Power Resistors • Controls and Potentiometers • Low Wattage Wire Wounds • Germanium Diodes

Wherever the Circuit Says

IRC

Precision Wire Wounds • Ultra HF and Hi-Voltage Resistors • Selenium Rectifiers • Insulated Chokes • Hermetic Sealing Terminals

HYCOR DIVISION of International Resistance Co., Los Angeles, Calif. & Puerto Rico
CIRCUIT INSTRUMENTS INC. (IRC Subsidiary) St. Petersburg, Florida

INTERNATIONAL RESISTANCE CO.
Dept. 582, 401 N. Broad St., Philadelphia 8, Pa.

Send data on resistors checked:
☐ Fixed Composition Resistors ☐ Deposited and Boron-Carbon Resistors ☐ Wire Wound Power Resistors ☐ Wire Wound Precision Resistors

Name ____________________

Company ____________________

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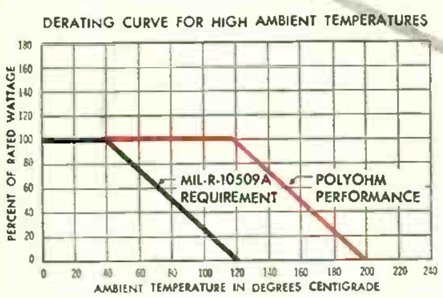
STABLE at 120°C

...new POLYOHM 1% RESISTOR

—takes full power at ambient temperature three times that specified by MIL-R-10509A

—exceeds all other MIL-R-10509A specifications



If you need a 1% resistor that is stable at high ambient temperature and humidity, we would like you to test free samples of our newly developed POLYOHMS. They exceed *all* MIL-R-10509A specifications as you can see from the comparison table below. Note, for example, that they take *full* power at ambient temperatures up to 120°C instead of only 40°C. Thus, they are ideal for use in aircraft and guided missiles. The same fact, of course, will result in much longer life when they are operated at lower temperatures.

POLYOHMS are well suited to replace bulky, expensive and highly inductive wire-wound resistors.

The resistor will remain well within its 1% tolerance even under the stringent moisture test which allows a 5% change. Its temperature coefficient is always lower than both the R and X characteristics.

POLYOHMS are manufactured in ½, 1, and 2 watt sizes with facilities controlled by the Signal Corps. They are presently available only for government end use. Please request samples on company letterhead.

TABLE OF TEST RESULTS

TEST	MIL-R-10509A Allowable change	POLYOHM Test Results (Median Value)
Temperature cycling	1%	.03%
Low temperature exposure	3%	.08%
Short time overload	.5%	.03%
Load life @ 40°C — 1000 hrs.	1%	.2%
@120°C — 1000 hrs.	—	.5%
Temp. coeff. ppm/°C (char. X)	±500	—150
(char. R)	±300	—150
Moisture resistance test	5%	.3%

See our exhibit at the I.R.E. Show! 293-295 INSTRUMENTS AVENUE

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Avionics	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Color Television	•	•	•	•	•	•	•	•	•	•	•	•	•	
Components	•	•	•	•	•	•	•	•	•		•	•	•	•
Computers	•	•	•	•	•	•	•	•	•		•	•	•	•
Control Consoles	•	•	•	•	•	•	•	•	•	•	•	•		
Government	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Guided Missiles	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Industrial Elec's	•	•	•	•	•	•	•	•	•		•	•		
Military Elec's	•	•	•	•	•	•	•	•	•		•	•	•	•
Mobile	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Printed Circuits	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Res. & Dev. Labs	•	•	•	•	•	•	•	•		•	•		•	•
Studio Equipment	•	•	•	•	•	•	•	•	•	•	•	•		
Telemetering	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Test Equipment	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Transistors	•	•	•	•	•	•	•	•	•	•	•	•	•	•
TV-Radio-Radar	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Vacuum Tubes	•	•	•	•	•	•	•	•	•	•	•	•	•	•
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OPERATION														
Broadcasting	•	•				•	•	•		•	•			
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Microwave	•	•				•	•	•		•	•	•		
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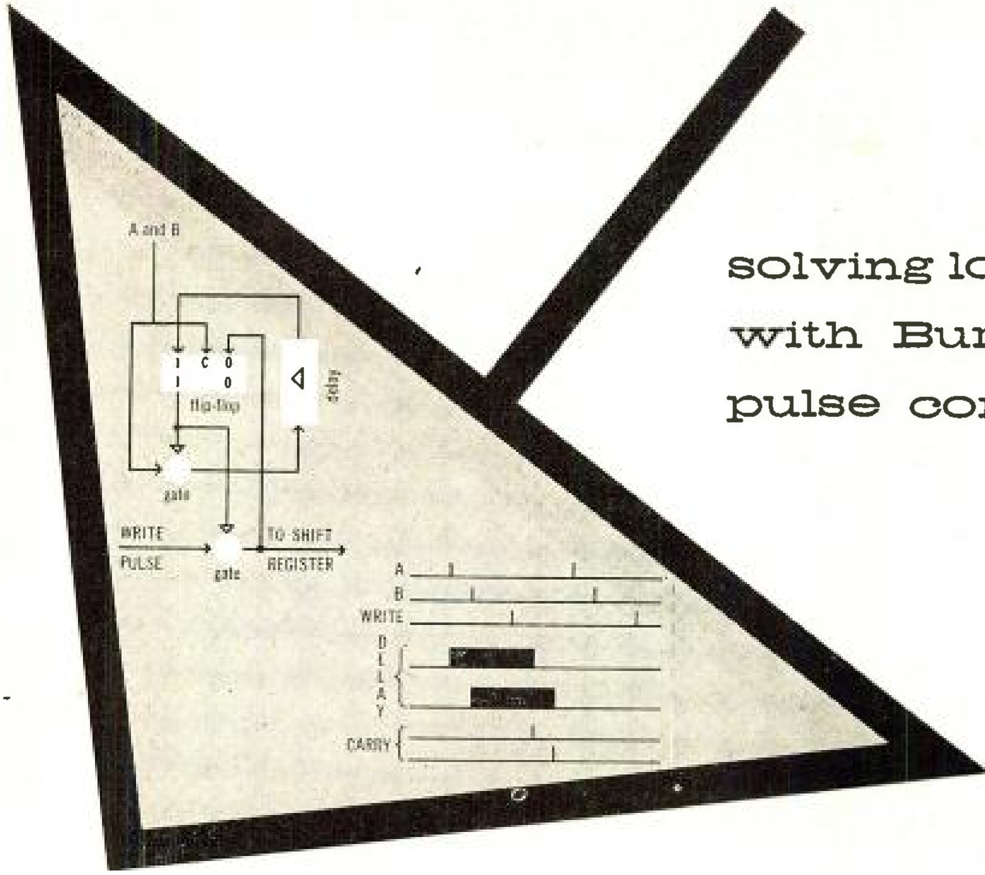
Chart shows how TELE-TECH's 27,000 circulation is concentrated among top-level engineers in the electronic industry's principal buying power groups.

THE ELECTRONIC INDUSTRIES DIRECTORY

Published annually as an integral section of TELE-TECH in June



solving logical problems with Burroughs pulse control systems

a one flip-flop serial binary adder

. . . conceived and proved in the same day

This new and unique serial binary adder will find many uses in digital work. But it might never have been developed without Burroughs Pulse Control Equipment to act as a catalyst for the engineer's imagination.

The engineer who developed the adder, like all others in logical design, is constantly faced with the problem of finding new components which require a certain amount of experiment and imagination. He is most efficient when using equipment that is as flexible as the problem and capable of keeping pace with his thinking. In this case, for example, his problem was reduced to: (1) setting down the idea in block diagram form, (2) interconnecting his Burroughs units accordingly, and (3) checking results.

His original idea was quickly brought to working reality, because a Burroughs System eliminates many of the usual steps in between. And while setting down the diagram for the system hook-up, he was automatically specifying not only the equipment he would ultimately need to build the unit, but also how to assemble it. Thus, he did away with breadboard hardware entirely.

You can give yourself the same creative edge by letting a Burroughs Pulse Control System give your imagination a chance to work. Just send us your pulse problem, and we'll gladly work out a Burroughs Pulse Control solution . . . at no cost. Or, write for Bulletin 236.

tools for engineers

Burroughs

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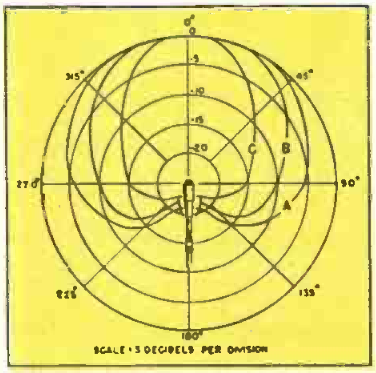
For product information, use inquiry card on last page.

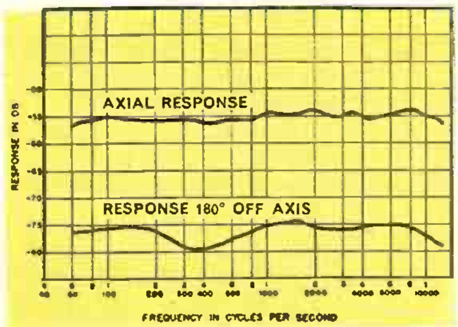
Cut Ambient Noise, Feedback and Reverberation.

Electro-Voice® Creates New Concept in Cardioid Dynamic Microphone for Public Address and Other Applications

Every public address installation...every personal tape recorder... every radio amateur rig...can be improved with the new high-fidelity "664." This new E-V Variable D* unidirectional cardioid provides highly efficient sound selectivity without interference of unwanted sounds ...gives clear, natural pick-up and reproduction of voice and music... brings broadcast quality to p.a. Exclusive E-V dynamic features make the "664" highly resistant to mechanical shock and climatic conditions... guarantee extra rugged service indoors and outdoors.



Polar Pattern—Uniform at All Frequencies
A—300 cps B—5,000 cps C—10,000 cps



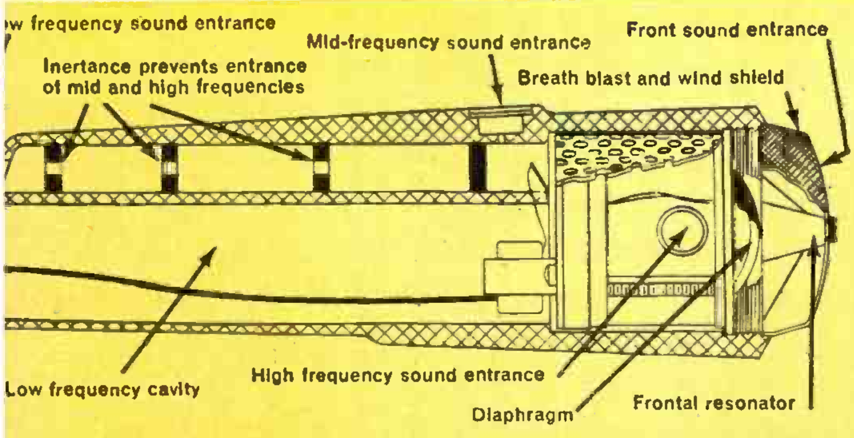
Smooth, Peak-Free Frequency Response

Gives High Front-to-Back Discrimination and Smooth, Wide-Range Response—Without Close-Talking Boominess

Directly in front, the "664" picks up sound at full level. Sounds to the side can be cut in intensity as much as 50%, while those directly behind the microphone are cut to 10% or less of normal intensity. *Cardioid pattern is uniform . . . response is smooth, peak-free . . . at all frequencies.*

Proper microphone placement eliminates unwanted sounds—permits you to pick up and reproduce the sound you want, as you want it—clearly, distinctly, naturally. Extends pick-up range at front. Can be beamed to augment or cancel out sound sources. Permits higher sound level without fear of feedback.

Single moving element (exclusive E-V Acoustalloy Diaphragm) withstands high humidity, temperature extremes, corrosive effects of salt air, and severe mechanical shocks. Gives more in-service, less out-of-service performance . . . provides dependable, long-life operation.



HOW IT WORKS

Exclusive E-V Variable D* (variable distance) provides three sound-cancelling entrances at different fixed distances in back of the diaphragm. These entrances, utilizing the proper acoustical impedance, combine to form effective front-to-back spacing which varies in distance from the diaphragm inversely with frequency. The resulting phase and amplitude conditions provide a uniform cardioid pattern at *all* frequencies.

...STOP UNWANTED SOUNDS

Now... Broadcast Performance Designed for Public Address

COMPLETELY NEW ALL-PURPOSE CARDIOID DYNAMIC MICROPHONE BRINGS NEW EFFICIENCY OVER WIDE FREQUENCY RANGE

All the advantages of the E-V Variable D* are now available in the new high-fidelity "664"...for public address, recording, communications and similar applications. Uniform cardioid polar pattern provides high front-to-back discrimination against unwanted sounds, without close-talking boominess. Easily solves sound pick-up and reproduction problems under a great variety of conditions. Gives distinct, natural reproduction of voice and music. Increases working distance from microphone. Gives greater protection against feedback. Especially useful where ambient noise and severe reverberation exist. Pop-proof filter minimizes wind and breath blasts. E-V Acoustalloy diaphragm guarantees smooth wide-range reproduction. Can be used on a floor or desk stand or carried in the hand. No finer microphone for performance and value! *Write for Technical Specification Sheet.* L63.

*EV Pat. Pend.

Model 664. Variable D* Super-Cardioid Dynamic Microphone. Uniform response at all frequencies from 60 to 13,000 cps. Output level —55 db. 150 ohm and high impedance. Impedance changed by moving one connection in connector. Line balanced to ground and phased. Acoustalloy diaphragm, shielded from dust and magnetic particles. Alnico V and Armco magnetic iron in non-welded circuit. Swivel permits aiming directly at sound source for most effective pick-up. Pressure cast case. ⅝"—27 thread. Satin chrome finish. 18 ft. cable with MC4M connector. On-Off switch. Size: 1⅞ in. diam. 7³⁄₁₆ in. long not including stud. Net wt.: 1 lb. 10 oz.
List Price $79.50

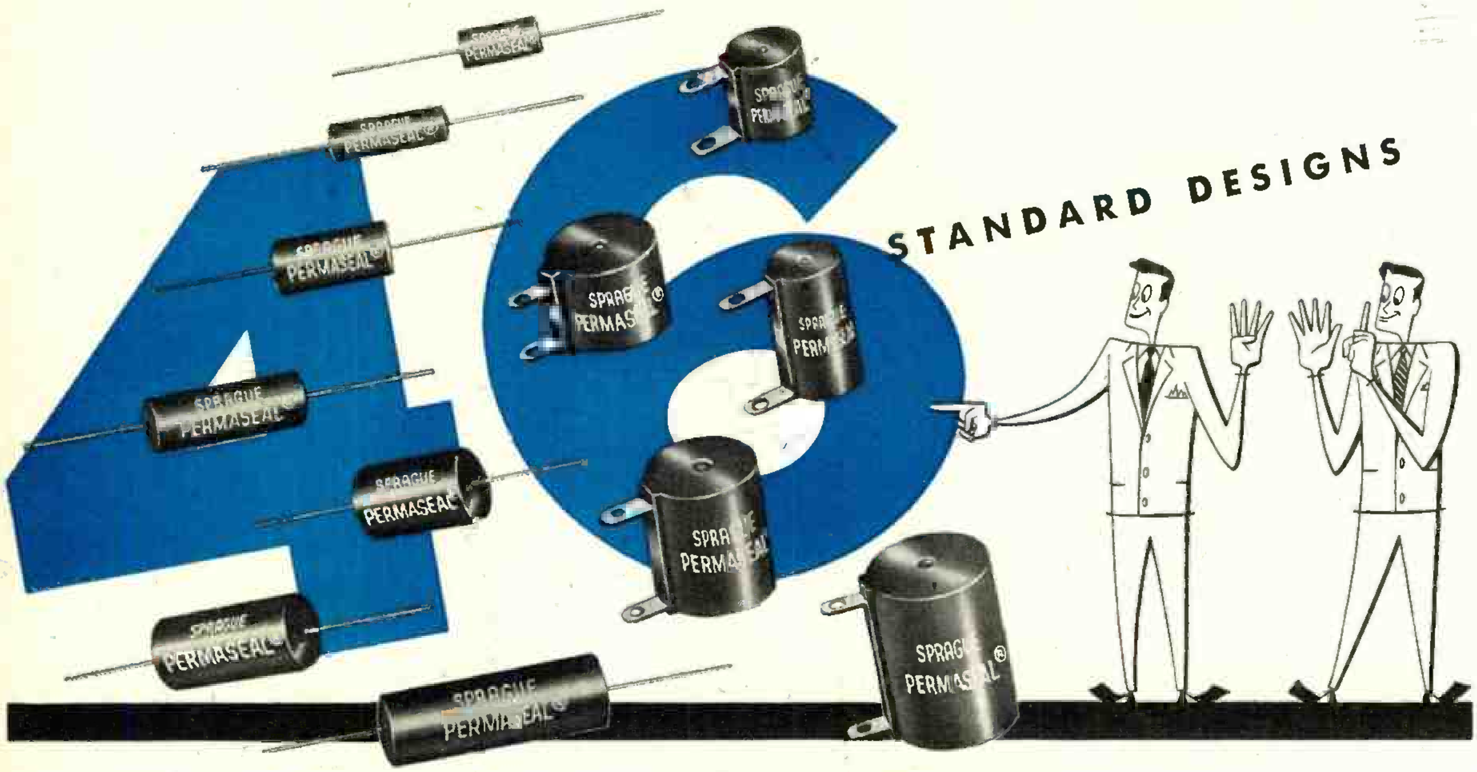
Model 419 Desk Stand available for use with the "664" (extra).

Electro-Voice®

ELECTRO-VOICE, INC. • BUCHANAN, MICH.

Export: 13 East 40th Street, New York 16, N. Y. U.S.A. Cables: Arlab

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...

NEW H-F TRANSISTOR

New germanium diffused-base transistors being manufactured at Bell Labs. Frequency cutoff of transistors is between 500-600 MC

IBM "BRANE" Guides Air Force Bombers

A new bombing and navigation system of unprecedented reliability has been developed by IBM for installation in the Boeing B-52 Stratofortress. Called BRANE, for Bombing RAdar Navigation Equipment, the system assists the B-52 crew in bombing and navigation problems under the most strenuous conditions.

Heart of the system is an analog computer which employs digital pulse techniques to coordinate information received from a multitude of radars. The development of long-lasting electronic and mechanical components has resulted in an estimated useful life of over 2,000 hours.

The navigation equipment is used to guide the plane to its destination where the system then automatically carries the plane through the bomb run, responding to corrections made by the bombardier-navigator. Exact operational details are restricted by military security.

Over 100 units, containing more than 300 vacuum tubes, make up the system, for which a transistorized version is being contemplated. Analysis of a year of pilot plant operation indicates that production costs will be about $300,000.

Curt I. Johnson, Gen. Mgr. of the IBM Airborne Computer Labs, Vestal, N. Y., was the engineer in charge of the development.

"Lumicon" Light Amplifier Demonstrated By Bendix

A promising new application of industrial closed-circuit TV was demonstrated by the Friez Instrument Div. of Bendix Aviation Corp. last month in the form of their new "Lumicon" light amplifier.

Essentially an extra-sensitive, high-resolution iTV system, the "Lumicon" will provide light amplifications up to 40,000 times. It also has unique spectral response characteristics which make it possible to view items which to the naked eye appear to be in total darkness.

The system consists of an image orthicon camera tube linked to a monitor through specially designed high-gain circuits. The repetition rate is the same as standard TV, 30 frames/sec., but the number of lines has been increased to 1029, providing almost twice the resolution of broadcast TV. The finest lens obtainable is employed in order to achieve the maximum light-gathering power.

The most immediate applications of the new system are seen in medical and industrial x-ray techniques, and in astronomical observations where the amount of light given off by celestial bodies is a sharply limiting factor.

Transistorized Hearing Aid Mounts in Eyeglass Frames

Otarion, Inc., of Dobbs Ferry, N. Y., announces a new hearing aid design that permits 360° ear-level hearing. Termed "The Listener," the hearing-aid now provides 360° full-circle hearing by providing microphones in both temples of the eyeglasses. An inconspicuous rotary volume control permits sound adjustment without removing the spectacles, while a tiny, flexible, transparent plastic tube conducts the amplified sound from the eyeglasses to the ear. The frames may be fitted with plain or prescription lenses to meet the wearer's needs.

The new Listener, like the first model, has a total power gain of over 80 db and an acoustic gain of over 50 db. There are 150 component parts. The volume control, one miniature microphone, the sound reproducer and the circuitry fit into one of the temples, while another microphone, a dime-size mercury battery, and a four-position switch are mounted in the other temple. The miniature one-cell battery fits into an invisible swing-out compartment and furnishes all the power needed by the transistors. There are three wires running between the two temples and through the frame. The hinges between the temples and the frame are the connectors for one wire, while two spring-loaded silver wiping contacts at each hinge are connections for the other two wires. When the unit is removed and either temple folded in the normal manner, the wiping contacts are opened and power to the hearing aid is interrupted.

Amplifier components are concealed in frames

Three transistor amplifier stages are employed; two stages using CK-782 transistors, and one output stage, with a CK-783 transistor. Gains per stage are 30 db, 30 db, 20 db, respectively. Each stage is compensated for temperature and resistance changes to make the selection of transistors simple and the circuit stable.

Most of the components are mounted on paper-base phenolic. The one semi-adjustable resistor is made up of a ceramic base with resistive material printed on it.

MORE NEWS on page 23

TELE-TIPS

IRE SHOW MEMORY. Making the rounds at last year's IRE show, we couldn't help but notice a trio of young, attractive female guests who seemed absorbed in all the displays. Engineers of the opposite sex are not, of course, that rare, but, were we actually seeing three at one time? One young thing gave us the answer as she turned to her companion, sighed, and murmured wistfully, "Gee, wouldn't it be nice to be able to ask something intelligent."

IF THERE IS ANY DOUBT about the importance of air navigation systems this recent British experiment should dispel it. Two of their 600 mph Comet jet airliners were dispatched from opposite ends of the same route. Midway, they passed, only a few hundred feet difference in altitude, yet their pilots *didn't even see each other.*

THE BELL SYSTEM plans to replace their mechanical switching relays with electronic units. Switching time will be cut from thousandths of a sec. to millionths of a sec.

IF ALL TV SETS in the country were lined up side by side along the coastline of the U.S. they would encircle the country, and there would be enough left over to stretch from N.Y.C. to Los Angeles. So says NBC exec.

THE BUSINESS EXEC spends 80% to 90% of his time communicating—trying to understand someone, or trying to make someone understand him. So says Frank E. Fischer in the new AMA handbook, "Effective Communication on the Job."

IS AERIAL INSPECTION POSSIBLE? Fairchild officials and the Air Force say yes—emphatically. From 40,000 ft., they say they can tell the height of any given house, what it was constructed of, and the relative age of the community. They can tell whether a rotary lawn mower was used to cut the grass, whether the occupants have a telephone, and an underground septic tank—and probably even describe the clothes hanging on the line.

(*Continued on page* 18)

IRE SHOW
Booth 50 Palace

A NEW DESIGN APPROACH . . .

Photograph of the earth from 100 mile altitude — Courtesy U. S. Air Force

. . . BEYOND-THE-HORIZON TRANSMISSION

BEYOND-THE-HORIZON TRANSMISSION

The newest military and commercial long-range communications systems are turning towards the advantages of "scatter" transmission. By transmitting *directly* to stations well beyond the horizon, scatter transmission systems eliminate the construction and maintenance of intermediate microwave stations and avoid cables and repeaters of wire systems, while retaining the wide bandwidths available at high frequencies. This *direct* transmission can span water or inaccessible terrain while giving predictably high signal reliability and freedom from interference.

A NEW APPROACH . . . CONTROLLED SYSTEM DESIGN

A complete analysis including the effects of climate, multipaths, modulation, diversity and prolonged equipment operation combined with an exclusive experimental method of simulating every proposed link enables Hycon Eastern, Inc. to *hit the performance target more precisely*. We can reduce the expense of a large margin for error and eliminate the possibility of costly site relocations by careful assessment of each customer's needs and operating conditions that will provide him with an optimum design.

HYCON EASTERN OFFERS AN INTEGRATED SERVICE

Within the areas of Hycon Eastern, Inc. and its associated companies can be found complete facilities not only to design, engineer and specify equipment for Beyond-the-Horizon Transmission Systems, but to design Central Offices, Connecting Wire Networks, perform Communication Traffic Density Surveys, Aerial Surveys and Mapping to determine the most efficient routes for land lines and for various radio links such as UHF/SHF line of sight. After the necessary facts have been gathered there further exists the experience to evaluate them and to specify practical equipment with complete independence of judgment necessary to create a complete communications system that will fulfill present and projected needs.

HYCON EASTERN, INC.

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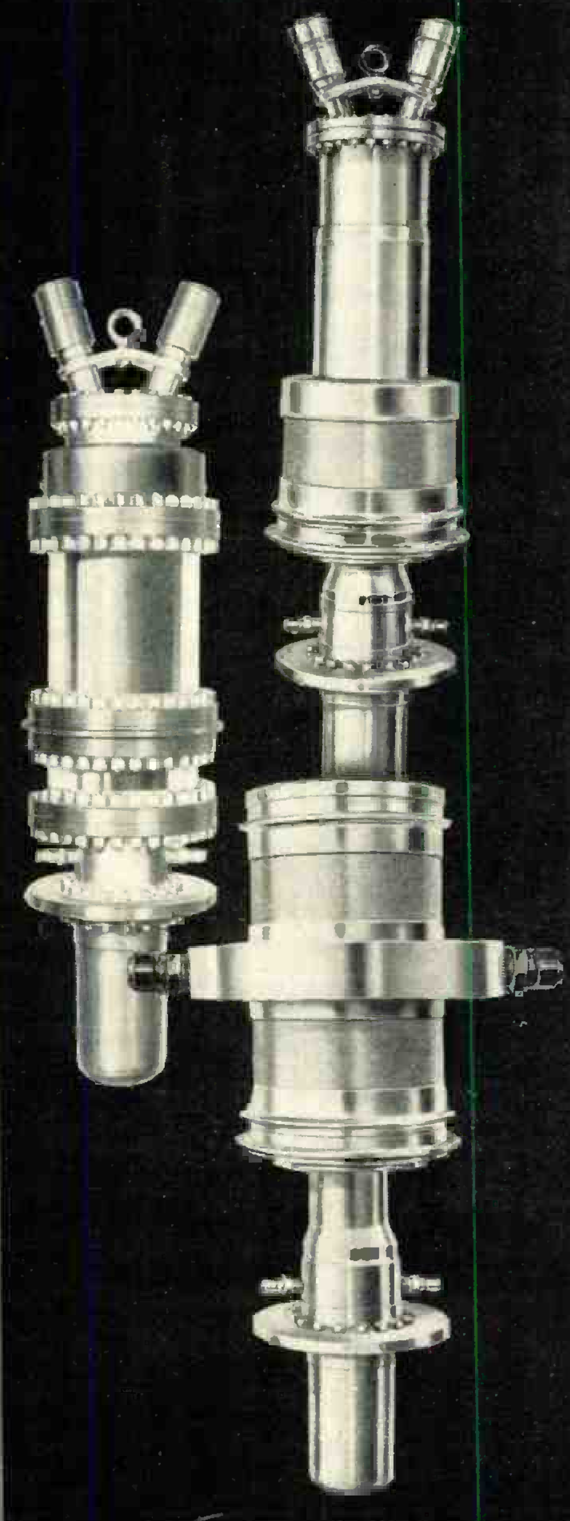
Affiliated with HYCON MFG. COMPANY, Pasadena, California

RCA DATA FOR



NOW...UNPRECEDENTED HIGH POWER OUTPUTS

. . . with RCA super-power tubes

Visualized by the Radio Corporation of America over two decades ago . . . and since then under a continuing development and field-testing program . . . RCA Super-Power Tubes are now being offered to progressive industries looking ahead to rf applications requiring higher and higher power at higher and higher frequencies.

Using concepts unusual in vacuum-tube design—including unique principles of electron optics, interelectrode shielding, and tube geometry—RCA Super-Power Tubes begin their work where conventional power tubes leave off.

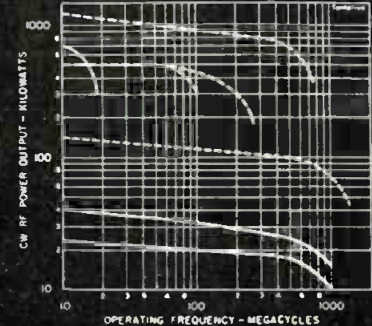
Ingenious internal liquid cooling of tube electrodes and unitized coaxial design make it practicable to generate higher power at much higher frequencies.

Thoriated-tungsten or matrix-type cathodes provide exceptionally high emission, economical power consumption, and long life.

Efficiency of rf transfer is assured through the use of high-conductivity seals and low-loss ceramic bushings.

Mechanical configurations—heretofore considered impossible—provide a new twist to vacuum-tube design to accomplish super-power generation. The ability of these tubes to handle high average power in cw operation permits unusually high power outputs in pulse and hard-tube modulator operation. All tubes are designed for single or multiple operation—for exciting new applications where higher and higher power extends the use of electronics.

RCA is ready to discuss with equipment manufacturers their present and future needs for Super-Power Tubes. Information may be obtained from the nearest RCA District Office—or write RCA, Commercial Engineering, Harrison, N. J.



DESIGNERS

ELECTRON TUBES
SEMICONDUCTOR DEVICES
BATTERIES
TEST EQUIPMENT
ELECTRONIC COMPONENTS

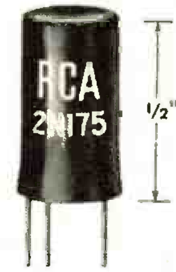
NEW TUBES— FOR BETTER TV-RECEIVER PERFORMANCE

RCA-2BN4,-6BN4... 7-pin miniature-type high-g_m medium-mu triodes for rf amplifier service in vhf TV tuners. Reduced inductance and rf lead resistance contribute to high gain. Basing arrangement facilitates neutralization.

RCA-5CG8,-6CG8 . . . 7-pin miniature-type triode-pentode converters for oscillator-mixer service in vhf TV tuners. Feature two cathode leads with separate base-pin terminals to minimize input loading effects of pentode mixer unit, and interaction between input and output circuits.

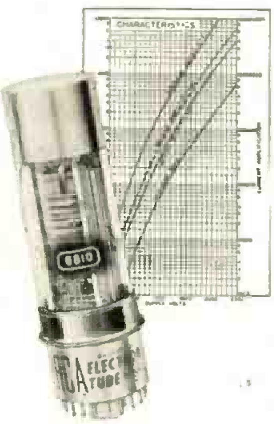
RCA-6CU5,-12CU5 . . . 7-pin miniature-type beam power tubes for audio output stages. Because of their high power sensitivity and high efficiency, these types can provide relatively high power output at low plate and screen voltages.

NEW LOW-NOISE TRANSISTOR FOR AF PREAMPLIFIERS OPERATING FROM LOW-LEVEL LOW-IMPEDANCE SOURCES—WITHOUT INPUT TRANSFORMER



RCA-2N175 . . . low-noise germanium-alloy junction transistor of the p-n-p type; intended primarily for preamplifier or input stages of transistorized audio amplifiers which operate with extremely small input signals. Features an exceptionally low wide-band noise factor of 6 db (max.), current amplification ratio of 65, and a matched-impedance power gain of approximately 43 db. Stability and uniformity of characteristics are excellent throughout life. The low-noise factor and low-input impedance characteristic of RCA-2N175 permit the design of audio amplifiers in which the transistor is directly operated from low-impedance, low-level devices such as magnetic microphones and magnetic pickups without an input coupling transformer.

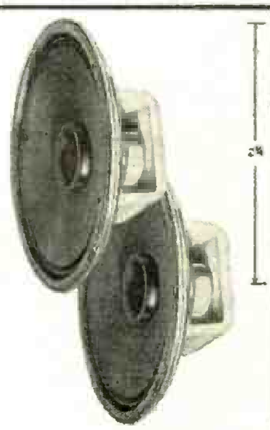
NEW 14-STAGE MULTIPLIER PHOTOTUBE



RCA-6810 . . . the most sensitive phototube in the RCA line . . . multiplies feeble photoelectric currents approx. 66,000,000 times when operated with 2300 volts supply potential—is a head-on type designed for scintillation counters, spectrophotometers, and other applications involving unusually low-level light sources. Featuring fast response, high current gain, relative freedom from after-pulses, and small spread in electron-transit time, RCA-6810 is particularly useful for fast coincidence scintillation counting. Because of the capability of delivering pulse currents up to 0.5 amp in magnitude without appreciable deviation from linearity, the need for an associated wide-band amplifier is eliminated in many applications.

TWO NEW MINIATURE-TYPE HIGH-SENSITIVITY SPEAKERS NOW AVAILABLE FOR COMPACT PERSONAL RADIOS

RCA generic designs XS-7659 and XS-7744 . . . only 2¾" in diameter . . . for use where limited space and high sensitivity are important design considerations. Both are p-m types. They provide good frequency balance and are designed to work into the air load provided by small, portable receiver cases. Voice-coil assemblies are encapsulated, making them impervious to damage from moisture and temperature changes. Voice-coil leads are brought out directly to the voice-coil terminals—not cemented to the cone—thus avoiding cone warping. Alnico V magnets are incorporated.



For complete technical data, write RCA, Commercial Engineering, Section C50R, Harrison, N. J. or call the RCA District Office nearest you:

EAST: ....HUmboldt 5-3900, 744 Broad Street, Newark 1, N. J.

CENTRAL: WHitehall 4-2900, Suite 1181 Merchandise Mart Plaza Chicago 54, Ill.

WEST: ....RAymond 3-8361, 6355 E. Washington Blvd. Los Angeles 22, Cal.

VISIT RCA BOOTH #151-155 AT I.R.E. SHOW

RADIO CORPORATION of AMERICA
TUBE DIVISION — SEMICONDUCTOR DIVISION
HARRISON, N. J.

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For analysis of your antenna or microwave problems, write us or telephone NEedham 3-0005 (through Boston).

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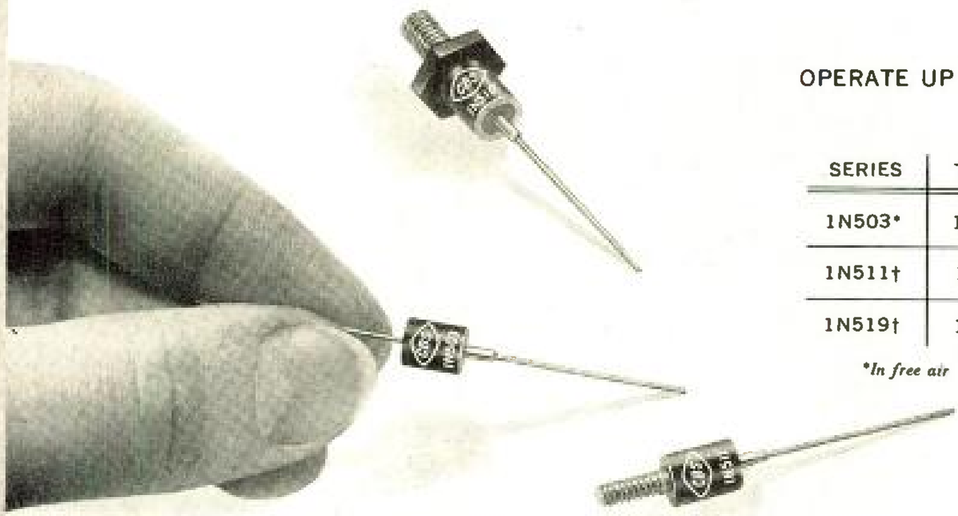
THREE
NEW FAMILIES OF
CBS SILICON

POWER RECTIFIERS



OPERATE UP TO THESE MAXIMUM LIMITS

SERIES	TEMP.	AMPS.	VOLTS
1N503*	150°C	⅓	50 to 600
1N511†	150°C	1	50 to 600
1N519†	150°C	1¼	50 to 600

**In free air* *†With suitable heat sink*

CBS-HYTRON offers you, in three basic designs, a wide selection of high-power silicon junction rectifiers with uniformly controlled characteristics. All three series feature compactness and high rectification efficiency (up to 99%) at high currents. Low forward and high back resistances give high power handling capabilities. And low thermal resistance permits operation up to 150°C.

Possible applications are innumerable . . . wherever you need highly efficient, high-current miniaturized rectifiers. As illustrated, the 1N503 series is supplied with convenient flexible leads. And the 1N511 and 1N519 series are designed with screw studs for easy attachment to heat sinks. For complete data ask for Bulletin E-263. Or request a quotation on CBS silicon power rectifiers suited to your applications.

Reliable products through Advanced-Engineering.

CBS semiconductors
CBS-HYTRON, Danvers, Mass.
A Division of Columbia Broadcasting System, Inc.

For product information, use inquiry card on last page.

TELE-TIPS

(Continued from page 12)

THE CALCULUS taught today fits the engineering needs of 1915, according to educators concerned with the problem.

THE POWER OF TV. Prominent cosmetic manufacturer explaining a loss of $460,000 for the fiscal year attributes the deficit to the success of "$64,000 Question," and to their own "very unproductive" TV campaigns.

TIMBER-R-R-R! Simple wooden containers that will permit the military to air-drop communication receivers from heights of up to 1,000 ft. without a parachute, have been developed by Cargo Packers Inc. of Brooklyn, N. Y. Key elements in the design are a set of plywood retarder plates, or air-drogues, and the placement of the cushioning. In recent test, a 125-lb. radio was dropped from plane travelling at 150 mph. The retarder plates not only slowed the fall to 52 mph but also oriented the package to strike the ground on a corner for maximum energy dissipation.

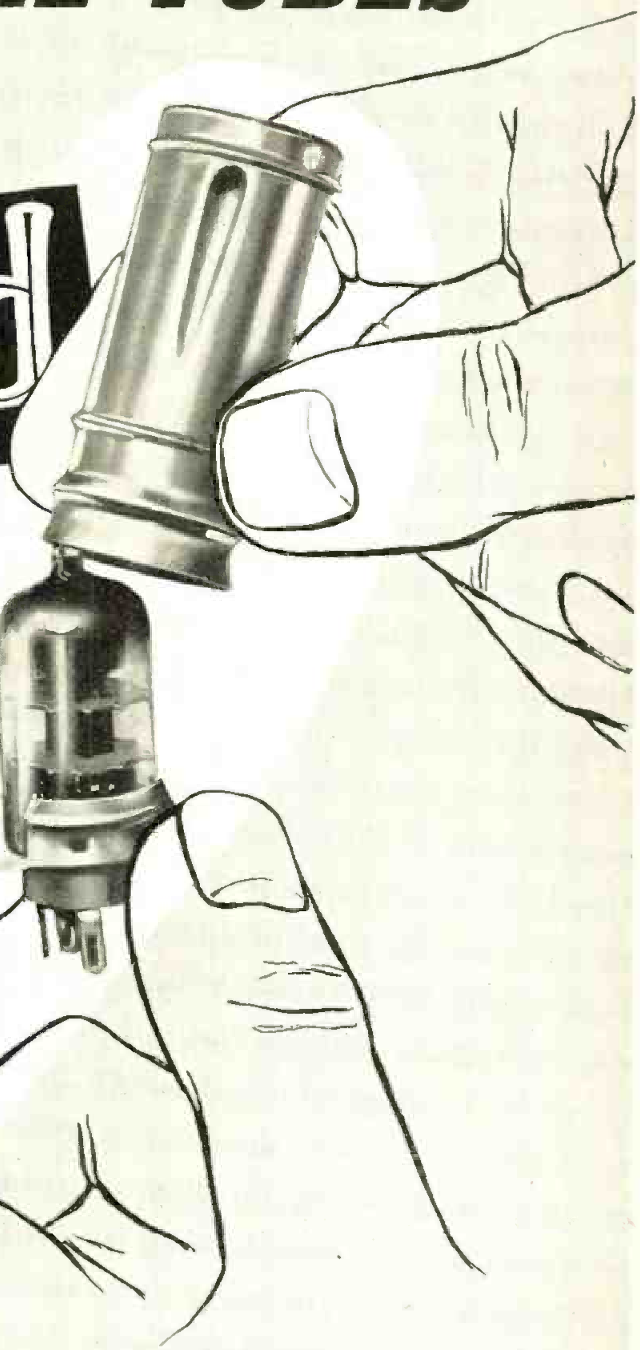
GEOTHERMAL POWER may take a place alongside atomic and solar energy as a source of electricity if studies being undertaken by Minneapolis-Honeywell engineers in New Zealand are successful. Plans call for stations that would tap the country's extensive hot springs and use the subterranean steam to generate electricity.

SERVICE-FREE TV is being offered by Magnavox. Purchasers of their Gold Seal TV receivers, retailing for $249.50 and up, will receive without charge, a three-month service contract and a 1-year warranty on all tubes and parts. Servicing will be handled either through regular service agencies or through service dealers, with Magnavox paying the cost.

"TV PARTIES." One California TV dealer is using the old "aluminum party" gimmick to sell his color TV line. Enthusiastic customers are asked to invite friends to their home for coffee and cakes—and to see color TV. They receive a remuneration in proportion to the number of color sets sold to their guests.

for ECONOMY SHIELDING of MINIATURE TUBES

New! Uni-Shield



Developed especially for use in printed circuits and vertical chassis, the new GOAT UNI-SHIELD is unsurpassed in efficiency and economy. It is designed for use with both 7-pin and 9-pin miniature tubes, and is available in a full range of sizes.

Of economical wrap-around construction, this new design affords the maximum in heat dissipation and air circulation. The base of the UNI-SHIELD clamps firmly on all types of sockets or clips and the tube is locked in the socket, minimizing vibration and breakage.

Made of electrolytic tin plated steel, UNI-SHIELDS are sturdy in construction and attractive in appearance.

You are invited to send us socket samples and tube dimensions and we will forward UNI-SHIELD samples to meet your requirements.

A GOAT QUOTATION WILL SAVE YOU TIME AND MONEY

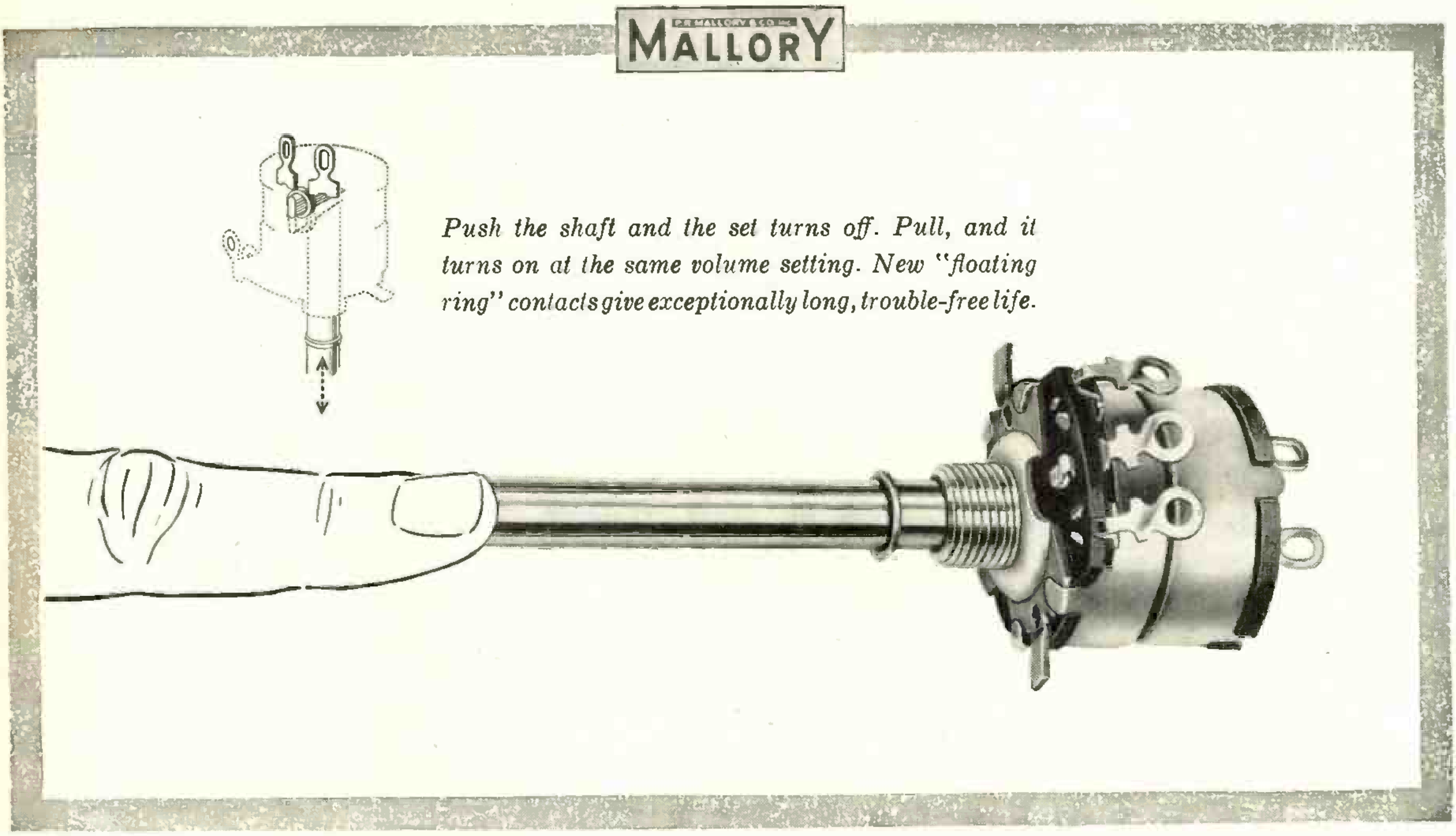
GOAT ELECTRONIC COMPONENTS CATALOG AVAILABLE ON REQUEST

THE FRED GOAT CO., INC. 1893

THE FRED GOAT COMPANY, INC.

314 Dean Street, Brooklyn 17, N. Y.

For product Information, use inquiry card on last page.



Mallory Controls Now Available With New Push-Pull On-Off Switch

FOR YOUR new designs for television receivers, home and auto radios, investigate the unusual, merchandisable performance features of Mallory controls with the new push-pull switch. This new kind of switch turns off when the shaft is pushed in . . . turns on when the shaft is pulled out.

No "groping" for volume setting. The set is turned on at the *same volume control* position as it was turned off.

Longer control life. The control needs to be rotated only for minor volume changes, instead of being moved through a major portion of its travel every time the line switch is actuated.

New switch design. The switch itself uses a unique "floating ring" contact design. Make and break is performed by spring-snapped motion of small rings made of special Mallory contact alloy. The rings float freely on pins . . . automatically align themselves perfectly. They rotate with each operation, exposing a new contact surface. Service life is extremely long. Make and break action is clean and positive.

Single and dual types of Mallory carbon controls are now available with this new switch . . . and with an improved carbon element that has even greater stability, better wearing quality and lower noise than ever before. Write or call Mallory for full details.

★ ★ ★

Long-Lasting "Floating Ring" Switch also in Rotary Model

The new "floating ring" contact design is also available in a switch with conventional rotary action, on Mallory single and dual carbon controls. It gives exceptionally long service . . . positive snap action "feel" . . . protection against loss of spring tension during overloads. Write to Mallory for data.

Serving Industry with These Products:

Electromechanical—Resistors • Switches • Television Tuners • Vibrators
Electrochemical—Capacitors • Rectifiers • Mercury Batteries
Metallurgical—Contacts • Special Metals and Ceramics • Welding Materials

Expect more . . . get more from

P.R. MALLORY & CO. Inc.
MALLORY
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PARTS DISTRIBUTORS IN ALL MAJOR CITIES STOCK MALLORY STANDARD COMPONENTS FOR YOUR CONVENIENCE

NOW... a truly professional quality audiotape

TRADE MARK

for EVERY sound recording need and EVERY recording budget!

PLASTIC-BASE AUDIOTAPE, on 1½-mil cellulose acetate, meets the most exacting requirements of the professional, educational and home recordist to excellent advantage, providing unsurpassed recording quality at minimum cost. This is the *standard* Audiotape, which has already been sold in billions of feet. Series 51, in the *red and black box.*

AUDIOTAPE ON 1½-MIL MYLAR* is a premium-quality tape that provides the utmost in mechanical strength and immunity to extremes of temperature and humidity. Assures freedom from breaking or stretching under stresses of super-fast rewind, instant stops and starts or poorly adjusted clutches. Will not dry out or embrittle with age, even under unfavorable storage conditions. Series 71, in the *green box.*

* Du Pont Trade Mark for polyester film

TYPE LR AUDIOTAPE on 1-mil "Mylar" gives you *50% more* recording and playback time — eliminates reel changes and permits uninterrupted recording of program material that exceeds conventional reel capacity by up to 50%. The 1-mil "Mylar" base is actually stronger at high humidity than the standard 1½-mil plastic base, assuring long tape life even under unfavorable conditions of use or storage. Series 61, in the *black and red box.*

PLASTIC-BASE LR AUDIOTAPE provides 50% more recording and playback time per reel, on a low-cost 1-mil cellulose acetate base. Hence it affords maximum economy for extended-play applications where high mechanical strength is not required. Series 41, in the *blue box.*

SUPER-THIN AUDIOTAPE on ½-mil "Mylar" gives you twice as much recording time per reel as standard plastic base tape. 1200 ft on a 5" reel, 2400 ft on a 7" reel. Suitable for extended play applications where tape tension is not excessive. Series 31, in the *yellow box.*

★ ★ ★

These five types of Audiotape differ only in base material, tape thickness and footage per reel. Whatever type best meets your particular requirements, you can be *sure* that there's no finer recording tape made anywhere, at any price. That's because there's only *one* Audiotape quality — the very finest that can be produced. Its fidelity of reproduction and consistent, uniform quality have made it the first choice of critical professional recordists the world over. Now amateur and home recordists can get this same professional-quality Audiotape at *no extra cost.* There's no need to go elsewhere or accept substitutes. You can meet *all* your requirements with genuine Audiotape. For the complete story on all 5 types, ask your Dealer for a copy of the new, 5-color Audiotape Bulletin No. 250. Or write to Audio Devices, Inc., Dept. T.

AUDIO DEVICES, Inc.

444 MADISON AVE., NEW YORK 22, N. Y.
IN HOLLYWOOD: 1006 N. Fairfax Ave. • IN CHICAGO: 6571 N. Olmsted Ave.
Export Dept.: 13 East 40th St., New York 16, N. Y., Cables "ARLAB"

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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.
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Smallest Size–Highest Power
SUB and SUB-SUB OUNCER TRANSFORMERS
Audio Miniatures
OUNCER and PLUG-IN UNITS
LINEAR STANDARD SERIES
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HIPERMALLOY and ULTRA COMPACT
High Fidelity Favorites
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SPECIAL SERIES . . . Audio and Power Components for the "Ham"
REPLACEMENT TYPES
VOLTAGE ADJUSTERS . . . STEPDOWN and ISOLATION TRANSFORMERS
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MIKE-CABLE TRANSFORMERS
EQUALIZERS
UNITED TRANSFORMER COMPANY
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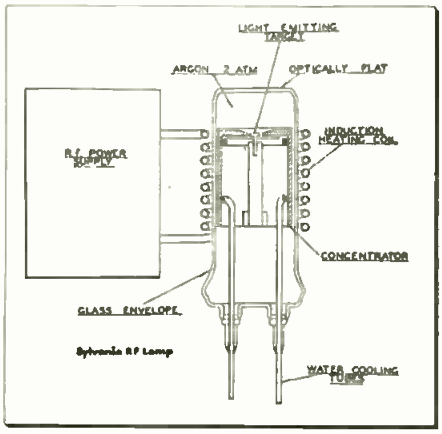
New High Intensity Lamp Uses R-F Heated Disc

A new lamp which uses an r-f induction heated disc of refractory material as a light emitting source has been developed by Sylvania Electric Products Inc. for applications requiring high light output, such as motion picture film processing and TV color tube manufacturing.



Cross section of r-f heated, water cooled lamp

The superiority of the new lamp is in the fact that the refractory material can be heated to much higher temperatures than the tungsten filaments of incandescent lamps, and also that the light from the disc is more uniform.

The complete unit, as presently in use at one Hollywood film studio, consists of a DC voltage source, an r-f power supply and the lamp. Turns of copper tubing around the lamp serve as the r-f heating coil, and water cooling tubes through the base of the lamp system is also provided to cool the lamp and coils.

In comparison tests with a conventional 1,000-watt incandescent lamp the new lamp's output intensity was measured at 2,000 screen lumens as against 800 for the older lamp.

Philco Corp. To Build Experimental TV Station

Philco Corporation has filed an application with the FCC for authority to construct and operate an experimental television broadcast station at Philco's Govt. and Industrial Div. in Philadelphia.

In its application, Philco requested permission to operate on all VHF and UHF channels on a non-interference basis with "basic operation for equipment development on Channel 23." The company plans to begin experimental operations early this year.

Color TV in Mass Production

Confident that the fall buying season will see the long awaited rise of mass sales in color-TV, RCA has now unveiled the fact that one production line in each of their two plants, one in Bloomington and one in Indianapolis have fully converted for color receiver production. These lines are geared to produce sets at a one-a-minute rate. Executive Vice-President Robert A. Seidel of RCA Consumer Products indicated that RCA expects to sell 200,000 sets in 1956 with the bulk of sales occurring after June. Present sales are reported as being approximately 1000 sets a week. It was also reported that contrary to the popular belief that current prices for color sets would enable sales to the higher income groups only, the bulk of present sales are being made to lower and middle income families, largely as installment purchases. There are no immediate price cuts in sight on current models. After mid year, however, new designs are expected to offer some reduction in cost.

The conversion of the Bloomington plant to color production has involved an expense of more than $5,000,000. It has a total of five production lines and the remaining four can readily be converted from their two-shift black and white operation with demand for color. There are four assembly lines in the Indianapolis plant.

The chassis presently being manufactured is a 26 tube design embodying some 2000 component parts. This contrasts to approximately 1200 component parts in a black and white receiver. Not too great a cost reduction can be made on the components being used in a color receiver since many of these items are the same as used in a black and white receiver, and thus are already priced by suppliers on a mass production basis. In the color receiver both the video and sound i-f strips are on individual printed circuits boards. On sets to be introduced later in the year the number of printed circuits boards are expected to go from two to six thereby effecting some manufacturing savings.

Present receivers are supplied to provide both VHF and UHF reception. Actually two tuners are employed, one for VHF and the other for UHF. The latter is "piggy-backed" or behind, and mechanically ganged to, the VHF tuner. When in use it feeds through the VHF tuner which meanwhile, through switching, has been converted into an additional i-f amplifier. If receivers were to be produced on a VHF- or UHF-only basis additional cost reduction would undoubtedly be possible here. Another expensive manufacturing cost lies in the extensive test and inspection facilities required. At Bloomington nearly ⅓ of

(Continued on page 24)

Scene at RCA's Bloomington, Ind. plant as color TV production goes on one-a-min. schedule

As We Go To Press (Cont.)

the lines are involved with inspection and test and ⅔ are on actual production.

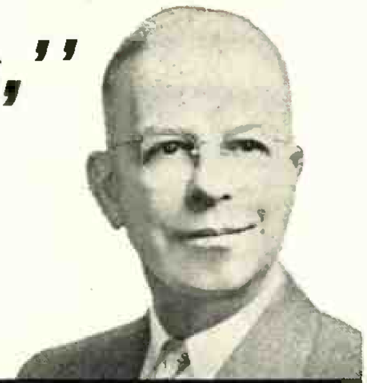
One of the big bottlenecks frequently mentioned by set makers has been the availability of color tubes. W. W. Watts, Executive Vice President, indicated that approximately 220,000 sq. feet of additional floor space had been added at the Lancaster plant and that employment in color-TV tube production will be upped 50% during 1956. The previously announced production capacity of 30,000 tubes per month by the last quarter of 1956 will be surpassed under present schedules. Additionally RCA is now buying color tubes from other manufacturers such as Sylvania, Thomas Electronics and Tung Sol.

Color tube production is over 30,000/month

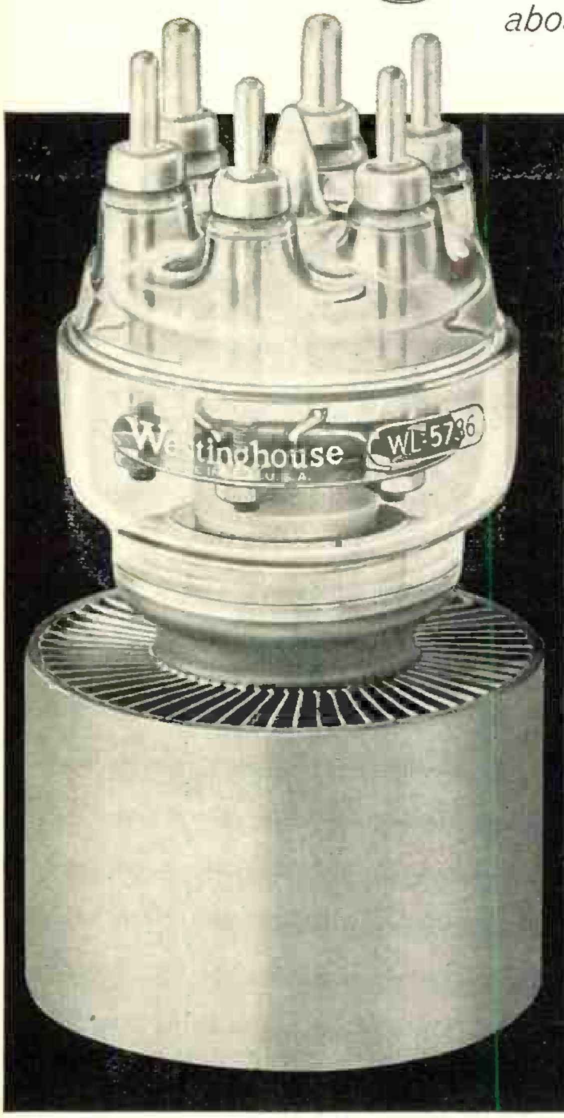
Other factors which were mentioned as strengthening the outlook for the upswing of color in the fall include: the recent reduction in the cost of service contracts to the consumer from 139.95 to 99.95. This contract includes installation and unlimited service during a twelve month period. Increased programming and increased color-TV origination facilities through the new NBC all color broadcasting station in Chicago starting in April, new studio facilities in the Ziegfeld Theater in N. Y., an additional color studio in Brooklyn and new control facilities in Burbank, Calif. R. A. R. Pinkham, Vice President in Charge of Television Network Programs for NBC said that the present 40 hours a month of high attraction programming could well double by Fall. NBC expects to continue the 90 minute spectaculars. Next month they will premier for the first time anywhere Richard III with Sir Laurence Olivier. It should prove an interesting experiment because TV viewers will see it first free. Movie goers will have to pay box office to see it!

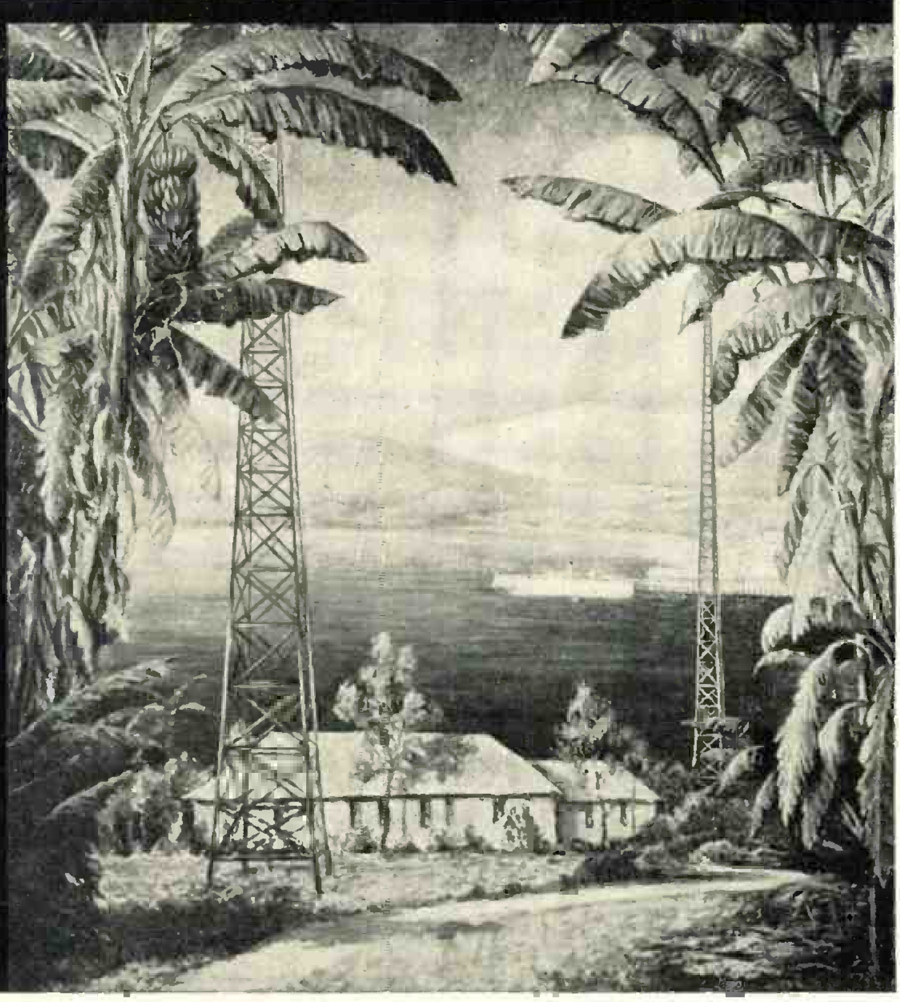
MORE NEWS on page 28

"Reliability where it counts,"



says C. C. Harris,
Vice President and Chief Engineer,
Tropical Radio Telegraph Company,
about the Westinghouse . . .





WL-5736 POWER TUBE

"*We have been using the WL-5736 for seven years,*" says Mr. Harris. "*We have found it to be highly reliable and to give long life. Tropical Radio Telegraph Company requirements are strenuous, especially in hot, humid, tropical climates. Our radio network is vital to Middle-American tele-communications service, and the WL-5736 has given us reliability where it counts.*"

Reports from dozens of other users echo the experience of Tropical Radio Telegraph. For the WL-5736 has long set the standard of excellence in communications and RF heating equipment of all types.

Wherever you need 2.5 kilowatts RF in a small, dependable package, you too will find its performance unbeatable.* Write today for full design data. Commercial Engineering Dept., Westinghouse Electric Corporation, Elmira, N. Y.

ENGINEERS! For challenge, security, growth potential, investigate career opportunities now being offered by Westinghouse Electronic Tube Division. Write Technical Placement Director today.

** Where cooling by low-pressure blower is desirable, specify the new WL-6623 with extra-large radiator and "flying leads."*

6ET-4106

YOU CAN BE SURE...IF IT'S Westinghouse

RELIATRON® TUBES

WESTINGHOUSE ELECTRIC CORPORATION, ELECTRONIC TUBE DIVISION, ELMIRA, N. Y.

NEW Low Cost KLYSTRON OSCILLATOR

... for Use at Frequencies from

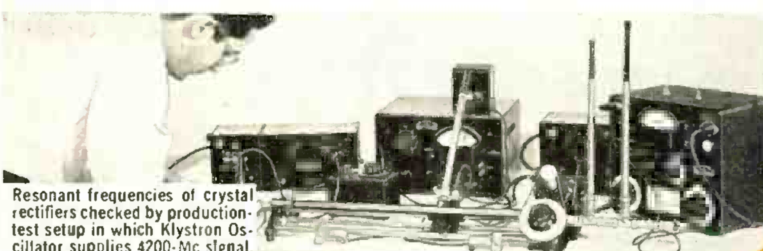
2700 to 7400 Mc

Type 1220-A Unit Klystron Oscillator shown here with plug-in Type 1201-A Unit Regulated Power Supply.

The Type 1220-A Klystron Oscillator is a low cost, small and compact microwave signal source designed for use where the complexity of a signal generator is not required. This new Oscillator is both convenient and flexible in operation . . . a UHF-SHF signal source that is capable of producing a stable high-frequency signal of adequate power for laboratory measurements, production-test work, or for use in college experimental class.

Standard reflex klystron tubes with self-contained cavities are used in the Oscillator. Eight different tubes are provided to cover the 2.7 to 7.5 kMc range. An important feature of this versatile self-contained unit is the provision for internal square-wave modulation, and the ease with which it can be pulse or frequency modulated from external sources.

1220-A Unit Klystron Oscillator supplies JAN specified 3000-Mc for measurement of coaxial-cable attenuation characteristics.



Resonant frequencies of crystal rectifiers checked by production-test setup in which Klystron Oscillator supplies 4200-Mc signal.

SPECIFICATIONS

Type 1220-AO Klystron Oscillator, $205, without tube

Frequency Range: Depends on klystron tube used (see table); all units are otherwise identical — frequency range of any unit can be changed to that of any other by inserting the appropriate klystron tube.

Range	Type No. & Price* Klystron Oscillator including tube	Klystron Tube Type	Price for Tube only	Nominal Power Out (mw) Average Over Frequency Range
2700–2960 Mc	1220-A1, $254.65	726C	$ 49.65	100
2950–3275 Mc	1220-A2, $272.90	6043	$ 67.90	90
3400–3960 Mc	1220-A3, $265.75	2K29	$ 60.75	90
3840–4460 Mc	1220-A4, $312.15	2K56	$107.15	75
4240–4910 Mc	1220-A5, $261.45	2K22	$ 56.45	100
5100–5900 Mc	1220-A6, $301.45	6115	$ 96.45	80
5925–6450 Mc	1220-A7, $272.90	QK404	$ 67.90	100
6200–7425 Mc	1220-A8, $272.90	5976	$ 67.90	90

The klystron tubes used in these oscillators are designed for relatively infrequent tuning. The flexible copper diaphragm used to vary the frequency is subject to failure due to fatigue.

*Note: Power Supply Required.

Internal Modulation: 1-kc square wave, adjustable ±15 cycles

External Modulation:

Square wave, 50 c to 200 kc; sine or square-wave modulating signal of at least 15v, rms required — G-R Type 1210-B R-C Oscillator recommended modulator.

Pulse, 1 to 10,000 μs duration, 0.25 μs rise and fall time, 50 c to 200 kc repetition rate; at least 20v peak pulse voltage required — Type 1217-A Unit Pulser recommended modulator.

Frequency Modulation at least ±10 Mc excursion obtained with less than 3 db change in output — at 60 c an rms input of the order of 10v is suitable.

Output Connector: 50Ω Type 874 Coaxial Connector.

Power Supply:

Type 1201-A Unit Regulated Power Supply, $80.00, recommended for high stability and minimum incidental fm.

Type 1203-A Unit Power Supply, $40, for less critical applications where cost is an important factor.

Type 1202-A Unit Vibrator Power Supply, $125.00, for use in the field from 6v or 12v, d-c power.

Accessories Recommended: Type 874-G10 10-db Pad and Type 874-G20 20-db Pad — Type 874-Q series of Adaptors for connection to circuits fitted with military-type connectors.

We Sell Direct. Prices shown are net, f.o.b. Cambridge or West Concord, Mass.

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90 West Street NEW YORK 6 — 8055 13th St., Silver Spring, Md. WASHINGTON, D. C.
1150 York Road, Abington, Pa. PHILADELPHIA
920 S. Michigan Ave. CHICAGO 5 — 1000 N. Seward St. LOS ANGELES 38

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FREQUENCY STANDARDS
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MEGOHMMETERS

MODULATION METERS
MOTOR CONTROLS
NULL DETECTORS
OSCILLATORS
PARTS & ACCESSORIES
POLARISCOPES
PRECISION CAPACITORS
PULSE GENERATORS
R-L-C DECADES
R-L-C STANDARDS

SIGNAL GENERATORS
SOUND & VIBRATION METERS
STROBOSCOPES
TV & BROADCAST MONITORS
U-H-F MEASURING EQUIPMENT
UNIT INSTRUMENTS
VARIACS
V-T VOLTMETERS
WAVE ANALYZERS
WAVE FILTERS

As We Go To Press (cont.)

New Video Recording Head Developed by Clevite

Development of a new magnetic recording and playback head capable of handling over four million cycles a second at a tape speed of 20 per second was announced by William G. Laffer, president of Clevite Corporation.

The new head reportedly employs a non-metallic structure not heretofore used in this field. It is expected to greatly extend the use of magnetic recording in new areas of technology because of its ability to record and reproduce densely stored magnetic information.

New 4 MC recording head, and miniature model

The new magnetic head is also expected to improve the techniques of recording television programs on magnetic tape, rather than on film, for later broadcast. It will also more than double the amount of information that can be recorded in the magnetic storage devices which are essential parts of many electronic computers.

Sample heads will soon be available to industry through Brush Electronics, Clevite subsidiary.

Radome Symposium At Ohio State U.

The 2nd Annual Radome Symposium will be held at the Ohio Union, on the campus of Ohio State Univ., on June 4-6. The program, which will "review the state of the art of radome design and fabrication," will be classified secret.

Clearance requests should be sent to Charles H. Everhart, (WCREA) Administrative and Security Officer, Electronics Components Lab., WADC, Wright-Patterson AFB, Ohio.

MORE NEWS on page 32

Coming Events

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

Mar. 12-16: Corrosion Show, held in conjunction with the Twelfth Ann. Conference of the NACE, Hotel Statler, New York City.

Mar. 19-22: IRE National Convention and Radio Engineering Show, Waldorf-Astoria and Kingsbridge Armory, New York City.

Mar. 19-23: ASTE Convention and Industrial Exposition. International Amphitheatre, Chicago, Ill.

April 2-4: Symposium on Microwave Properties and Applications of Ferrites, sponsored by Harvard Univ., AF Cambridge Research Center, and the IRE Prof. Gp. on Microwave Theory and Techniques, at Harvard University, Cambridge, Mass. Advance registration by mail is required.

April 5-6: Special Technical Conference on Magnetic Amplifiers, co-sponsored by: AIEE Committee on Magnetic Amplifiers, IRE PRO. Group on Industrial Electronics, ISA Central N.Y. Sec. Hotel Syracuse, Syracuse, N.Y.

April 10-12: Twelfth Annual Meeting and 1956 Metal Powder Show of the MPA, at the Hotel Cleveland, Cleveland, Ohio.

April 11-12: IRE 7th Region Technical Conference, Salt Lake City, Utah.

April 13-14: Tenth Annual Spring Television Conference, sponsored by Cincinnati Sec., IRE, 1349 E. McMillan St., Cincinnati, Ohio.

April 15-19; 34th annual convention of NARTB, Conrad Hilton Hotel, Chicago, Ill.

April 17-19: Fourth National Conference on Electromagnetic Relays, Oklahoma Inst. of Tech. Stillwater, Okla.

April 19-20: Spring Assembly Meeting of the Radio Technical Commission for Marine Services, at the Sheraton Hotel, St. Louis, Mo.

May 14-16: 8th Annual National Conference on Aeronautical Electronics, co-sponsored by the Dayton Chapter of the IRE, and the Prof. Gp. on Aeronautical and Navigational Electronics (IRE), at the Biltmore Hotel, Dayton, Ohio.

May 22-23: RETMA Symposium on Reliable Applications of Electron Tubes, at Irvine Auditorium, University of Pennsylvania, Philadelphia, Pa.

May 29-June 2: International Congress on Microwave Tubes, at the Conservatoire National des Arts et Metiers, Paris, France.

Aug. 15-17. The National Telemetering Conference, sponsored jointly by the IRE, the AIEE, the IAS, and the ISA, in Los Angeles, Calif.

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.

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: Canadian IRE Convention and Exposition, in the Automotive Bldg., Canadian National Exhibition Pk., Toronto, Canada.

Abbreviations:

ASTE: American Society of Tool Engineers
AIEE: American Institute of Electrical Engineers
IRE: Institute of Radio Engineers
ISA: Instrument Society of America
MPA: Metal Powder Association
NARTB: Nat'l. Assoc. of Radio and TV Broadcasters
NACE: National Assoc. Corrosion Engineers
RETMA: Radio-Electronics-TV Manufacturers Assoc.

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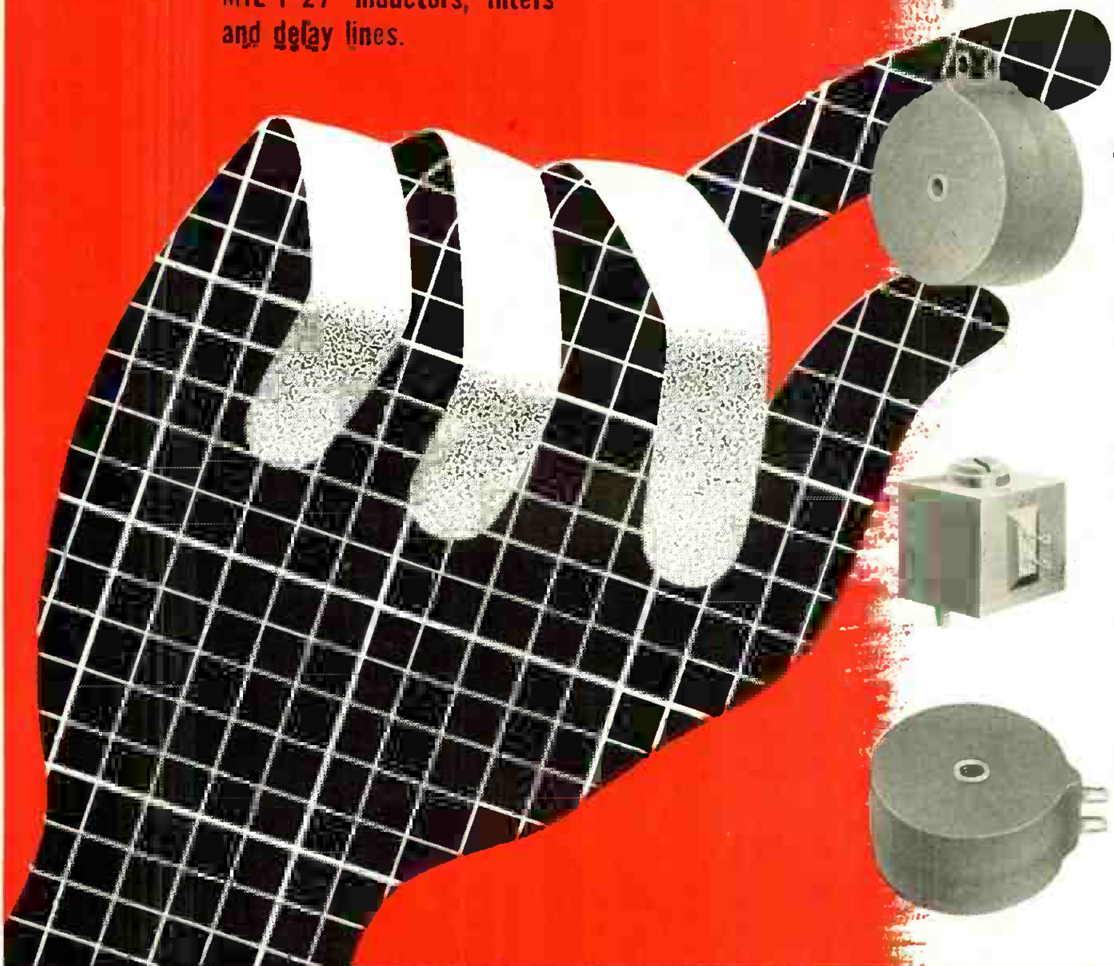
continues to offer the most advanced line of reliable MIL-T-27 inductors, filters and delay lines.

Variable Inductors
- inductance values up to 1000 henrys
- variable over a range of ± 10%
- high Q, small size
- for low-frequency tuning applications



Molded Toroids
- inductance precision within 1%
- high Q because molded construction minimizes distributed capacity
- subminiature to standard sizes
- compact and sturdy

Subminiature Adjustoroids
- precise continuous adjustment of inductance over a 10% range
- no external control current needed
- hermetic sealing
- low cost

Encapsulated Toroids
- hermetically sealed
- high Q
- center mounting permits stacking
- miniature to standard sizes

FOR YOUR CIRCUIT NEEDS...

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Crystal Filters
- nominal cost
- excellent delivery
- frequency range 50 kc to 5000 kc
- high stability

Tom Thumb Telemetering Filters
- miniaturized for guided missiles
- high temperature stability
- designed to withstand shock and vibration
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- for audio and low radio frequency applications
- constancy of time delay
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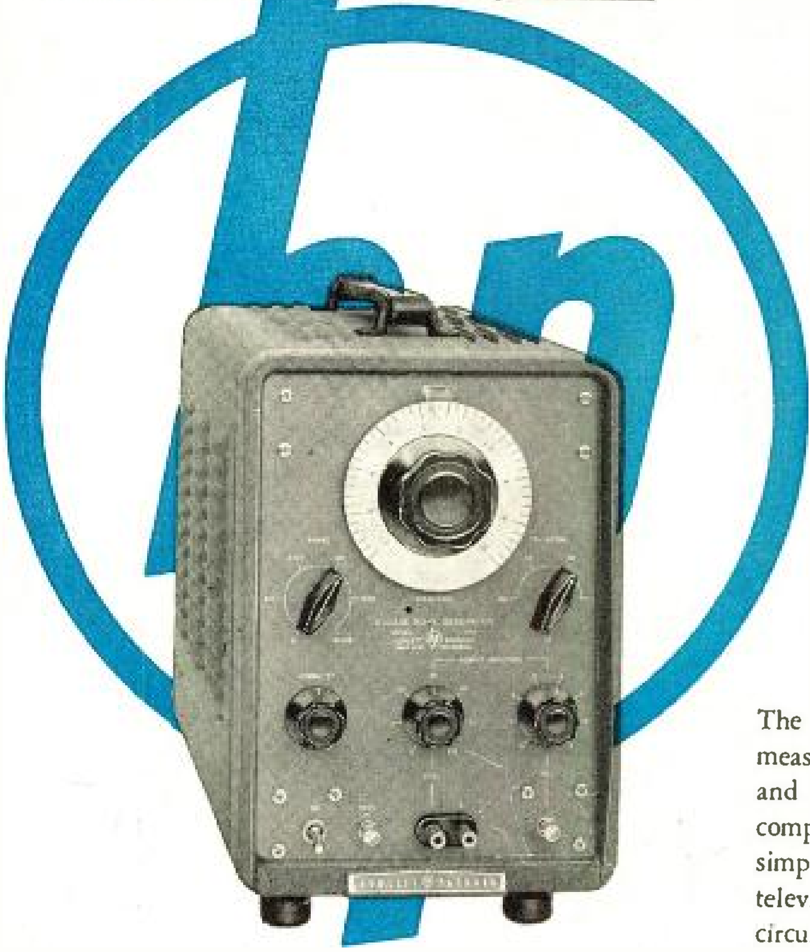

1 cps to 1 MC
Square Wave Generator
with 0.02 µsec rise time

Other Unusual Features

7 volt 75 ohm TV circuit
55 volt 600 ohm high level circuit
Full amplitude variation
External synchronization

The new *-hp-* 211A Square Wave Generator permits fast measurement of audio and video amplifier frequency phase and transient characteristics up to several megacycles. In computer, pulse code and telemetering work, it materially simplifies triggering and switching. It is excellent for testing television circuitry, and ideal for modulating high frequency circuits, testing attenuators, filters and delay lines. In general laboratory use it is an excellent means of measuring time constants, indicating phase shift, frequency response and transient response.

Model 211A has many unique features. Besides the 0.02 µsec rise time and two separate outputs (with full amplitude variation on both), the generator can be operated either free-running or externally synchronized. External synchronizing can be either with a positive going pulse or a sine wave signal of 5 volts amplitude. Much of the instrument's circuitry is etched to provide clean, trouble-free layout, compact size, freedom from stray capacity variations, and thus, a highly uniform product. The generator is of quality construction throughout and is housed in a streamlined, lightweight metal cabinet.

SPECIFICATIONS

Frequency Range: 1 cps to 1 MC, continuous coverage.

Low Impedance Output: 7.0 v peak-to-peak across 75 ohm internal impedance. Rise time less than 0.02 µsec. BNC Connector.

High Impedance Output: 55 v peak-to-peak across 600 ohm internal impedance. Rise time less than 0.1 µsec. Dual banana jacks —¾″ centers.

Amplitude Control: Low Impedance Output — Potentiometer and 60 db attenuator, variable in 20 db steps. High Impedance Output—Potentiometer.

Frequency Control: Dial calibrated "1 to 10" and decade multiplier switch. Six bands.

Symmetry Control: Allows exact square-wave balance.

Sync Input: Positive-going pulse or sine wave signal, minimum amplitude 5 volts peak. BNC connector.

Power: 115/230 v ±10%, 50/60 cps, 195 watts.

Size: 9¾″ wide, 13⅞″ high, 13⅜″ deep.

Weight: Net 22 lbs.; Shipping 44 lbs.

Price: $265.00.

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

Complete Coverage, Highest Quality

SEND FOR OPERATING TECHNIQUES, CAPABILITIES, COMPLETE DATA

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Please send complete data on *-hp-* 211A Square Wave Generator

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Company____________________

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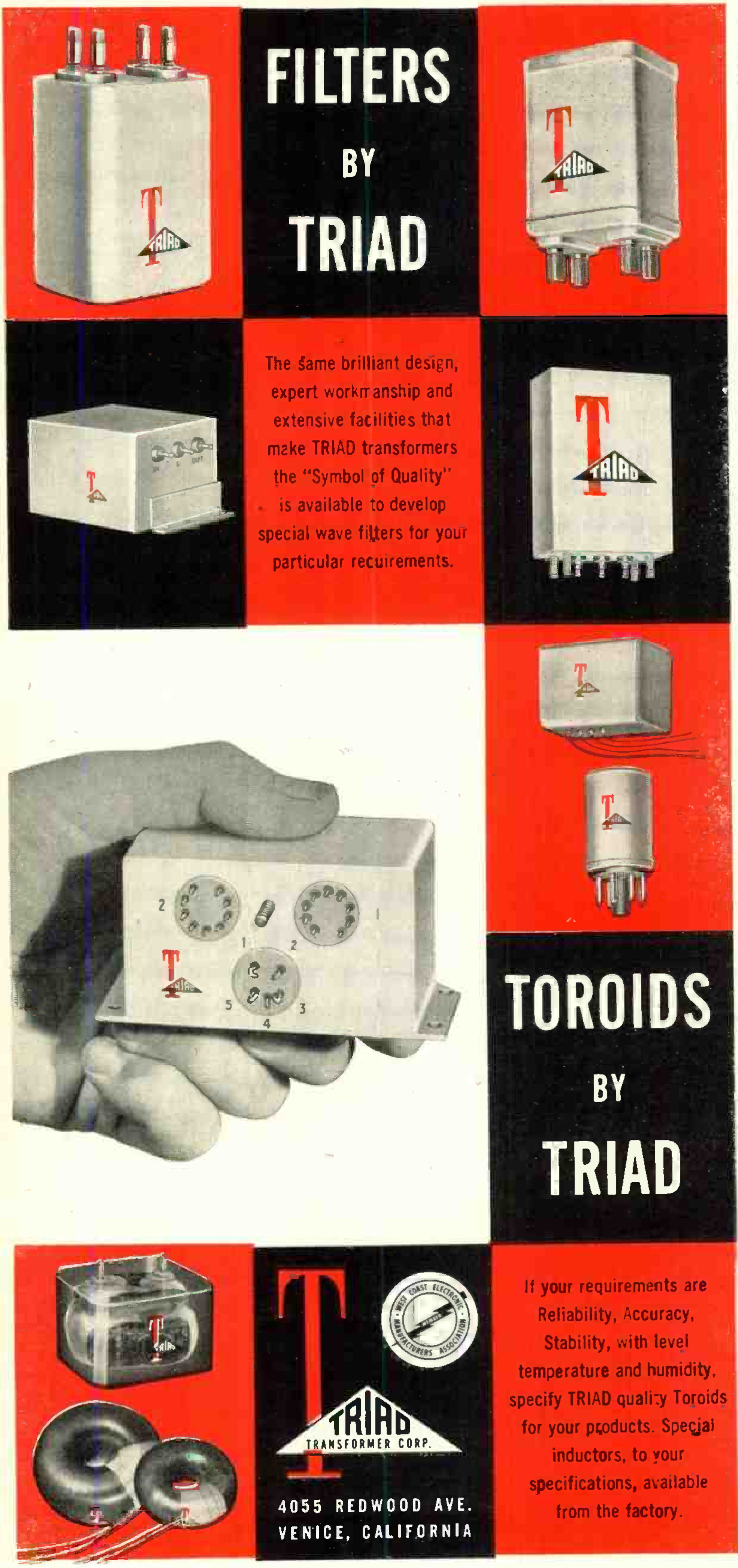
For product information, use inquiry card on last page.



As We Go To Press (Cont.)

WEST COAST WELCOME

Sherman M. Fairchild (l.) is congratulated by Thomas P. Walker, pres. of WCEMA, at the opening of the Fairchild Camera & Instrument Co.'s new W.C. plant in Los Angeles, Calif.

Norris Head of Nuclear

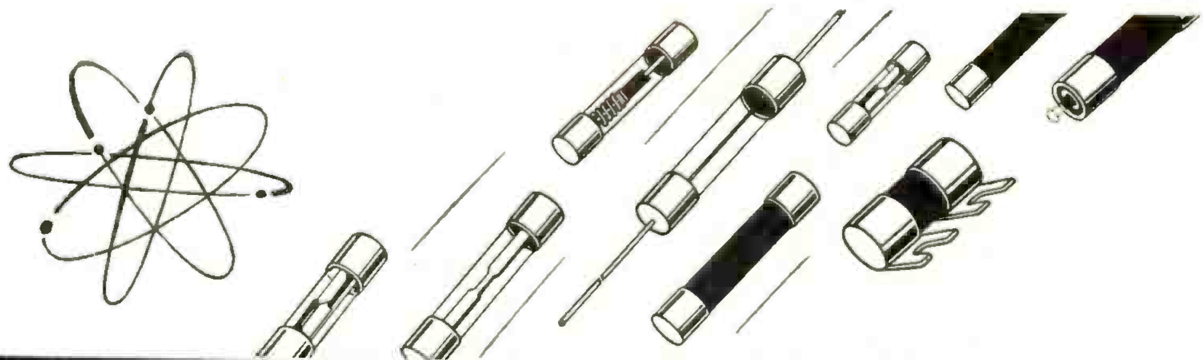
Election of Sam Norris as president of Nuclear Corp. of America, Inc. has been announced by Louis R. Kurtin, chairman of the company.

Mr. Norris is the first operating president of Nuclear Corp., which was formed through the merger of Reo Holding Corp. and Nuclear Consultants, Inc. He was formerly president and director of Amperex Electronic Corp. of Hicksville, New York, which is part of the worldwide organization of N. V. Philips of The Netherlands.

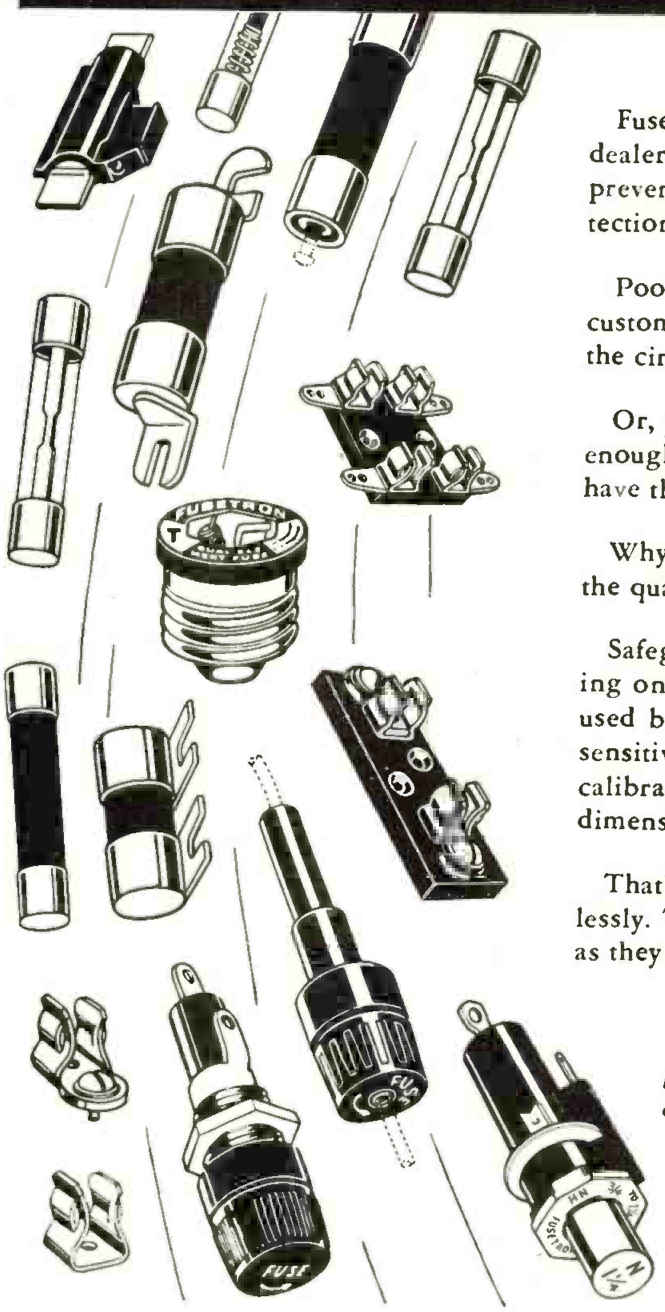
$22 Million Expansion At Lockheed Aircraft

The Lockheed Aircraft Co.'s plans for a $22,000,000 expansion of their research and missile division facilities, which appeared to be shelved last year under pressure of the government's dispersal program, are now apparently being revived. Robert E. Gross, Lockheed president, announced last month plans for construction of a series of research laboratories on a 22-acre site at Stanford Univ., located at Palo Alto and at Sunnyvale, as the first step in a planned 3-year building program.

Construction will begin immediately on two laboratory buildings at the Stanford site, each of which will occupy 51,000 sq. ft. As soon as planning considerations permit construction will begin on 96,000 sq. ft. of manufacturing space at the 275-acre site in Sunnyvale. Both sites are expected to be in operation by the end of the year.



dependable BUSS FUSES can help safeguard the good name of your Product or Service



Fuses may be considered a small item by many service dealers and manufacturers—however, BUSS quality fuses can prevent endless trouble by giving dependable electrical protection under all service conditions.

Poor quality fuses can blow needlessly and shut down your customers' equipment — even though no trouble exists on the circuit.

Or, poorly made fuses might *not* shut down the circuit quick enough when there is an electrical fault — and your customers have the expense of replacing needlessly burned out parts.

Why chance having these troubles mistakenly blamed on the quality of your product or service?

Safeguard against loss of customer good will by standardizing on "trouble-free" BUSS fuses. Each BUSS fuse, normally used by the Electronic Industries, is electronically tested. A sensitive device automatically rejects any fuse not correctly calibrated, properly constructed and right in all physical dimensions.

That's why BUSS fuses blow only to protect — never needlessly. Thus they help safeguard your good name — as surely as they protect users.

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

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TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
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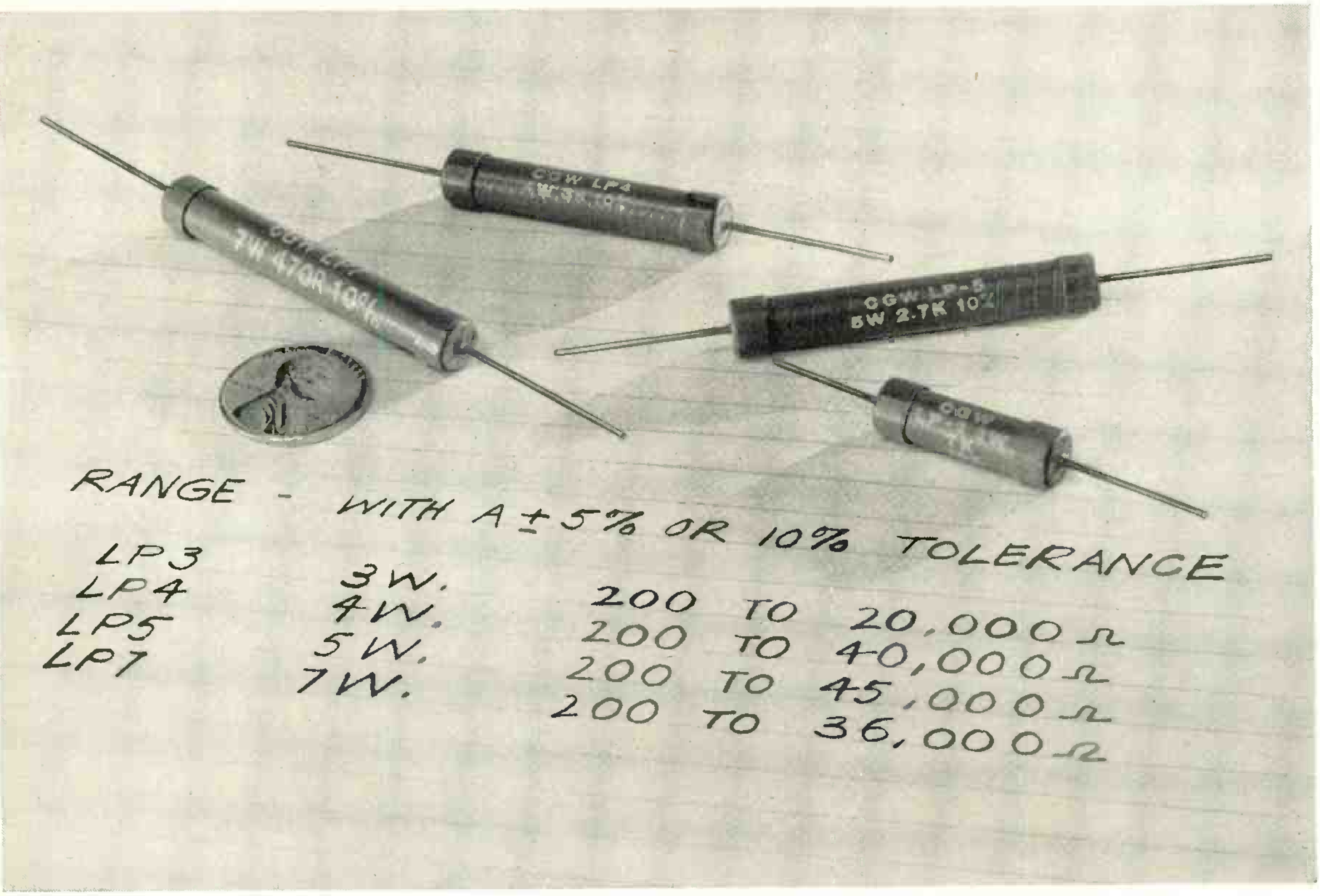
For product information, use inquiry card on last page.



Build better radio and TV circuits with low-price, high-resistance Corning LP Resistors

When we say these low-power resistors are for radio and television circuits, we hasten to add that you can *afford* to use them.

Even though they're the highest-resistance range, low-power resistors around, they're priced within the narrow limits dictated by such mass production requirements as radio and TV.

Corning Low-Power Resistors are designed for your toughest circuits. They are stable and noninductive. They are impervious to moisture and dirt. The tough conductive metallic oxides bonded to the glass blanks are so rugged that special handling is never required. As a result, you can often cut down on handling costs and speed up production—not to mention cut down on rejects.

The tolerance of these low-power resistors is within plus or minus 5 or 10%. Resistance spiralling is automatic and is electronically controlled. You can get these superlative Corning Low-Power Resistors in the values illustrated.

Power rating is based on 40° C. ambient temperature for the 3-, 4-, and 5-watt sizes, and 25° C. ambient for the 7-watt size. Our LP resistors operate to 150° C. ambient with derating.

For detailed specifications, prices and samples, use the reader service number in this publication, or write to us direct.

Ask for information on these other Corning Resistors:

Type S • Stable performance to 200° C. Meet MIL-R-11804B specs. Values to your order.

Type R • High-power 2% or 5% resistors, 7 to 115 watts. Range from 10 to 1,000,000 ohms.

Type H • High-frequency 2% or 5% tolerance—Standard ranges from 10 to 1,000,000 ohms and ratings from 7 to 140 watts.

Type HP • High-power resistors. 17, 30, 70, and 150 watts. Tolerances of 2% or 5%. 20 to 500,000 ohms.

Type WC-5 • Water cooled. Range—35 to 300 ohms. Versatile and adaptable.

Type N • Accurate grade. Made to meet all requirements of MIL-R-10509A. Characteristic X and R.

Other products for Electronics by Corning Components Department:
Fixed Glass Capacitors*, Transmitting Capacitors, Canned High-Capacitance Capacitors, Subminiature Tab-Lead Capacitors, Special Combination Capacitors, Direct-Traverse and Midget-Rotary Capacitors*. Metallized Glass Inductances, Attenuator Plates. **Distributed by Erie Resistor Corporation*

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Components Department, Electrical Products Division

Corning means research in Glass

Electronic Industries News Briefs

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

EAST

ACE ELECTRONICS ASSOCIATES have announced the completion of their move to new and larger quarters at 103 Dover St., Somerville, Mass.

ACTON LABORATORIES, INC. has acquired the entire Instrument Div. of Technology Instrument Corp. Both companies are located in Acton, Mass.

BENDIX AVIATION CORP., Radio Div., Baltimore, Md., has established a new aviation dept. to consolidate all activities concerned with commercial business in the field.

DAYSTROM, INC., has purchased approx. 20 acres of land on Mountain Ave., Berkeley Heights, N.J., as a site for a new executive office building for the corporation's headquarters staff.

ENTHONE, INC., New Haven, Conn., have announced a change in name only of their acid activating compound "Actane" (trademark registered) to Actane 20. There has been no change in the designation of their acidic fluoride-containing compound, Actane 70.

GENERAL ELECTRIC COMPANY's Naval Ordnance Dept., Pittsfield, Mass., has announced the formation of a separate radar antenna engineering organization within the framework of the department

GENERAL PRECISION LABORATORY, Pleasantville, N.Y., has announced a number of organizational changes in the company's Engineering Products Div. N. M. Marshall has been designated to direct sales of TV equipment to the industrial markets. J. W. Belcher has been named manager of a newly created Application Engineering Dept.

GENERAL TRANSISTOR CORP. have moved their plant and offices to enlarged quarters at 130-11 90th Ave., Richmond Hill, N.Y.

HIGH VOLTAGE ENGINEERING CORP., Cambridge, Mass., has announced plans for a new building, which will house the world's largest radiation machine test facility, at Burlington, Mass.

INSULATED CIRCUITS, INC., have opened their new plant, containing approx. 32,000 sq. ft of working area, in West Caldwell, N.J.

INTERNATIONAL BUSINESS MACHINES CORP. is reorganizing a portion of the company's present engineering operations at Poughkeepsie, N.Y., into a Product Development Laboratory to be directed by Horace S. Beattie.

KEARFOTT CO., INC., has announced plans for a new Engineering-Sales bldg. to be constructed opposite the present offices and plants in Little Falls, N.J.

LOCKHEED AIRCRAFT CORP. has established a Special Projects Engineering Div. within the Engineering Branch of Lockheed's Georgia Div. at Marietta, Ga.

NORDEN-KETAY CORP. has contracted to acquire all the assets, business, name and good will of Gyromechanisms, Inc., Halesite, L.I.

NORTH ATLANTIC INDUSTRIES, INC., has opened its new facility at 603 Main St., Westbury, N.Y.

NORTH AMERICAN PHILIPS CO., INC., Research & Control Instruments Div., Mount Vernon, N.Y., has established a new office at 96 Bloomfield Ave., Newark, N.J.

RCA TUBE DIVISION, Harrison, N J., has announced a liberalization of the adjustment policy covering the RCA-5820 image orthicon camera tube. The 5820 is now covered by full adjustment up to 50 hrs. and pro rata up to 500 hrs. of service.

RAYTHEON MANUFACTURING Co., Waltham, Mass., has announced receipt during the month of December, 1955, of orders for military products and services in excess of 24 million dollars.

SPERRY GYROSCOPE CO., Great Neck, N.Y., has been awarded a $7,619,804 contract for the production of very advanced airborne radar systems by the USAF.

SYLVANIA ELECTRIC PRODUCTS, INC., is planning a new 48,000 sq. ft. engineering and pilot production building in Towanda, Pa., for the company's Tungsten and Chemical Div.

THOMAS A. EDISON, INC., through its wholly-owned subsidiary, Measurements Corp., Boonton, N. J., has acquired the business and assets of Linear Equipment Laboratories, Inc., Copiague, L.I.

RADIO STATION WINS, New York, N.Y., has purchased the first production model of a 50 kw max.-power type RCA transmitter, known as "Ampliphase," designed to use phase modulation to produce standard broadcast amplitude modulation.

MID-WEST

ARMOUR RESEARCH FOUNDATION of Illinois Inst. of Tech., Chicago, Ill., has announced a 5 million dollar building program to develop one of the most complete industrial research centers in the world.

CARTER MOTOR CO., Chicago, Ill., has completed plans for a new manufacturing plant to be located a few blocks from the present main office and factory at 2644-A N. Maplewood Ave.

ELECTRO-VOICE, Radio Manufacturing Engineers Div., has moved its facilities to larger quarters at 501 Walnut St., Washington, Ill.

THE MAGNAVOX COMPANY, Fort Wayne, Ind., will build a new plant at Jefferson City, Tenn., for the manufacture of cabinets for radio and TV sets.

MINNEAPOLIS-HONEYWELL REGULATOR CO., St. Paul, Minn., announces that 41 engineers and technicians, representing 34 U.S. industrial firms and 7 foreign ones, have enrolled in the first 1956 class on industrial instruments conducted by the company's Industrial Div.

TRIO MANUFACTURING CO., Griggsville, Ill., has formed a New Product Development Board which will analyze and study dozens of ideas for new products presented to the firm each month.

WEST

THE CIRCON COMPONENT CO., Northridge, Calif., have announced expansion plans involving the removal of their present manufacturing facilities and general offices to new quarters at the Santa Barbara, Calif., Municipal Airport.

COLLINS RADIO CO. has opened a new sales office, in the White Henry Stuart Bldg., 1318 Fourth Ave., Seattle, Wash.

ALLEN B. DU MONT LABORATORIES, INC., is planning the expansion of their new Missiles Engineering Dept., and the installation of additional facilities at their new West Coast headquarters at 11800 W Olympic Blvd., Los Angeles, Calif.

LENKURT ELECTRIC CO., San Carlos, Calif., has formed an Export Div., to provide additional sales engineering service to customers outside the U.S. and Canada.

PACKARD-BELL CO., Los Angeles, Calif., has purchased the assets of Technical Reproducts, Inc., a Calif. firm in the printed circuit field.

SPINCO DIV. of BECKMAN INSTRUMENTS, INC., now located at Belmont, Calif., have broken ground in Stanford Industrial Pk. for a $500,000 research and development center devoted to highly-specialized instruments for the advancement of medicine and the diagnosis of disease.

SYLVANIA ELECTRIC PRODUCTS, INC., has commenced construction of a 50,000 sq. ft. addition to its TV picture tube plant at Fullerton, Calif.

VARIAN ASSOCIATES, Palo Alto, Calif., have announced a new name, Instrument Division, for the group responsible for development and production of the new Varian Super High Resolution N-M-R Spectrometer.

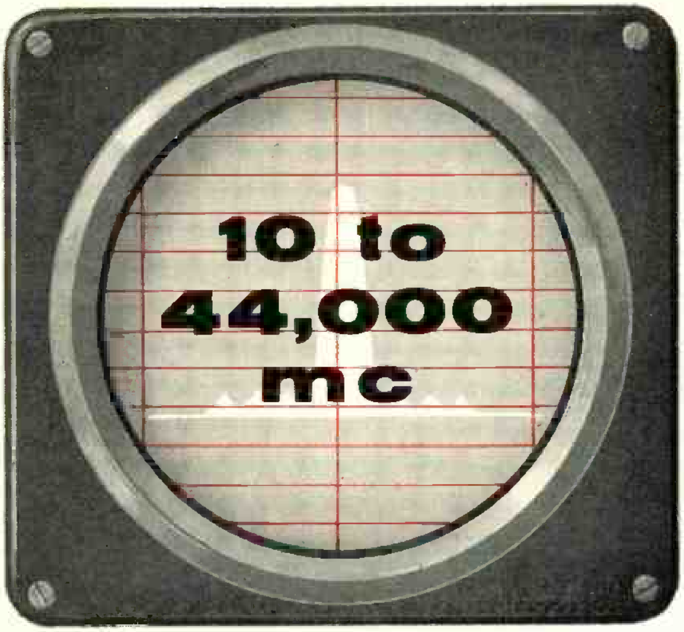
FOREIGN

FILOTECNICA SALMOIRAGHI, S.p.A., of Milan, Italy, has been appointed exclusive agents and licensees in Italy for the Kollsman Instrument Corp.

THE LONDON AUDIO FAIR 1956 is the title for the audio fair to be held in London, England, April 13 to 15. Approx. 40 top British manufacturers will exhibit.

SEMSA ELECTRONICA, S.A., Monterrey, Mexico, has been formed as a manufacturing subsidiary of Sylvania Electric Products, Inc.

TRANS CANADA TELEPHONE SYSTEM expects to have its coast to coast radio relay system, now under construction, completed in 1957 or early 1958. A light route microwave system has been operating satisfactorily between Halifax and Saint John.



POLARAD
PROVEN RELIABILITY

DIRECT READING SPECTRUM ANALYZER

UNI-DIAL CONTROL

Years of day-in, day-out field operation by most exacting users, have proven the Polarad Model TSA Spectrum Analyzer to be a versatile test instrument of highest reliability and accuracy for both laboratory and production applications.

It is a broadband instrument with greatest pulse sensitivity over the band—10 to 44,000 mc. And each of its five interchangeable RF tuning heads operate with utmost simplicity and frequency stability. All tuning is by Uni-Dial control. Frequencies are read with 1% accuracy right on the linear dial as the set is tuned. No mode charts or interpolations necessary.

The Polarad Model TSA has been designed to save engineering manhours. Its 5 inch CRT display of the RF spectrum is bright and easily defined. And its 1 cycle sweep speed makes for fine resolution. For detailed specifications, contact your nearest Polarad Representative, or write directly to the factory.

APPLICATIONS

- Transmitter characteristics tests
- Broadband receiver for AM, FM, CW, MCW, and pulse modulated signals
- Component tests
- Frequency measurements
- Leakage, interference and radiation measurements
- Bandwidth measurements
- Modulation tests
- Adjacent signal channel tests
- Attenuation measurements
- Filter measurements
- Standing wave measurements

MULTI-PULSE SPECTRUM SELECTOR

MODEL SD-1

Increases the versatility of Polarad Spectrum Analyzers. It displays and allows selection for analysis of a specific train of microwave pulses, as well as any one pulse in the train; selects and gates a group of pulses up to 180 μsec. in length; and is designed to work with fast, narrow pulses; can be adjusted to gate any pulse including the first at zero time. Special circuitry discriminates automatically once pulses have been selected. Operates at any of the frequencies accepted by Polarad Spectrum Analyzers.

FEATURES:

Continuously variable sweep widths; 15 to 180 μsec. • Continuously variable gate widths for pulse selection; 0.4 to 10 μsec. • Continuously variable gate delays for pulse selection; .3 to 180 μsec. • Automatic gating of spectrum analyzer during time of pulse consideration. • Intensified gate (brightening) to facilitate manual pulse selection. • Triggered sweep on first pulse in any train. • No sweep in absence of signal.

SPECIFICATIONS:

Maximum Pulse Train Time 180 μsec. • Pulse Rise Time .05 μsec. Minimum • Minimum Pulse Separation .2 μsec. • Repetition Rate 10—10,000 pps. • Minimum Pulse Width .1 μsec. • Input Power 95 to 130 volts, 50/60 cps., 325 watts. • Input Impedance 50 ohms. • Output Impedance 50 ohms (to match TSA Spectrum Analyzer).

BROADBAND SPECTRUM ANALYZER

FEATURES

- Greatest signal sensitivity over entire frequency band.
- Single frequency control with direct-reading dial accurate to ±1%.
- Complete frequency coverage from 10 mc to 44,000 mc.
- Internal RF attenuator (RF Tuning Unit Models STU-1, STU-2A, STU-3A).
- Adjustable frequency display from 400 kc to 25 mc.
- Frequency differences as small as 40 kc measurable by means of adjustable frequency marker with variable amplitude.
- 25-kc resolution for all bands.
- Stable klystron oscillators using non-contacting plungers to insure longer life.
- No klystron modes to set.
- 5-inch CRT display.
- Portable and completely self-contained.

MODEL TSA

SPECIFICATIONS

Model No.	Equipment
Model Du........	Spectrum Display and Power Unit
Model STU-1...	RF Tunning Unit 10-1,000 mc.
Model STU-2A.	RF Tuning Unit 910-4, 560 mc.
Model STU-3A.	RF Tuning Unit 4,370-22,000 mc.
Model STU-4	RF Tuning Unit 21,000-33,000 mc.
Model STU-5...	RF Tuning Unit 33,000-44,000 mc.

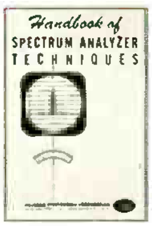
SPECIFICATIONS:

Frequency Range: 10 mc to 44,000 mc.
Frequency Accuracy: ±1%
Resolution: 25 kc.
Frequency Dispersion: Electronically controlled, continually adjustable from 400 kc to 25 mc per one screen diameter (horizontal expansion to 20 kc per inch)
Input Impedance: 50 ohms—nominal
Sensitivity:*
STU-1 10-400 mcs—89 dbm
400-1000 mcs—84dbm
STU-2A 910-2,200 mcs—87 dbm
1,980-4,560 mcs—77 dbm
STU-3A 4,370-10,920 mcs—75 dbm
8,900-22,000 mcs—60 dbm
STU-4 21,000-33,000 mcs—55 dbm
STU-5 33,000-44,000 mcs—45 dbm
Overall Gain: 120 db
Attenuation:
**RF Internal 100 db continuously variable,
IF 60 db continuously variable
Input Power: 400 Watts
*Minimum Discernible Signal
**STU-1, STU-2A, STU-3A

AVAILABLE ON EQUIPMENT LEASE PLAN

FIELD MAINTENANCE SERVICE AVAILABLE THROUGHOUT THE COUNTRY

Consult us on your Spectrum Analysis Problems



Write for your copy of the Polarad "Handbook of Spectrum Analyzer Techniques". 50c per copy. Includes discussion of Spectrum Analyzer operation, applications and formulae for analysis techniques.

POLARAD PROVEN RELIABILITY **ELECTRONICS CORPORATION** 43-20 34th STREET, LONG ISLAND CITY 1, N. Y.

REPRESENTATIVES • Albuquerque • Atlanta • Baltimore • Boston • Buffalo • Chicago • Dayton • Englewood • Fort Worth • Los Angeles • New York Philadelphia • San Francisco • Syracuse • Washington, D. C. • Westbury • Winston-Salem • Canada, Arnprior, Toronto—Export: Rocke International Corporation

For product information, use inquiry card on last page.

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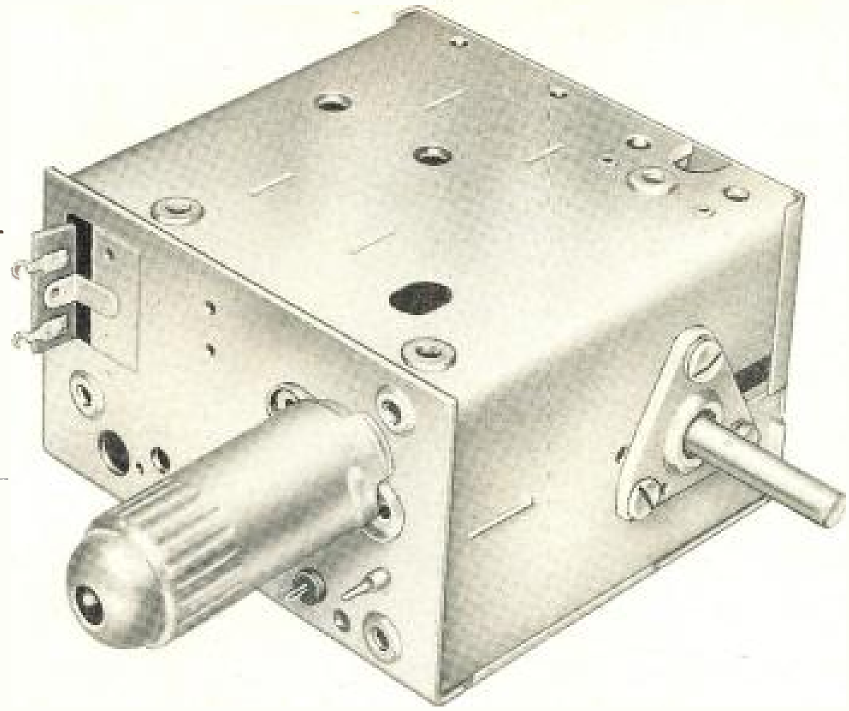


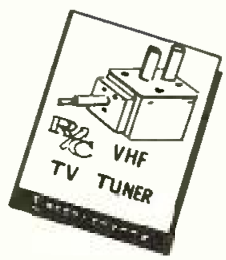
how we cut tuner costs without cutting quality corners

The hotly competitive TV market has long wanted high quality tuners at low prices. But everytime we took a production tuner and cut enough circuit and package "corners" to effect a significant price cut, we wound up with a product unworthy of our R/C trademark.

But last year we had our Engineering Department design a new series of tuners from scratch . . . requesting top performance and bottom costs. What we got was remarkable performance —better than requested—but no appreciable price differential. Until production got into the act, that is. Production designed and sold management on setting up a line of mechanized production equipment. And that equipment brought costs down to the desired level.

The result is evident in the T-90 uhf TV tuner illustrated. Double-circuit tuned, it features oscillator radiation fixes . . . meets all RETMA spurious radiation requirements. Performance is just what you would expect from Radio Condenser, *but the T-90 costs you far less than any previous R/C uhf tuner!*

If you want information on the new R/C line of low cost tuners, we'll be happy to have one of our engineers call at your convenience.



Get Complete Engineering and Performance Data.
Write Radio Condenser for your free copy of Bulletin T-90

RADIO CONDENSER CO.

Davis & Copewood Streets • Camden 3, New Jersey
EXPORT: Radio Condenser Co., International Div., 15 Moore St., N.Y. 4, N.Y., CABLE: MINTHORNE
CANADA: Radio Condenser Co. Ltd., 6 Bermondsey Rd., Toronto, Ontario

SEE US AT THE I.R.E. SHOW—Booth 780 Airborne Ave.

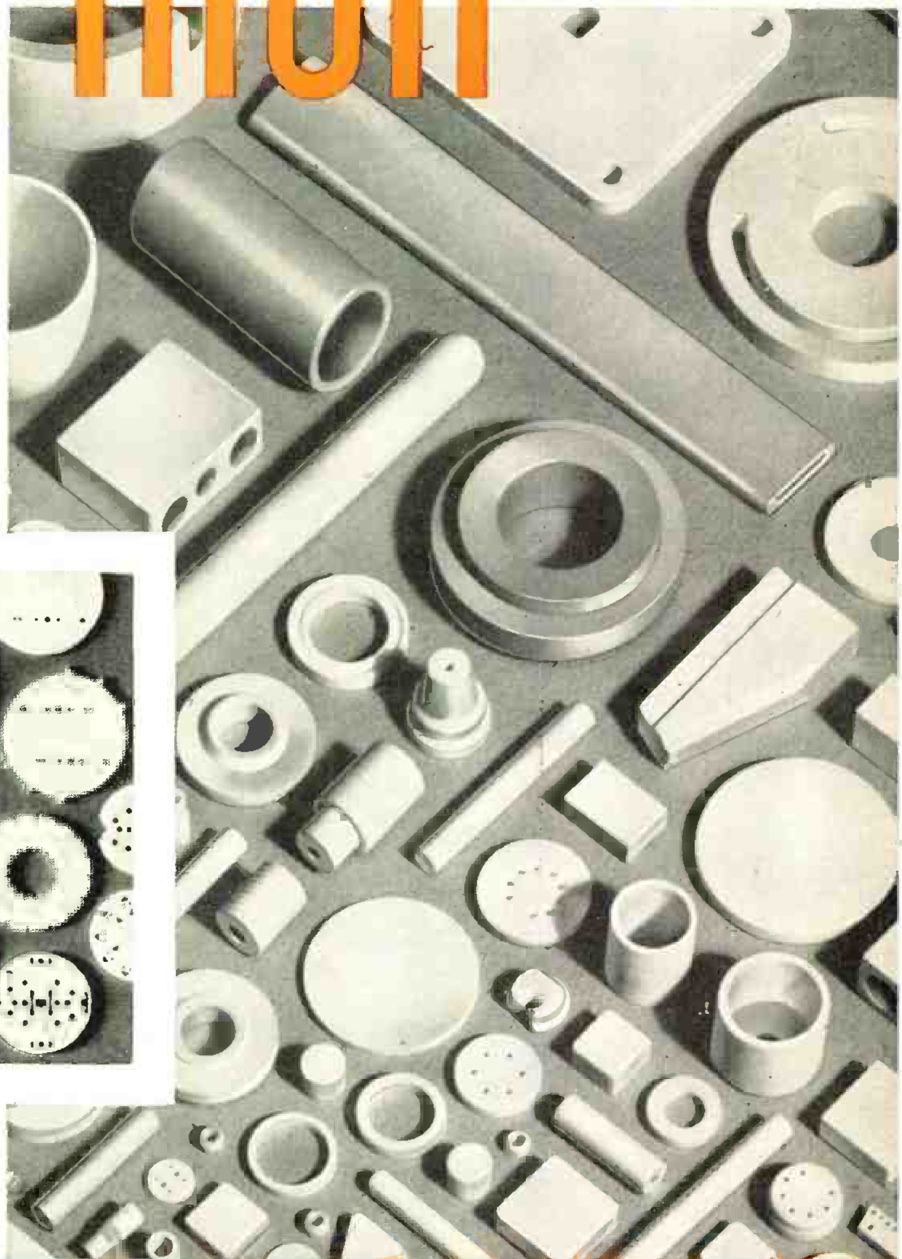
ALSIMAG®

advanced ALUMINA CERAMICS

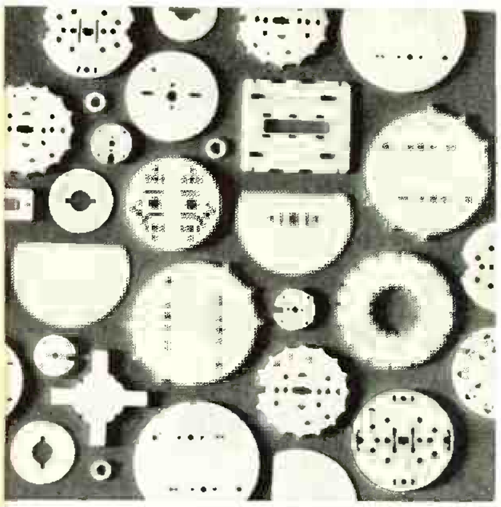
with new HIGH

temperature
strength
quality
production

Greatly enlarged facilities now produce high quality, pace-setting AlSiMag Alumina ceramics in quantity lots. Complete range of up-to-the-minute Alumina compositions now permit you to design to higher temperatures and higher strengths. Advantages include improved electrical characteristics at elevated temperatures—beyond the melting point of most metals. Higher tensile and impact strengths. Greater resistance to corrosion and abrasion. Smoothness of texture. Close dimensional tolerances. Custom formulations for special needs.



Volume production in a complete range of precision parts, including electron tube shapes processed to be highly porous, readily degassed, thicknesses as low as .009".



• An outline of your requirements, enclosing a blueprint or sketch, will bring you full details.

Visit Booth 124 at IRE Show, Military Avenue

54TH YEAR OF CERAMIC LEADERSHIP

AMERICAN LAVA CORPORATION

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A Subsidiary of
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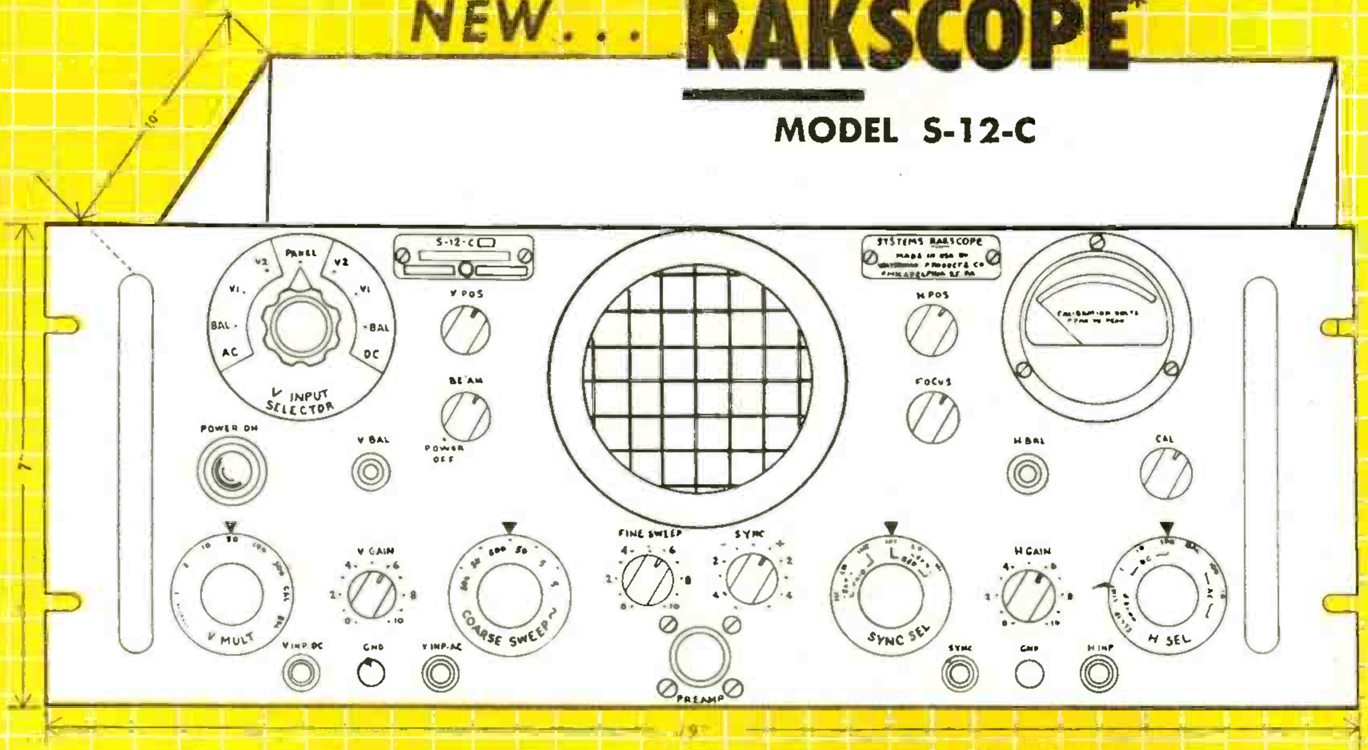
Branch offices in these cities (see your local telephone directory): Cambridge, Mass. • Chicago, Ill. • Cleveland, Ohio • Dallas-Houston, Texas Indianapolis, Ind. • Los Angeles, Calif. • Newark, N. J. • Philadelphia, Pa. • St. Louis, Mo. • South San Francisco, Calif. • Syracuse, N. Y. • Tulsa, Okla. **Canada:** Irvington Varnish & Insulator Div., Minnesota Mining & Mfg. of Canada, Ltd., P. O. Box 757, London, Ontario. **All other export:** Minnesota Mining & Mfg. Co., International Division, 99 Park Ave., New York, N. Y.

see the NEW... SYSTEMS **RAKSCOPE***

MODEL S-12-C



by Waterman

The S-12-C series of Systems Rakscopes have been developed specifically for monitoring and troubleshooting of rack-mounted equipment.

In these oscilloscopes, flexibility to a new degree is obtained with the multiple input selector. Now, for the first time, it is possible to select different signal sources, permitting the omission of an entire switching panel from the overall system with resultant circuit and space economies. A ruggedized construction philosophy has been carried throughout.

- Optional vertical input selector up to 11 positions, with built-in attenuators. The switch selects either front panel connectors for troubleshooting or rear connectors for systems monitoring.
- Vertical amplifier sensitivity 50 mv rms/inch . . . frequency response DC to 700KC. (–2db).
- Signal calibration employs direct-reading meter.
- Horizontal amplifier deflection sensitivity 72 mv rms/inch . . . frequency response DC to 700 KC (–2db).
- Time base from ½-cycle to 50KC.
- Synchronization; trigger or repetitive regardless of polarity.
- Synchronization lockout circuits employed for stable operation over wide range of frequencies and amplitudes.
- Special plug-in elliptical sweep for rapid frequency calibrations.
- Power Source: 105-125 volts, 50 to 400 cycles.
- Accessory probes available; attenuator and amplifier types.

. . . AT THE IRE SHOW BOOTH 158-160

MEMO... Write for details today!

WATERMAN PRODUCTS CO., INC.

PHILADELPHIA 25, PA. • CABLE ADDRESS: POCKETSCOPE

MANUFACTURERS OF

POCKETSCOPES*
RAKSCOPES*
PULSESCOPES*
PANELSCOPES*

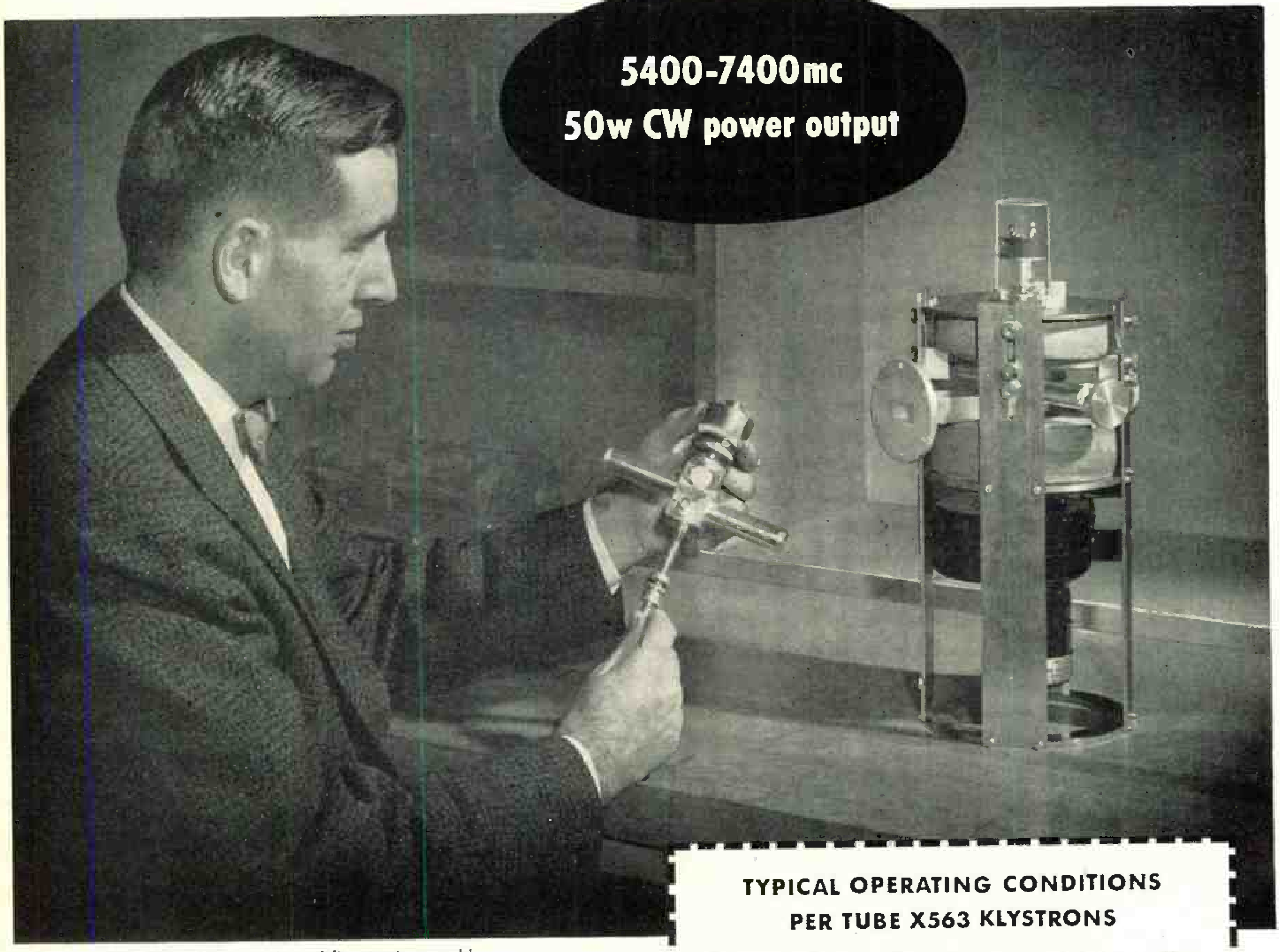
RAYONIC* CATHODE RAY TUBES
And Other Associated Equipment

WATERMAN PRODUCTS

*T.M. Reg.

For product information, use Inquiry card on last page.

EIMAC Klystrons bring new power to another frequency range...



Eimac X563E, 5900-6400mc, and amplifier circuit assembly.

TYPICAL OPERATING CONDITIONS PER TUBE X563 KLYSTRONS

D-C Beam Voltage	2750v	Power Output	60w
D-C Beam Current	110ma	Efficiency	20%
D-C Focusing Voltage	−50v	Driving Power	5mW

Eimac X563 amplifier klystrons make 50 watt CW power output commercially available at 5400-7400mc. A bonus feature of the X563 is its adaptability to present C-Band systems. Existing milliwatt equipment is sufficient to drive a conservatively rated X563 to power gains of 10,000 times and efficiencies of 20-25%.

Single adjustment tuning knobs make each of the X563's four integral cavities as easy to tune as a standard AM broadcast receiver.

The Eimac X563 is also available with magnetic circuit components, output waveguide fitting and collector and cathode sockets comprising a suitcase-size amplifier assembly weighing only 20 pounds.

See the X563 and other new Eimac klystron, ceramic and negative grid tube developments at booth 549-551 during the I.R.E. Show and Convention in New York City, March 19-22.

Eimac

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

A major step forward has been achieved by uniting Fairchild precision potentiometers with dynamically balanced and sensitive pressure-sensing elements. The result is a line of superior pressure transducers with potentiometer outputs and featuring all the characteristics of precision, reliability and quality that are identified with Fairchild potentiometers. A specially trained staff of engineers is at your service to consider problems of transducer design and manufacture to meet your specific requirements.

**BOOTH 648
IRE SHOW
NEW YORK**

PRESSURE TRANSDUCERS

Featuring Fairchild accuracy and reliability

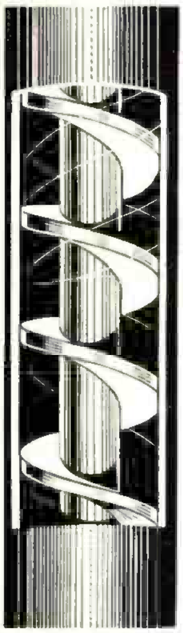
The TPD-300 Transducer illustrated introduces a new line of Fairchild controls. Now, pressure transducers will be available to you in a wider range of resistances in either linear or functional, single or dual potentiometer output elements. The unit shown features two pressure-sensitive diaphragm elements which actuate two precision potentiometers through a dynamically-balanced, stable mechanical linkage. Variations of size, conformation and pressure ranges for measurement of differential, absolute or gauge pressures are also available. For complete information, write Fairchild Controls Corp., Components Division, Dept. 140-69E.

EAST COAST
225 Park Avenue
Hicksville, L. I., N. Y.

WEST COAST
6111 E. Washington Blvd.
Los Angeles, Calif.

FAIRCHILD
PRECISION POTENTIOMETERS
PRESSURE TRANSDUCERS

For product information, use inquiry card on last page.



Installed by U. S. Army Signal Corps in Important Alaskan Microwave System.

Styroflex coaxial cable's ability to operate under extreme climatic conditions is being dramatically demonstrated by the U. S. Army Signal Corps microwave system in Fairbanks, Alaska. Here—*where temperatures frequently drop as low as minus 60 degrees Fahrenheit*—the cables are operating successfully around the clock without interruption or failure.

Styroflex reel is loaded on truck for transportation to installation site.

Styroflex cables connect transmitters directly to roof-supported dishes.

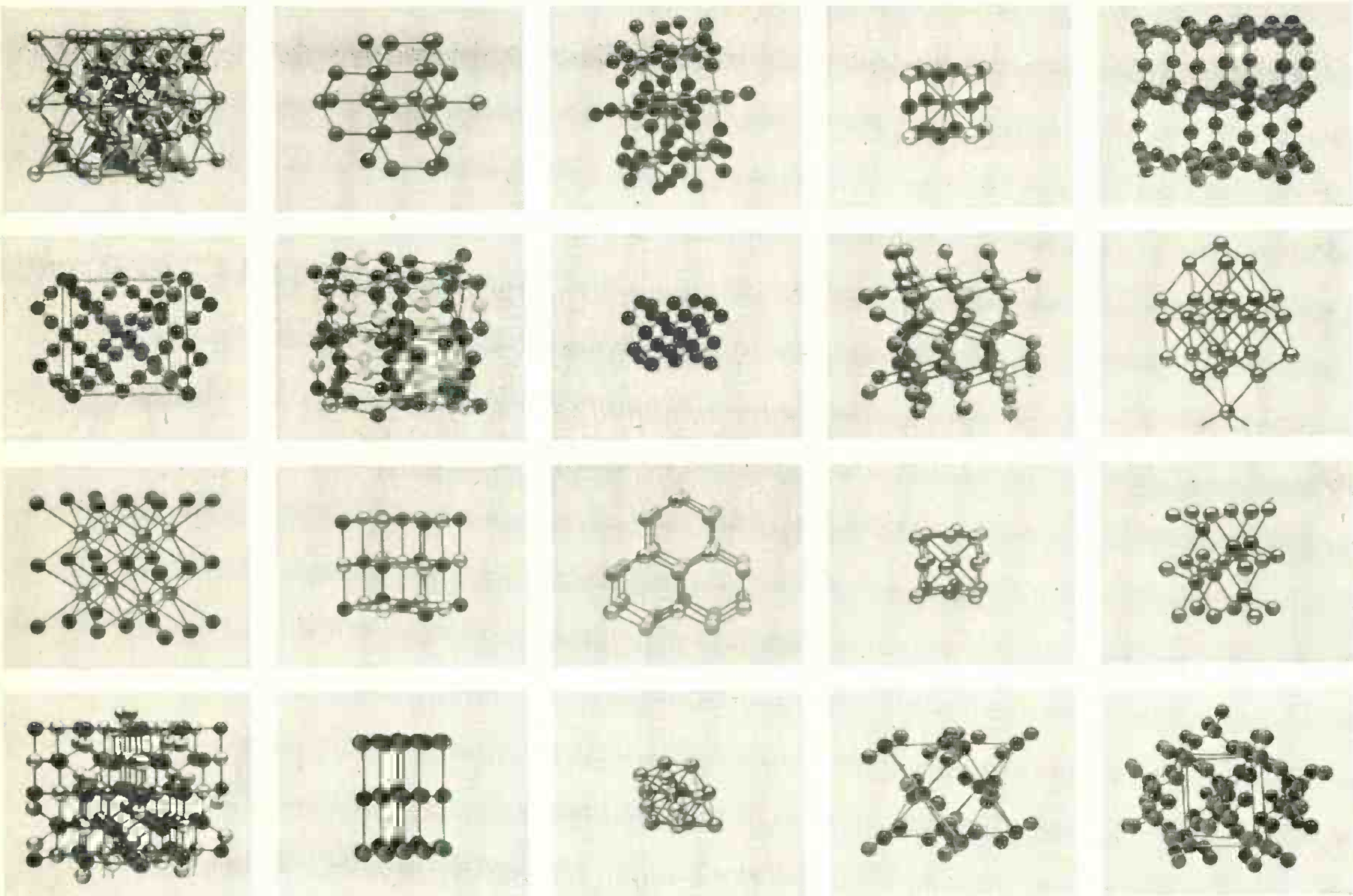
U. S. Army Photographs

PHELPS DODGE COPPER PRODUCTS

CORPORATION

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

For product information, use inquiry card on last page.



Crystal structure models. Top row, left to right: cuprite, zincblende, rutile, perovskite, tridymite. Second row: cristobalite, potassium dihydrogen phosphate, diamond, pyrites, arsenic. Third row: caesium chloride, sodium chloride, wurtzite, copper, niccolite. Fourth row: spinel, graphite, beryllium, carbon dioxide, alpha-quartz.

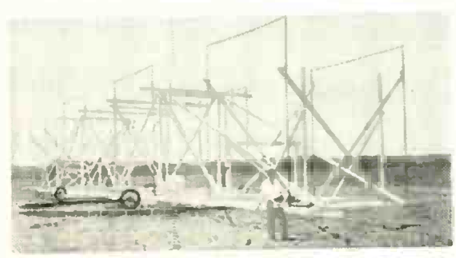
FROM ATOMS TO STARS

Research at Bell Telephone Laboratories ranges from the ultimate structure of solids to the radio signals from outer space. Radio interference research created the new science of radio astronomy; research in solids produced the transistor and the Bell Solar Battery.

Between atoms and stars lie great areas of effort and achievement in physics, electronics, metallurgy, chemistry and biology. Mechanical engineers visualize and design new devices. Mathematicians foreshadow new communications techniques.

Despite the diversity of their talents, Bell Laboratories scientists and engineers have much in common. A habit of teamwork channels these talents into great communications advances. These men have developed the world's finest telephone system. In doing so, many have become leaders in their fields. Opportunities for achievement await properly qualified scientists and engineers at Bell Telephone Laboratories.

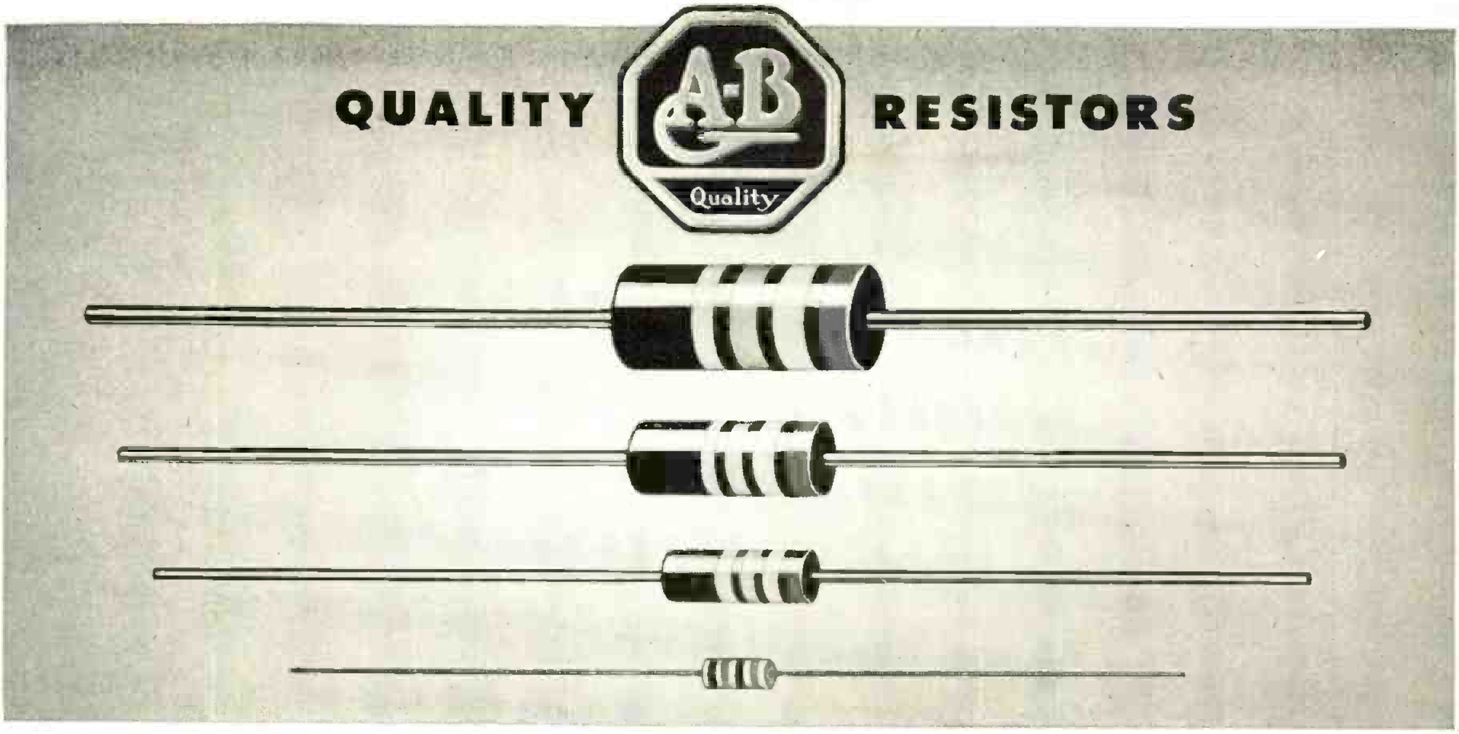
Models of the atomic patterns in solids help Bell Laboratories scientists visualize their electrical behavior.



Directional antenna used by Karl G. Jansky in discovery of stellar radio signals at Bell Telephone Laboratories in 1932.

BELL TELEPHONE LABORATORIES

WORLD CENTER OF COMMUNICATIONS RESEARCH • LARGEST INDUSTRIAL LABORATORY IN THE UNITED STATES



FIXED COMPOSITION RESISTORS IN FOUR SIZES

All rated at 70C — not 40C

There is an EXTRA MARGIN OF SAFETY in Allen-Bradley molded fixed resistors, because they are rated at 70C ambient temperature . . . not at 40C. These resistors can withstand extremes of temperature, pressure, and humidity without deterioration. They require no impregnation to pass salt-water immersion tests.

Allen-Bradley fixed resistors are available in 4 sizes... Type HB—2 watt; Type GB—1 watt; Type EB—1/2 watt; and Type TR—1/10th watt, in standard RETMA values from 10 ohms to 22 megohms. Their close dimension tolerances are an outstanding advantage when used in automatic assembly lines. The color coding does not chip.

For applications where resistors must not fail, use Allen-Bradley. Of course, they are also "the best" for all uses . . . and they cost no more than ordinary resistors. Send for Allen-Bradley resistor data.

Allen-Bradley Resistors Are Packaged in Cartons and on Reels

Allen-Bradley resistor patented cartons have corrugated strips which hold the resistors in an upright position which prevents bending or tangling of leads.

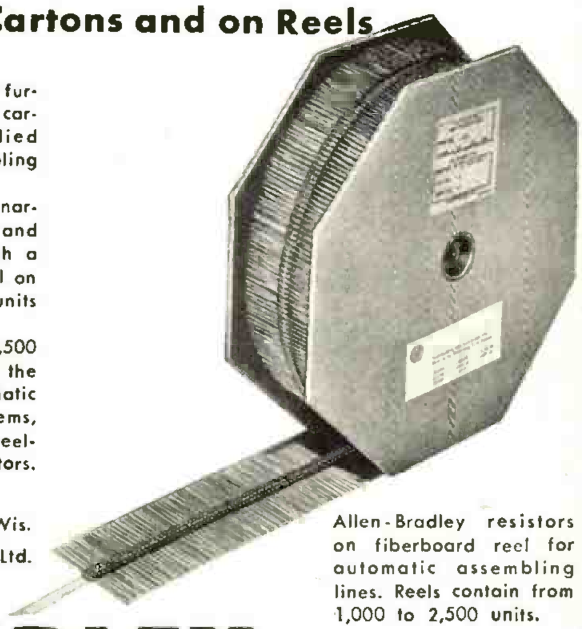
Allen-Bradley fixed resistors are furnished, as standard, in patented cartons. They can also be supplied in reels for automatic assembling equipment.

The resistors are aligned on a narrow, pressure-sensitive tape and wound on a fiberboard reel with a 9/16-inch mandrel. A lateral pull on the resistor leads detaches the units from the tape.

Reels contain from 1,000 to 2,500 units per reel, depending upon the size of the resistor. If automatic assembling is one of your problems, it may pay you to investigate the reel-packaging of A-B QUALITY resistors.

Allen-Bradley Co.
1342 S. Second St., Milwaukee 4, Wis.

In Canada—Allen-Bradley Canada Ltd.
Galt, Ont.



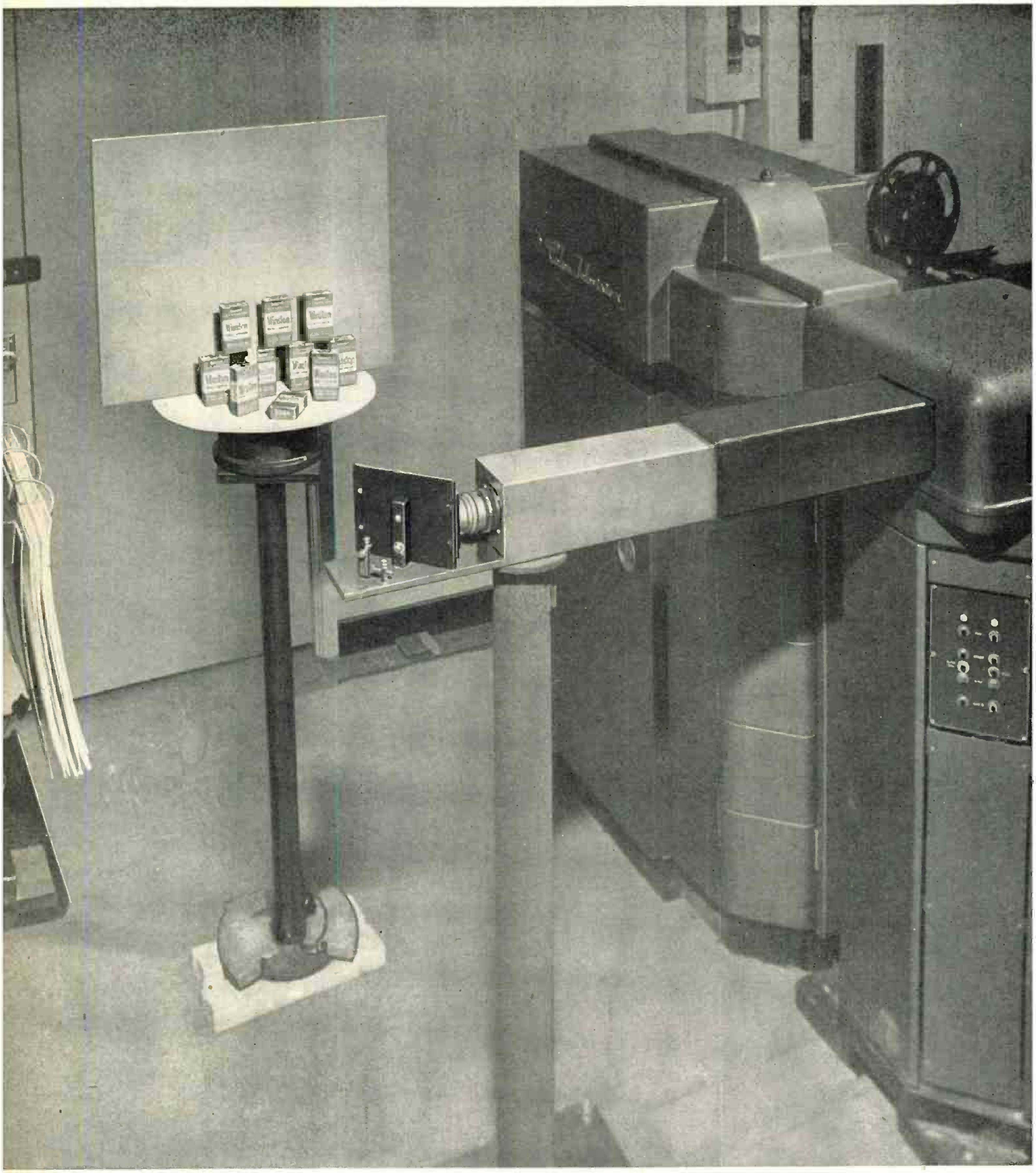
Allen-Bradley resistors on fiberboard reel for automatic assembling lines. Reels contain from 1,000 to 2,500 units.

ALLEN-BRADLEY

RADIO, ELECTRONIC AND TELEVISION COMPONENTS

For product information, use inquiry card on last page.

Live Color Commercials



"3V" Color Film System as arranged for pickup of color opaques and live action commercials.

RCA Pioneered and Developed Compatible Color Television

with your RCA "3 V"!

Simple lens system added to RCA "3V" Film Camera picks up live-action color commercials...and color opaques of all kinds

NOW you can go to "live" color in the least expensive way imaginable. RCA engineers have worked out an extension lens system which can be used with any RCA "3V" Camera to pick up all kinds of product displays . . . live . . . in action . . . in highest quality color. And the same system can be used for televising color opaques in the simplest possible manner.

Products to be colorcast are set up on a small, fixed stage (as shown on opposite page). Any type of action which can be carried out in a limited area is practical. You can turn products around, upside down, etc. . . . show liquids foaming . . . real bottle pouring . . . use of tools . . . appliances in operation . . . wind-up toys in action . . . all kinds of animation.

Color opaques can be artwork, charts, maps, diagrams, magazine pages, comic strips. They can be mounted on an easel, on a flip-over stand (as shown at right), or held in the hand. You can use artwork or catalog illustrations and thus avoid making slides. Color rendition is nearly perfect; there are no density problems as with color slides.

Both products and opaques are televised in the open . . . in fully lighted rooms. No need for light covers or strobe lights. Pictures have high resolution inherent in vidicon type camera. Picture quality and color is equal in every way to that attained with studio type color cameras.

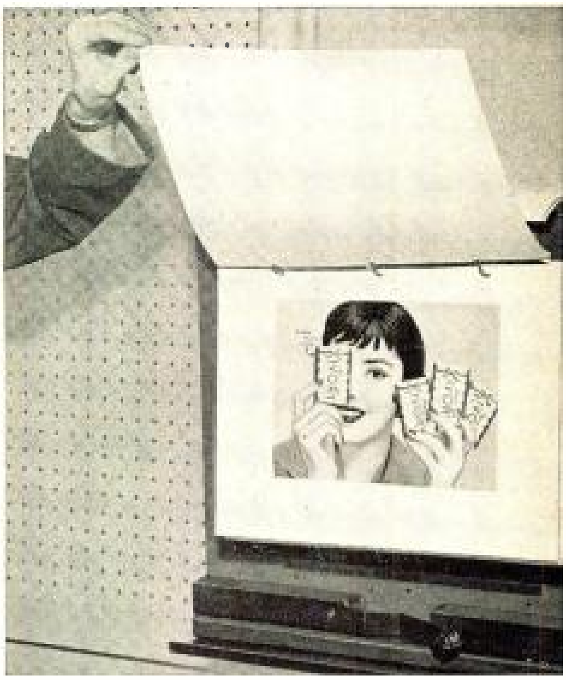
Development of a push-button operated 4-input multiplexer makes it possible to use an RCA "3V" camera for televising "live" color commercials, color opaques, color transparencies, color slides and color films. Such an arrangement provides maximum usefulness of equipment—gets you into color in the fastest and least expensive way.

And remember, the RCA "3V" Film Camera System is the system which most broadcast engineers believe to be the best.

For complete technical information on the new RCA "3V" Color Film System, call your RCA Broadcast Sales Representative. In Canada: write RCA VICTOR Company Ltd., Montreal.

RADIO CORPORATION of AMERICA

BROADCAST EQUIPMENT, CAMDEN, N. J.



Color opaques in series, at a flip of the wrist.

Live color commercials with a minimum of props, showing hands, etc.

Making Electrical Connections Under Pressure

by Andy Wyzenbeek, Chief Engineer

Fusite Hermetic Terminals with new V-24 glass use the principles of both fusion and compression between the metal and glass to assure a rugged air tight electrical connection.

Where great pressures are involved either internally or externally the limiting factor is often solder or other method of sealing rather than the junction of materials on the terminal itself.

The same is true of Fusite Terminals in applications subject to extreme vibrations, or mechanical or thermal shock.

Where one or more of these conditions exist, Fusite threaded bushing terminals have proved themselves capable of withstanding great punishment. The threaded mechanical seal together with soft solder, suitable gasket or epoxy resin extends the capacity of the connection and brings it more nearly to the high limits engineered into the Fusite Terminal itself.

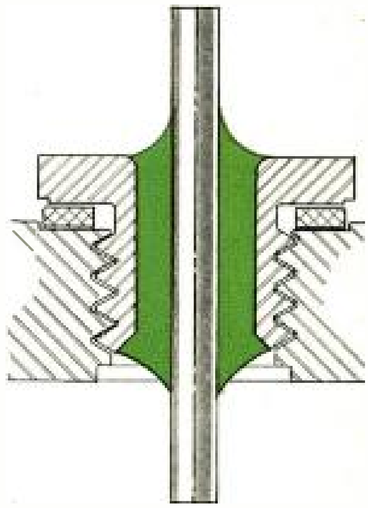
Each of the three illustrated terminals are available in five different electrode treatments and come with standard threads as shown. In addition, for extreme pressure conditions, these terminals are made with tapered pipe plug threads.

We were gratified and a little bit alarmed by a letter of inquiry received recently from a new user of a Fusite pipe plug terminal.

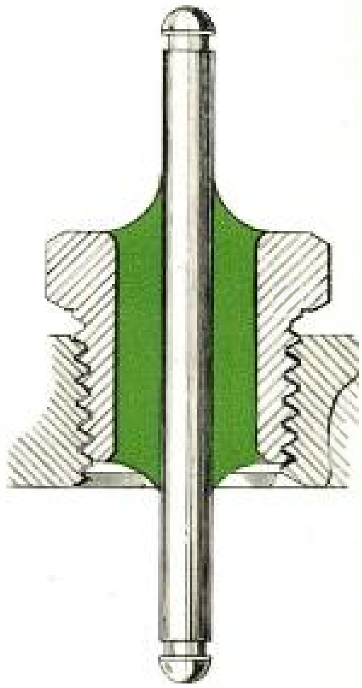
"Thank you for the samples of your terminal and drawings of 1/8 pipe plug. We tested several of these units to 29,500 PSI at 212° and they did not fail. We are curious as to how much higher pressure they will stand."

We had to plead ignorance as to maximum pressure possibilities, but if you would like to test them in your own application, samples are yours for the asking.

Write FUSITE, Dept. U-2, 6026 Fernview Avenue, Cincinnati 13, Ohio



Threaded Bushing Terminal with Gasket



Pipe Plug Terminal

104 TB Series
8-32 Thread 5/16" Hex Head

105 TB Series
1/4-28 Thread 3/8" Hex Head

109 TB Series
3/8-24 Thread 1/2" Hex Head

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

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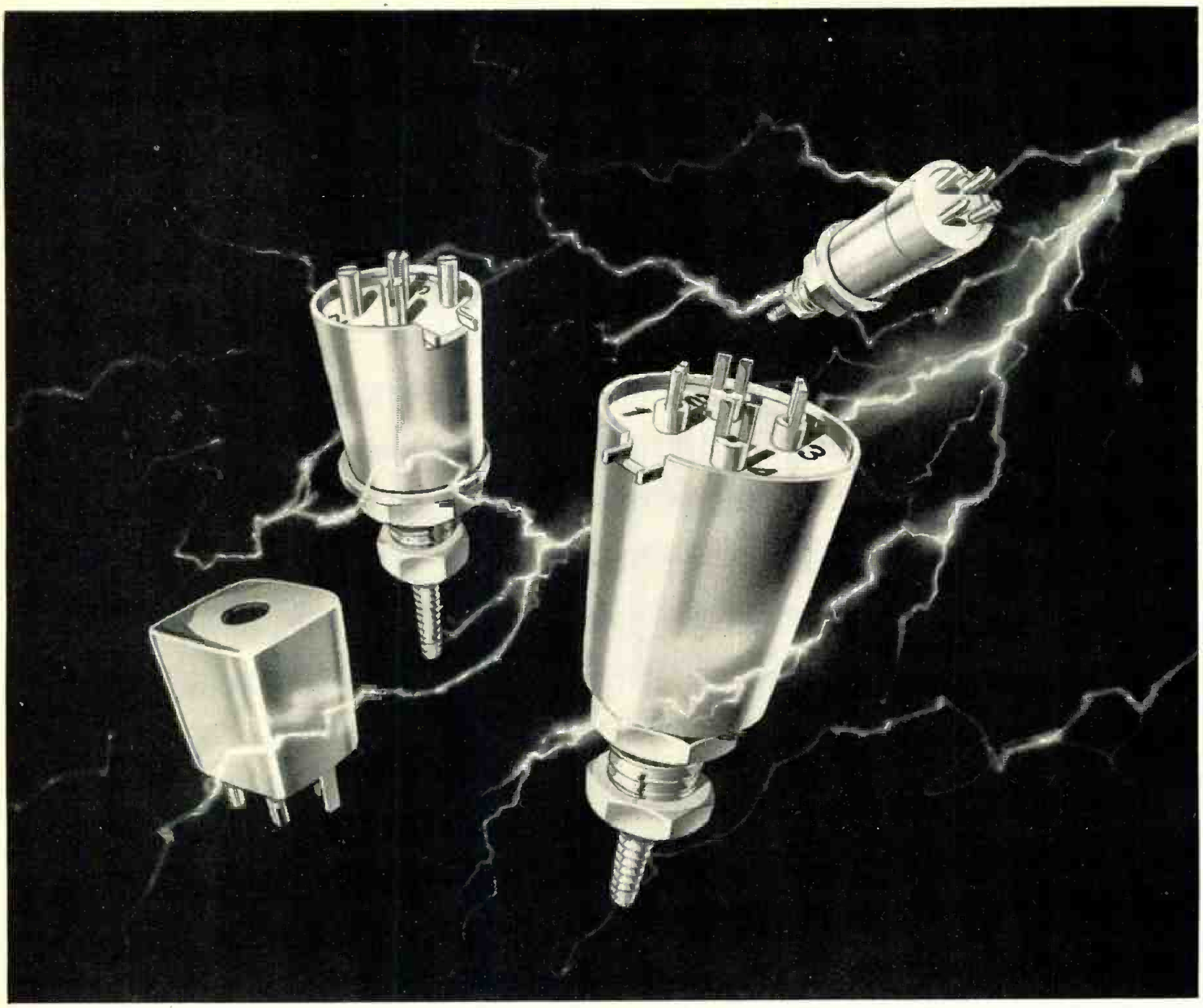

Four sizes of shielded coil forms cover a wide range of design requirements. Dimensions when mounted, including terminals, are: LS-12 (square type for printed circuits), ½″ x ½″ x ½″; LS-9, 7/16″ diameter x ½″ high; LS-10, 5/8″ x 15/16″; LS-11, 15/16″ x 17/32″. Each form mounts by a single stud. Windings may be universal or wound to your specifications.

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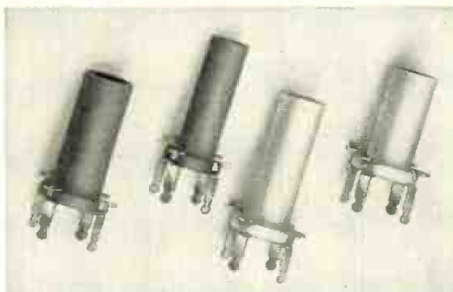
CTC miniaturized shielded coil forms are highly shock resistant. With mechanically enclosed, completely shielded coil windings, they bring all the ruggedness and dependable performance you require for your "tight spot" applications — IF strips, RF coils, oscillator coils, etc.

CTC combines *quality control* with *quantity production* to supply exactly the components you need, in any amount. CTC *quality control* includes material certification, checking each step of production, and each finished product. And CTC *quantity production* means CTC can fill your orders for any volume, from smallest to largest.

For samples, specifications and prices, write to Sales Engineering Dept., Cambridge Thermionic Corporation, 436 Concord Ave., Cambridge 38, Mass. On the West Coast contact E. V. Roberts and Associates, Inc., 5068 West Washington Blvd., Los Angeles 16, and 61 Renato Court, Redwood City, Cal.



TYPE SPC phenolic and ceramic printed circuit coil forms can be soldered after mounting. Phenolic forms: ¾″ high when mounted, in diameters of .219″ and .285″. Ceramic forms: ¼″ diameter, in mounted heights of 5/8″ and 13/16″, with 10/32″ powdered iron core, and collars of silicone fibreglas. Forms come with threaded slug and terminal collar. Units mount through two to four holes, as required. Available as forms alone or wound as specified.

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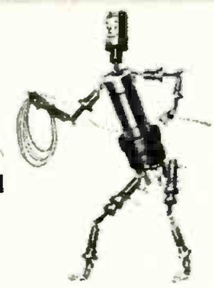

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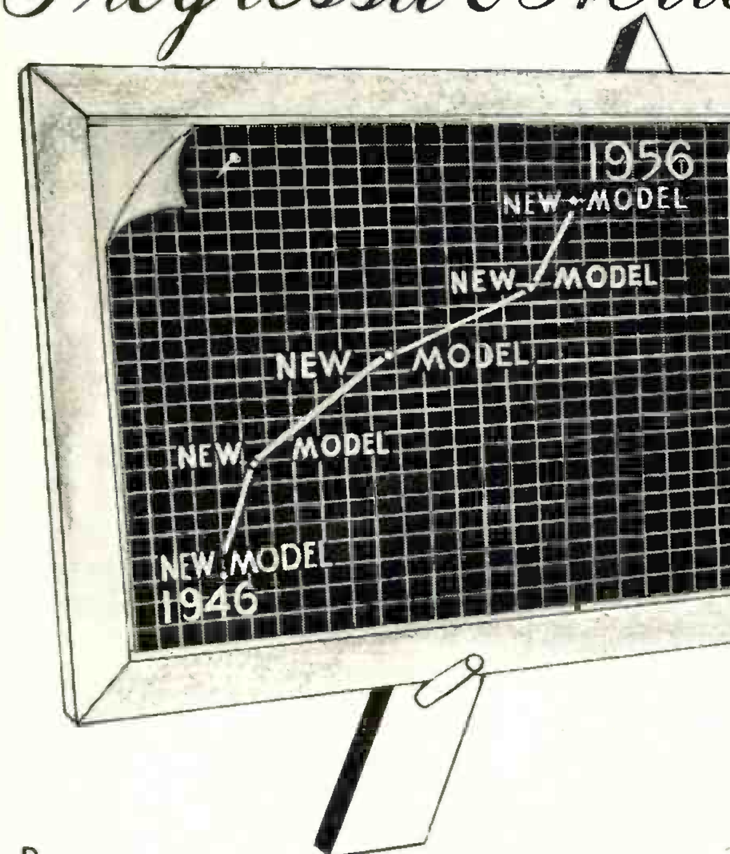

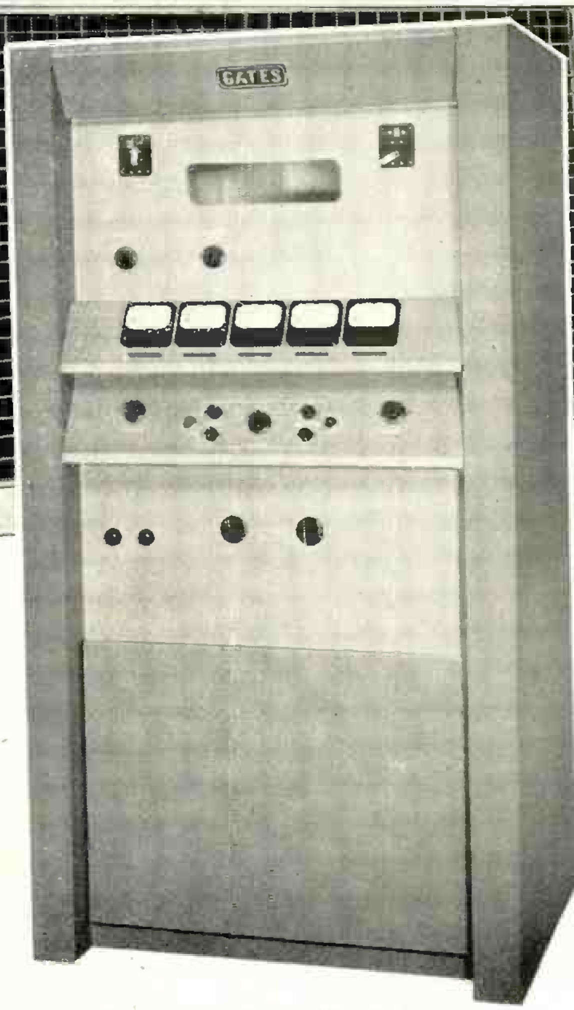

Broadcasters deserve continuing new models. The Gates 1KW story is typical. Five new models in 9 years. The BC-1J, introduced in the spring of 1955, is broadcasting's entirely new transmitter. — New not only in pace-setting performance specifications but new all the way! — Speaking of pace-setting, this one kilowatt story is a good example of how Gates has saved the industry untold thousands, probably millions. Reason? — Gates pace-sets selling prices too. — Accentuating, late models, new features and *progressive action* along with modest selling price is why Gates value divided into cost equals the "Hi-Watter" trade-mark of "More watts per dollar invested".

Pace-setter of the one kilowatt field
——the Gates BC-1J "Hi-Watter"

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Models DO and DOS fill many industrial needs for a compact, lightweight relay that handles power loads usually requiring much larger, heavier units. They are particularly adaptable to aircraft and mobile equipment where severe shock and vibration are encountered. The increased operating sensitivity of Model DOSY relay, equipped with twin coils, makes the DOSY adaptable to a wide range of electronic control circuits, such as plate circuit controls. At 115 VAC or 32 VDC, noninductive load, Models DOS and DOSY have contact ratings of 15 amp; Model DO, 10 amp; and Model CRU, 5 amp. Available in a wide range of coil operating voltages and contact combinations.

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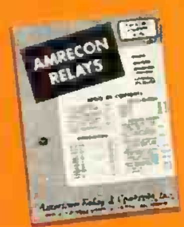

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BOOKS

Color Television Engineering

By John W. Wentworth. Published 1955 by McGraw-Hill Book Co., Inc., 330 West 42nd St., N.. 36, N.Y. 459 pages; price $8.00.

Aimed at engineers already familiar with monochrome TV, this book gives an up-to-date explanation of color TV, from basic principles of color and color sensation, right through to the actual transmitters, studio equipment, and receivers producing a color show in the set owner's home.

Various electronic techniques used for processing, multiplexing, and transmitting color TV signals are described. The block diagram is used extensively, and step by step derivations bridge the gap between familiar monochrome principles to the more complex color techniques.

Laplace Transforms for Electrical Engineers

By B. J. Starkey, Dipl. Ing., A.M.I.E.E. Published 1955, by Philosophical Library, Inc., 15 E. 40th St., New York 16, N.Y. 279 pages, price $10.00.

The present book, first published in England in 1954, is based largely on a series of lectures which the author has given to his colleagues at the Signals Research and Development Establishment in England, dealing with a method of analysis known as the Laplace Transform. In these lectures, his approach was from analytical methods, such as vector algebra, already well-known to communication engineers, rather than from a purely mathematical background. The language used in this book is well-known to engineers in general and the method of explanation of problems is particularly familiar to electrical engineers. Twelve chapters, such as those on Symbolic Method and Fourier Transformations, Generalized Impedances and Cisoidal Oscillations, and Applications of Laplace Transforms to Electric Circuit Theory, are all helpful in providing quick solutions to a great range of engineering and physical problems and saves much laborious calculation by other methods.

Radio-Philatelia

By Herbert Rosen. Published 1956 by Audio-Master Corp., 17 East 45th St., N. Y. 17, N. Y. Paper bound, 48 pages, price $2.00.

The development of telecommunications is traced through the medium of postage stamps. Listings include stamps dedicated to radio stations, microphones, radio at sea, at war, and in the air. Inventors including Morse, Tesla, Edison, Bell, Marconi, etc. are shown in the over 500 stamps listed, as well as several hundred postmarks and slogans. Over 200 stamps are illustrated in their original size.

(Continued on page 59)

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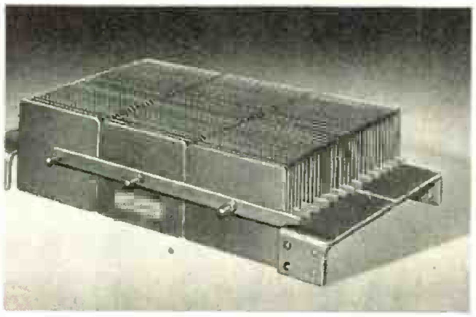

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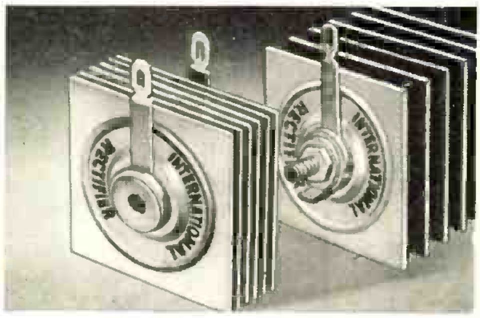

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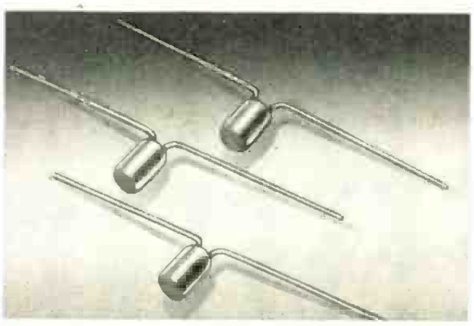
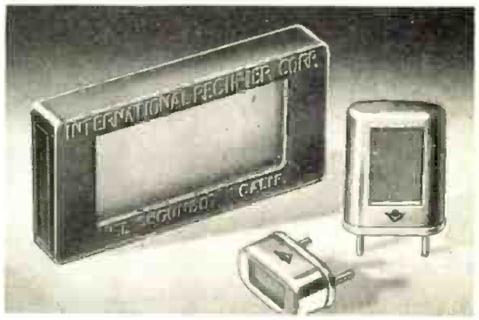
Designed for long life and reliability in Half-Wave, Voltage Doubler, Bridge, Center-Tap Circuits, and 3-Phase Circuit Types. Phenolic Cartridge and Hermetically Sealed types available. Operating temperature range: −65°C to +100°C. Specify **Bulletin H-2**



SUB-MINIATURE SELENIUM DIODES

Developed for use in limited space at ambient temperatures ranging from −50°C to +100°C. Encapsulated to resist adverse environmental conditions. Output voltages from 20 to 160 volts; output currents of 100 microamperes to 11 MA. **Bulletin SD-1B**



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Self-generating photocells available in standard or custom sizes, mounted or unmounted. Optimum load resistance range: 10 to 10,000 ohms. Output from .2 MA to 60 MA in ave. sunlight. Ambient temperature range: −65°C to +100°C. **Bulletin PC 649**

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High quality units of improved design are the results of years of experience in the production of exceptionally fine germanium crystals plus extensive research, development and field performance testing!

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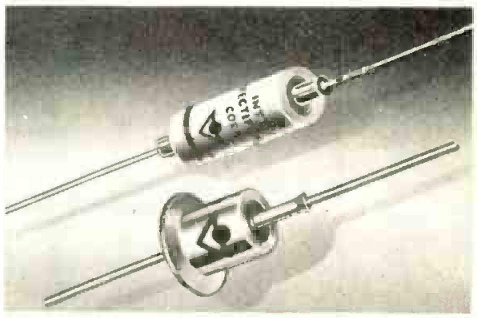
This new line features: High efficiency—up to 97%, Lowest forward drop, High reverse to forward current ratio, unlimited life expectancy. No reforming required after storage. Ratings: 26 to 66 AC input v. per junction: 150 to 100,000 amps DC output. Operating temperature range: −55°C to +75°C. In three styles. **Bulletin GPR-1**



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BOOKS

(Continued from page 56)

Halbleiterprobleme (Semi-Conductor Problems; Vol I and Vol II.)

Edited by Prof. Dr. Dr-Ing. h.c. W. Schottky. Published 1954 and 1955 by Friedr. Vieweg & Sohn, Braunschweig, Germany. 387 pp. and 292 pp. Price: 28.80 German Mark each.

The two volumes contain a series of lectures by experts in the various branches of semi-conductor research. The lectures in the first volume were delivered in Innsbruck in 1953 and those in the second volume in Hamburg in 1954 at two meetings of the "Semi-Conductor Section" of the "German Physical Society." Each lecture and subsequent discussion is followed by a short English summary.

Highly theoretical as well as practical aspects are treated; e.g., the behavior of semi-conductors is studied on the basis of wave mechanics and lattice theory, including irregularities, effects of electromagnetic fields are discussed, while other sections deal with the performance and production of rectifiers and amplifiers.

An up-to-date, thorough and extensive treatment of a subject which is being rapidly developed at this time could be accomplished only by the cooperation of the researchers working on each of the various topics presented. It is felt that anybody attempting an original contribution in this field should be familiar with the pertinent sections of this text which can also be highly recommended to anybody who intends a serious study of semi-conductors.

BBC Handbook 1956

Published 1955 by the British Broadcasting Corp., London, England. 288 pages. Available in the U. S. from British Publications, Inc., 30 East 60th St., N.Y. 22, N.Y., price 75¢.

The story behind the vast operation of BBC broadcasting, both in sound and TV, is covered in this handbook. The first part of the book explains what the BBC is, how it is organized, and how it fulfills its tasks in its home and overseas services.

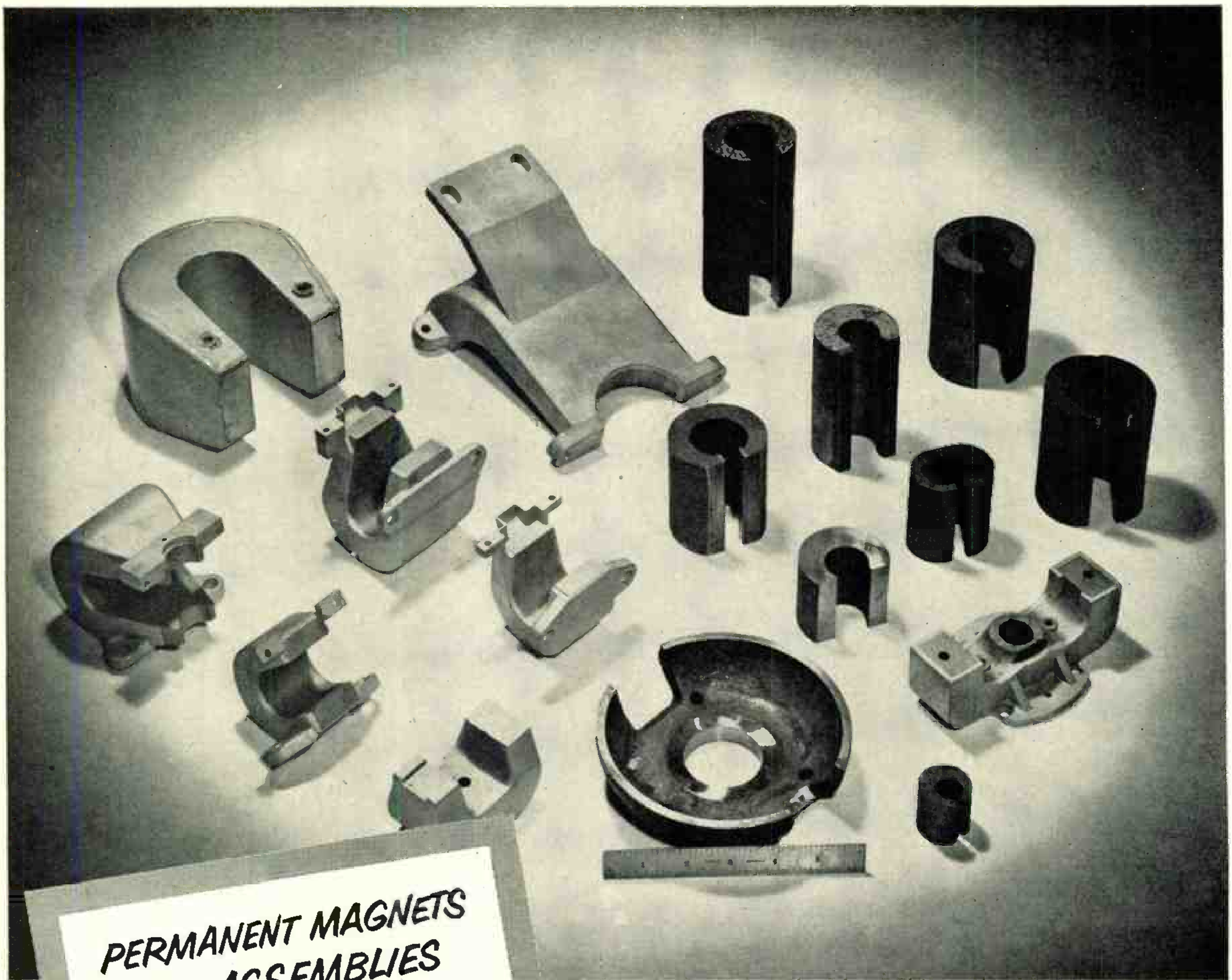
A review of the year with lists of representative programs follows. Staff, policy and finance are included. The latter part of the book provides useful reference material, including the Royal Charter and License.

Electronic Data Processing In Industry

A case book of management experience published by the American Management Association, 330 W. 42nd St., New York 36, N.Y. 256 pp. Price $7.75 (AMA members, $5.75)

This new American Management Association, Special Report No. 3, is a comprehensive report on the latest developments in "the office revolution."

(Continued on page 62)



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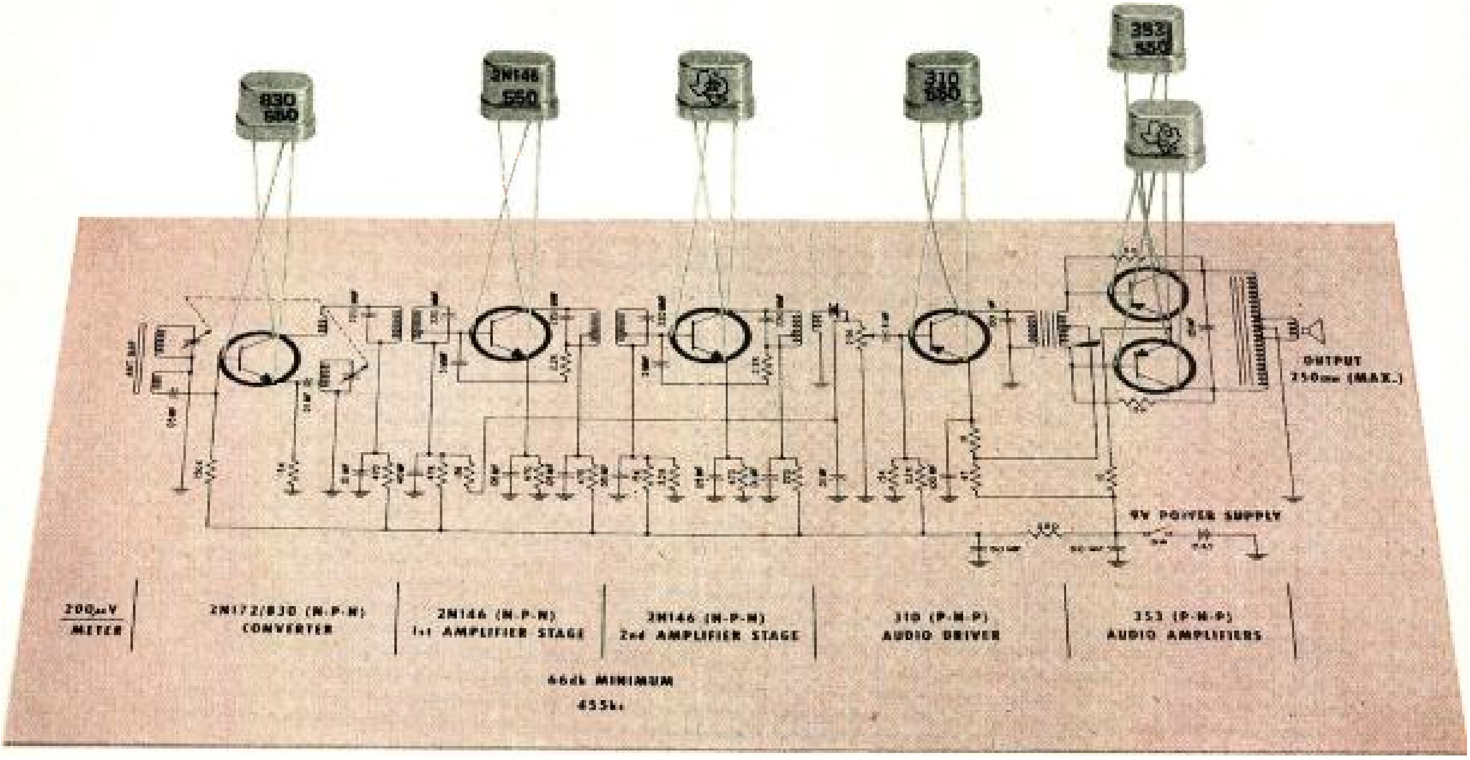

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IF Neutralizing Capacity . . .	Selected	Fixed
Audio Output Power	20mw	250mw
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IN THE CIRCUIT ILLUSTRATED ABOVE:

Left to right: a 2N172/830 germanium N-P-N graded junction converter, two 2N146 germanium N-P-N graded junction IF amplifiers, a 310 germanium P-N-P fused junction driver, and two 353 germanium P-N-P fused junction outputs. This is a typical TI circuit designed for optimum performance.

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BOOKS

(Continued from page 59)

The volume describes graphically how automatic data-processing offers unparalleled speed, accuracy, controls, and savings for industry. It gives specific practical information on: how to determine whether a company should adopt electronic data-processing; how to plan the installation of such a system; what equipment is available; and how progressive companies are now using these systems. Also included are reports of company experience with small, medium, and large computers, a forecast of future developments in electronics, and a valuable glossary of programming terms.

Television Factbook No. 22

Published 1956 by Television Digest, Wyatt Building, Washington 5, D. C. 448 pages, plus 43 x 29 in. wall map. Price: single copy $4.50, 5 or more $3.00 each.

All the TV stations in the world, nearly 475 in the U. S. and some 200 in the rest of the world, are listed in this latest compilation of TV facts and figures. Special emphasis is on U. S. and Canadian stations, with data on their facilities, personnel, rates, etc.

Included are directories of TV networks, program producers, manufacturers of TV receivers, tubes, radios, phonographs, etc., plus other directories covering the telecasting and electronic industries, all with addresses, phone numbers, and names of key executives. Altogether there are more than 75 directories in this 1956 Spring-Summer edition of this TV industry factbook.

Books Received

Summary of Registered Crystal Diodes

By Joint Electron Tube Engineering Council. Published by RETMA, Engineering Dept., 11 West 42nd St., N. Y. 36, N. Y. 50 pages, paper bound. Price $1.00.

Pertinent electrical and mechanical data for all crystal diodes registered by JETEC to Jan. 1956.

Engineers Job Directory

Published by Decision Inc., 1483 First National Bank Bldg., Cincinnati 2, Ohio. 88 pages, price $3.50.

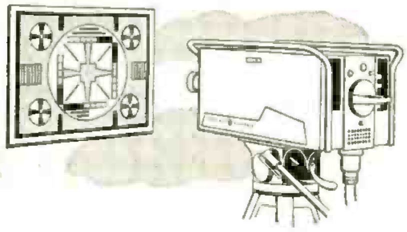
Company information concerning 236 major firms. Special index lists companies seeking specific types of engineers.

Tungsten

By Mildred G. Andrews. Published 1955 by The Tungsten Institute, 1757 K St., Washington, D.C. Paper bound, 28 pages, price $1.50. The story of tungsten, one of our most useful metals.

Infrared: A Library of Congress Bibliography

Published by OTS, U.S. Dept. of Commerce, Wash., D.C. Price $3.00. A 374-page bibliography on infrared radiation and its applications in science, industry and technology. (Order PB 111643)



◀ Sharp image resolution—uniform and accurate image reproduction—these are qualities for which every G-E image orthicon is exhaustively tested. In addition, a complete record of the tube's operating characteristics is made and kept. Reports later, from TV-station users, complete a statistical picture which tells a comprehensive tube performance story, serving as a valuable guide to G.E.'s program of steady image-orthicon improvement.

Quality leadership of G-E image orthicons is assured by 3-phase research, development, and test program!

More hours of efficient tube life: this is target of effort backed by General Electric's full resources and facilities!

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In connection with G.E.'s test program, the valuable help received from TV-station engineers in reporting how they cycle camera tubes, what target voltages and studio lighting they use, will pay dividends to broadcasters later in the form of operating recommendations from General Electric. Stations will be kept posted on ways to achieve top image quality and realize maximum efficient camera-tube life.

With G-E image orthicons, you benefit from a continuously better product . . . . you profit from expert guidance on how to use tubes for greatest efficiency and economy. Phone your G-E tube distributor! *Tube Department, General Electric Company, Schenectady 5, New York.*

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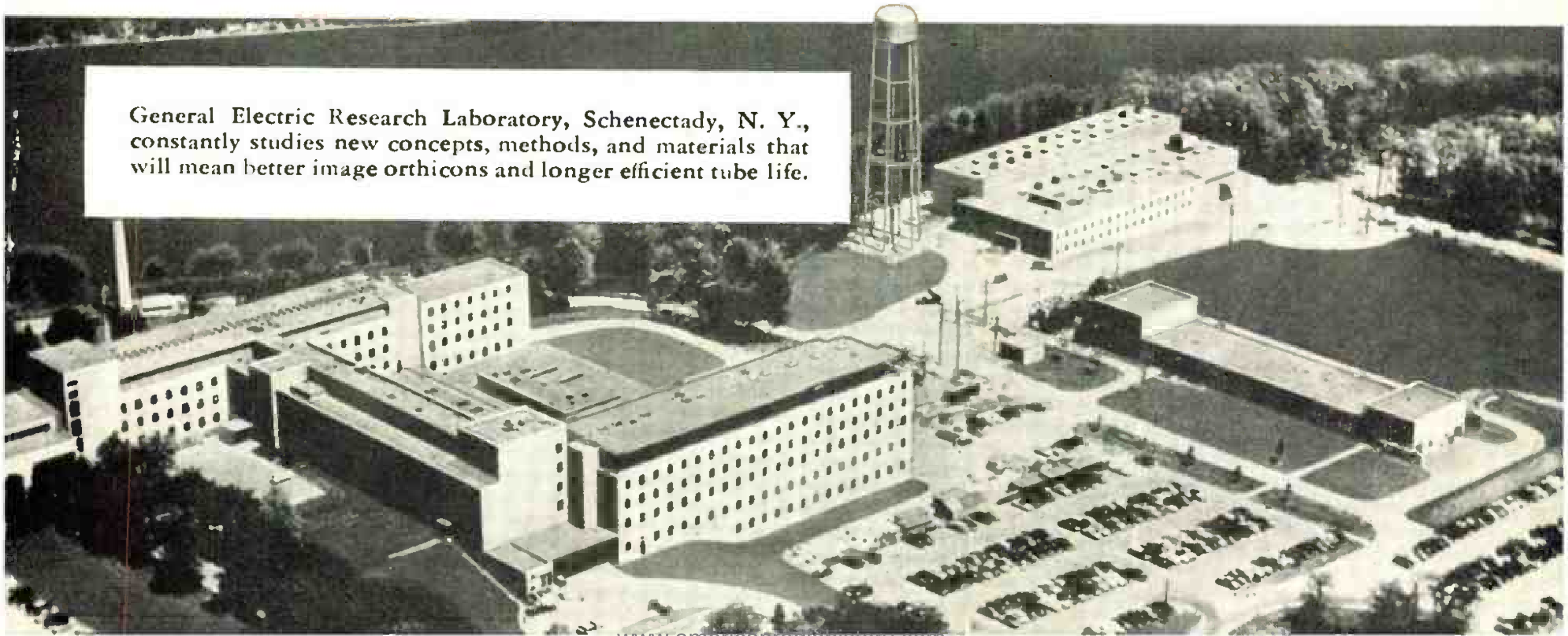
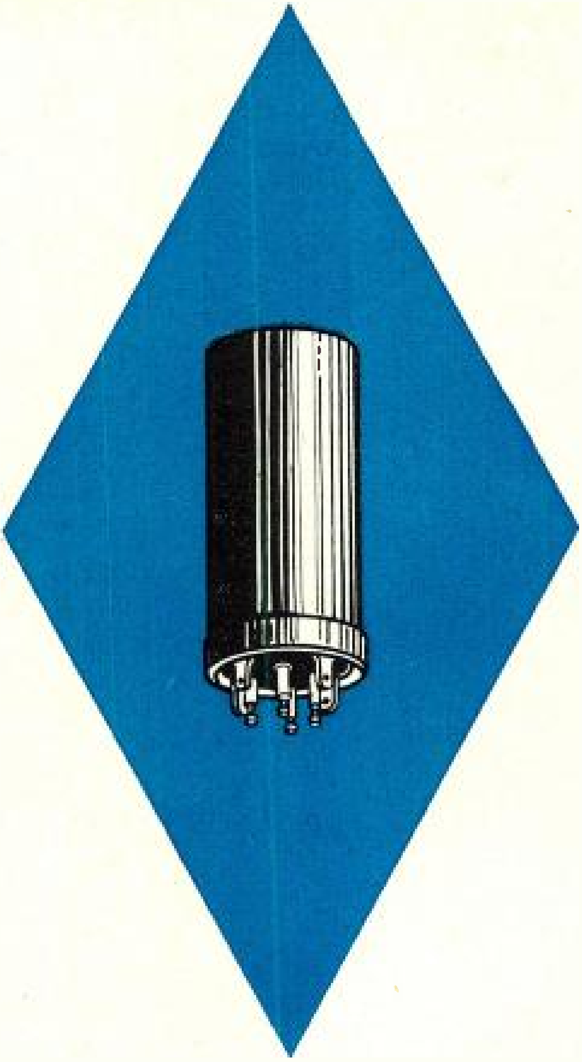


General Electric Research Laboratory, Schenectady, N. Y., constantly studies new concepts, methods, and materials that will mean better image orthicons and longer efficient tube life.



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Watch Your Trademarks!

During the past year the sales tempo in the United States for electronic products of foreign manufacture has increased considerably, and there is every reason to believe that future sales pressures will be at least equally as great. Recently Japanese products have been appearing on the American market in ever increasing numbers, and it is in this connection that we offer a word of caution. There is considerable evidence that some Japanese manufacturers are producing and exporting electronic equipment using well-known American trade names and trademarks. Much of the equipment seems to be in the "Hi-Fi" audio field, but it is not in this field exclusively. The Department of State advises that use of American trademarks is increasing in other industries as well.

The International Department of RETMA has been quite active in attempting to obtain protection for its membership, and some of the resulting suggestions might well be followed by all electronic equipment manufacturers. For further information on this subject one should first obtain the World Wide Information Services publication "Trademark Protection in Japan," Part 2 No. 55-8 from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Cost is 10 cents a copy. Then there is a subscription to the Japanese "Trademark Gazette." This publication lists all trademark applications in Japan and thus serves as an alerting source when trademark rights are endangered. It is obtainable from Hatsumai Kyokai, c/o Patent Agency No. 2, Sannencho, Chiyoda-Ku, Tokyo. Interested manufacturers should register their trademarks in Japan as well as in other foreign market areas as soon as possible. Remember, too, that trade names should be registered, and in Japan, for added protection they should also be registered as trademarks.

Patent Consent Decrees

A most significant event for the electronic industries occurred recently in the signing of antitrust suit consent decrees by AT&T and IBM. Under these decrees some 8600 existing AT&T patents and 1000 IBM patents became subject to mandatory licensing arrangements. Previously these firms could license or not as they saw fit on any patent that they owned. Under the decrees some of the patents are to be licensed to all applicants without royalties and on other present and future patents licensing is to be on a reasonable, nondiscriminatory rate basis. Cross licensing is permitted.

For the electronic industries, these may set the pattern for other organizations in similarly strong patent position. It is still a little too early to predict the benefits that might accrue to small business through the Government's action aimed at breaking up monopoly. Larger well established organizations are better able to take immediate advantage to make themselves more competitive. It is also possible that because of mandatory licensing, a host of new businesses may come into being. Then too, there is also the question now as to the future values of patents because of the government's action. Will the larger manufacturers be as anxious to patent their new developments as before in view of "limited" protection? Time alone can resolve these complex issues. There are other cases pending and due for decision shortly. We await the outcome with great interest.

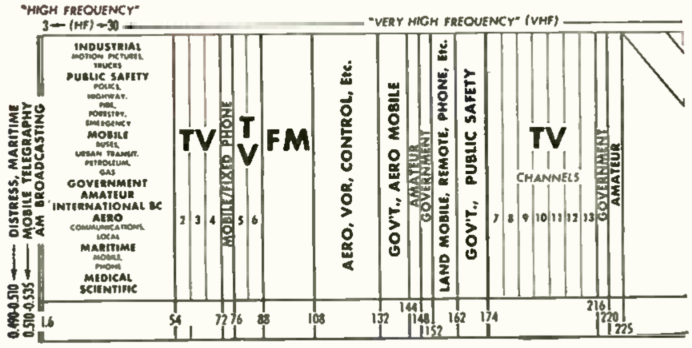
Engineer Teachers

Hope for a solution to the critical teacher shortage in the sciences and engineering is seen in Brig. Gen. David Sarnoff's recent recommendation that industrial firms be required to free trained personnel for 1-year terms to teach in their local schools. The program which would require the firms to pay the engineer's regular salary for the teaching period, would be established on a national basis as a National Education Reserve Corps. It would be, in part, a restitution by industry of personnel it has drawn from the school system.

Gen. Sarnoff's plan, which for the first time puts the burden of responsibility directly on industry itself, may well be the only workable solution to this very serious problem. Previous attempts to interest the technical societies (See "Education Too Little Too Late," p. 65, Dec. 1955) and other segments industry and government have not as yet been fruitful.

There are, however, some very interesting sidelights to the program to consider. For instance, will individual organizations give up a top-notch engineer for a 1-year period? Particularly when they are in such short supply for urgently needed military electronic programs as well as for consumer products. Or will we find a parade of over-age men, long out of school, or comparatively inexperienced junior engineers making the trip back to the classroom? What will be the effect upon long-time faculty members of colleges, when they find their new colleagues, with possibly less formal training than they, are earning twice their salaries? Would this result in an even more accelerated rush from the classroom to industry? Perhaps the plan will make it necessary for industry, in time to subsidize all science teaching programs across the country. At any rate, because it is a positive suggestion we are for it. **How about you?**

RADARSCOPE

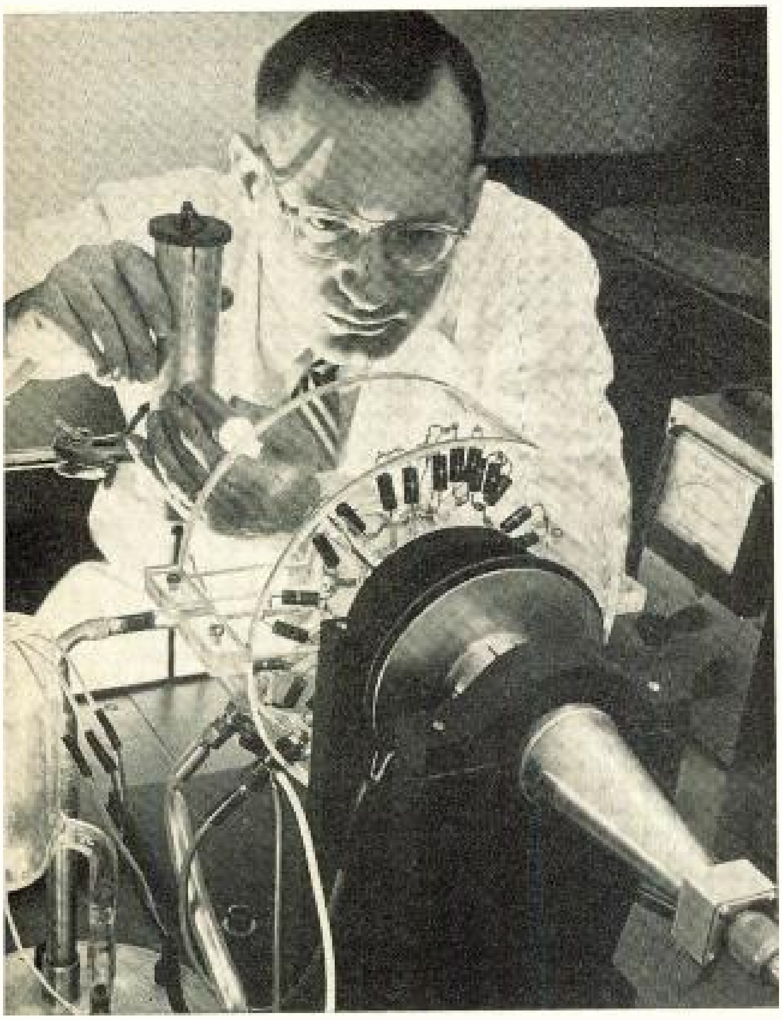


Revealing important developments and trends throughout the spectrum for radio, TV and electronic research, manufacturing and operation

NEW MAGNET WIRE soon to hit the market will interest manufacturers of coils and similar products. Contained in the enamel insulation is an adhesive substance that will permit the winding of self-supporting coils, eliminating the need for cotton or fabric insulation materials formerly used.

COMPUTERS are being employed at GM's Oldsmobile Div. to determine the amount of balancing needed on wheels and tires. The wheels are supported in a horizontal position by a pivot at the hub and the computer measures the degree of tilt resulting from the unbalance.

ATOMIC ERA "STOP WATCH"



Westinghouse scientists have given a new meaning to "split-second" timing with this new timing device designed for nuclear physics research. The specially designed photomultiplier tube detects time intervals of less than one-billionth of a second. Within the measured interval light rays would travel only a few inches

BATTERY PORTABLE TV SETS came one great step closer last month with the announcement by two firms in the nuclear field that they had developed tiny self-contained power supplies capable of putting out 16-17,000 v. One version is a 17,000 v. single cell atomic battery, smaller than the 1½ v. flashlight battery. The other is a transistorized DC to DC power supply that produces up to 16,000 v. from a 1½ v. input.

NEARLY ALL RADIO MFRS. are now producing transistorized portable radios. Prices range upward from $39.95; tops is approximately $90.

"CORDLESS CLOCK," utilizing seven transistors, will soon be introduced. Operating power is picked up by induction from the 60-cycle line.

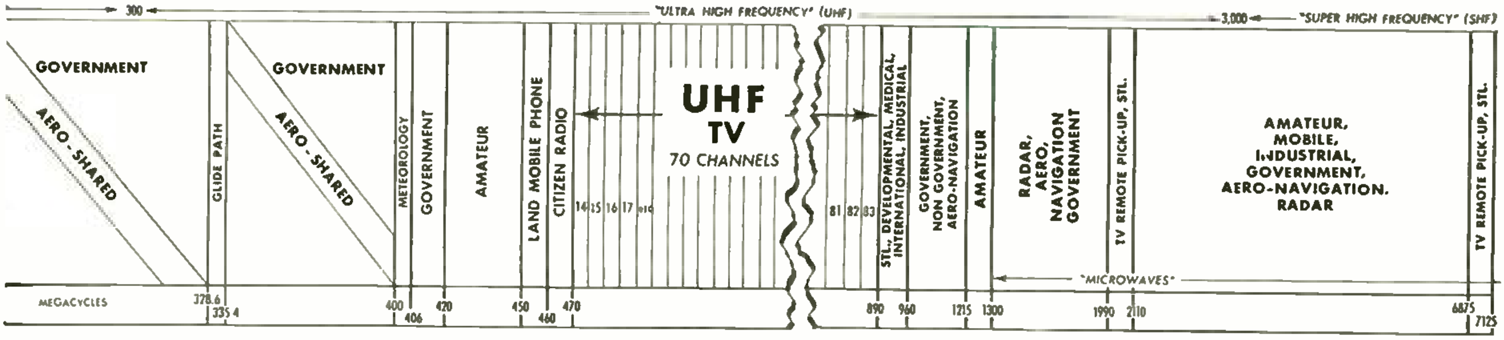
NEW DRY CELL BATTERIES utilizing aluminum in place of zinc have been developed by Alcoa. Former attempts to use the attractive properties of aluminum (low electrochemical equivalent and high electrode potential) failed due to the low shelf life of the cells. This deficiency has now reportedly been eliminated.

NEW SOLDERING TECHNIQUE developed at Los Alamos Scientific Lab joins aluminum, stainless steel, glass and ceramics without special equipment, and at less cost than present ultrasonic soldering methods.

WEATHER RADAR systems are being used extensively by the U.S. Weather Bureau to forecast floods, hurricanes, tornadoes and squall lines.

INDUSTRIAL TV, after a try-out last year in Detroit as a traffic control tool, got a conditional approval from the city's traffic dept. The final report questioned the reliability of the equipment with regard to unattended operation, and said that for maximum effectiveness TV would have to be tied in with a complete system of signs, signals and traffic lights. Traffic experts saw the chief hope for traffic control TV in the fact that the state of the art is becoming increasingly better.

TV ANTENNA MANUFACTURERS are collectively pulling in their belts. With the decline of new TV areas, a major portion of their income is being cut off. Replacement market, while substantial, cannot support all the present firms. It is the handwriting on the wall to the smaller companies; to survive they must find diverse lines that will pick up the slack. One major firm, with extensive manufacturing facilities, is reportedly going into the field of industrial extrusions.



TRANSISTORIZED MUSICAL PHONE will be field-tested in the Illinois area this spring by Bell Telephone Labs. Initial experiments have shown that the musical tone is much preferred by the consumer, and is also more audible to the hard-of-hearing; and, important from Bell's angle, its adoption will mean significant power savings. Transistorized unit can be energized by 1 v., approximately the same power required by ordinary phone conversation: the conventional telephone bell requires 85 v.

TRANSISTORS

TOP TRANSISTOR MANUFACTURERS lament that despite every effort they cannot get the factory price of transistors below 90¢. At that price, transistors will find tough sledding outside the portable radio market. . . . Despite the large number of transistor types registered with RETMA, less than 30 are being applied in current portable radios. . . . GE reports that they have turned out 100,000 transistorized portable radios. . . . Some transistor manufacturers apparently believe the time has arrived to consider the replacement market. One of the largest is making his first attempts to woo the service trade this month, and another is reportedly considering similar action. . . . Transistorized portables currently on the market are using 6-8 transistors each, plus detector crystals. Most employ push-pull output. . . . Look for shrill protests from the servicing trade when transistorized sets need repair. With each manufacturer using his own transistor types, the technicians will often have to go back to the set manufacturer for replacements. No interchangeability information is available.

RADAR

Considerable civilian and military interest is being shown in some new high intensity cathode ray tubes that can be used to project radar information directly on a navigator's plotting table or for the pilot directly on a screen or on his windshield in bad weather. The optical blow-ups obtainable through a lens system are extremely helpful both from the standpoint of the increased size of presentation and also because such devices obviate the need for a "peering" screen around the radar display on the face of currently employed CR tubes. One current design recently viewed projected radar data effectively on a screen size of approximately 3 x 4 ft. The light output from such tubes is better than 100 times that obtainable from TV direct view screens now in use. The high intensity of illumination is also obtained with only a moderately high voltage of 14-15 kv.

AUTOMATION

THE AUTOMATION POSSIBILITIES in the electrical equipment and appliance industries were investigated recently by the American Society of Tool Engineers. They found some 75,000 manufacturing operations that appeared automatable, either through replacement or modification of existing production equipment. An immediate opportunity for automation was seen in the metal forming operations where about half of the operations could be automated by modifying existing equipment. Plans of the industry indicate that about 14% of its '56 purchases of production equipment will specify automation.

COLOR TV PRODUCTION

New 26-tube color receivers roll off the line at RCA's Bloomington, Ind. plant. Present production is geared to one-set a minute. Plans call for more than 200,000 sets by end of the year. More details on RCA's color TV production will be found on page 23.

Broadband Microwave Crystal Developments

By E. J. FELDMAN and S. L. LEVY

The recent requirements for broadband counter-measures and the advent of tunable magnetrons and their incorporation in radar systems has created a definite need for broadband microwave crystals. This need exists in "mixer" applications as well as in "video detector" applications

E. J. Feldman

S. L. Levy

THE conventional microwave mixer crystals, such as the 1N23, 1N78, 1N26, etc., are designed and tested in a manner which specifies and guarantees their performance only at a single frequency, or, at best, over a narrow range of frequencies. Table 1 summarizes the specifications, along with the specific test frequencies for these familiar types. It will be noted that large gaps are left in the frequency spectrum.

The two distinct physical configurations used for microwave diodes are the cartridge package used for the 1N21, 1N23 series and the coaxial package which is used for the higher frequency crystals, such as the 1N78, 1N26 and the 1N53. These packages, with their internal geometries, were designed with narrow band operation in mind. Fig. 1A shows the internal construction of the cartridge crystal. The geometry of the metallic parts, such as the pin used to mount the silicon and the prong used to hold the whisker, is critical with respect to r-f match in a given holder at a given frequency. The mass of metal used in these parts has a definite influence on the crystal's performance. Since microwave crystals, in general are controlled by JAN specifications, the tendency has been to optimize this geometry with respect to the JAN test conditions. This results in crystals that are not particularly suitable for wideband applications.

Fig. 1B illustrates the cross section of the coaxial crystal. It will be noted that the center conductor is supported by a bead of dielectric material. This material constitutes a discontinuity in the coaxial line formed by the center conductor and the outer shell. To eliminate adverse effects, the length of the bead is chosen to be one-half wavelength at the design center frequency. Obviously, at any other frequency, a discontinuity will appear in this coaxial line with its attendant disturbance to impedance match and overall performance.

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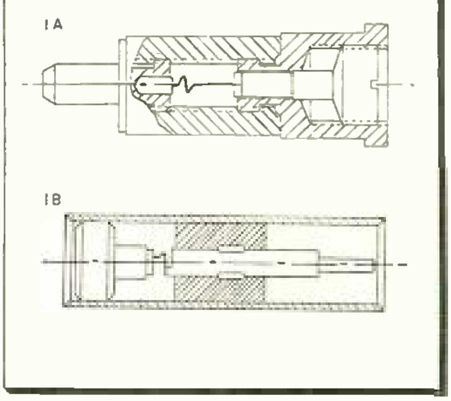
Fig. 1: Cartridge type (A) and coaxial type (B) microwave crystal configurations



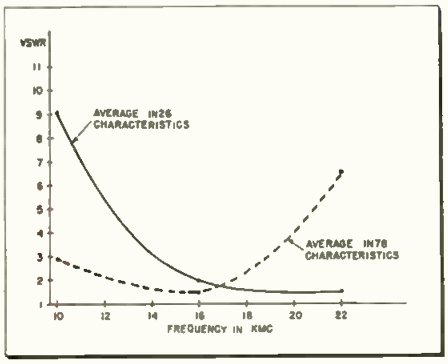


Fig. 2: VSWR of 1N26 and 1N78 crystals

Type 1N286

In February, 1953, a Bureau of Ships contract was initiated with Sylvania for the development of a broadband mixer crystal, and suitable crystal mounts, to perform over the frequency range of 10 to 22 kmc. This contract led to a new crystal type designated as the 1N286. At the inception of this contract, measurements were made to determine the limitations in broadband applications of the existing crystal types. Table 2 compares the conversion loss of the 1N26, 1N78 to the 1N286 as measured over the 10 to 22 kmc range. The 1N26 and the 1N78 show their lowest VSWR at their design center frequency, but on either side of this particular frequency, the VSWR tends to increase. Fig. 2 shows the VSWR of both the IN78 and the 1N26 over the 10 to 22 kmc range when measured in a holder matched out to 65 ohms at the particular test frequency.

The basic approach to the design of a crystal which would result in good broadband characteristics was: (1) Eliminate, insofar as possible, all

Table 1:

S Through K Band Specifications

TYPE	DESIGN FREQUENCY	CONVERSION LOSS	NOISE RATIO
1N21C	3060 MC	5.5	1.5
1N23C	9375 MC	6.0	2.0
1N78	16,000 MC	7.5	2.5
1N26	23,984 MC	8.5	2.5

frequency variables connected with the crystal package. (2) attempt to arrive at the optimum semiconductor material for operation over this frequency range.

Fig. 3 compares the new broadband bead design to the conventional design used in the existing coaxial types. The center conductor used in the 1N286 is undercut in the dielectric in order to preserve a 65-ohm characteristic impedance. This eliminates the necessity for making the bead ½ wavelength long and thus introducing a frequency sensitive element. To compensate for the capacitive susceptance at the point of undercut, the undercut is extended slightly beyond the dielectric material to introduce a small series inductance.

It was further determined, on an experimental basis, that better performance could be realized if the silicon dice were recessed into the back plug. In the past, the dice has been mounted on the surface of the plug and, thus, it extended into the region between the whisker and the plug.

Fig. 4 illustrates the cross section of the 1N286 with the undercut bead and the silicon recessed into the back plug.

The specifications finally established for the 1N286 are shown in Table 3. It will be noted that these specifications indicate a performance comparable to that of the 1N78 and the 1N26 with the advantage of extremely broadband frequency coverage.

The problem of design of a broadband holder for use with the 1N286

Fig. 3: Broadband coaxial bead design (A) compared to conventional, existing design (B)

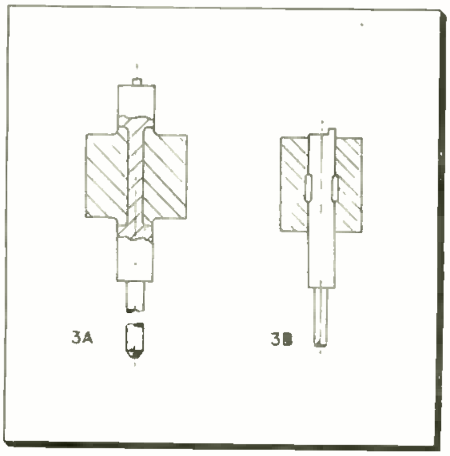


Table 2:

Conversion Loss vs. Frequency

FREQUENCY	1N78	1N26	1N286
10,000 MC	10.0 DB	13.0 DB	7.6 DB
16,000 MC	6.5 DB	7.0 DB	7.8 DB
24,000 MC	19.0 DB	8.0 DB	8.0 DB

Note: The above table is based on a group of c age crystals.

Table 4:

1N358 Specifications

TANGENTIAL SIGNAL SENSITIVITY FREQUENCY=1000, 6750, 12,400 MC	—40 DBM MIN.
VIDEO IMPEDANCE	4500 - 18000 OHMS
FIGURE OF MERIT (Untuned Broad-band Holder)	10 MIN.
BURNOUT BY PULSING (1 µs pulses)	20 MW

is considerably simpler than the problem which must be faced for broadband design using conventional crystal types. The following section describes that portion of the work done as part of the original contract aimed at developing mounts suitable for use with the 1N286 over the frequency range 10 to 22 KMC.

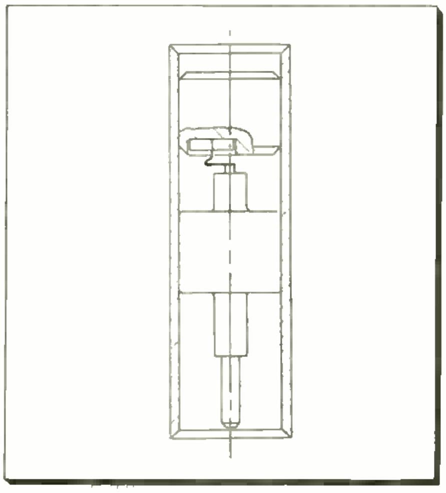


Fig. 4: 1N286-Cross section showing undercut

Crystal Mounts

The contract required the design and construction of two waveguide crystal holders to cover the frequency range of 10 to 22 KMC. One holder was designed in WR-75 (RETMA) waveguide (guide width between X-band RG52/U and Ku-band RG91/U) to cover 10 to 15 KMC; and the other holder was designed in WR-51 waveguide (size between RG91/U and K-band RG53/U.

Since no low level components were available in the RETMA waveguide, four tapered transitions were designed and built to enable testing to be done from three standard waveguide sources in X-band, Ku-band and K-band. Both WR-75 and

Table 3:

1N286 Specifications

CONVERSION LOSS	8.5 DB MAX.
IF IMPEDANCE	250 - 450 OHMS
RF IMPEDANCE (VSWR) FREQUENCY = 10 KMC THROUGH 22 KMC	3.0 MAX.
NOISE RATIO	2.5 TIMES MAX.

WR-51 matched terminations were built to adequately check out the suitability of the transition pieces. The VSWR of the transitions was less than 1.02.

The WR-51 holder was the first one designed and the WR-75 holder was a "scaled-up" version. The final form of the WR-75 holder included practical tailoring-up of some dimensions. Fig. 5 shows these holders.

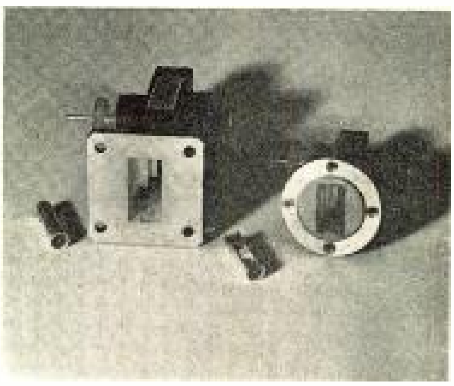
The holder design was not hindered or limited by crystal design. Since the crystal design was aimed to match its 65-ohm characteristic impedance coaxial geometry, the holder was designed to match a 65-ohm termination. In this way, crystal and holder development could be carried on simultaneously. Also, the holder is completely independent of any crystal.

A coaxial termination was built with Durez and Uskon as the absorbent materials. This "load" or termination matched less than 1.02 at the upper frequencies, but at the lower frequencies (10 to 12 KMC), it was not lossy enough to provide such a match, so it was used as a sliding load. This termination to a 65-ohm coaxial line was used to test both crystal holders.

Fig. 6 and 7 show the assembly of each holder. They employ ridge waveguide design. A single ridge was used to transform the waveguide to the coaxial line impedance. The standard waveguide was tapered slowly by ridged steps to the required size. Originally, a smooth taper was employed, but the steps were used to shorten the overall length by a factor of two. The steps are of binomial design theoretically

(Continued on page 134)

Fig. 5: Mounts for 1N286 crystal



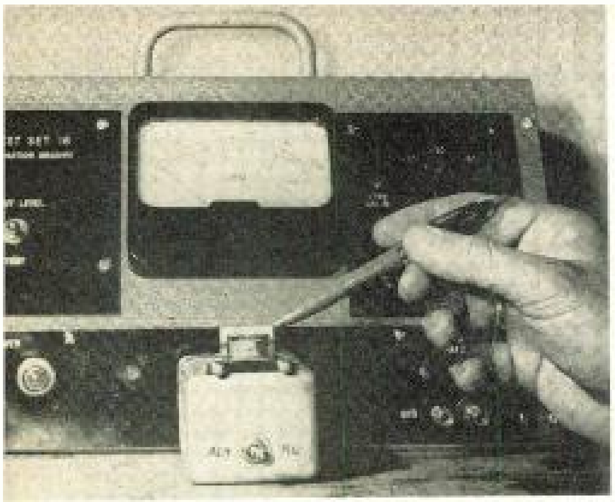


Fig. 1: Test set showing sample lamination placed in test coil for permeability grading

Transformer designers and lamination manufacturers can maintain closer quality control at lower cost with this rapid method of measuring permeability. Permeability is determined by measuring the current of a near-resonant parallel circuit whose coil has as the major part of its core the lamination under test

Permeability Testing Of Nickel Laminations

THE variation of permeability of nickel laminations has long been a problem to the transformer designer and the lamination manufacturer. At this time no reliable method of accurately controlling the permeability in the various manufacturing processes has yet been developed. The problem must then be approached from the viewpoint of measuring the permeability of the finished lamination and applying this knowledge to the best advantage.

All lamination manufacturers run quality control checks on their laminations after the final anneal, by selecting a test sample of laminations from either an annealing tray or an annealing box, and stacking these laminations one by one into a test coil, by which the permeability at 40, 200 and 2000 gauss is measured at 60 cycles. This method is accurate but has several disadvantages. First, it requires considerable time to stack a suitable sample into a test coil. Secondly, the values measured are for only a very small portion of the batch checked and considerable variation can be expected throughout the batch. Lastly, the test data recorded by lamination manufacturers is seldom passed on to the transformer manufacturer.

Measurements

To help correct these conditions a new method of measuring permeability for an individual lamination has been developed. This method consists basically of measuring the current drawn by a near resonant parallel circuit consisting of a capacitor and a coil. The coil has, as the major portion of its magnetic path, the lamination to be tested; the inductance of the coil

Fig. 2: E-25 lamination (48% nickel alloy): showing grade limits at 200 cycles

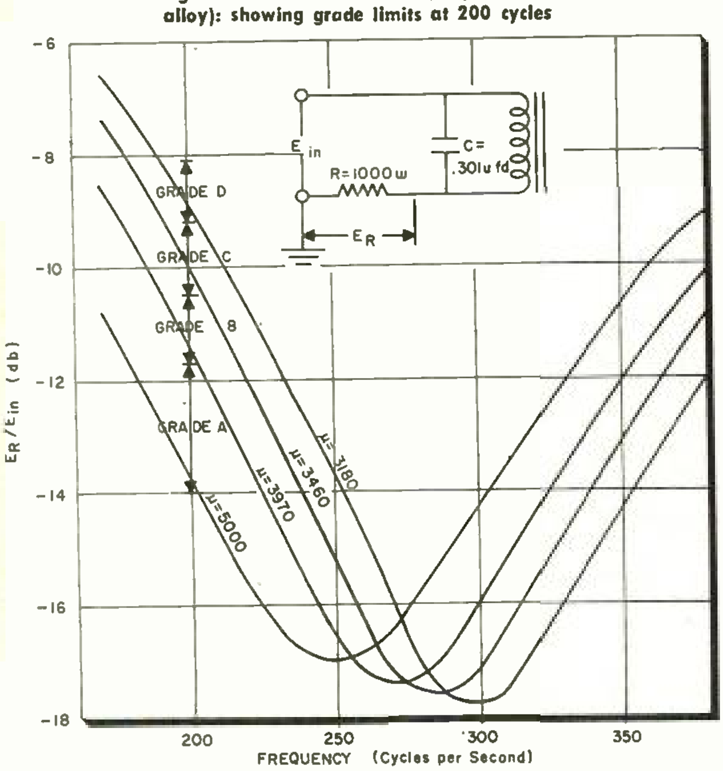
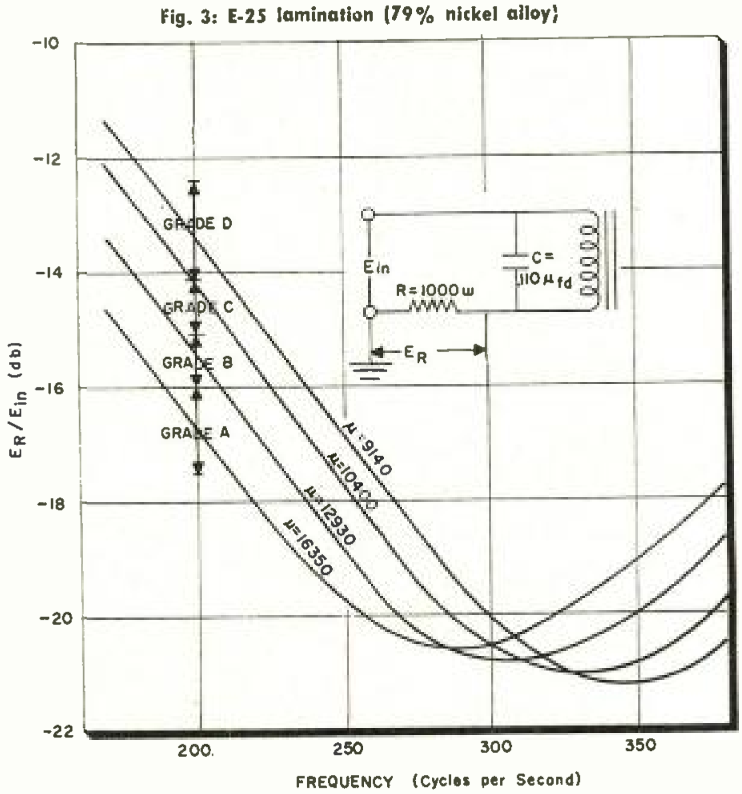


Fig. 3: E-25 lamination (79% nickel alloy)



By F. W. FRAZEE

F. W. FRAZEE, Mgr., Transformer Engineering Dept., Lenkurt Electric Co., Inc., San Carlos, Calif.

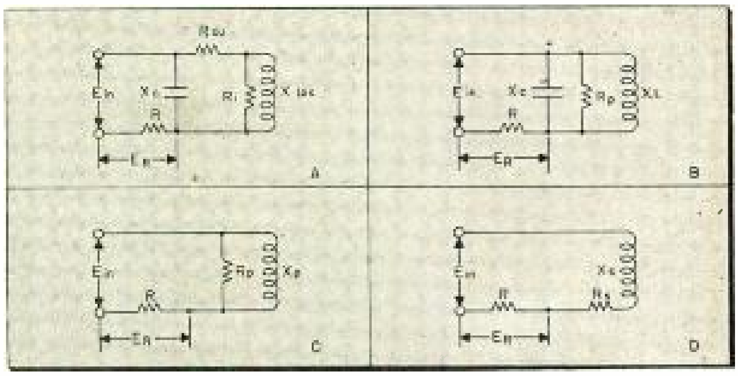


Fig. 4: Progressive steps in solution of permeability grader circuit

relates to the permeability of the lamination according to the following formula. (See Fig. 7.)

$$L = \frac{K_1}{K_2 + \frac{l}{\mu A}} \qquad (1)$$

L = Inductance in henries.

K_1 = 3.2 × (no. turns)^2 × 10^{-8}

K_2 = Constant depending on the parameters of the fixed portion of the magnetic circuit.

l = Effective magnetic length of test lamination (in.).

μ = Permeability of test lamination at the frequency and level applied to the coil.

A = Cross-sectional area of the center leg of test lamination (sq. in.).

The capacitor in the circuit is selected so that, even with the highest permeability possible, the resonance frequency will be higher than the operating frequency. Hence, the higher the permeability, the more nearly the circuit approaches resonance and the lower the ratio of E_R/E_{in} becomes (See Figs. 2 and 3). The operating frequency of 200 cycles per second, instead of 60 cycles per second, was selected because it required smaller capacitors, the coil resistance can be made smaller, and the level can be made higher for a corresponding magnetic induction.

Losses

Since the "Q" of the coil is relatively low, the losses in the coil cannot be neglected. These losses consist of the resistance of the coil (R_{cu}) and the loss in the magnetic circuit (R_i). The losses and open circuit reactance (X_{Loc}) can be resolved into a parallel resistance (R_p) and parallel inductive reactance (X_L) (See Figs. 4A and 4B). The capacitive reactance (X_c) and inductive reactance (X_L) are then combined to form the parallel reactance (X_p) (See Fig. 4C). This circuit must then be converted into a series resistance (R_s) and a series reactance (X_s) by the following formulas, and Fig. 4D.

$$X_s = \frac{X_p R_p^2}{R_p^2 + X_p^2} \text{ and } R_s = \frac{X_p^2 R_p}{R_p^2 + X_p^2} \qquad (2)$$

The voltage drop across the series resistance (R) can then be calculated by the formula:

$$\frac{E_R}{E_{in}} = \frac{R}{\sqrt{(R + R_s)^2 + X_s^2}} \qquad (3)$$

Hence, by knowing the permeability and losses of the test lamination, a corresponding value of E_R/E_{in} can be calculated; and conversely each ratio of E_R/E_{in} corresponds to a value of permeability of the test lamination, provided the losses are constant. Since the resistance of the coil is constant, the only variable loss is the iron loss. Figs. 5 and 6 show the variation of E_R/E_{in} for high, low and normal iron loss at various permeabilities.

(*Continued on page* 192)

Fig. 5: E-25 lamination (48% nickel alloy): 60 cycle, 40 gauss permeability vs. E_R/E_{in} showing grade limits

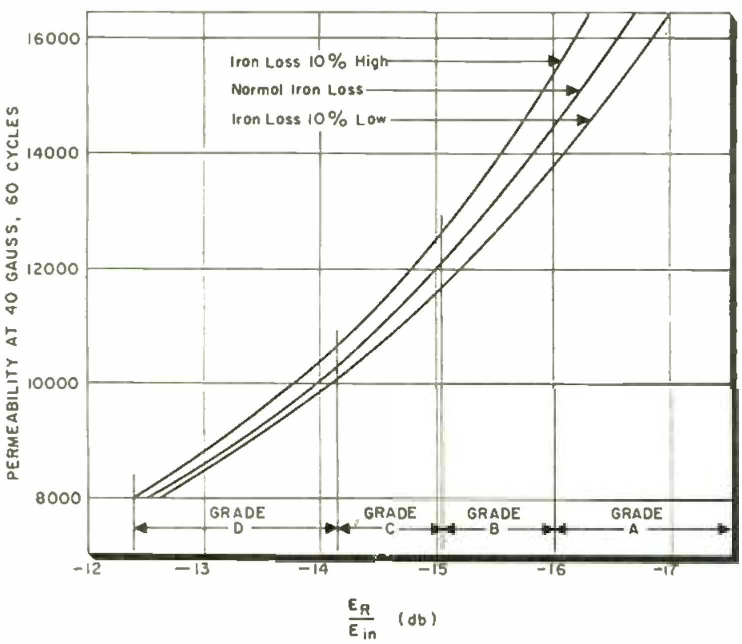
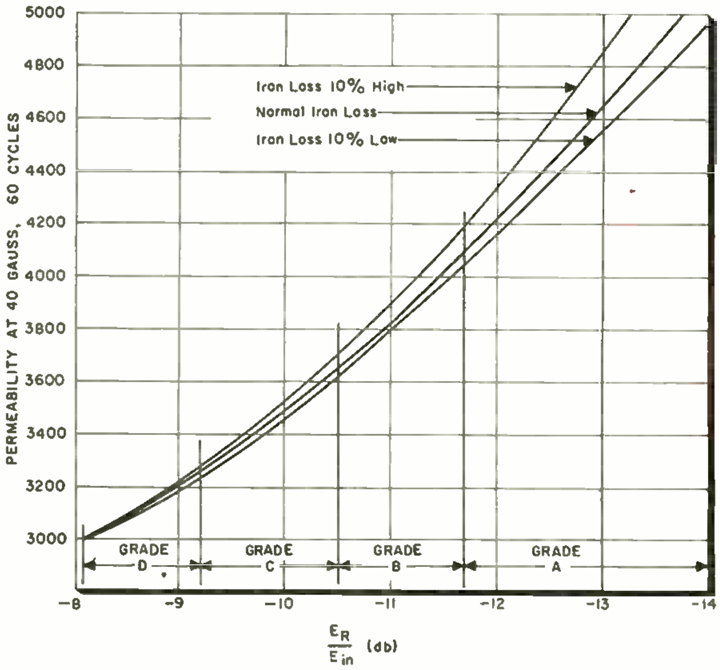


Fig. 6: E-25 lamination (79% nickel alloy): showing grade limits



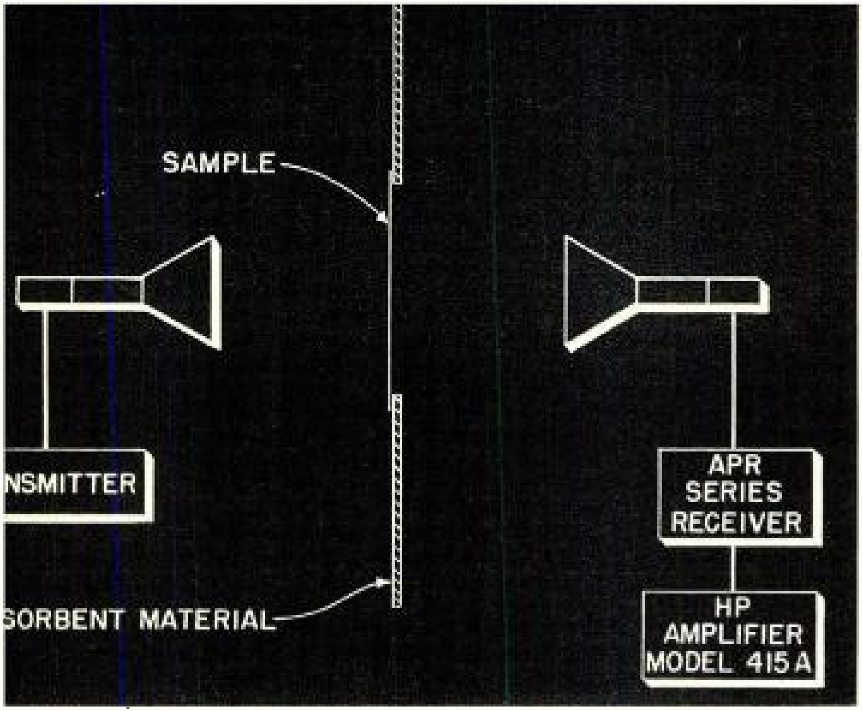


Fig. 1: Test arrangement for measuring transmissivity of aluminum mesh

Advantages of open mesh in meeting wind loading conditions and permitting ease of manufacture must be compromised with amount of energy that can be allowed to pass through the reflecting surface. Here is a method of determining largest permissible mesh opening for a given application.

By L. J. RICARDI and M. E. DEVANE

Aluminum Mesh in R-F Reflectors

IN the design of high gain antenna systems a conducting surface is almost invariably used to concentrate the radiated energy in the desired direction or directions. The

L. J. Ricardi

M. E. Devane

system usually consists of a reflecting surface illuminated by a relatively small antenna. Theoretically, this surface is considered to be made of a solid, high conductivity material. Practically, it is usually made of wire screen, metal grating, perforated metal, or "expanded" metal. This article discusses the use of "expanded" aluminum which is being used extensively as an r-f reflecting material. The other type reflectors have been discussed previously and design information is available[1].

Some of the advantages in using expanded aluminum as a microwave reflector are:

LEON J. RICARDI and MARK E. DEVANE, Lincoln Laboratory, Box 73, Lexington, Mass. The work described in this article was undertaken while the authors were employed at The Gabriel Laboratories, Div. of the Gabriel Co., 135 Crescent Rd., Needham Heights, 94, Mass.

1. Low wind resistance.
2. Low cost.
3. Ease of frabrication and assembly.
4. Ability to conform to various shaped reflector surfaces.

However, as with all types of partially open reflectors, some energy is transmitted through the surface and results in one or perhaps all of the following:

1. The efficiency or gain of the antenna system is reduced.
2. The relative intensity of the back lobe is increased.
3. Cross talk between adjacent antennas is increased.
4. The relative intensity of the side lobes adjacent to the main beam is increased.

The degree to which the above disadvantages are realized is dependent upon the portion of energy transmitted through the reflector. Since for a given application both the advantages and disadvantages become more significant as the surface is made more open, the designer is faced with the problem of how open the surface can, or must be and still have the antenna system meet the necessary requirements.

In many applications it is possible to predict the worst possible results once the transmissivity of the reflector is known. Consequently, the r-f transmission through several samples of plane sheets of expanded aluminum at various frequencies has been measured. The results for a linearly polarized plane wave at normal incidence are shown in Figs. 4 and 2. The details of the samples are shown in Fig. 3. Measurements were taken with the polarization parallel (Fig. 1) and perpendicular (Fig. 2) to the long dimension of the diamond.

The data was obtained in a manner similar to that previously reported[2]. This is, a ground plane, 12 ft. sq., was covered with absorbing material leaving an aperture in the center 2.5 ft. sq. (Fig. 1). The transmitting antenna was placed on the same side as the absorbing material. The receiving antenna was placed on the opposite side directly behind the aperture of the ground plane.

The power transmitted through the aperture was measured with and without a sample in place. This power level without any sample in place was recorded as P′. Then the sample was placed across the aperture and moved horizontally toward and away from the ground plane and the maximum and minimum level of transmitted signal noted. Thus the quantity P″ was determined as

$$P'' = \frac{\text{maximum} + \text{minimum}}{2}.$$

The percentage of transmission was calculated by the following expressions:

$$P' - P'' = 10 \log \frac{P_1}{P_2}$$

$$\% \text{ transmission} = 100 \frac{P_2}{P_1}$$

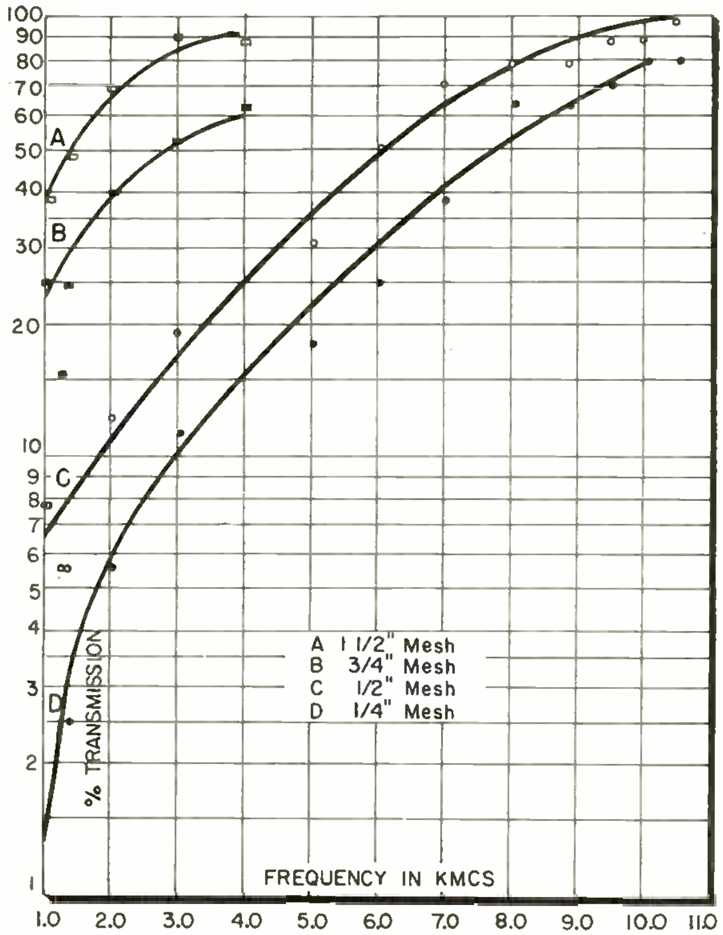


Fig. 2: Polarization perpendicular to long dimension

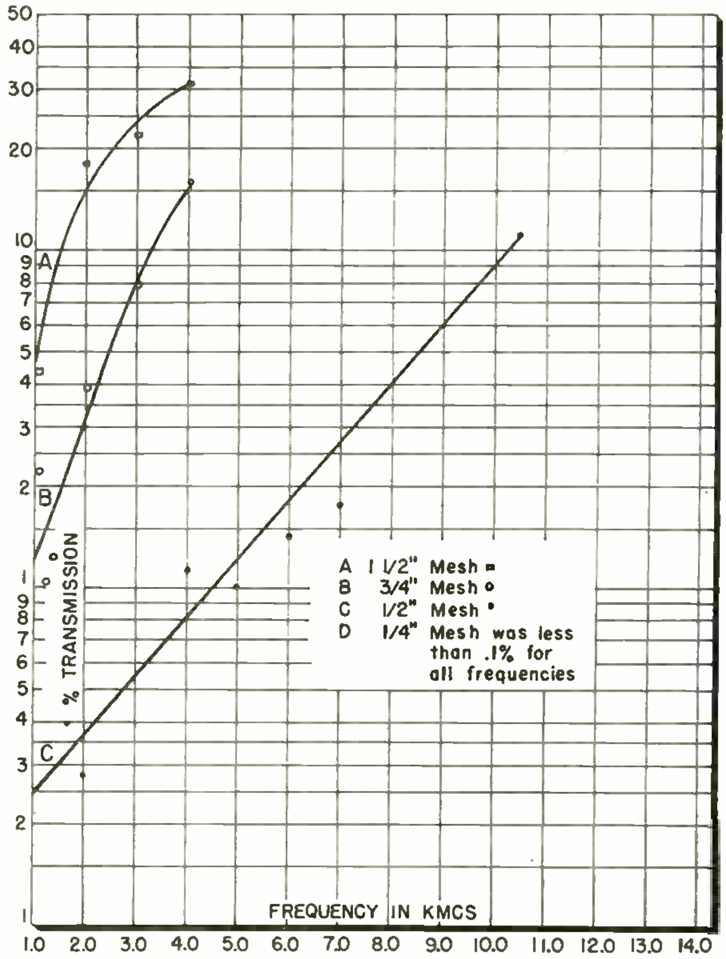
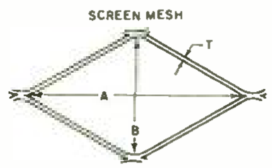


Fig. 4: Polarization parallel to long dimension



SAMPLE	A	B	MESH	T	% OPEN
A	2 ½	1 ¼	1½"	5/64	90.8
B	1 ¾	7/8	3/4"	3/64	92.5
C	1	1/2	1/2"	3/64	87.4
D	3/4	3/8	1/4"	3/64	83.8

(A&B - INSIDE DIMENSIONS)

Fig. 3: Dimensions of sample screen mesh

(P′ and P″ measured in decibels) The resulting data are shown in Figs. 4 and 2. The curves indicate the average of the experimentally determined values. The values are indicated in accordance with legend shown.

In determining P″ the maximum and minimum value differed by less than 3 db. Taking this into account with the other inherent errors in the test setup, the values given in Figs. 4 and 2 are believed to be correct to within at least a factor of 2 when the transmissivity is low (less than 3%) and within ±10% of the true value when more than 10% of the r-f energy is transmitted through the reflector. The applications for which this information can be used, in general, requires no greater accuracy than that indicated above.

The transmission of r-f energy polarized at any angle ψ with the long dimension of the diamond can be determined as follows. Resolve the electric field into two fields, one parallel and one perpendicular to the long dimension of the diamond. Then calculate the energy transmitted through the reflector for each polarization. The total transmitted energy is the sum of these two values.

In this manner, one finds that the percent, K_o, of the total power transmitted at any angle of polarization, ψ, is given by:

$$K_o = (\cos^2 \psi \, K_{//} + (\sin^2 \psi \, K_{\perp} \quad (1)$$

where . . .

ψ=angle between the electric vector and the long dimension of the diamond.

$K_{//}$=the percent transmission with the polarization parallel to the long dimension of the diamond (Fig. 1).

$K_{\perp}$=the percent transmission with polarization perpendicular to the long dimension of the diamond (Fig. 2).

The angle Θ between the electric vector of the transmitted field and the long dimension of the diamond is given by:

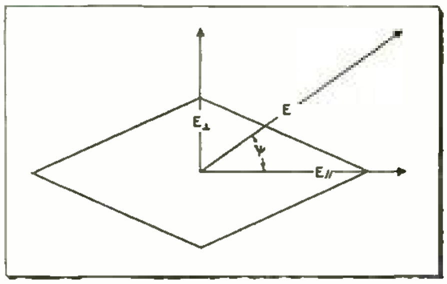


Fig. 5: Fields are parallel and perpendicular

$$\theta = \tan^{-1}\left[\sqrt{\frac{K_{\perp}}{K_{//}}} \tan \psi\right] \quad (2)$$

ψ-Θ is equivalent to the angle through which the total electric field is rotated.

As stated previously we feel that the data is sufficiently accurate to serve as a guide for the designer who is contemplating a reflector of expanded aluminum. The aspects of each individual case will indicate which mesh can be used. No general conclusions can be drawn regarding a definite mesh for a class of reflectors. In general the advantages in using say ½ in. mesh instead of ¼ in. mesh are not substantial compared to ¾ in. mesh versus the ¼ in. mesh.

1. W. D. Hayes, "Gratings and Screens as Microwave Reflectors," *Rad. Lab. Report #54-20.*
2. Op. Cit. No. 1

Page from an Engineer's Notebook

No. 35 — Transistor Alpha-Beta Conversion

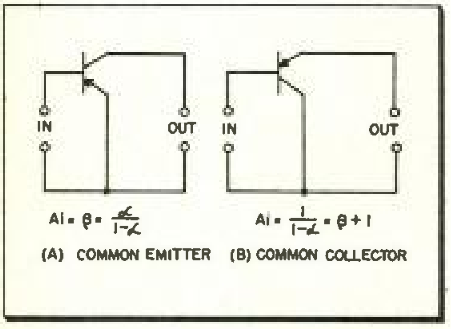


Fig. 1: Transistor base input configurations

By R. P. TURNER

Graphical method of converting emitter-to-collector current amplification factor (α) into corresponding base-to-collector current amplification factor (β) and vice-versa

SINCE current amplification is the basic property of the transistor, current amplification factor is an important characteristic in appraisal of transistor performance. The emitter-to-collector current amplification factor, α, appears in the expressions for current, voltage, and power amplification; input resistance, output resistance, and mutual resistance. In the design of certain transistorized dc amplifiers, current amplification values are of direct concern. The same is true in transistor testing.

It is the present practice of transistor manufacturers to list in their literature either the emitter-to-collector current amplification factor (α) or base-to-collector current amplification factor (β), seldom both. This causes some annoyance to the designer who, intending to use a common-emitter or common-collector circuit, finds only the common-base α specified; or, intending to employ the common-base circuit, finds only the common-emitter β listed.

The accompanying graph (Fig. 2) permits the rapid location of corresponding α and β values. It is intended as a time-saver for the engineer who either must make an initial selection of transistors or requires the two current amplification (A_i) values for transistors on hand.

These curves are based on the relationships:

Common Emitter

$$A_{i\,(ce)} = \beta = \frac{\alpha}{1 - \alpha} \qquad (1)$$

$$\alpha = 1 - \left(\frac{1}{\beta + 1}\right) \qquad (2)$$

Common Collector

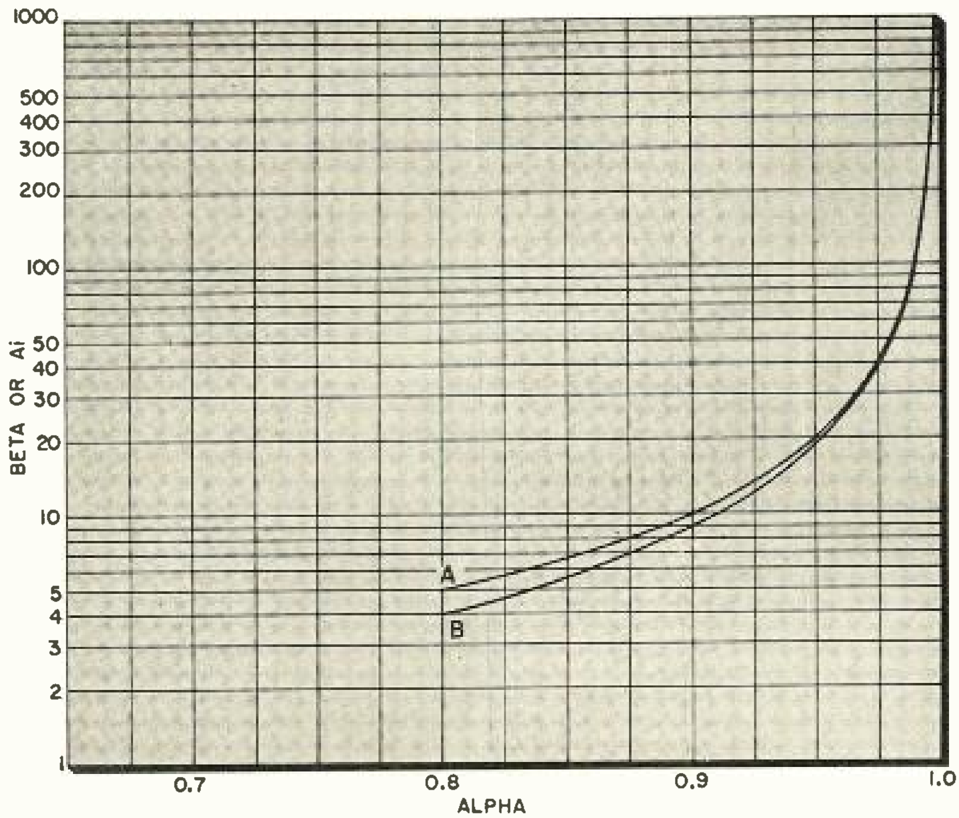
$$A_{i\,(cc)} = \frac{1}{1 - \alpha} = \beta + 1 \qquad (3)$$

$$\alpha = 1 - \left(\frac{1}{A_i}\right) \qquad (4)$$

From exploratory calculations, and to some extent from the curves, the unity difference between $A_{i\,(cc)}$ and $A_{i\,(ce)}$ is seen to amount to a 20% difference between their numerical values at $\alpha = 0.8$, to a 0.1% difference at $\alpha = 0.999$.

It is advisable to calculate A_i values (using the proper one of the preceding formulae) corresponding to α between 0.975 and 0.999, since curves drawn to any reasonable scale cannot display the small differences in α corresponding to rather large changes in β or A_i.

Fig. 2: Transistor current amplification curves. A. Common collector. B. Common emitter



R. P. TURNER, P.E., 919 East 116th Place, Los Angeles 59, Calif.

Herre Rinia, Vice-President

Haraden Pratt, Secretary

Dr. W. R. G. Baker, Treasurer

Donald G. Fink, Proceedings Editor

Preview of 1956 IRE* National Convention

714 Engineering Exhibits and 55 Technical Sessions will be featured at this year's show

WITH an anticipated attendance of 45,000 engineers and scientists, the 1956 IRE National Convention, scheduled to be held in New York City from March 19th through the 22nd, promises to be the most active in the Institute's history.

The program of 55 technical sessions and 714 engineering exhibits will cover almost every new development in the communication and electronic field. Technical sessions are scheduled for all four days of the convention at the Waldorf Astoria Hotel, Kingsbridge Armory, and the Belmont Plaza Hotel. The entire 4-acre floor of the Kingsbridge Armory will be used for the Radio Engineering show exhibits which will overflow into the Kingsbridge Palace located nearby.

The Annual Meeting of the IRE will take place in the Grand Ballroom of the Waldorf-Astoria Monday morning, March 19th. Feature of the meeting will be a talk by John T. Henderson, Director of the Canadian Region of IRE.

A get-together cocktail party that evening, and the annual IRE banquet, on Wednesday evening, at which the annual IRE Awards for 1956 will be presented, will round out the activities.

The technical program will include the following papers:

**A. V. LOUGHREN, 1956 IRE President (see front cover).*

Monday, March 19, P.M.

INSTRUMENTATION—I

Chairman: W. C. Moore, Boonton Radio Corp., Intervale Rd., Boonton, N. J.

A Transadmittance Meter for VHF-UHF Measurements, W. R. Thurston, General Radio Co., 275 Mass. Ave., Cambridge 39, Mass.

Measurement of Electron Tube Admittance Matrix Parameter at UHF, M. M. Zimet and S. Friedman, Material Lab., New York Naval Shipyard, Bklyn. 1, N. Y.

Transistor Measurements at High Power Levels, S. I. Kramer and R. F. Wheeler, Fairchild Guided Missiles Div., Wyandanch, N. Y.

A Transistorized Events-Per-Unit Time Meter, H. Chisholm, Berkeley Div., Beckman Instruments, Inc., 2200 Wright Ave., Richmond, Calif.

The Application of Magnetic Techniques to a Reliable 40 KC EPUT Meter Design, D. A. Weinstein, Berkeley Div., Beckman Instruments, Inc., 2200 Wright Ave., Richmond, Calif.

MEDICAL ELECTRONICS—I

Chairman: J. K. Hilliard, Altec Lansing Corp., 9356 Santa Monica Blvd., Beverly Hills, Calif.

The Perception of Direction as a Function of Binaural Temporal and Amplitude Disparity, R. J. Christman, Commander, Rome Air Development Center, Attn: RCSHW, Griffiss Air Force Base, Rome, N. Y.

An Apparatus for Brain Tumor Localization Using Positron Emitting Radioactive Isotopes, S. Aronow and G. L. Brownell, Mass. General Hospital, Boston, Mass.

The Application of Automatic, High-Speed Measurement Techniques to Cytology, W. E. Tolles, R. C. Bostrom and H. S. Sawyer, Airborne Instruments Laboratory, Inc., 160 Old Country Road, Mineola, N. Y.

An Intercommunication System for the Surgical Operating Room, M. M. Davis, Jr. and M. Baldwin, Nat'l. Inst. of Mental Health and Nat'l. Inst. of Neurological Diseases and Blindness, Nat'l. Institutes of Health, Bethesda 14, Md.

The Physiograph—A New Instrument for the Teaching of Physiology, L. A. Geddes, Lab. of Biophysics, Baylor University College of Medicine, Houston 25, Tex.

VEHICULAR COMMUNICATIONS: "NEW HORIZONS FOR VEHICULAR COMMUNICATIONS"

Chairman: W. M. Rust, Jr., Chief, Geophysics Research Sect., Humble Oil & Refining Co., 1200 Main St., Houston 2, Tex.

Miniaturization Techniques Utilized in a Multi-Channel Crystal Controlled VHF Oscillator, E. M. Stryker, Jr., Collins Radio Co., Cedar Rapids, Ia.

A New Concept for Communication Vibrator Design, A. B. Tollefsen, Jr., P. R. Mallory & Company, Inc., Indianapolis 6, Ind.

More Words Per Minute Per Kilocycle, C. B. Plummer, Chief, Broadcast Bureau, F.C.C., Washington 25, D. C.

A Vehicular User Looks at the Future, D. E. York, United Fuel Gas Corp., Charleston, W. Va.

Is 960 MC Suitable for Mobile Operation? C. J. Schultz, Motorola, Inc., 4545 Augusta Blv'd., Chicago 51, Ill.

GENERAL COMMUNICATIONS SYSTEMS

Chairman: H. P. Corwith, V-P, Development and Research, Western Union Telegraph Co., 60 Hudson St., N. Y. 13, N. Y.

The Place of Communications in Integrated Data Processing, A. O. Mann, SKF Industries, Inc., Front St. & Erie Ave., P. O. Box 6731, Philadelphia 32, Pa.

A New Means for Analysis of Communication Equipment and System Performance Using Log-Log Selectivity Curves, E. Toth, Naval Research Lab., Wash. 25, D. C.

Sixteen Channel Time Division Multiplex System Employing Transistors and Magnetic Core Memory Circuits, J. C. Myrick, Rixon Electronics, Inc., 2414 Reedie Dr., Silver Spring, Md.

W. E. Morrow, MIT Lincoln Labs., Cambridge 39, Mass.

Transmitting Tubes for Linear Amplifier Service, R. L. Norton, PENTA Laboratories, Inc., 312 N. Nopal St., Santa Barbara, Calif.
Methods of Reducing Frequency Variations in Crystals Over a Wide Temperature Range, L. F. Koerner, Bell Telephone Labs., Whippany, N. J.

ANTENNAS AND PROPAGATION—PROPAGATION

Chairman: H. G. Booker, Dept. of Engr. Physics & School of Elec. Eng'rg., Cornell Univ., Ithaca, N. Y.
Wave Propagation Over a 350-Mile Path at 960 MC, I. H. Gerks and A. J. Svien, Collins Radio Co., Cedar Rapids, Ia.
Ionospheric Cross Modulation from a 1000 KW Long Wave Broadcast Transmitter, E. T. Martin and G. Jacobs, Broadcasting Service, U. S. Information Agency, Wash. 25, D. C.
Atmospheric Refraction of 8.7 MM Radiation, G. R. Marner and R. M. Ringoen, Collins Radio Co., Cedar Rapids, Ia.
Recent Developments in the Theory of Sea Clutter, M. Katzin, Consulting Eng'r., 711 14th St., N. W., Wash., D. C.
Radar-Type Propagation Survey Experiments for Communication Systems, R. E. Lacy and C. E. Sharp, Signal Corps Eng'rg. Labs., Ft. Monmouth, N. J.

ASSURING OUR ENGINEERING FUTURE

Chairman: H. L. Richardson, V-P, Eng'rg. Operations, Sylvania Electric Products Inc., 1740 B'way., N. Y. 19, N. Y.
Industrial Research of the Future, E. D. Reeves, Exec. V-P., Esso Research and Eng'rg. Co., 15 W. 51st St., N. Y. 19, N. Y.
Human Relations Responsibilities of Engineers, P. E. Hemke, V-P, Rensselaer Polytechnic Inst., Troy, N. Y.
The Challenge of Engineering Management, C. H. Linder, V-P, GE, N. Y. C.
Education for Engineering Management, E. Shapiro, Assoc. Dean, School of Industrial M'gmt., M. I. T., Cambridge, Mass.

INFORMATION THEORY—I

Chairman: N. Marchand, Marchand Electronic Labs., 85 Railroad Ave., Greenwich, Conn.
Information Theory and Quality Control, J. Rothstein, Signal Corps Eng'rg. Labs., Ft. Monmouth, N. J.
Coherent Detection of Sinusoidal Signals in Gaussian Noise, K. S. Miller, Asso. Prof. of Math., New York Univ., N. Y. 53, N. Y., and R. I. Bernstein, Electronics Research Labs., Columbia Univ., N. Y. 27, N. Y.
Piecewise Quadratic Detectors, R. Deutsch, Hughes Research Labs., Culver City, Calif.
A Theory for the Experimental Determination of Optimum Nonlinear Systems, Amar G. Bose, Research Laboratory of Electronics, M. I. T., Cambridge 39, Mass.
Evaluation of Complex Statistical Functions by an Analog Computer, R. R. Favreau, Electronic Associates, Inc., Princeton Computation Center, Princeton, N. J., and H. Low, I. Pfeffer, The Ramo-Wooldridge Corp., 8820 Bellanca Ave., L. A. 45, Calif.

THE EFFECTS OF ENVIRONMENTAL AND OPERATING CONDITIONS ON THE RELIABILITY OF ELECTRON TUBES

Chairman: R. W. Shepard, Evans Signal Lab., Ft. Monmouth, N. J.
A Basic Study of the Effects of Operating and Environmental Factors on Electron Tubes, W. S. Bowie, Supervisor, Reliability Analysis Laboratory, GE, 316 E. 9th St., Owensboro, Ky.
The Effects of Shock and Vibration, F. Warnock, Jr., GE, 316 E. 9th St., Owensboro, Ky.
The Effects of Heater Voltage and Heater Cycling, W. S. Bowie, Supervisor, Reliability Analysis Lab., GE, 316 E. 9th St., Owensboro, Ky.
The Effects of Ambient Temperature, P. F. Barnett, GE, 316 E. 9th St., Owensboro, Ky.
The Effects of Plate Voltage, Plate Current and Plate Dissipation, D. E. Lammers, GE, 316 E. 9th St., Owensboro, Ky.
The Effects of Pulse Operation, W. U. Shipley, GE, 316 E. 9th St., Owensboro, Ky.

Tuesday, March 20, A.M.

ULTRASONICS

Chairman: Karl S. Van Dyke, Scott Physics Lab., Wesleyan Univ., Middletown, Conn.
Ultrasonic Stroboscope, E. A. Hiedemann, Dept. of Physics, Michigan State Univ., E. Lansing, Mich.
Surface Resonances of Bubbles and Biological Cells, E. Ackermann, Acoustics and Biophysics Lab., Physics Dept., Penn. State Univ., Univ. Pk., Penn. and T. F. Proctor, Corning Glass Works, Corning, N. Y.
Electronic Design Considerations in the Application of Piezoelectric Transducers, W. Bradley, Jr., General Manager, Endevco Corp., 161 E. Calif. St., Pasadena, Calif.
Propagation of Elastic Pulses Near the Stressed End of a Cylindrical Bar, A. H. Meitzler, Bell Telephone Labs., Whippany, N. J.
Transient and Steady-State Response of Ultrasonic Piezoelectric Transducers, E. G. Cook, Schlumberger Well Surveying Corp., Ridgefield, Conn.
Some Resonator Properties of Synthetic and Doped Synthetic Quartz, A. R. Chi, Signal Corps Eng'rg. Labs., Ft. Monmouth, N. J.

AUTOMATIC CONTROL

Chairman: J. C. Lozier, Bell Telephone Labs. Inc., Whippany, N. J.
Feedback-Controlled Length-Modulated Pulse Generator, J. E. Shea and P. Ordung, Yale Univ., School of Eng'rg., New Haven, Conn.
A Nonlinear Noise Suppression Network for Feedback Control Systems, R. L. Gordon, Sperry Gyroscope Co., Great Neck, N. Y.
Measurement and Stabilization of Nonlinear Feedback Systems, G. Casserly and J. G. Truxal, Microwave Research Inst., Polytechnic Inst. of B'klyn., 55 Johnson St., B'klyn. 1, N. Y.
Optimum Switching Criteria for Discontinuous Automatic Controls, N. J. Rose, Stevens Inst. of Tech., Hoboken, N. J.
The Reasonableness Check in Automation, C. H. Doersam, Jr., Doerco-Consultants, P. O. Box 177, Port Wash., N. Y.

AIR TRAFFIC CONTROL

Chairman: W. W. Felton, Sen. Staff Eng'r., Franklin Inst., Labs. for Research & Development, 20 & P'kway., Phila. 3, Pa.
Symbolic Display System for Air Traffic Control, L. T. Harris, Rome Air Development Center, Griffiss Air Force Base, Rome, N. Y.
A New Look at Requirements for Electronic Systems in Air Traffic Control, R. S. Grubmeyer, Franklin Inst., 20 & P'kway., Phila. 3, Pa.
Traffic Control Electronics Research Goes Modern, E. N. Storrs, J. L. Ryerson, Rome Air De-

(*Continued on page* 168)

1956 IRE National Convention—Technical Program

	BELMONT-PLAZA	WALDORF-ASTORIA						KINGSBRIDGE ARMORY	
	Moderne Room	Empire Room	Starlight Roof	Astor Gallery	Jade Room	Sert Room	Grand Ballroom	Marconi Hall	Faraday Hall
Monday, March 19 2:30 - 5:00 P.M.	Session 1 INSTRUMENTATION - I		Session 2 MEDICAL ELECTRONICS - I	Session 3 VEHICULAR COMMUNICATIONS: "NEW HORIZONS FOR VEHICULAR COMMUNICATIONS"	Session 4 GENERAL COMMUNICATIONS SYSTEMS	Session 5 ANTENNAS AND PROPAGATION - PROPAGATION	Session 6 ASSURING OUR ENGINEERING FUTURE	Session 7 INFORMATION THEORY - I	Session 8 THE EFFECTS OF ENVIRONMENTAL AND OPERATING CONDITIONS ON THE RELIABILITY OF ELECTRON TUBES
Tuesday, March 20 10:00 A.M. - 12:30 P.M.	Session 9 ULTRASONICS		Session 10 AUTOMATIC CONTROL	Session 11 AIR TRAFFIC CONTROL	Session 12 TRENDS IN TV EQUIPMENT	Session 13 AUDIO TECHNIQUES	Session 14 * ANTENNAS AND PROPAGATION	Session 15 SYMPOSIUM ON AIR FORCE COMMUNICATIONS AND ELECTRONICS PROBLEMS AND PHILOSOPHIES	Session 16 MICROWAVE TUBES
Tuesday, March 20 2:30 - 5:00 P.M.	Session 17 QUALITY CONTROL AND RELIABILITY STUDIES OF ELECTRONIC EQUIPMENTS		Session 18 NUCLEAR INSTRUMENTATION	Session 19 NAVIGATION	Session 20 TV TRANSMITTING EQUIPMENT AND TECHNIQUES	Session 21 HIGH QUALITY SOUND REPRODUCTION		Session 22 TELEMETERING COMPONENTS	Session 23 ELECTRON TUBES
Tuesday, March 20 8:00 - 10:30 P.M.			Session 24 (Joint) SYMPOSIUM: THE U. S. EARTH, SATELLITE PROGRAM - VANGUARD OF OUTER SPACE					Session 25 (Joint) COLOR TELEVISION TAPE RECORDING	
Wednesday, March 21 10:00 A.M. - 12:30 P.M.	Session 26 MICROWAVES I - GENERAL		Session 27 ENGINEERING MANAGEMENT TECHNIQUES	Session 28 FLIGHT DATA REDUCTION SYSTEMS	Session 29 BROADCAST AND TELEVISION RECEIVERS	Session 30 CIRCUITS I - SYMPOSIUM ON APPLICATION OF RECENT NETWORK IDEAS TO FEEDBACK SYSTEM PROBLEMS	Session 31 * NUCLEAR EFFECTS ON ELECTRONIC SYSTEMS	Session 32 ELECTRONIC COMPUTERS - I	Session 33 ANTENNAS AND PROPAGATION - ANTENNAS
Wednesday, March 21 2:30 - 5:00 P.M.	Session 34 MICROWAVES II - FERRITES		Session 35 DESIGN APPROACHES WITH PRINTED WIRING	Session 36 OVER-THE-HORIZON SYSTEMS	Session 37 COLOR TELEVISION RECEIVERS	Session 38 TELEMETERING SYSTEMS		Session 39 ELECTRONIC COMPUTERS - II	Session 40 ANTENNAS AND PROPAGATION - MICROWAVE ANTENNAS
Thursday, March 22 10:00 A.M. - 12:30 P.M.	Session 41 CIRCUITS II- DESIGN AND APPLICATION OF ACTIVE NETWORKS		Session 42 ELECTRONIC COMPUTERS III - SYMPOSIUM ON THE IMPACT OF COMPUTERS ON SCIENCE AND SOCIETY	Session 43 (Joint) COLOR TELEVISION	Session 44 COMPONENT PARTS - I	Session 45 INDUSTRIAL ELECTRONICS	Session 46 * INFORMATION THEORY - II	Session 47 MICROWAVES III - FILTERS	Session 48 INSTRUMENTATION - II
Thursday, March 22 2:30 - 5:00 P.M.	Session 49 CIRCUITS III - NETWORK SYNTHESIS TECHNIQUES	Session 50 SOLID STATE DEVICES		Session 51 WHERE IS MEDICAL ELECTRONICS GOING? - A SYMPOSIUM IN PREDICTION	Session 52 COMPONENT PARTS - II	Session 53 INFORMATION THEORY - III		Session 54 (Joint) MICROWAVE INSTRUMENTATION	Session 55 BROADCAST TRANSMISSION SYSTEMS - NEW HORIZONS

* Sessions terminate at 12:00 Noon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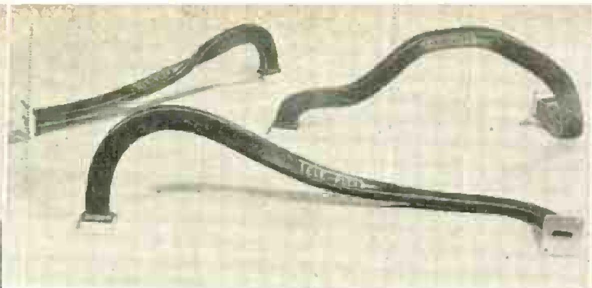
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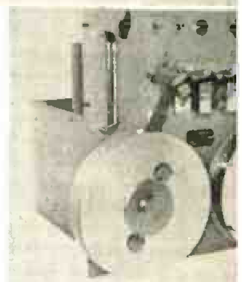
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New Broadcast & Microwave Equipment at The Show

1—Telechrome Inc.

Model 1003-A Video Transmission Test Signal Generator produces multi-frequency burst, stair-step and window signals, including composite sync. Also: Chromatron Monitors and Telemetering Equip. Booth 181 & 183

2—Blonder-Tongue Lab., Inc.

Observer TV Camera for industrial TV. Can be used up to 3000 ft. from receiver without additional amplification. No special illumination required. Also Rotary Cable Strippers. Booth 143

3—Telex

Boom-type headset, weighs less than half as much as standard two-way headsets. Also: miniature plug-in decade resistance units and miniature jack and plug combinations. Booth 7

4—Telerad Manufacturing Corp.

Tele-Flex Flexible Waveguide, can be run at random lengths and joined to fittings of the customer's choosing. Also: test equipment and coaxial connectors. Booth 220

5—Gates Radio Corp.

Twinsistor is a complete two-channel high level remote amplifier incorporating the use of 6 transistors. Transmote is a single channel remote transistor amplifier. Booth 157, 159, 161, 163 & 165

6—Davies Laboratories, Inc.

Type 103 Tape Transport utilizes 1 or 2, single, dual, or triple speed hysteresis synchronous motors, permitting up to 6 different tape speeds from 60 to 0.83 ips. Booth 222

7—Kay Lab

Model 1985 Industrial TV system affords increased overall system sensitivity and resolution. Also sync generators, dc amplifiers, and microvolt-ammeters. Booth 261, 263

8—Bendix, Eclipse-Pioneer Div.

Airborne Weather Radar Antenna Type 40022-2-A provides circular azimuth scanning at a rate of 15 RPM. Also: 3-gyro stable platforms and gyro transmitters. Booth 128, 130, 132. 134, 136, 138 & 140

9—Emerson & Cuming, Inc.

Echo Reflector, a passive target radar energy is broad banded throughout the microwave frequency range. Also: microwave products, plastics, impregnants, laminating resins. Booth 659

10—General Precision Laboratory, Inc.

Closed-circuit industrial and institutional TV camera, Model PD-150-5 with remote control iris, focus, and indoor pan and tilt. Enclosure is explosion and dust proof. Booth 152, 154

11—Antlab, Inc.

Antenna pattern plotter with associated amplifiers and control equipment plots either the sq. root or linear function of input signal on a polar scale. Full scale deflection is 5μv. Booth 36

12—Technical Material Corp.

GPR-90 is a 15 tube double conversion superhetrodyne communication receiver covering the frequency range of .54 to 31 mc in 6 bands. Also radio transmitters. Booth 449, 451

13—Diamond Microwave Corp.

KU Band Antenna and Feed System is broad band 15 to 17 kmc, with gain greater than 47 db. Also: attenuators, directional couplers, duplexes, and phase shifters. Booth 487

14—A-V Manufacturing Corp.

Double Capstan Tape Transport, precision performance with 3600 ft. reels of 1 in. tape at 60 ips. Wow and flutter less than 0.1% RMS within 30 μsec. Booth 882, 884

15—Union Switch & Signal

"TVL" Inductive Elevator Control, for use with 2-passenger elevator which glides up and down inside TV antenna tower. Also: selinium tubular rectifiers. Booth 112, 114

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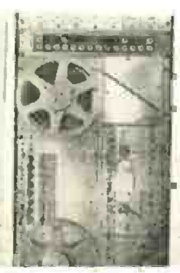
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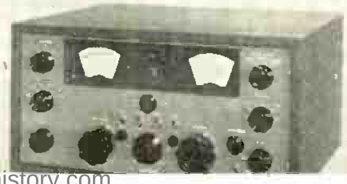

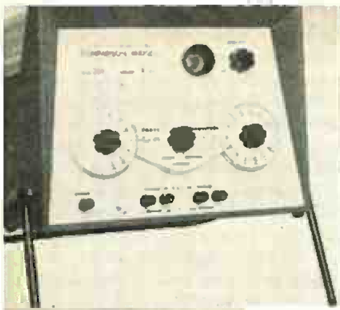

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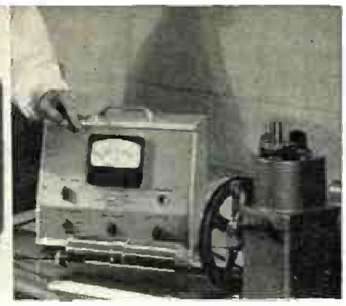

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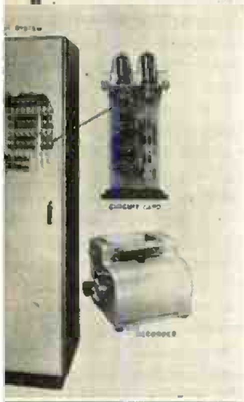

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New Test and Laboratory

16—Electro-Measurements, Inc.

Model 260 Comparison Bridge compares the magnitude and phase differences of components against a standard. Also: precision voltage dividers and potentiometers. Booth 212

17—Dubrow Development Co.

Germanium Diode Tester Model 455 is a portable instrument used to detremine the quality of all types of germanium diodes. Also: dc Amplifier Booster, Model 489. Booth 37

18—Electro Instruments, Inc.

AC-DC Digital Voltmeter measures ac to 1% accuracy and dc to 0.01% with stability of 0.01% from 40° to 125°F. Also: transistor amplifier and X-Y recorder. Booth 63

19—American Metrix Corp.

AF Oscillator Type 816 has range from 30 cps. to 30 kc. Accuracy is 2% ± 2 cps. Also: tube analyzers, tube checkers, multimeters, universal meters, and VTVM's. Booth 321

20—National Research Corp.

A high vacuum torture system will show the reliability of NRC new vacuum components. Components include vacuum gauges, diffusion pumps and vacuum pumps.

21—Radiation, Inc.

Analog-to-Digital-to-Analog Recording System (ADAR) generates up to 24,000 binary coded data points every second. Binary code is recorded on chart paper. Booth 10

22—F. L. Moseley Co.

Model 3 Autograf X-Y Recorder uses independent servo-drives, actuating a drafting machine type recording mechanism to provide 0.25% accuracy. Sensitivity; 0.5 mv./in. Booth 315

23—Marconi Instruments

FM/AM Signal Generator Type 1066 covers all mobile communication frequencies. (10-470 mc). Also: Deviation Meters, Wave Meters, X Band Wattmeters, and Power Meters. Booth 260 & 262

24—Teletronics Laboratory, Inc.

Diode Tester, Model DT-100A, is used for measuring the static characteristics of germanium low-power selenium and power type germanium diodes. Also: electronic switch. Booth 302

25—Acton Laboratories, Inc.

Type 550-A Direct Writing Oscillographic Recorder, used in conjunction with Type 503-A Direct-Coupled Amplifiers, provides a direct recording system on 35 mm film. Booth 723

26—Computer-Measurements Corp.

Model 314A Preset Controller automatically controls any operation after a preselected count has been reached. Also: frequency and period counters. Booth 310

27—Rawson Electrical Instrument Co.

Type 519 Astatic Wattmeter (shown) and Astatic Voltmeters are electro-dynamic type instruments with frequency response flat to at least 1000 cps. Booth 210

28—Industrial Instruments

Model AB-4 Auto-Bridge, for testing precision resistors, is shown controlling a spiraling lathe. Also: megohmeters and low resistance ohmmeters. Booth 637

29—Advance Electronics Co., Inc.

Ultra-Low Frequency Phase Angle Counter measures phase angle between 2 voltages down to 0.00001 cps. Accuracy: 1 count in 10⁵. Also: delay lines. Booth 284

30—Laboratory for Electronics, Inc.

Improved Model 411 Oscilliscope features 6 X-axis plug-in units: 1. basic; 2. delay; 3. video switch; 4. market generator; 5. TV trigger; 6. long sweep generator. Booth 229, 231, 326, 328

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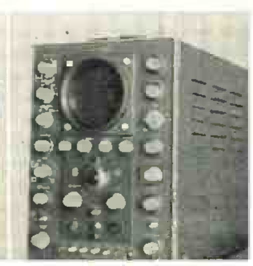

  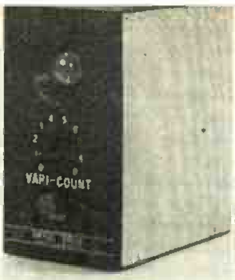

 

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Equipment at the IRE Show

31—Electrical & Physical Instr. Corp.

Model 720 Wide Band Amplifier, featuring pulse rise time of .04 μsec, voltage gain of 1,000. Also: pulse generators, automatic scaler and pulse transmission equipment. Booth 785

32—Servo Corp. of America

Spectrum Generator Secondary Frequency Standard. Also: dead reckoning tracer for rectangular plotting, airborne computers, pyrometers, direction finding equip. Booth 203 & 300

33—Haydu Bros.

"Vari-Count" variable scale counter, produces output pulse for from 1 to 10 input pulses. Also: low voltage beam switching tube; direct reading numerical indicator tube.

34—Brubaker Electronics Inc.

"Marker-Pulser" Pulse Generator, measures time delays of 0.01 μsec. Also: delay lines, relays, pulse transformers, switches, test equipment and research & devel. facilities. Booth 640

35—Simpson Electric Co.

TV Field Strength Meter. Also: variable dot generator for color TV; multi-range calibrating standard; 7" oscilloscope, dual bandwidth, flat within 1 db to 4.5 MC. Booth 448

36—Levinthal Electronic Products Inc.

Power Supply with 50-KV Isolation, continuously variable output, 0-7500v., @ 500 ma. Also: sweep frequency VSWR measuring system, with accuracy less than 2%. Booth 137

37—Hewlett-Packard Co.

Model 201C Audio Oscillator, 20 cps to 20 KC, in three overlapping bands. Also: low frequency oscillator, V-T voltmeters, traveling wave tube amplifier, 1 MC counter. Booth 248 & 250

38—General Radio Co.

Type 1230-A DC Amplifier and Electrometer. Six volt ranges, 30 mv to 10 v. d-c full scale. Variacs, impedance comparator and pulse, sweep and time delay generators. Booth 251, 253, 255

39—Fairchild Camera & Instr. Corp.

Oscillo-Record Camera, for still and continuous-motion CRO protography. Also: sine-cosine pot, pressure transducer, w-w and metal film potentiometers. Booth 592.

40—Perkin Engineering Corp.

Magnetic Amplifier Regulated DC Power Supply, dual voltage range, output 5-30 v. and 10-40 v. at 30 a. Also: tubeless 1 KVA magamp regulated ac line voltage regulator. Booth 324

41—Electro-Pulse Inc.

Model 3450A Megacycle Pulse Generator, produces simultaneously available positive and negative pulses variable to 50 v. amplitude. Also: counters, calibrators, generators. Booth 221

42—Specific Products

Model WWVC Standard Frequency Comparator. Crystal controlled receiver for precise radio frequency standards work, and time interval measurements. Booth 814

43—Rutherford Electronics Co.

Model 300 Pulse Forming Unit, produces high repetition rate pulses of fast rise time and carefully controlled pulse shape. Repetition rates up to 1 MC. Booth 424

44—Waveline Inc.

Model 2200-M Modulated Power Unit, used with accessory equip. as noise power source. Also: microwave noise measuring instruments, attenuators, waveguide mounts. Booth 367

45—Electronic Research Assoc. Inc.

Transistored Regulated Power Supply, featuring small size, light weight, high conversion efficiency. Voltage ratings from 5-300 VDC @ 100 ma. Either 60 or 400 cps. Booth 216


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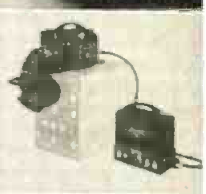
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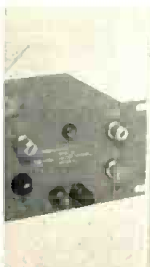 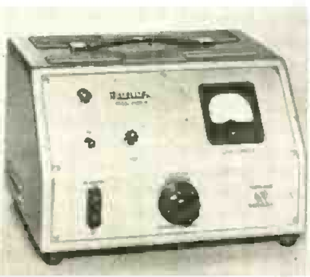 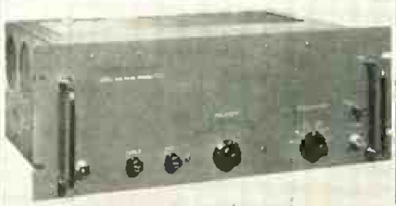 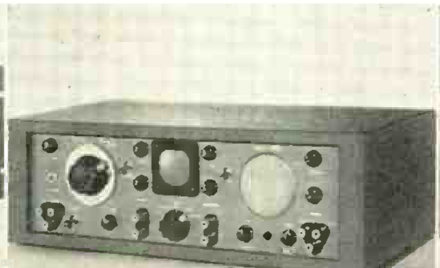 



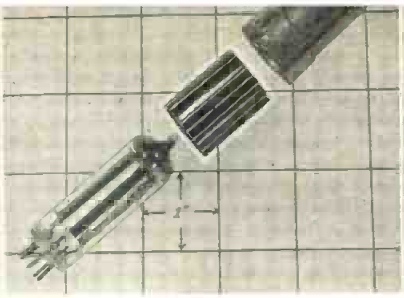

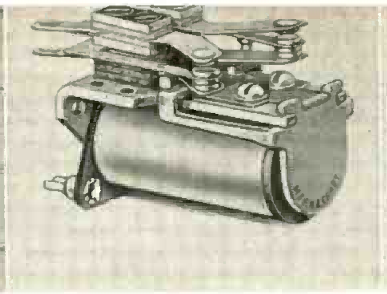
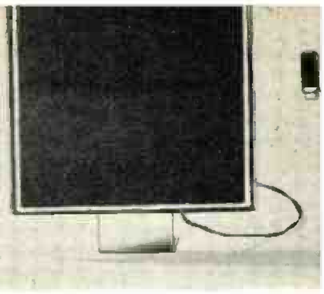

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New Components & Technical

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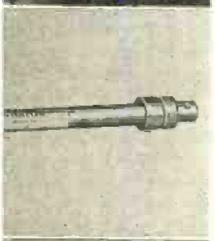

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46—Polyphase Instrument Co.

P10H pulse transformer kit contains 10 different plug-in type pulse transformers for use in transistor circuits. Pulse width range is from 0.2 to more than 100 μsec. Booth 767

47—Transitron Electronic Corp.

New silicon power rectifiers with 500 and 600 v. peak inverse voltage ratings are available with 400 ma. current ratings at 100°C. Also silicon bonded diodes. Booth 580

48—Atlas E-E Corp.

New insert for standard type JAN tube shields lowers bulb temperatures of miniature tubes by as much as 100°C. Units available in 6 sizes for both 7 and 9-pin tubes. Booth 745

49—Magnecraft Electric Co.

Class 22R Miniature Power Relay handles 10 a. non-inductive load with great operating sensitivity. Available for any voltage to 440, 60 cy. ac; 230 vdc. May be hermetically sealed. Booth 286

50—International Rectifier Corp.

Available in sizes and power ratings from 0.14 to 10.5 sq. in. in photosensitive area and from 0.1 mw. to 15 mw. power output in direct sunlight, selenium Sun Battery Cells are designed to power transistors. Booth 730

51—Perkins-Elmer Corp.

Vernistat, new 400 cycle, high linearity (.05% standard), small ac potentiometer-auto transformer is for use in servo systems and analog computers. Booth 507

52—CBS-Hytron

Power Transistor, Silicon Power Rectifier, Glass Diode, h-f Transistor, Gold Bonded Junction Diode, General Purpose Transistor, Plastic Diode and Power Transistor (l. to rt.) Theatre 3

53—Narda Corp.

Fixed coaxial termination has a VSWR less than 1.05 over range 2400 to 12,400 mc. Also: wide band coaxial directional couplers, sliding terminations and echo boxes. Booth 278

54—Cox & Co.

Thermoplastic heaters with ratings up to 30 w./sq. in. and higher attach to any surface using room temperature curing adhesive. Also: Thermowire, Thermopatch and Thermosheet heaters. Booth 819

55—Boonton Radio Corp.

Metal Film Gauge Type 255-A provides means for simple accurate, and non-destructive testing of plating or film thickness of various combinations of materials. Booth 225 & 227.

56—Micro Switch

21AT1 "Electrical Memory" Toggle Switch uses 3 single-pole double-throw functional basic switches and 1 single-pole double-throw memory switch. Booth 356 & 358

57—Raytheon Manufacturing Co.

Ruggedized mounting brackets for terminal and resistor boards provide rigid support under conditions of shock and vibration. Also: captive hardware and shaft locks. Booth 145, 147 & 149

58—Ace Electronics Associates

Acetrim sub-miniature wire-wound precision potentiometer trimmers have resistance range from 10 ohms to 50K and temperature range from —55° to 125° C. Linearity 3%. Booth 11

59—Robinson Aviation Inc.

Model K266 all metal mounting system is for delicate airborne electronic equipment. Also: industrial machine tool mounts, mobile equipment and packaging case mounts. Booth 751

60—Alford Manufacturing Co., Inc.

Type 1025 Precision Transmission Line Hybrid is for use in the measurement of very small impedance mismatches. SWR's as low as 1.002 have been measured. Booth 393

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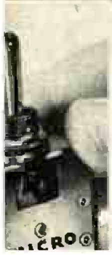

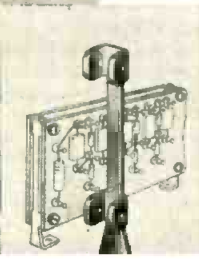
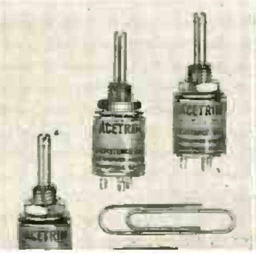


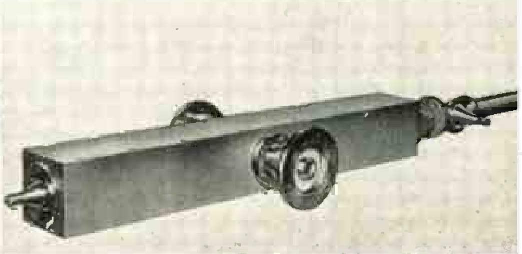

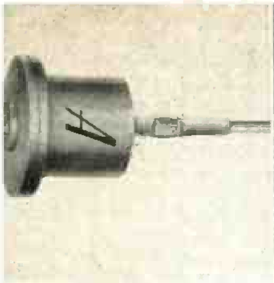
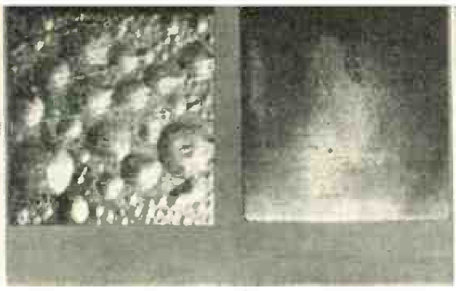
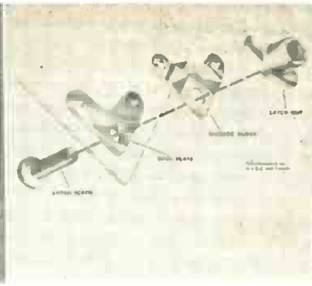
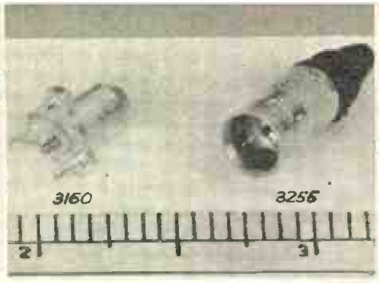

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Products to See at The Show

61—Automatic Manufacturing Corp.

Silicon Power Rectifier, 1N445, for ambient temperatures to 150°C. Low forward resistance (1 ohm), small reverse leakage current. All welded hermetic seal. Booth 355

62—National Vulcanized Fibre Co.

Line of copper clad phenolic laminates, designated "HP" series, featuring bond strength of 12-15 lb., soldering temp. res. of over 30 sec. at 500°F. Booth 777.

63—Scovill Mfg. Co.

Line of "Paneloc" fasteners and rotary latches for inspection doors, access panels, covers, and control panels. Steel, cadmium-plated. Designed for easy installation. Booth 803

64—Microdot Inc.

New 3160 printed-circuit connector, and 3255 matching plug. Also: complete line of several hundred microminiature coax items, hermetic seal connectors. Booth 679.

65—Winchester Electronics Inc.

New "W" series of printed-circuit connectors for right angle mounting, containing individually-isolated, right-angle pin contacts. Locking devices. Booth 628

66—Artos Engineering Co.

New Automatic TA-20-S Terminal Attaching Machine, measures, cuts and strips wire in one operation, and with accessories will mark wires with identification. Booth 711

67—Chicago Tel. Supply Corp.

Compact, self-supporting multiple variable resistors, designed for printed circuits and automatic assembly operations. In 2- and 3-control units. Booth 450

68—Switchcraft Inc.

New 16000 series "Telever Switch," in 2- and 3-position types, locking or non-locking action. Contacts are welded cross bar palladium standard. Booth 435

69—Kepco Laboratories

Voltage Regulated Power Supplies, in 16 models, featuring regulation less than 0.2 v. for fluctuations from 105-125 v. Ripple less than 3 mv. rms. Booths 342, 344

70—The Polymer Corp.

New ferromagnetic plastic, "Ferrotron," in flexible rod and tape, suitable for operation to 200°C. High impact strength, good machinability, high volume resistivity. Booth 811

71—Falstrom Co.

Metal fabrications for the electronics industry. One piece blanking, drawing, forming and embossing, eliminating welded construction. Booths 766, 768

72—The International Nickel Co.

Ultrasonic soldering iron for fluxless soldering and pre-tinning of metals. Electronic equip. utilizing nickel and nickel-bearing alloys. Booths 173, 175, 270, 272

73—Universal Manufacturing Co., Inc.

Toroidal Winding Machine, with shuttle and magazine of over 20" dia. Also smaller machines to handle #5 to #40 wire. Transformer lamination stacker. Booths 560, 562

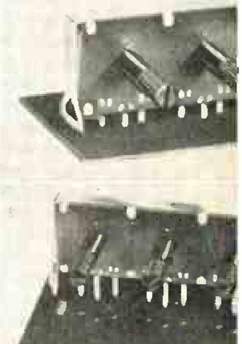
74—Avery Adhesive Label Corp.

New Pressure-Sensitive Foil Label. All-metal labels for permanent-type uses on all smooth surfaces, applied without moistening. Automatic label dispenser. Booths 389, 391

75—Aironic Accessory Co.

Line of cable clamps, of U-clamp design, molded from nylon, to eliminate need for tying or serving cables. For temperatures to 250°F. Booth 308

(*Continued on page* 130)



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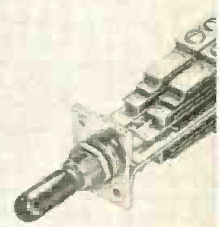

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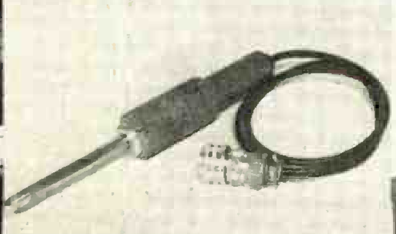
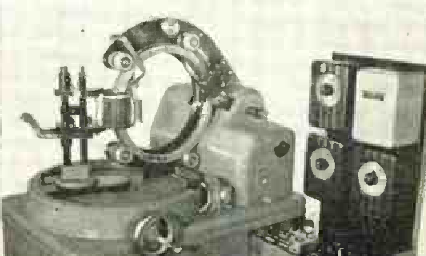



By R. C. HERGENROTHER, A. S. LUFTMAN, and C. E. SAWYER

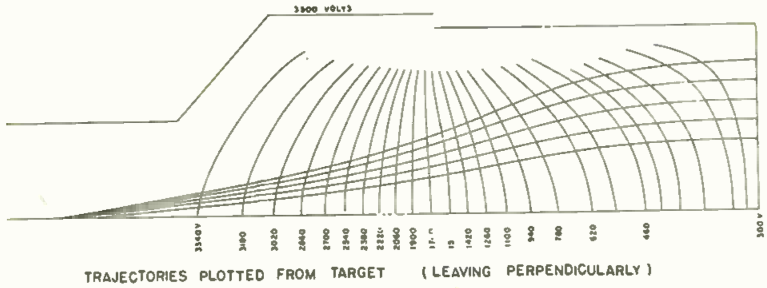


Fig. 1: Field plots of electron trajectories show improved collimation of QK464 which improves background level uniformity

Improved Storage Tube Design

Newly designed storage tube, with the storage surface on the electron gun side of the storage screen, provides higher resolution, a more uniform background, and faster writing and erasing speeds

As described in previous articles[1-2], the QK357 Raytheon Recording Tube was made up of a basic triode-gun electron source, a decelerating lens and screen, a storage screen, and a collector-reflector or signal electrode. The two screens were 500-mesh nickel with a high transparency (60%-70% open area). The storage surface was made by vacuum-evaporating or coating the side of the storage screen nearer the signal electrode with a dielectric material such as calcium fluoride. The improved version, the QK464, which we will discuss here is basically similar but with the storage surface on the electron gun side of the storage screen. (See Fig. 2.)

Operation

Normal operation of either the QK357 or the QK464 takes place in a four-step cycle: erase, prime, write and read. In the first three steps, the electron beam is used to vary the charge level on the storage surface; while during read, the charge pattern previously written amplitude-modulates a constant beam from the electron gun.

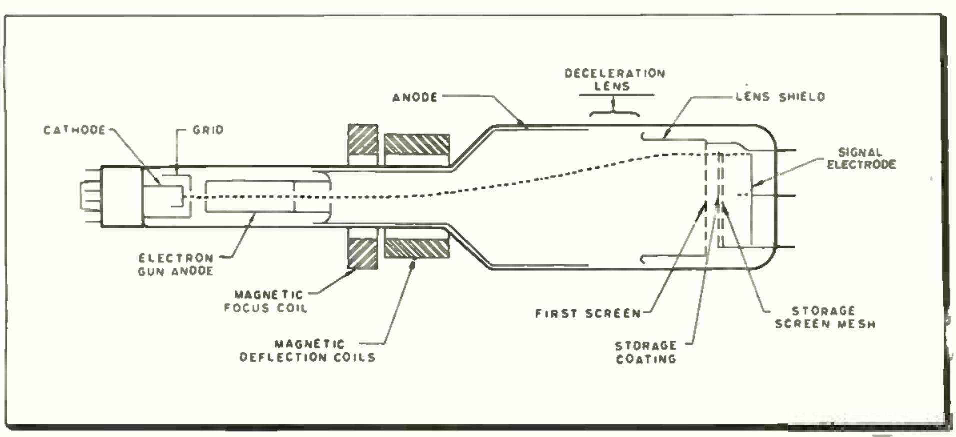
To erase any previous signal or charge pattern, the storage screen voltage is set well above the critical potential of the storage material, so that the electron beam charges the dielectric surface positively until it has reached the same potential as the storage screen.

To prime the tube after storing information, the storage screen potential is set somewhat below the critical value. The electron beam now charges the storage surface in a negative direction until it reaches cathode potential, resulting in a difference in potential between the storage screen and the storage surface.

To write the desired charge pattern on the storage surface, the storage screen potential is switched so that the storage surface potential is above its critical value, and the storage surface is scanned with an electron beam which is amplitude-modulated by the input signal to be written. The storage surface will thus be charged by the modulated beam current toward the storage screen potential, the amount of charge for any particular element being proportional to the beam current amplitude when that element was scanned.

To read the stored charge pattern, the storage screen potential is switched to a value such that areas of the pattern which have had no signal written will be sufficiently below cathode potential to cut off the electron beam from the signal electrode. When an unmodulated electron beam is scanned across the storage elements, storage surface areas with no charge will cut off the beam from the signal electrode and areas with charge values up to a certain saturation level will permit a portion of the electron beam corresponding to the amount of charge which has been written to be transmitted to the signal electrode. An amplitude-modulated current is thus received by the signal electrode corresponding with the charge pattern

Fig. 2: QK464 Recording Tube, showing storage coating located on front side of screen



R. C. HERGENROTHER, A. S. LUFTMAN, and C. E. SAWYER, Tube Development Labs., Raytheon Manufacturing Co., Waltham, Mass.

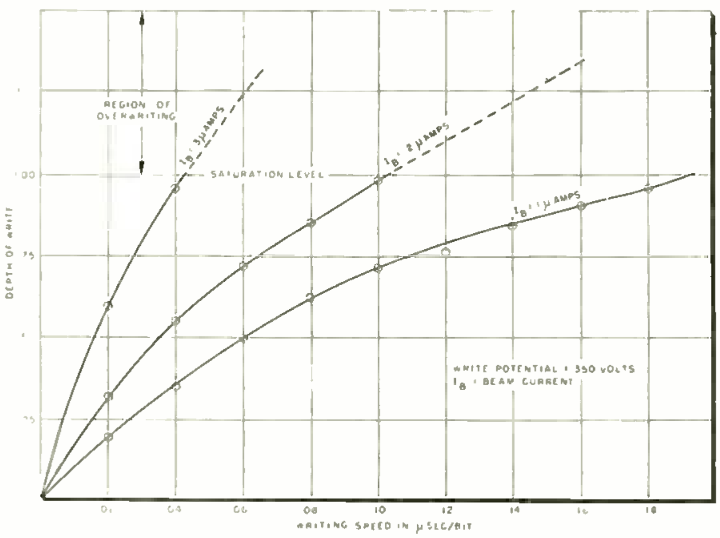


Fig. 3: Beam current determines writing speed

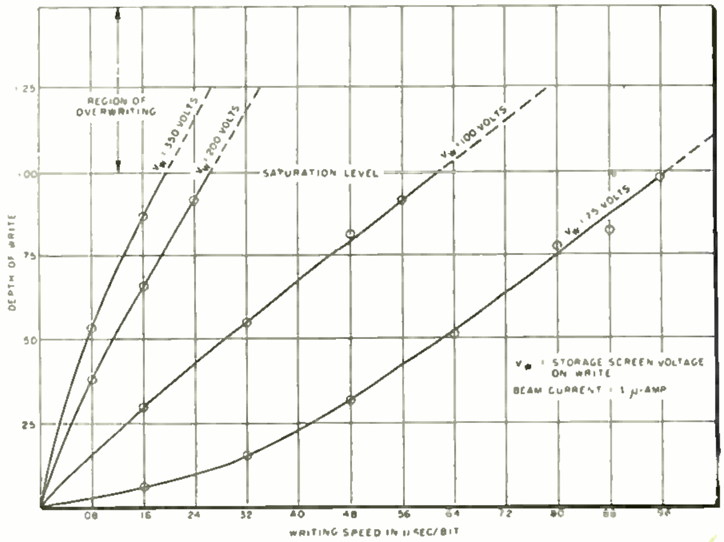


Fig. 5: Curves of storage screen voltage vs. writing speed show speed reduction obtainable

which has been written. The charge pattern is thus used only to modulate an electron beam and is not depleted by repeated read-outs of the stored data.

There is one basic difference in the operation of the two tubes. With the QK357, it was necessary to maintain the signal electrode at a negative potential during erase, prime, and write in order to reflect the primary electron beam onto the storage surface, while the potential had to be switched positive for the read operation. With the QK464, however, the use of front-surface storage permits the signal electrode to be maintained at a constant positive potential throughout the cycle.

Previous Drawbacks

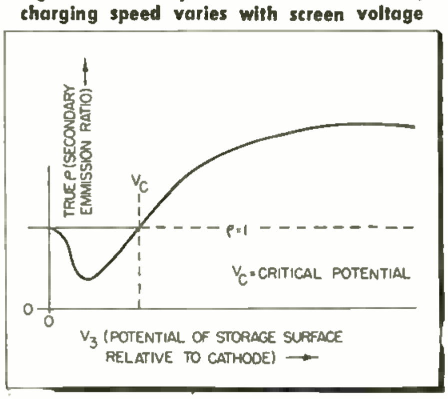
Field experience with the QK357 Recording Tube revealed certain characteristics which tend to restrict its application. Such characteristics include: 1) the switching transient fed to the output video amplifiers when the signal electrode is switched from −300 v. for write to +300 v. for read, 2) the relatively slow priming speed capabilities of the tube, 3) the limitations to dynamic range produced by inaccurate collimation of the electron beam, and 4) the presence of noise caused by the ringing of the storage screen for prolonged periods of time after it has been shock-excited by voltage switching between operations.

To remedy these shortcomings, the QK357 has been redesigned as a front-surface storage tube with an improved collimating lens and with certain modifications to minimize the shock excitation of the storage screen caused by voltage switching. The improved tube is designated QK464.

As has been mentioned, the basic change is that the storage material, which was on the signal electrode side of the storage screen in the QK357, is now located on the side directly facing the electron gun. This does not interfere with the tube's ability to read out stored signals repetitively, since the electron charge pattern on the storage surface during read makes all areas on that surface negative with respect to cathode potential and the electron beam therefore cannot strike the storage surface. The advantage is that, with the storage surface now facing the electron gun, the signal electrode potential need not be switched but can be kept at a fixed positive potential throughout the operating cycle. Reversing the storage screen thus eliminates the switching transient in the signal output and, as will be shown, also results in improved charging speeds and resolving power.

It has been shown in a previous paper[3] that an electron beam passing through an aperture into a reflecting field will be increased to a diameter 50% larger than the aperture by the time it has returned to the plane of the aperture. In the QK357, where the modulated electron beam was reflected in this manner during the write operation, the enlargement of the spot size of the electron beam resulted in a marked decrease in resolution. In the improved tube, on the other hand, since the electron beam impinges directly on the storage surface, resolution is improved by a factor of nearly 25%. Resolution in the average QK357 was between 375 and 400 lines, whereas resolutions in excess of 450 lines as measured at half amplitude are achieved in the majority of QK464's.

Fig. 4: Secondary emission characteristics; charging speed varies with screen voltage



Writing Speed Determinants

The writing speed characteristics of the QK464 as derived from general equations are as follows:

$$\frac{dV}{dt} = 10^9 \frac{4\pi d}{\epsilon} \cdot \frac{d\sigma}{dt}$$

$$\frac{d\sigma}{dt} = I_p (\rho - 1)$$

$$I_p = \alpha_1 (1 - \alpha_2)(I_k - I_A)$$

By lumping constants and integrating, we arrive at:

$$V = \int_0^{t_1} dV = k [d (I_k - I_A) (1 - \alpha_2)(\rho - 1)] t_1$$

V = Potential of storage dielectric in volts

d = Thickness of storage dielectric in cm

ϵ = Dielectric constant of storage material

σ = Charge density of storage dielectric in coulombs

ρ = Secondary emission of the storage dielectric

α_1 = Transmission of the first screen

α_2 = Transmission of the storage screen (after coating)

I_K = Gun cathode current

I_A = Gun anode current

t_1 = Time required for the beam to be scanned the distance between adjacent spot elements times the total number of scans

I_p = Current impinging on the storage surface

(*Continued on page* 158)

With the frequency spectrum already severely congested, and demands increasing for additional channels, particular attention must be given to restricting the space occupied by existing stations. Described here are the frequency requirements of On/Off and frequency shift keying systems

By J. B. MOORE

Bandwidth Requirements Of SW Radio Telegraphy

J. B. Moore

AS THE short-wave portion of the radio spectrum has become more congested, and the world demand for commercial telegraph and other channels has grown, it has become increasingly important to restrict the amount of spectrum space allocated to, and occupied by, each radio-telegraph or radio-teleprinter signal.

The importance and urgency of this problem have become so great, that at the present time, the CCIR (International Radio Consultative Committee), and many governments and private operating agencies are devoting considerable study and effort to find a generally satisfactory solution for world-wide use. For this reason, it is necessary that those engaged in the engineering or operation of such facilities have a clear understanding of the basic characteristics and requirements of both On/Off and FSK telegraphic keying.

On/Off Keying

Codes used for telegraphic or teleprinter operation, over short-wave radio circuits, are of the two-condition type. Basically, these two conditions are the so-called "Mark" (On) and "Space" (Off) of codes such as the Morse. Baudot and Moore.[1]

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Though keying of the final radio carrier or sub-carrier may be of some other form, such as frequency-shift keying, the telegraphic coding and keying originate, and finally are reproduced, in the On/Off form. Other forms involve merely conversion to and from this simple and fundamental On/Off mode. Therefore, analysis of any telegraph or teleprinter problem logically must be based on the characteristics and requirements of the On/Off mode of keying.

Dot-Cycle

For purposes of practical analysis, the basic unit of telegraphic keying is the dot-cycle. This consists of a Mark followed by a Space; each having a time duration of the shortest, or unit, element of the code in question. An unbroken train of such dot-cycles is depicted, in conventional manner, in Fig. 1.

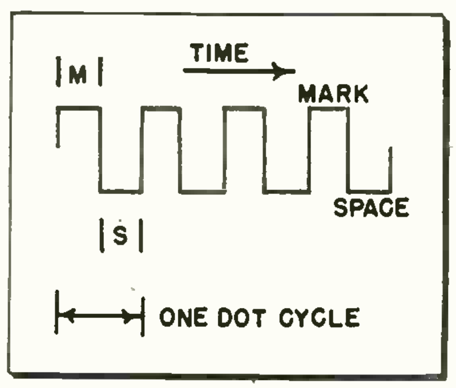
Such a continuous train of dot-cycles generally requires, for a given fidelity of reproduction, a greater band-width than is required by the mixed dots and dashes of actual code combinations. Therefore, a system that will give the required fidelity of keying and final reproduction, of such a dot-cycle train, will provide the required performance on actual traffic keying. For this reason, practical solutions of the simpler cases may disregard isolated "unit elements" and complicated transient analyses.

This fortunate simplification permits us to use the standard Fourier series analysis of such a train of rectangular, or so-called "square," dot-cycles. This is illustrated in Fig. 2.

The "square" dot-cycle would provide theoretically perfect On/Off keying. This would require, however, an extremely wide pass band. Fortunately, practical operations do not require such perfect rectangularity. If we transmit and reproduce the fundamental, third harmonic and fifth harmonic, of the keying frequency, the resultant dot shape, as shown at the bottom of Fig. 2, is sufficiently close to the ideal for generally all practical purposes. To obtain a further and appreciable increase in the steepness of the sides, or slope, would require an unjustifiable increase in the number of higher harmonics required and thus in the width of band occupied.

In the case of a short-wave radio circuit, the received signal "fades" up and down in amplitude. Even with automatic gain control, and diversity reception, the level of the signal from the radio receiver proper can not always be held constant. Therefore any utilization device, such as a tone keyer or relay having a fixed operating level of so many volts or milli-amperes, will have its transition from M to S or from S to

Fig. 1: Dot-cycle in on-off mode of keying



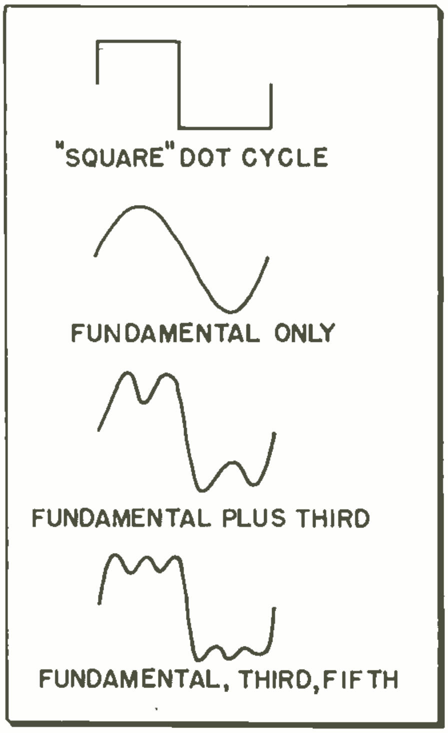


Fig. 2: General requirements are met by transmitting fundamental and 3rd and 5th harmonics

M effectively shifted up and down on the envelope shape of the signal. If the wave shape is essentially rectangular, or "square," the ratio of Mark duration to Space duration—the so-called "weight of keying"—remains constant. If however the wave shape is not rectangular, but has sloping sides, the weight of keying will vary as the signal fades.

To minimize such variations in weight of keying, due to deep fading of short-wave signals, it has been customary to permit transmission of up to and including the 5th harmonic of the fundamental keying frequency. (CCIR). Where fading of fidelity requirements are less severe, the usual recommendation is that only the 3rd harmonic of the fundamental keying frequency be transmitted. In the case of radio signals not subject to fading, and generally on land-line circuits, the specified pass band may transmit something less than the third harmonic of the keying frequency; the operating level, of keyers or relays or regenerators, then being set at a critical point on the voltage or current wave shape of the received signal.

The foregoing analysis is generally satisfactory for Morse-code telegraphy and for the less-exacting applications of teleprinters.

A more specific analysis, involving additional concepts, becomes necessary when we deal with applications where band widths must be reduced to a practical minimum; where the radio signal is subject not only to the usual fading but also to multi-path propagation; and where teleprinter operation, on a start/stop basis or by synchronous multiplex methods, must be as reliable as possible.

As regards keying fidelity, the basic requirement of any teleprinter system is that elongation or shortening, of the received signals, must not exceed some specified value.

For ease of mental calculation, let us assume round figures as follows:

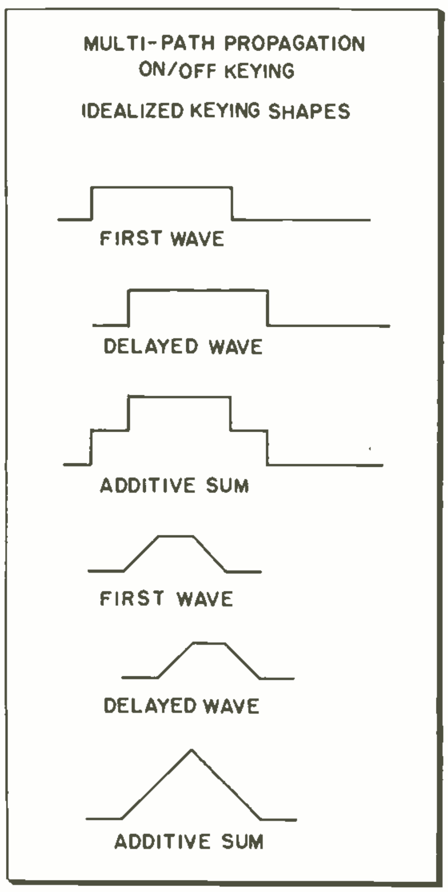
Fundamental keying frequency	25 CPS
Dot-cycle length	40 ms
or	
Baud speed	50 ms
Unit interval or "Baudel"	20 ms
(This is one half of a dot-cycle)	

These round values happen to be those used in the European network, and are fairly close to the 22 ms value of unit-element duration widely used in the U.S.A.

Such a start/stop teleprinter will tolerate a variation of approximately 6.5 ms in the length, or time duration, of a 20 or 22 ms unit element. In the case of synchronous time-division multiplex, a 2-channel system will tolerate some 5 ms to 7.5 ms elongation of a basic 11 ms unit element; the exact value of tolerance being dependent on the design of the equipment.

These values define the maximum permissible elongation for each system or design of equipment. In each case, this is the limit of the total variation or elongation due to: (1) fading up and down on the sloping sides of the keying wave shape; (2) multi-path propagation; and (3) distortion in associated land-lines or other terminal facilities such as channel filters, etc.

Fig. 3: Illustrating addition of waveforms



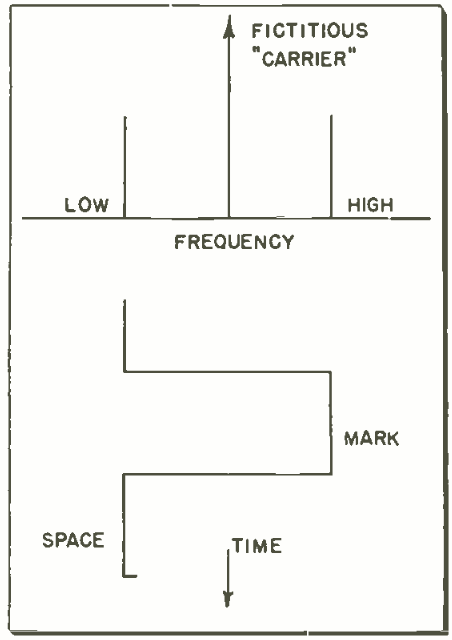


Fig. 4: Graphical illustration of FSK keying

Assuming that distortion and consequent "weight" changes can be controlled and stabilized in land-line channel filters and other terminal facilities, we need then deal only with those elements due to the radio propagation path and to the pass-band frequency characteristics of the radio transmitting and receiving equipment. Let us further simplify this by combining the transmitter and receiver frequency characteristics into one overall system characteristic of frequency pass band.

In the absence of multi-path propagation, we can allow the entire amount of permissible elongation to be caused by "weight of keying" changes due to fading of the signal; the operating point of the final utilization device sliding up and down on the sloping-sided voltage or current wave form of the keying.

By specifying the permissible variation in absolute terms of milliseconds, we can utilize standard methods of low-pass and band-pass circuit analysis to give the specified slope of the output-signal prior to any "squaring up" or regeneration of the keying wave shape. This may be, say, at the output of the i-f amplifier or final linear rectifier of the radio receiver. The total pass band required, in an i-f or a-f system, is inversely proportional to the millisecond variation so specified; a variation of 5 ms requiring a system pass band of 200 CPS.

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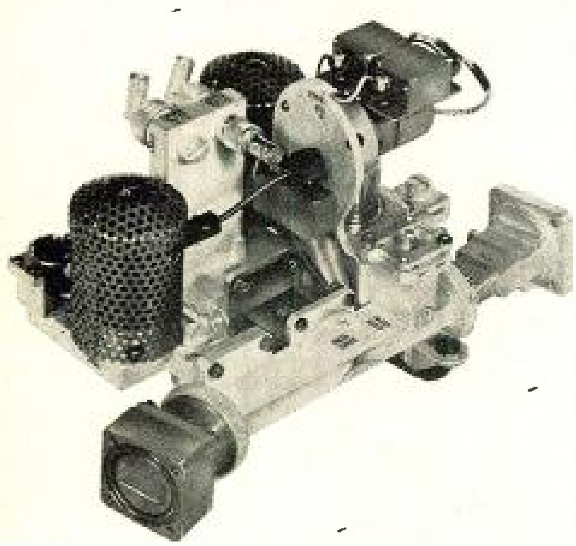

Fig. 1: Production X-Band balanced mixer-duplexer using the short-slot hybrid

The short-slot hybrid as an alternate to the hybrid-T in balanced microwave mixer design offers excellent noise cancellation characteristics. The relations necessary for hybrid performance are developed here, and a balanced mixer is explained by both algebraic and vectorial arguments

By L. D. STROM

Noise Cancellation In Microwave Mixers

L. D. Strom

THE short slot hybrid is a waveguide structure consisting of two parallel waveguides with a coupling aperture in the common narrow wall. When the short slot hybrid is used as the coupling element in a microwave balanced mixer, nearly complete cancellation of the noise contributed by the local oscillator is achieved and the sensitivity of the receiver is greatly improved. The short slot hybrid may be classified as a 90° relative phase shift hybrid. The analysis presented here applies to all members of this family.

A representative balanced mixer is shown in Fig. 1. This assembly replaces a single-ended mixer and uses the same mounting provisions. Since the design was started before today's improved crystals became available, 1N23B crystals (not selected or matched) were used. Overall noise figures of 10-13 db have been realized in the production of the radar set for which this mixer was designed. With respect to the original single-ended mixer, the present design is at least 5 db more sensitive. The use of improved crystals would allow further increase in receiver performance.

Fig. 6 shows the construction of a short slot hybrid. One of the major advantages of the component is its compact form. As a result of the parallel and adjacent input and output arms, crystal mounts are readily applied to the hybrid. Among other advantages which have been cited[1] are excellent impedance, coupling, and directivity characteristics over considerable r-f bandwidth.

The operation of a hybrid-T (Magic-T) balanced mixer has been

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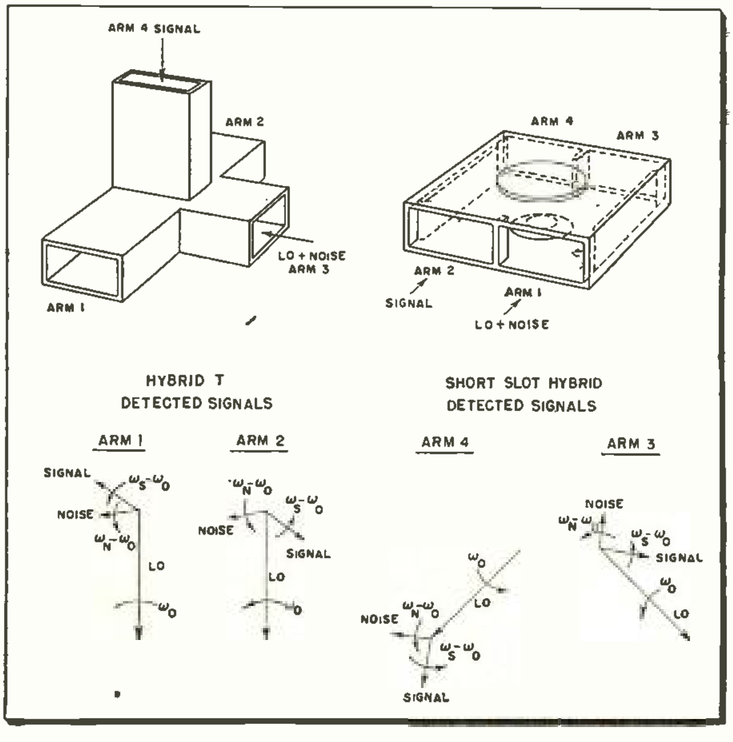


Fig. 2: Vector phase relations of the hybrid-T and the short-slot hybrid mixers

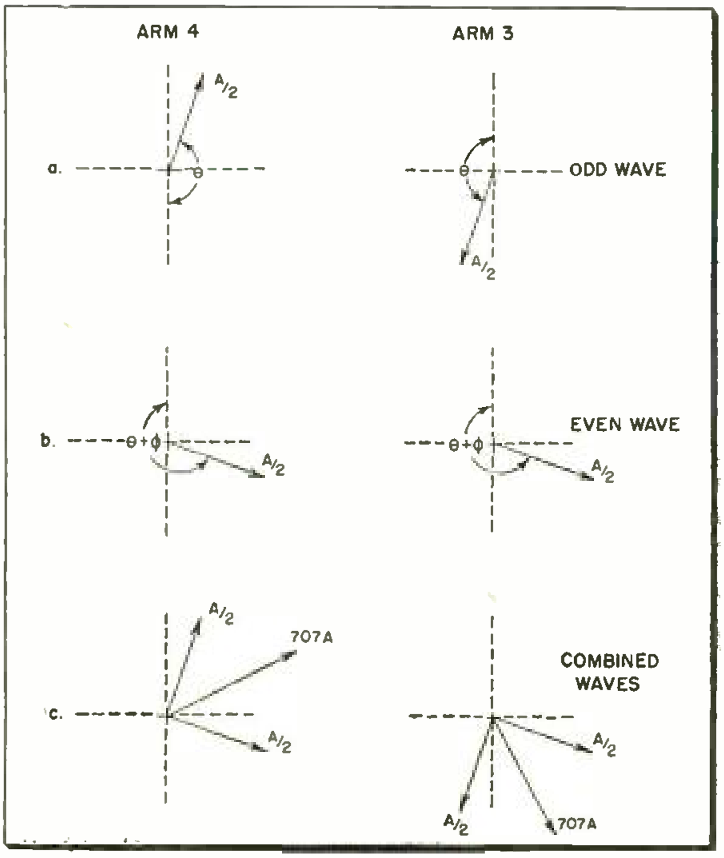


Fig. 3: Vector relations in short-slot hybrid

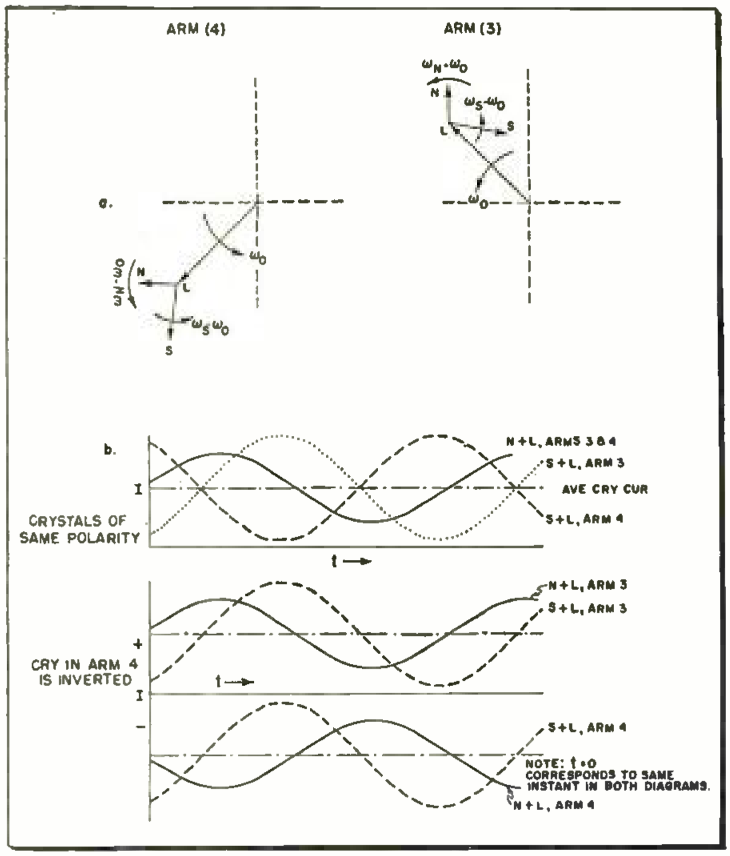


Fig. 5: Crystal current output waveforms showing phase inversion

described by Pound.[2] Fig. 2 describes the instantaneous vector phase relations of the hybrid-T and the short slot hybrid mixers. The cancellation of local oscillator noise in the hybrid-T is achieved if the phase of one crystal output is reversed and added to the output of the other crystal. (Pound also describes the operation of a hybrid-T with 90° added phase shift in one colinear arm.[3] This r-f phase shift is added to avoid image frequency radiation. Since both the local oscillator and signal waves are shifted a like amount, the modified hybrid-T provides noise cancellation in the same manner as the hybrid-T of Fig. 2.)

In the following, the operation of the short slot hybrid is developed in terms of symmetrical and asymmetrical waves. This approach is similar to that used by Kyhl[4] for the long slot directional coupler. After the operation of the hybrid is described, the cancellation of local oscillator noise in a 90° relative phase hybrid is described algebraically and vectorially.

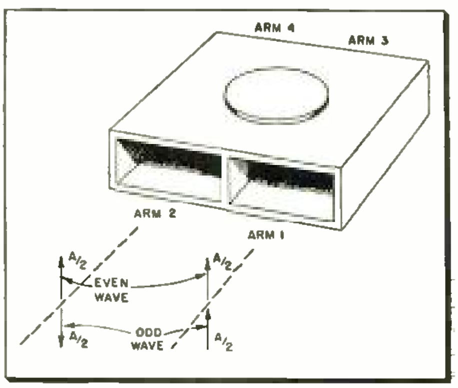
Short Slot Hybrid

Networks having a plane of electrical symmetry can be analyzed by considering the various inputs and outputs to consist of combinations of symmetrical and asymmetrical waves. In the present instance, a single input to a four terminal pair network having electrical symmetry will be considered. By superposition the argument may be extended to any number of inputs.

Let a wave of amplitude A be applied to a terminal of the hybrid. This input can be resolved into a symmetrical and an asymmetrical coherent wave applied to two terminals providing the wave has amplitude and phase as described in Fig. 4. The principle employed here may be stated as follows: *An even wave will be undisturbed if a magnetic wall is placed in the plane of symmetry and the odd wave is undisturbed by an electric wall.*

The odd wave will propagate through the hybrid undisturbed by the presence or absence of slots or centerline elements. For the odd wave the following phase relation

Fig. 4: Input wave of amplitude A resolved into a symmetrical and asymmetrical wave



exists at Arms 3 and 4. The phase shift, Θ, is the electrical length of the hybrid in odd wave wavelengths. In the slotted region the odd wave is TE_{20}, therefore

$$\theta = L\lambda_{go} \qquad (1)$$

where L is the length of the hybrid and λ_{go} is equal to the TE_{10} wavelength in rectangular waveguide having a width one-half that of the slotted region. The phase of the odd wave emerging from Arms 3 and 4 is shown in Fig. 3a.

The even wave will be altered, as least in phase, by the presence of the slot and any centerline element present within the slot. Let ϕ be the phase difference between the even and odd waves. Then, since

$$\phi = L(\lambda_{ge} - \lambda_{go}),$$

ϕ can be varied at will by changing slot lengths, adding centerline elements or otherwise changing λ_{ge}. A reflection of the even wave may be caused by the slot and centerline elements. If a reflection exists, the transmitted even wave can no longer be A/2 in amplitude. Such a reflection will appear in Arms 1 and 2. In Arm 1 it will provide a mismatch; in Arm 2 it will decrease the directivity. An input impedance near Z_o is requisite for high directivity and vice-versa.

The even mode can be matched by several techniques, but a proper value of ϕ must be maintained. $\Gamma \cdot \lambda_{ge}$

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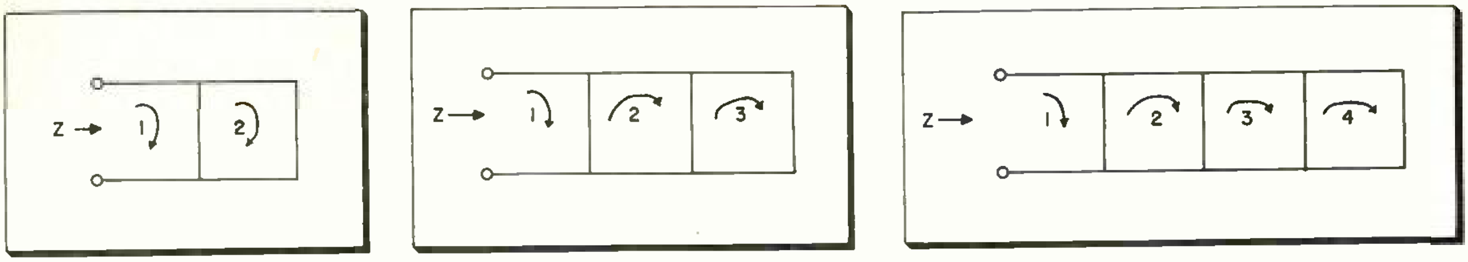

Figs. 1, 2, 3: Input impedances of ladder networks of successive numbers of current loops exhibit a certain regularity

Synthesis of Function Generators by Continued Fraction Theory

The problem of devising a function generator, commonly used in computer and servo-control systems, is simplified by the use of continued fraction theory. The accuracy of the generated function can be improved indefinitely by expanding the network in a prescribed regular manner

By Dr. V. W. BOLIE

IN several areas of electronics engineering, such as computers and servo-control systems, there frequently arises the problem of devising a function generator. The function generator usually consists of some type of electrical analogue. For example, the time-function f(t) = kt can be synthesized in an approximate form by use of an integrating circuit having a constant voltage input. Similarly, a function which is the quotient of two other functions can be synthesized by use of servo-driven potentiometers. Arbitrary time-functions can be generated by causing the beam of a cathode-ray tube to follow a function-graph which is placed in front of the tube face.

Potentiometer networks and non-linear potentiometers have been widely used in computer circuits in recent years. Non-linear potentiometers which generate sine and cosine functions are commercially available. Several circuits incorporating linear potentiometers to generate functions approximating the sine function have been patented. A recent article[1] by Levenstein describes some general cut-and-try rules for using linear potentiometers to approximate certain non-linear functions.

The purpose of this article is to show how the theory of continued fractions can be used to synthesize certain non-linear functions by use of linear potentiometers. The chief feature of this technique is that the accuracy of the generated function can be improved indefinitely (subject to the linearity of the potentiometers) by expanding the network in a prescribed, regular manner. The technique is limited, however, by the fact that only certain types of functions can be represented as suitable continued fractions leading to synthesis of circuits with linear, passive elements. Following an outline of the theory of continued fractions and a discussion of the input impedance to a ladder network, several function generator networks will be illustrated, one of which will be described in detail. A bibliography of references to continued fraction theory and to other synthesis techniques is appended to this article.

The theory of continued fractions has been investigated by mathematicians for over a half century. An Article written by Thomas Muir[2] in 1876 describes how the ratio of two Taylor's Series expansions,

$$\frac{1 + A_1x + A_2x^2 + A_3x^3 + \dots}{1 + B_1x + B_2x^2 + B_3x^3 + \dots} \qquad (1)$$

can be expressed as a continued fraction which has the form,

$$1 + \cfrac{x}{a_1 + \cfrac{x}{a_2 + \cfrac{x}{a_3 + \dots}}} \qquad (2)$$

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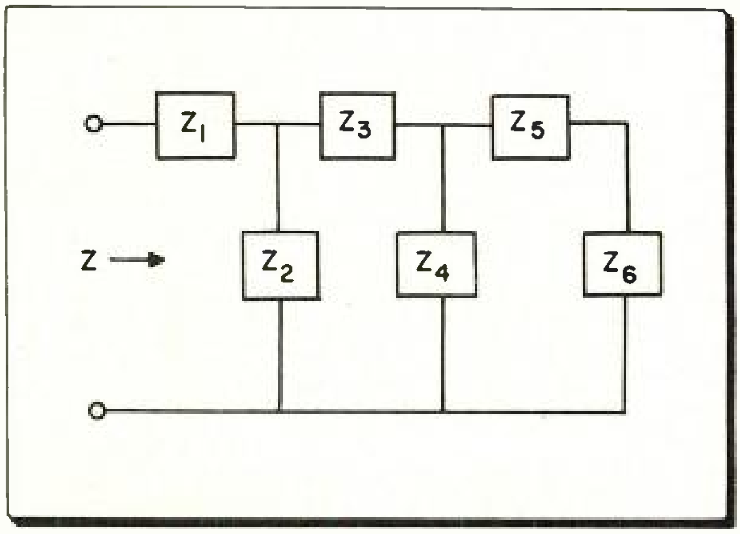
Fig. 4: Numerator and denominator of the fraction are the series and shunt impedances of the network. (See Eq. 14)



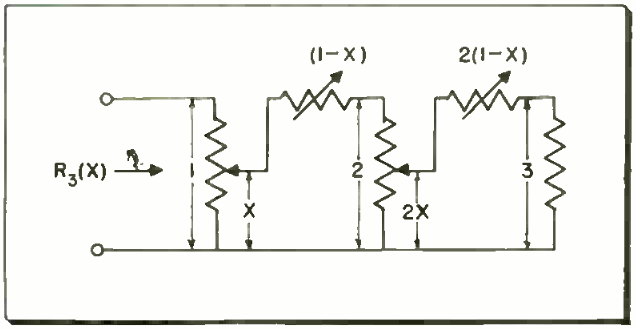


Fig. 5: Third convergent $R_3(x)$ of R(x), as synthesized by linear potentiometers. (Eq 16)

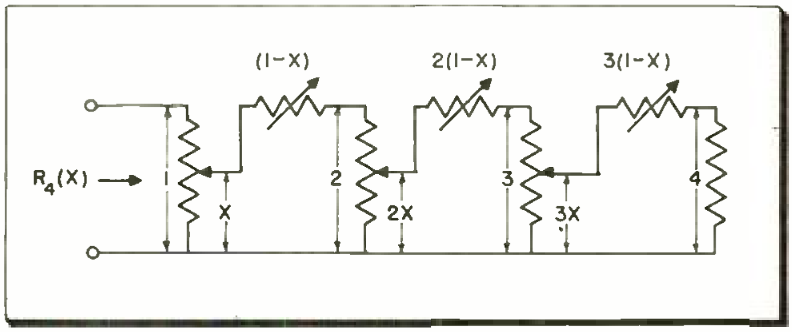


Fig. 6: Fourth convergent of R(x) is more accurate than the third convergent

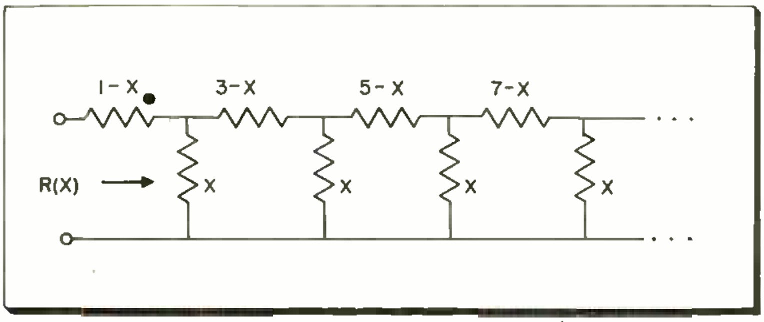


Fig. 7: Synthesis of the function R(x)=x/tan x

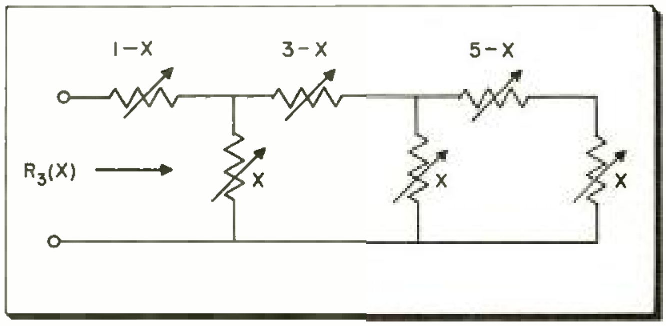


Fig. 8: Third convergent of R(x) = x/tan x

The coefficients a_i of the latter expression are defined in terms of the coefficients A_j and B_k of the former expression by formulas which are too unwieldy and complicated to be of value in this article. Rather, some examples of continued fraction representations of functions will be given without showing the process of deriving their required coefficients.

The continued fraction representation of poorly-convergent power series has recently been found to be valuable in digital computer techniques. The power series

$$\arctan x = x - \frac{x^3}{3} + \frac{x^5}{5} - \ldots \quad (3)$$

representing the arctangent function converges slowly and requires a large number of terms for accurate evaluation. The corresponding continued fraction representation

$$\arctan x = \cfrac{x}{1 + \cfrac{x^2}{3 + \cfrac{(2x)^2}{5 + \cfrac{(3x)^2}{7 + \ldots}}}} \quad (4)$$

converges rapidly and requires relatively few terms for accurate evaluation. Teichroew[3] presents Table I to illustrate the relative convergence rates of the power series expansion and the continued fraction representation of the arctangent function.

TABLE I: Number of terms required to compute arctan x to 6 decimals

x	Power Series	Continued Fraction
.1	3	3
.2	4	3
.3	5	4
.4	6	5
.5	8	5
.6	11	7
.7	15	7
.8	22	7
.9	44	8
1.0	—	8
2.0	—	15

This table shows the practicality of considering the continued fraction representation of otherwise slowly-convergent power series.

Other examples of continued fraction representations of functions are the following

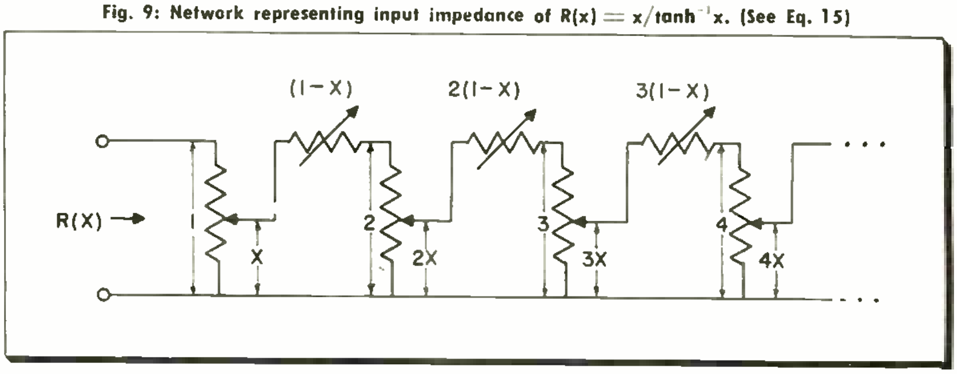
$$\tan x = \cfrac{x}{1 - \cfrac{x^2}{3 - \cfrac{x^2}{5 - \cfrac{x^2}{7 - \ldots}}}} \quad (5)$$

$$\ln(1+x) = \cfrac{x}{1 + \cfrac{1^2x}{2 + \cfrac{1^2x}{3 + \cfrac{2^2x}{4 + \cfrac{2^2x}{5 + \cfrac{3^2x}{6 + \ldots}}}}}} \quad (6)$$

It should be noted that there are several different forms of the continued fraction expansion of a function. For example, Eq. 6 may be replaced by the equivalent form,

$$\ln(1+x) = \cfrac{1}{\frac{1}{x} + \cfrac{1}{\frac{2}{1^2} + \cfrac{1}{\frac{3}{x} + \cfrac{1}{\frac{4}{2^2} + \cfrac{1}{\frac{5}{x} + \ldots}}}}} \quad (7)$$

Fig. 9: Network representing input impedance of $R(x) = x/\tanh^{-1}x$. (See Eq. 15)



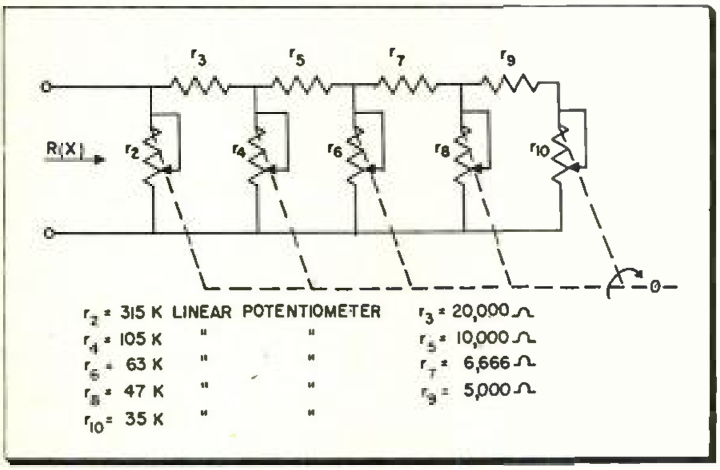


Fig. 10: Scale factors can change the magnitude of input resistance where required. (See Eq. 18)

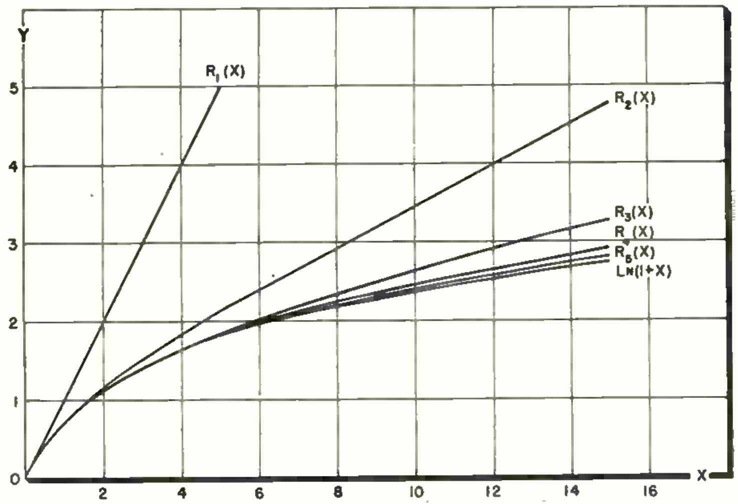


Fig. 11: First five convergents of $R(x) = \ln(1+x)$

Fraction Theory (continued)

Similar equivalent forms apply to other representations. The next section will be concerned with the continued fraction expression of the input impedance to a ladder-type electrical network.

Input Impedance

Two equivalent continued fraction representations for the input impedance to a ladder network will be developed. These forms will be used directly to synthesize certain non-linear function generator networks.

By solving several systems of network equations, it is found that the input impedances to ladder networks of successive numbers of current loops exhibit a certain regularity. This is demonstrated by the following example (See Fig. 1)

$$Z_{11}I_1 + Z_{12}I_2 = E_1 \qquad (8)$$

$$Z_{21}I_1 + Z_{22}I_2 = 0 \qquad (9)$$

$$Z = \frac{E_1}{I_1} = \frac{E_1 \begin{vmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{vmatrix}}{\begin{vmatrix} E_1 & Z_{12} \\ 0 & Z_{22} \end{vmatrix}} = Z_{11} - \frac{Z_{12}^2}{Z_{22}} \qquad (10)$$

$$\therefore Z = Z_{11} - \frac{Z_{12}^2}{Z_{22}} \qquad (11)$$

In the above calculations, the symbol Z_{ii} represents the total self-impedance of the ith current loop, and the symbol Z_{ij} represents the mutual impedance between the ith and jth current loops.

Similar procedures give the following ladder networks together with their respective input impedances. (See Figs. 2 and 3.)

For Fig. 2,

$$Z = Z_{11} - \cfrac{Z_{12}^2}{Z_{22} - \cfrac{Z_{23}^2}{Z_{33}}} \qquad (12)$$

For Fig. 3,

$$Z = Z_{11} - \cfrac{Z_{12}^2}{Z_{22} - \cfrac{Z_{23}^2}{Z_{33} - \cfrac{Z_{34}^2}{Z_{44}}}} \qquad (13)$$

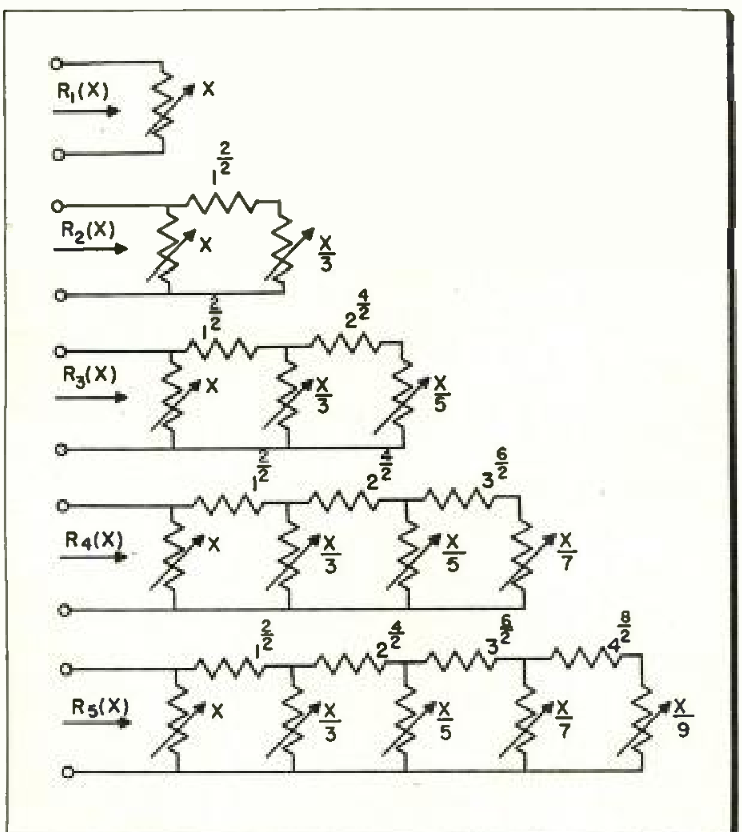


Fig. 12: Synthesis of the first five convergents of $R(x) = \ln(1+x)$ by potentiometer networks

From the foregoing input impedance formulas, it is seen that the mutual impedance of a ladder network can be written in the form of a finite continued fraction. The successive numerators of the continued fraction are the squares of the mutual impedances in the network. The leading terms in the successive denominators of the continued fraction are the self-impedances of the network.

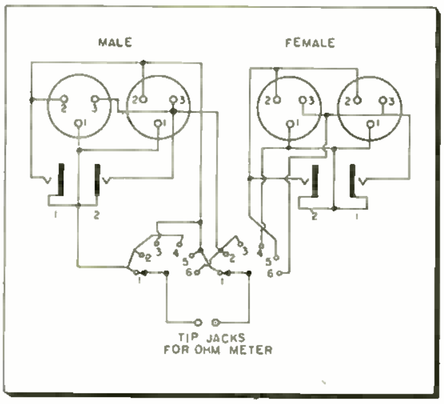
The input impedance to a ladder network can be written as a finite continued fraction of another type in which the numerator and denominator entries are the series and shunt impedances of the network. The ladder network, together with its input impedance, as given by Brune[4], is shown in Fig. 4.

In the next impedance expression, the elements in the continued fraction can be directly associated with the series and shunt impedances of

(*Continued on page* 184)

CUES for BROADCASTERS

Practical ways of improving station operation and efficiency



Male and female sockets are mounted on chassis, and connected to meter through rotary switch

Microphone Cable Checker

DONALD M. WHEATLEY,
Ch. Engr.
WJOY, Burlington, Vt.

AN aid in checking mike cables, built at WJOY, has been a great help. By mounting in a chassis, sets of sockets (male and female) of all the types used, and, by putting the suspected cable into its corresponding sockets and plugging in an ohmmeter, we can tell at once if a wire is broken or shorted, simply by turning the rotary gang switch to each of the six positions.

Position No. 1 should show no reading unless wires 1 and 2 are shorted.

Position No. 2 should show no reading unless wires 1 and 3 are shorted.

Position No. 3 should show no reading unless wires 2 and 3 are shorted.

Position No. 4 should show a reading unless wire 1 is open.

Position No. 5 should show a reading unless wire 2 is open.

Position No. 6 should show a reading unless wire 3 is open.

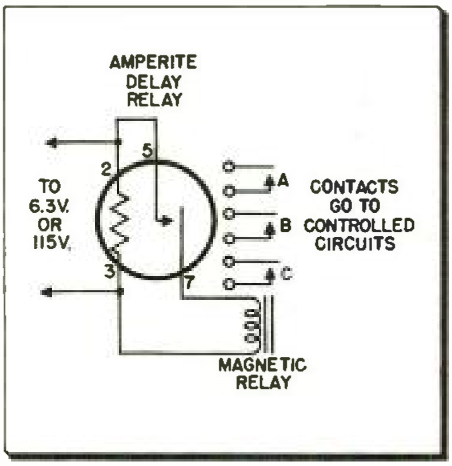
The phone jacks are placed to fit a double plug patch cord.

An Inexpensive Time Delay Relay

FORREST H. FRANTZ, Sr.
610 College Drive
Starkville, Miss.

TUBE and component life may be increased by allowing a filament preheat period before applying high voltage. With mercury vapor rectifiers, a preheat period is a must. Most time delay relays are expensive, and once purchased allow no lee-way on contact pile-ups.

A Thermostatic Delay Relay in conjunction with a magnetic relay makes an excellent time delay scheme for controlling voltages and currents that are beyond the range of the thermostatic delay relay contacts (ordinarily 115V-3A AC max.). The circuit diagram illustrates a typical arrangement. Note the switching scheme depends on the number of contacts on the magnetic relay. The time delay depends on the thermostatic delay relay. The table indicates appropriate Amperite Delay Relays for various time delays for 6.3 and 115 v. heater operation.



Thermostatic delay relay for preheating

Delay (Secs)	6.3 v heater	115 v heater
10	6N010	115N010
30	6N030	115N030
45	6N045	115N045
60	6N060	115N060
120	6N0120	115N0120

Bucking P.A. Filament Hum

SAMUEL T. LILES, Jr.
Trans. Supvr.
WPTF, Raleigh, N.C.

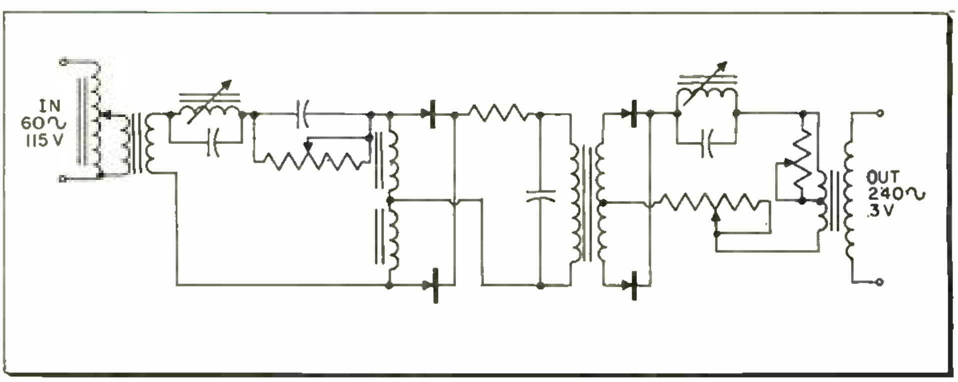
A good approach to the hum reduction problem of single phase filament power tubes is in the use of a hum-bucking arrangement such as the one installed at WPTF. The transmitter is a Westinghouse 50-HG using a push-pull final and push-pull modulators. It was originally equipped with multiphase filament 895 and 893 tubes. When the hum from these tubes reached the carrier it showed up in a complex mixture of 180 CPS and several higher frequencies, a combination difficult to buck out because it would be next to impossible to duplicate the various frequencies, their amplitudes, wave shapes and phases.

When we installed the single-phase filament 5671 tubes in both P.A. and modulator, the resulting hum voltages on the carrier resolved themselves into a single hum frequency at 240 cycles. This single frequency is keyed to the 60 cycle ac supply, of course, and so the 60 cycle supply is the logical starting point for a hum bucking signal.

We use a double doubler to arrive at 240 cycles. This starts with a simple full wave rectifier using selenium rectifiers which produces a ripple voltage of 120 CPS. This is fed into a second full wave rectifier, the output ripple of which is 240 CPS. Smoothing reactors are inserted to make the distorted wave shapes of the rectifier ripple voltages approximate the nearly sine wave shape of the carrier hum voltages. Several phase

(Continued on page 154)

Double doubler provides 240 CPS output which is phased to cancel out hum



In a number of present-day electronic techniques various synchronized submultiple frequencies must be obtained from a single oscillator. Until now, such frequency division has been sharply limited in its flexibility by the instability of vacuum tubes and their associated circuits. A solution to this problem is seen in the use of cascaded flip-flops

By IRVING GOTTLIEB

Frequency Division By Cascaded Binaries

IN many electronic techniques, and in particular, those relating to carrier frequency telephone applications, it is necessary to obtain synchronized sub-multiple frequencies from a stable master oscillator. This is commonly accomplished by one type or another of relaxation circuit having in common the fact that the period of the derived submultiple corresponds approximately to a properly selected RC time constant. It is well known that the synchronizing stability of such circuits (multivibrators, univibrators, phantastrons, gas tube circuits, etc.) diminishes as the dividing factor is increased. The cumulative effects of tube and component aging, heater voltage variations, and changes in the level of the synchronizing signal make difficult the design of foolproof dividers when a division factor greater than about five is required. For this reason, it is common practice to incorporate in these circuits a panel or chassis control whereby synchronization can be adjusted as the circumstances demand. It would, however, be highly desirable to obtain immunity to all disturbing factors short of an exhausted tube.

One approach toward the attainment of stability involves the employment of cascaded dividers, none of which perform division by a factor greater than, say, four. Thus, division by twelve could be synthesized from two cascaded stages, one dividing by three and the other dividing by four. The stability of such an arrangement would be fairly good. However, this procedure cannot be used for such division factors as 5, 7, 10, 11, 13, 14, or 15. These represent dividing factors frequently required in carrier current telephony where various carrier and hetrodyning frequencies must be derived from a crystal oscillator operating in the general vicinity of 100 KC. A factor such as 14 could, it is true, be split into its two component factors of two and seven. However, in such a case the "by seven" divider would constitute the weak link in the arrangement, for it would impose the limits of stability that could be obtained.

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"Flip-Flops"

From the foregoing it can be appreciated that a very useful function would be served by a technique capable of providing stable frequency division for any desired dividing factor. This can, indeed, be achieved from cascaded bi-stable elements generally known as "flip-flops," or "binaries." These circuits are inherently frequency halvers and dividing factors greater than two are obtained by cascaded arrangements. This is not new, but it has not generally been recognized that the dividing factor is not limited to the number given by 2^n where "n" represents the number of such cascaded binaries. Thus, it might appear that we could only obtain dividing factors of 2, 4, 8, and 16 respectively from systems of one, two, three, and four binaries. In pulse counting applications it is frequently found that a series of four binaries have been modified to provide a "scale of ten" rather than sixteen. Such a modified binary system is likewise capable of decade frequency division. It will be shown that the particular technique responsible for this modification in operation can be extended to enable any integral dividing factor to be obtained from cascaded binaries. The stability is excellent irrespective of the dividing factor. This is primarily due to the fact that this type of circuit is aperiodic, i.e., no RC time constant is involved in the attainment of the dividing factor.

First, the characteristics of the single binary stage should be considered. As shown in Fig. 1, two tubes are used in this circuit. Usually, these consist of a double triode in order to maintain economy of tube envelopes. The circuit is schematically and operationally symmetrical. One tube conducts, or is "on," while the other tube is non-conducting, or "off." The tubes alternate in this respect so that the circuit as a whole can be said to have two states of equilibrium. One state corresponds to the condition when V_1 is off and V_2 is on. Conversely the other state exists when V_1 is on and V_2 is off. The loop gain is, in the absence of applied signals, less than unity so that the circuit does not operate as a free running oscillator.

Suppose that a negative pulse is impressed at the input terminal when V_1 is off and V_2 is on. The plate potential of V_1 is suddenly decreased. (The plate potential of V_2 is practically unaffected, being clamped by the conduction of V_2). The resultant negative transient is transferred to the grid of V_2 through C_4. This causes reduction of plate current in V_2 with an accompanying rise in its plate potential. The rapid increase of plate potential is communicated through C_1 as a positive pulse to the grid of V_1. In turn, V_1 now draws more plate current with an attendant decrease in its plate potential. By virtue of this sequence of events, the stimulus responsible for the transient condition is reinforced by the response it has evoked. The circuit is in a regenerative state; a rapid switching action ensues, culminating with an exchange of roles between V_1 and V_2.

If, now a second negative pulse is injected at the input terminal, a

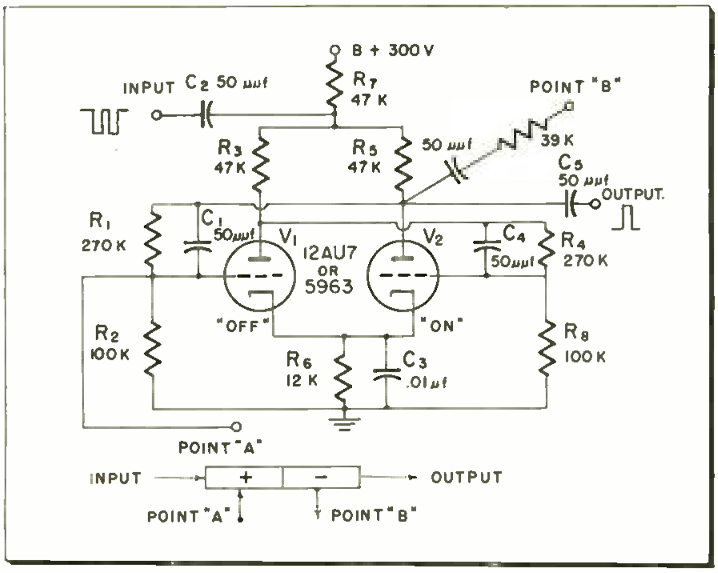
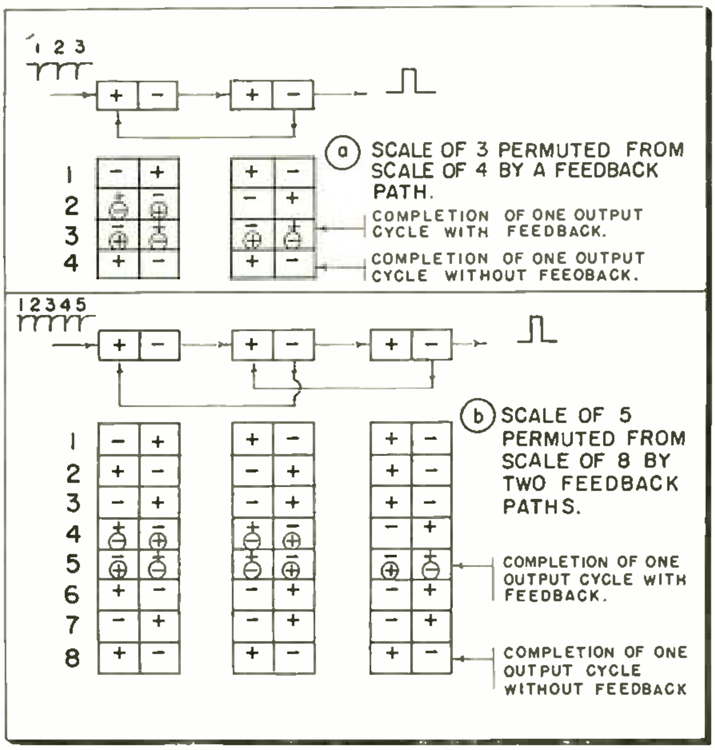


Fig. 1: (above) Schematic and block diagram of single-stage binary

Fig. 2: (below) Two examples of scaling factor permutation by inclusion of feedback paths in cascaded binary systems



A	2^n, n=1	2	
A1	2^n, n=2	4	
A2	2^n, n=3	8	
A3	2^n, n=4	16	
B	2^n-1, n=2	3	
B1	2^n-1, n=3	7	
B2	2^n-1, n=4	15	
C	$2(2^n$-1), n=2	6	
C1	$2(2^n$-1), n=3	14	
C2	$4(2^n$-1), n=2	12	
C3	$(2^n-1)(2^n-1)$, n=2	9	
D	2^n-3, n=3	5	
E	2^n-5, n=4	11	
E1	2^n-3, n=4	13	
F	$2(2^n$-3), n=3	10	

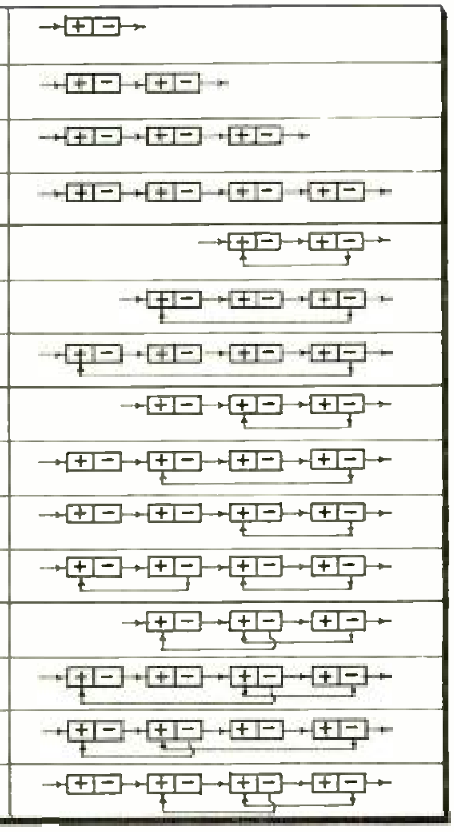
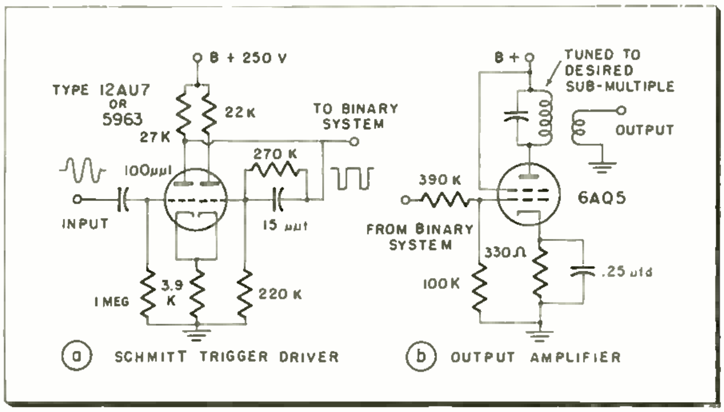


Fig. 3: (above) Binary systems for providing scaling factors from 2 through 16

Fig. 4: (below) Suggested driving and output ckts for use with binary systems



similar sequence of events occurs with V_1 and V_2 occupying interchanged conditions of conduction from that described for the first incoming pulse. Accordingly, after the second pulse has been applied to the input terminal, the circuit has been restored to its original state of equilibrium with V_1 off and V_2 on. The significant point that two cycles of applied signal has been required to produce a single complete cycle at the output terminal because it takes two signal cycles to restore the circuit to the equilibrium state which existed before application of the signal. Therefore, the binary is inherently a frequency halver, or a "scale of two."

In order to appreciate the potentialities of this simple device, several important cause and effect relationships should be understood. These follow from the above analysis of the operating principles.

1. Two negative pulses injected at the input terminal produce one full output cycle.

2. Positive pulses applied to the input terminal evoke no disturbance of binary equilibrium.

3. Positive pulses applied at point "A" cause V_1 to become the "on" tube if this is not already the case.

4. Negative pulses applied at point "A" cause V_1 to become the "off" tube if this is not already the case.

Thus, it is possible to change the state of equilibrium not only by applying negative pulses at the input terminal, but also by impressing pulses at point "A." It can now be shown that the introduction of a feedback path conveying pulses from the output of a latter stage to the point "A" terminal of an earlier stage in a cascaded binary system is a mechanism whereby the dividing factor can be permuted to something different than that given by 2^n.

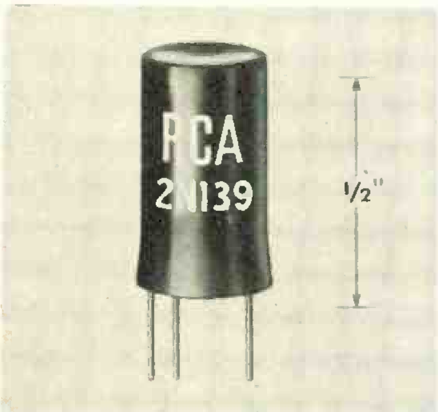
Two examples of such permutation are depicted in Fig. 2. In (a) a scale of four binary system is permuted to divide by three. The binary states corresponding to the input pulses are tabulated. The + sign is arbitrarily chosen to denote the "off" condition whereas the − sign indi-

(Continued on page 142)

New Circuit Components For

JUNCTION TRANSISTORS

The 2N139 and 2N140 are of the hermetically sealed, germanium-alloy, p-n-p junction type and have excellent stability. 2N139 is designed for 455 KC intermediate-frequency amplifier applications. It is capable of providing a power gain of 30 db at 455 KC in suitable common-emitter circuits of quantity-produced receivers. The 2N140 has characteristics which are controlled especially to meet the requirements of converter and mixer-oscillator applications in the standard AM broadcast band. Individual 2N139's and 2N140's may be interchanged in their respective circuits of suitable design. **Tube Div. RCA, Harrison, N. J.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 3-126)

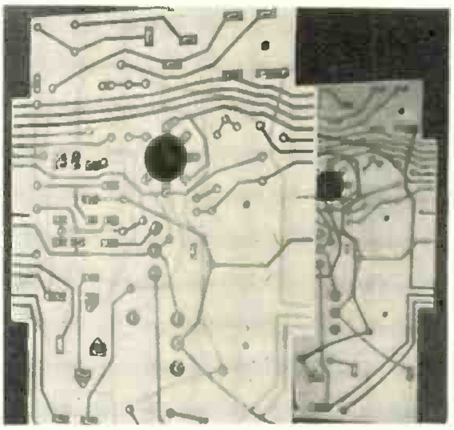


VARIABLE DELAY LINES

A unit of Type 602 or Type 602a Step Variable Delay Line consists of 110 sections of LC m-derived networks and a 22-pole 11-section rotary switch. Type 602a has a max. delay of 2.75 μsec. The rotation of the switch offers 11 positions with equal variation in time delay of 0.25 μsec. per step. Both the input and output impedance are equal to 75 ohms, so that the unit can be used to match any transmission system with 75 ohms impedance. Max. input voltage can be as high as 500 v. **Advance Electronics Co., Inc., 451 Highland Ave., Passaic, N. J.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 3-112)

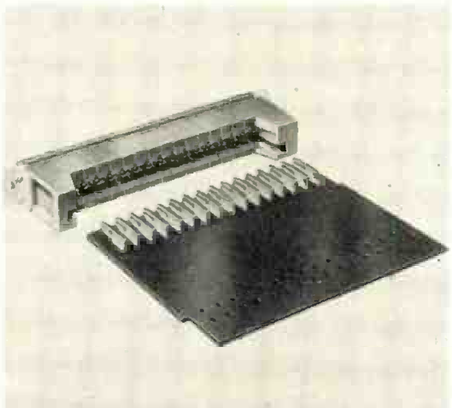
FLAME RESISTANT EPOXY

New high temp. Epoxy Fibre-glass Laminate has been developed for use where military requirements specify non-combustible material. Trimount Grade EE-284 not only differs from other Epoxies in its flame extinguishing properties, but doubles as class H insulating material as well. Its low water absorption (10 times lower than min. standards of conventional Epoxy Laminate) guarantees excellent insulation resistance under humid conditions. Available with or without a copper clad surface in all thickness ranges. Sheet size: 24 in. x 38 in. **Tri Mount Plastic Co., Inc., 71 Dudley St., Arlington 74, Mass.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 3-108)



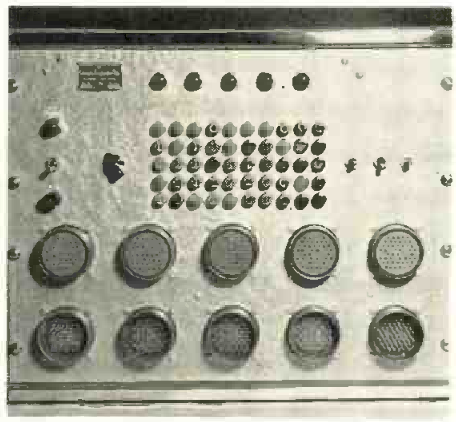
P-C CONNECTOR

General specifications for the Series 5,000 Printed Circuit Vacuum Connectors include: Current Rating—10 a. Withstanding Voltage (Sea Level)—3,500 v. R.M.S.; Withstanding Voltage (3.4 in./Hg.)—900 v. R.M.S.; Contact Resistance—.002 ohm; Insulation Resistance (dry)—25,000 megohms min. Contact Material: Phosphor Bronze Silver Plated. Female contacts are free floating inside their housing. Connector will accommodate .062 in. to 0.74 in. thick board with normal warpage. Removable polarizing inserts which fit between contacts can be provided. **ELCO Corp., "M" St. below Erie Ave., Philadelphia 24, Pa.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 3-129)



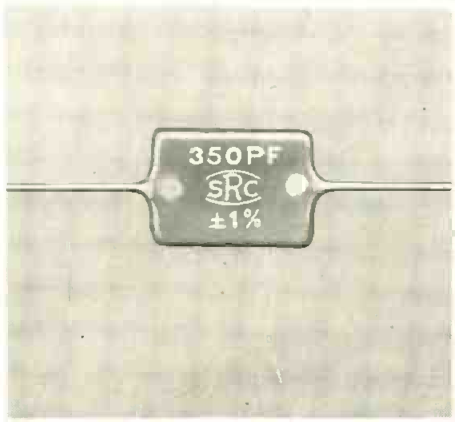
CONTINUITY TESTER

The Continuity Tester is designed to test automatically electrical continuity between conductors terminated in any type of connector. Up to 200 conductors in groups of 50 in any given cable or harness assembly can be checked automatically with the equipment. It uses stepping switches to provide automatic switching from one circuit to another. The read-out is positive since each circuit is identified by a numbered lamp actuated by the conductor under test. Six v. dc is used for test voltage. If a failure occurs, the tester will stop on the defective circuit with a numbered lamp indicating the faulty circuit. **Century Engineers, Inc., Burbank, Calif.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 3-117)



CAPACITORS

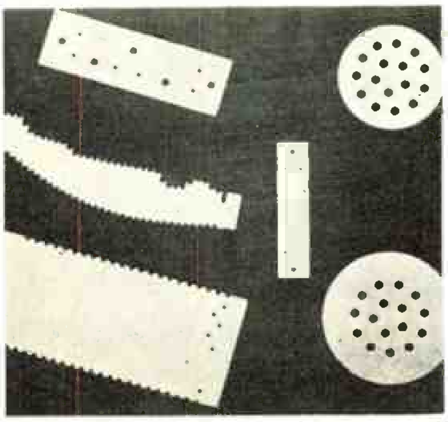
The capacitance range of these Silvered Mica Capacitors is 2mmF to 0.1 mF; tolerances 0.5% to 20%; 500 V. D.C.W. and 750 V. D.C.W. The temperature coefficient is —35 parts per million per °C. The temperature rating of —30° C. to +70° C. can be greatly exceeded in potted assemblies and a special type is made for epoxy compounds. The condenser is manufactured by Stability Radio Components of London and the importers are **British Radio Electronics Ltd., 1833 Jefferson Place, N.W., Washington 6, D. C.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 3-133)



the Electronic Industries

INSULATING MATERIAL

MICARAMIC is a new insulating material made from flake mica and a mineral binder. It possesses the properties of heat distortion at 1700°F, complete flame resistance, and arc resist-



ance with no carbon tracking, as well as excellent dielectric strength and workability. A wide range of electrical insulation applications are considered as the material is available in thin sheets (20 mils to ½ in.), can be easily punched and shaped as well as extruded. Evaluation of the material in printed circuit applications is being made. **Spruce Pine Mica Co., Spruce Pine, N. C.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 3-103)

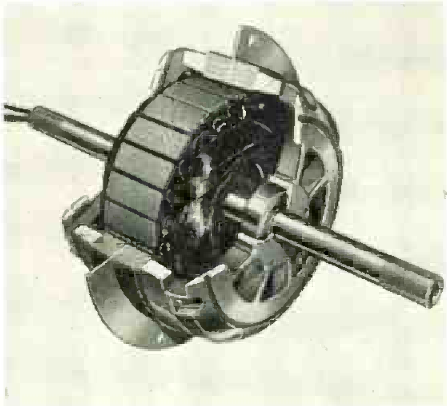
SILICON DIODE

A new silicon diode—the 1N23D—can lower the overall system noise down to 7.5 db. in a system with well-designed plumbing. It is designed for X-band mixer use in superheterodyne receivers where low overall noise and minimum conversion loss are required. These characteristics enable the systems engineer to design for both max. receiver sensitivity and max. output signal to noise ratio. With proper

mounting and circuitry these diodes may also serve as low level detectors and measuring devices in the X-band region. Both normal and reversed polarity are available. **Bomac Laboratories, Inc., Beverly, Mass.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 3-128)

BLOWER MOTOR

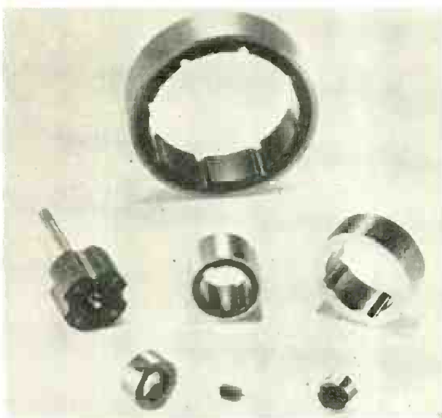
Increased efficiency with reduced size and weight are among the advantages offered by a completely new integral drive fractional hp. blower motor. The new motor differs from conven-



tional motors in that the rotating member, or rotor, is on the outside and revolves around a stationary shaft and stator assembly. Lead wires pass through the hollow stationary shaft to the stator windings. The motor itself is a 6-pole permanent split capacitor type, which has high electrical efficiency and high power factor. Full load speed is 1050 rpm. First production models are rated at ¼ horsepower. **Electronics Div., Iron Fireman Manufacturing Co., 2838 S.E. 9th Ave., Portland 2, Ore.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 3-105)

MAGNETS

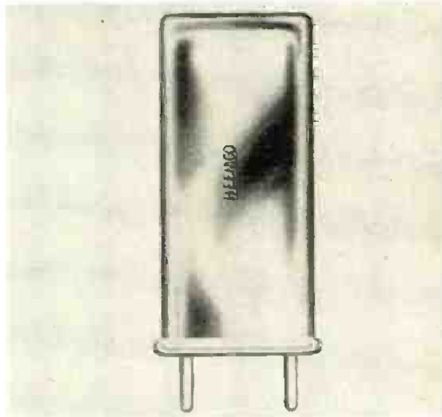
Pressed plastic bound permanent magnets are now available to American manufacturers. New method of manufacture makes it possible to press shafts, temperature compensation pieces and bearings right into the magnets or to make magnets of advantageous but intricate designs on a mass production basis. All machining is eliminated. In



addition to this economical manufacturing method, outstanding features are: highest precision magnetic tolerances; lower aging requirements, and, where applicable, cost reduction of entire magnet systems. **Baermann-Nord Corp. Amherst, Ohio.** TELE-TECH & ELEC TRONIC INDUSTRIES (Ask for 3-114)

CRYSTALS

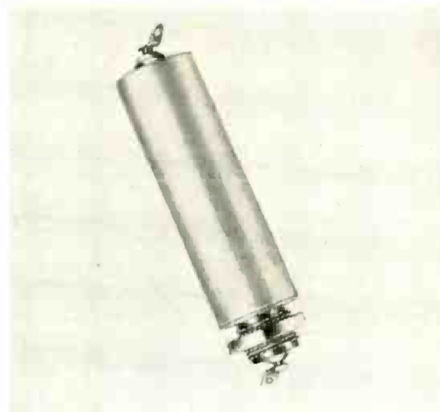
A miniature 1.75 to 20 kc audio frequency crystal which is now available in production line quantities. This unit, hermetically sealed in the standard Heemco holder, MIL HC-13/U, shows



deviation in frequency of less than ±0.010% over the temperature range of −40°C to +70°C. Meets vibration and shock requirements of MIL-C-3098A. Can also be supplied in −55°C to +105°C with stability of ±0.025%. Available for production at 800 cps to 1.75 kc with above specs. applying. Holder same as above, except can height is 2½ in. **Hill Electronic Engineering and Manufacturing Co., Inc., New Kingston, Pa.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 3-16)

PI FILTERS

These metal-cased, hermetically-sealed tubular type filters, in the threaded-neck mounting style, afford high insertion loss values for the suppression of radio noise. They are made to the smallest possible sizes and min. weight for the stated ratings and attenuation characteristics. Selection of current ratings range from .1 to 50.0 a. Voltages are 28, 50, 100, 300 and 500 dc;



and 115 and 125 ac. Frequencies are 60, 400 and 1,000 cps. Use of slotted hole mounting effectively prevents the filter unit from turning or jogging loose. **Cornell-Dubilier Electric Corp., S. Plainfield, N. J.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 3-25)

New Test Equipment

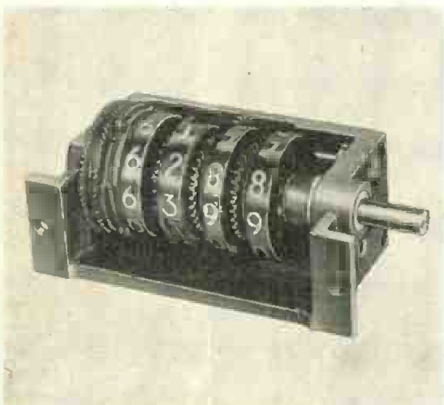
TRANSISTOR TESTER

A fast comparative check on PNP and NPN transistors is provided by completely self-contained, portable transistor tester, Model TR-2. The unit —completely transistorized—features 4

in. meter with 2 ranges that allow the operator to read Alpha, Beta, and I_{co} directly. Alpha tests up to .99 and Beta to 100. The model is available in ac or dc versions. Emitter current is adjustable from 1 to 10 ma., while a selector switch provides a collector voltage of 1.5 to 6 v. to the transistor under test. A calibration control compensates for wide variations. **CG Electronics Corp. 212 Durham Ave. Metuchen, N. J.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 3-23)

MIL COUNTER

Model 1864 has four drums, provides 10 counts on its unit drum for each revolution of its input shaft, from which upward counting takes place through clockwise rotation. Counting from 0 to 6399 mils with return to 0, the 1864 is reversible at any point in its complete cycle, and is rated at 1800 rpm. The unit is equipped with Oilite bearings, but ball bearings may be specified if required. It will withstand 50-hour salt



spray tests, and will operate in a temp. range from —55° C. to 85° C., without sacrifice of life or performance. **Bowmar Instrument Corp., 2415 Penn. St., Fort Wayne, Ind.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 3-115)

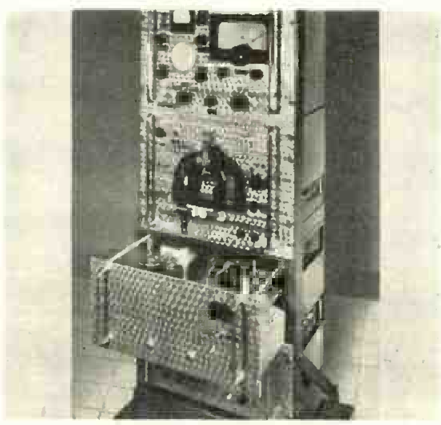
VOLTMETER

Use of the meter movement for just the top 5 to 10% of the range permits this Portable Single Range Expanded Scale Voltmeter to obtain high accuracy from a rugged, low-accuracy

meter movement. Only the voltage range of interest is expanded full scale. Guaranteed accuracy is ±0.5% of input voltage. The instrument offers over-voltage protection, wide frequency range (50 to 5000 cps) and voltage expansions of ±5, ±10, or ±15v at 115V. Both meter and circuit elements are hermetically sealed. The unit is true RMS reading. **Shasta Div., Beckman Instruments, Inc., P. O. Box 296, Station A, Richmond, Calif.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 3-20)

MINORITY CARRIER METER

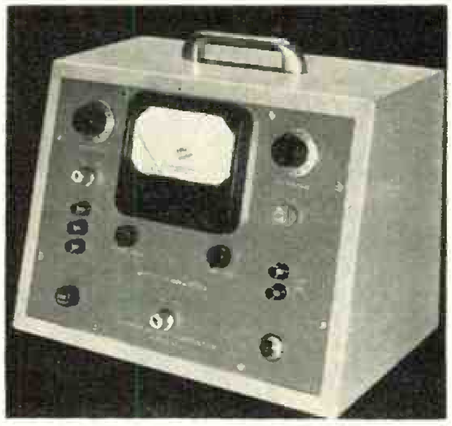
This Lifetime Minority Carrier Meter permits the bulk lifetime value of minority carriers in semiconductors to be read directly from its scale for values from a few μsec. to 1 msec. Additional calculations not required. Phase difference between photomagneto-electric effect and photo-resistive effect is measured. Instrument compares the signal resulting from each of these 2 effects with a reference signal. Reference sig-



nal is also employed to modulate light from a mercury vapor tube which initiates the signals generated by the 2 photo effects. **American Radio Co., 445 Park Ave., N.Y. 22, N.Y.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 3-120)

TRANSISTOR ALPHA TESTER

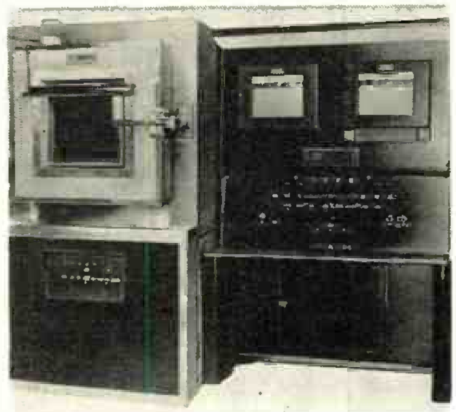
The Model AT-10 Alpha Tester is a direct reading instrument which automatically indicates the dynamic values of the Alpha and Beta parameters for all types of transistors, simply by plug-



ging the transistor into the input terminal. Operation is from a 115v. ac 60 cps. source. Alpha measurement range is 0-0.99, Beta range 0-100. Accuracy is to within 5% of full scale reading. Alpha cut-off may be measurerd to 5 MC, utilizing an external oscillator. The unit also provides dc biases for NPN or PNP transistors, I_c 0-10 MA, E_c 0-100 v. **Electronic Research Associates, Inc., 67 E. Centre St., Nutley, N. J.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 3-101)

INSTRUMENT CONSOLE

A unique console form of instrument localization, used in conjunction with environmental test equipment, has been developed. Shown here with Tenney flight chamber 12STR, it is seen that the new console is a unit-in-itself with all switches, dials, and contacts mounted on the front for easy control and more accurate operation. An especially ingenious advantage of this instrument console is that it can readily be re-



moted for any operation which involves danger. This handy remote control presents the answer to inaccessible locations. **Tenney Engineering, Inc., 1090 Springfield Rd., Union, N. J.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 3-121)

MARCH 1956

TELE-TECH's *International* ELECTRONIC SOURCES

ABSTRACTS & REVIEWS of WORLDWIDE ELECTRONIC ENGINEERING

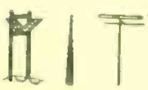
PUBLICATIONS REVIEWED IN THIS ISSUE

Abbreviation	Publication Name
Ann. de Radio	Annales de Radioélectricité
Auto. Con.	Automatic Control
Auto. El.	Automatic Electric Technical Journal
Avto. i Tel.	Avtomatika i Telemekhanika (USSR)
BBC Mono.	BBC Engineering Monographs
BC News	Broadcast News
Bell J.	Bell System Technical Journal
Bell Rec.	Bell Laboratories Record
Bul. Fr. El.	Bulletin de la Société Française des Électriciens
Comp.	Computers and Automation
Con. Eng.	Control Engineering

Abbreviation	Publication Name
El.	Electronics
El. & Comm.	Electronics and Communications
El. Des.	Electronic Design
El. Eq.	Electronic Equipment
El. Mfg.	Electrical Manufacturing
El. Rund.	Electronische Rundschau
Freq.	Frequenz
GE Rev.	General Electric Review
Insul.	Insulation
J. BIRE	Journal of British Institution of Radio Engineers
J. ITE	Journal of The Institution of Telecommunication Engrs.
Nach. Z	Nachrichtentechnische Zeitschrift
NBS Bull.	NBS Technical News Bulletin

Abbreviation	Publication Name
Onde	L'Onde électrique
Phil. Tech.	Philips Technical Review
Proc. BIEE	Proceedings of the British Institution of Electrical Engineers
Proc. IRE	Proceedings of the Institute of Radio Engineers
Radiotek	Radiotekhnika (USSR)
Rev. Sci.	Review of Scientific Instruments
Syl. Tech.	Sylvania Technologist
Tech. Haus.	Technische Hausmitteilungen
Tele-Tech	Tele-Tech & Electronic Industries
Vestnik	Vestnik Svyazy (USSR)
Wirel. Eng.	Wireless Engineer

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



ANTENNAS, PROPAGATION

Non-Linear Distortions Caused by Mismatched Antenna Feeders in Multi-Channel FM Systems, by S. Borodich. "Radiotek." Oct. 1955. 12 pp. Quantitative analysis of the distortions arising from mismatched feeders. Formulas are derived for calculation of noise power caused by non-linear transfers in the channels of the system. Included are: 1. Method of calculation; 2. Correlative distortion function; 3. Spectral density of the products of non-linear distortions; 4. Examples of calculation of noise power from non-linear transfers. Source 3/6-1

The Use of Feeder Stubs for Tuning Short Wave Transmitting Antennae. "Vestnik." Nov. 1955. 3 pp The use of feeder stubs shorter than ¼ wave length for tuning short wave transmitting antennae, and the required design formulas are derived. Construction of feeder stubs is described with detailed design formulas. Source 3/6-2

Aluminum Mesh in R-F Reflectors, by L. J. Ricardi and M. E. Devane. "Tele-Tech" Mar. 1956. 2 pp. Advantages of open mesh in meeting wind loading conditions and permitting ease of manufacture must be compromised with amount of energy that can be allowed to pass through the reflecting surface. Method of determining largest permissible mesh opening is given. Source 3/6-3

A New Type of Insulator for High-Voltage Antennas Having Great Tensile Strength, by W. Peters. "Nach. Z." Dec. 1955. 4 pp. It is proposed to shape the insulator, inserted into the guy ropes of an antenna, as two half-circles arranged at right angles and connected at their centers. Several such insulator installations are shown and their electrical and mechanical data given. Source 3/6-4

The Field-Strength Protection Ratio of two Medium-Wave Transmitters as a Function of the Frequency Difference, by E. Belger and F. von Rautenfeld. "Tech. Haus." No. 11/12, 1955. 3 pp. Experimentally obtained field-strength ratios are plotted as a function of the carrier frequency difference. Performance of the receiver is of prime importance. Source 3/6-5

Growing Waves Due to Transverse Velocities, by J. Pierce and L. Walker. "Bell. J." Jan. 1956. 17 pp. Propagation of slow waves in 2 dimensional neutralized electron flow, where all electrons have equal velocity in the direction of propagation but where streams of 2 or more velocities are normal to the direction of propagation. Source 3/6-7

Shunted Dipoles, by V. Kuznetsov. "Radiotek." Oct. 1955. 9 pp. The article examines dipoles consisting of several parallel conductors, in which the feed is to one or several conductors and the remainder are grounded either directly or through an impedance. A method for analyzing such dipoles is developed and design formulas are derived. Source 3/6-9

The Theoretical Design of Direction-Finding Systems for High Frequencies, by W. C. Bain. "Proc. BIEE, Part B." Jan. 1956. 7 pp. Two types of systems, those in which the equations of the wave interference field are solved and those in which lines of constant phase are fitted to the observed field, are treated. A plane earth and non-interacting antennas are assumed. Source 3/6-10

Broadband Antenna for Field-Intensity Meters, by E. Singer and H. Caler. "El." Feb. 1956. 2 pp. Broadband antenna and balun give unity gain over any 4.5 to 1 frequency range. Unit described covers range from 88 to 400 mc. Source 3/6-11

An Investigation of Slot Radiators in Rectangular Metal Plates, by D. G. Frood and J. R. Wait. "Proc. BIEE, Part B" Jan. 1956. 7 pp. The radiation characteristics of an axial half-wave slot in a rectangular metal plate of limited extent are found to depend on the width, rather than the length, of the plate. Measured and calculated pattern and radiation conductance agree over a wide range of plate widths. Source 3/6-12

Pulse Equipment for Microwave Antenna Tests, by E. J. Henley and L. G. Young. "Bell Rec." Jan. 1956. 4 pp. Antenna test set, using radar pulse techniques, measures antenna directivity patterns with ratios up to 90 db and crosstalk ratios up to 140 db at frequencies in the 4,000, 6,000, and 11,000 mc common carrier bands. Source 3/6-13

Adcock Direction Finder; Polarization Errors Due to Aerial Bending, by W. C. Bain "Wirel. Eng." Jan. 1956. 5 pp. Experimental investigation of an observed polarization error, negligible at low frequencies but considerable at about 20 mc, revealed the inward bending of the main antennas in a U-type Adcock antenna due to the pull exerted by the triatics supporting the central directional antenna. The theory of this effect is developed and numerical values included. Source 3/6-14

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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."

TELE-TECH's *International Report of* ELECTRONIC SOURCES

Forward Scatter of Radio Waves. "NBS Bull." Jan. 1956. 5 pp. Small inhomogeneities in the atmosphere scatter radio waves in all directions, but principally forward. This phenomenon known as ionospheric forward scatter is discussed, and a description of NBS tests is given. Source 3/6-15

AUDIO

Two New Negative-Impedance Voice-Frequency Repeaters, by R. P. Dimmer. "Auto. El." Dec. 1955. 11 pp. Theory, application, design, performance, and installation of two transistorized negative-impedance repeaters. Source 3/6-17

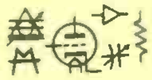
Problems of Stability in Low-Frequency Amplifiers with Negative Feedback, 3rd Installment, by W. Langsdorff. "Freq." Dec. 1955. 7 pp. The attenuation and phase shift introduced by the output transformer are measured and compared with networks of minimum phase shift and equal attenuation. An equivalent four-terminal network is presented. Design considerations are derived. Source 3/6-18

Silencer Kills Audio Output on Noise Peaks, by A. Gerlach. "El." Feb. 1956. 2 pp. A discussion of noise suppressor techniques, followed by an example of a time filter for suppressing high level noise. Source 3/6-19

Harmonic Generators for Telephone Tones, by A. B. Haines. "Bell Rec." Jan. 1956. 3 pp. Small, efficient harmonic generators with no moving parts or electron tubes produce stable, high quality tones for various telephone uses. Harmonics are selected from nonsinusoidal output of transformer with highly saturable magnetic core. Source 3/6-20

Technique of Sound Transformation in Radio Station Studios, in Particular the Application of Frequency Spectrum Distortion, by L. Heck and F. Bruerck. "El. Rund." Jan. 1956. 7 pp. To obtain sound effects in studio performances, a distortion of the frequency spectrum, i.e., extension or shortening of the intervals between adjacent tones, is resorted to. The method, involving a ring-modulator and special demodulator, is described. Source 3/6-21

The Design of a Ribbon Type Pressure-Gradient Microphone for Broadcast Transmission, by D. E. L. Shorter and H. D. Harwood. "BBC Mono." Dec. 1955. 21 pp. New microphone has improved transmission quality at reduced weight and size. Factors affecting microphone design, experimental methods used, and various aspects of performance are discussed. Test data is obtained from a number of production samples. Source 3/6-22



CIRCUITS

Noise Cancellation in Microwave Mixers, by L. D. Strom. "Tele-Tech" Mar. 1956. 4 pp. The short slot hybrid, a structure consisting of 2 parallel waveguides with a coupling aperture in the common narrow wall is an accepted alternate to the hybrid T in balanced microwave mixer design. The relations necessary for hybrid performance is developed and a balanced mixer explained. Source 3/6-24

Some New Aspects of the Wien Bridge Oscillator, by M. Achuthan. "J. ITE" Dec. 1955. 9 pp. Factors influencing the use of this oscillator in the r-f range. Linear wideband frequency modulation is discussed. Source 3/6-27

The Effects of Atmospherics on Tuned Circuits, by A. Edwards. "J. BIRE" Jan. 1956. 9 pp. Effects of radiation from lightning discharges on tuned circuits. Fourier component of the amplitude spectrum of the disturbance at the resonant frequency of the circuit is determined. Some experimental work is described. Source 3/6-28

Practical Circuits for Grid Control of Thyratrons, by P. H. Chin and E. E. Moyer. "El. Mfg." Jan. 1956. 11 pp. Fundamental thyratron grid control circuits for industrial application. Grid circuit bridge circuitry and on-off control with ac and dc plate voltage is covered. Source 3/6-29

Designing Cathode-Coupled Amplifiers with Conductance Curves, by K. A. Pullen, Jr. "El. Des." Jan. 15, 1956. 4 pp. The use of conductance curve techniques simplifies the design of linear and non-linear amplifier stages. Considered are a cathode coupled amplifier, used as an amplifier or limiter, and a TV sync separator. Source 3/6-30

Fast Trigger Circuit, by W. Davidson and R. Frank. "Rev. Sci." Jan. 1956. 2 pp. 6BQ7A is used in a trigger circuit with a recovery time of approximately 0.15 μsec. and an input sensitivity of 0.17 v. Circuit operation and test results are given. Source 3/6-32

A Geometrical Representation of the Parallel- and Series-Reactance of Zero-Loss Parabolic Four-Terminal Network, by J. de Buhr. "Nach. Z." Dec. 1955. 6 pp. This is a graphical method, based on a stereographic projection of the unit sphere onto the complex plane, which permits the evaluation of the effect on an impedance due to a series or parallel connected reactance. Source 3/6-34

Diode Circuit Characteristics for Periodically Recurring Pulses, by R. Suhrmann. "Nach. Z." Dec. 1955. 7 pp. The diode circuits required for the dc restoration in TV signals as well as for instruments measuring peak voltages of short duration are studied. Essentially a compromise value for the time constant must be determined. Source 3/6-35.

Circuits with Non-Linear Resistance, Calculation of Behavior, by A. Liebetegger. "Wirel. Eng." Jan. 1956. 6 pp. The formulas are derived for a closed loop containing a diode, a constant power voltage supply and an impedance, for the cases that the impedance is either a pure resistance, an inductance, a capacitance or a series combination of these. The 2/3 power law is assumed for the diode. Source 3/6-36

RC-Oscillators, by H. Voelz. "El Rund." Jan. 1956. 4 pp. Calculations relating to RC oscillators and phase-shift oscillators and associated networks are carried out. Increased phase slope improves the distortion factor as well as frequency and amplitude response. Source 3/6-37

Constant-Frequency Oscillators, by A. S. Gladwin. "Wirel. Eng." Jan. 1956. 7 pp. The frequency of a regenerative oscillator will be independent of resistance variations provided the input, output, and transfer impedances of the feedback network are resistive. Formulas for impedances to be inserted in a conventional LC oscillator with mutual-inductance coupling are derived and compared with experimental results. Source 3/6-38

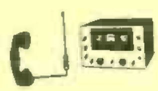
Experiments on the Regeneration of Binary Microwave Pulses, by O. DeLange. "Bell. J." Jan. 1956. 24 pp. Description and performance of a regenerator of binary pulses at microwave frequencies, in the presence of serious noise and bandwidth problems. Source 3/6-39

An Amplifier for a Stroboscopic Oscillograph, by V. Vol. "Radiotek." Oct. 1955. 6 pp. A method for the design of an amplifier for a stroboscopic oscillograph is given, in which the exponentially decaying pulse is reshaped into a pulse of a definite predetermined shape, approximately bell-shaped. Circuit analysis and calculation is included. Source 3/6-40

Frequency Stability and Quartz Crystal Oscillators, by A. Erkens. "Ann. de Radio." Oct. 1955. 7 pp. Characteristics of the GT and Y type quartz crystals are compared. The P 18 oscillator is described as well as the associated Thermistor-temperature-compensation circuit. The oscillator has a maximum frequency variation of 10^{-9} due to tube characteristics and voltage fluctuations, and is stable for temperature variations between 5° and 40°C. Source 3/6-41

K-Stabilizers for Voltages of Laboratory Rectifiers, by L. Dekabrun. "Radiotek." Oct. 1955. 6 pp. The article examines the stabilization of dc voltages at the output of the rectifier by means of automatic regulation of the magnitude of the ac voltage input. Stabilizers operating on such a principle (data for one of them designed for a voltage range of 1200 to 6500 v. is given), permit floating regulation of the output voltage over a wide range. Source 3/6-42

The Sensitivity of Frequency Discriminators with Resonant Circuits, by V. Volpyan. "Radiotek." Oct. 1955. 15 pp. The sensitivity of frequency discriminators to frequency deviations is determined for discriminators designed for a given band of frequencies. The concept of the limit of sensitivity in the absence of circuit losses is introduced. Equations are derived for the parameters, including the limiting parameters. A design method is given which assures obtaining a sensitivity which is close to the limiting value. Source 3/6-43



COMMUNICATIONS

The Efficiency Concept in Information Theory, by P. Neidhardt. "El. Rund." Jan. 1956. 5 pp. The efficiency in communication theory is defined as the ratio of the entropy at the receiver output and at the source of information. It is held that this definition indicates what percentage of the supplied information contents is transmitted. Theoretical considerations are followed by examples. Source 3/6-45

Calculations with Background Noise. 2nd Installment: Passage of Background Noise Through Non-Linear Elements, by G. Bosse. "Freq." Dec. 1955. 7 pp. In the first installment of this article (Freq., Sept. 1955), functions correlated to the input voltage and output voltage are introduced. The function correlated to the input voltage is now used in a Laplace transform, representing the characteristic of the four-terminal non-linear network, resulting in the function correlated to the output voltage. This last function is evaluated for simple characteristics. Source 3/6-46

Potential Interference Rejection in Radio Telegraphy Reception, by L. Filippov. "Radiotek." Oct. 1955. 12 pp. The potential (maximum possible) interference rejection is calculated for reception of radio telegraphy. By comparing the interference rejection of one type of reception using the ratio method with the reception of an "ideal" receiver, it is shown that interference rejection can be considerably increased for reception of pulse signals. Source 3/6-47

Fourier Representation of a Demodulated Beat Frequency, by R. Leisterer. "El. Rund." Jan. 1956. 2 pp. The low-frequency discriminator output resulting from the superposition of a sinusoidal noise voltage (interfering transmitter) on the signal frequency voltage is studied. The resulting noise signal is plotted for several amplitude ratios and a Fourier analysis is carried out. Source 3/6-48

Improved Reception in Common Channels by Means of Frequency Shift, by E. Belger and E. von Rautenfeld. "Tech. Haus." No. 11/12. 1955. 3 pp. Experiments with two transmitters, whose two carrier frequencies are slightly shifted, as to the disturbing effects are reported. It is concluded that a frequency difference of 20 cycles between the two carrier frequencies is advantageous. Source 3/6-49

An Automatic Remote Fed Repeater Station. "Vestnik." Nov. 1955. 4 pp. The basic technical data for the station is given, and the system of operation and fields of application are examined. A description of the operation of the separate sections is included. Block diagrams are used, but design equations and mathematical circuit analysis are not included. Source 3/6-50

A Class of Binary Signaling Alphabets, by D. Slepian. "Bell. J." Jan. 1956. 32 pp. "Group alphabets," having the following features are described. 1) all letters are treated alike in transmission; 2) encoding and maximum likelihood detection is simple; 3) in certain practical cases there exists no better alphabets. Source 3/6-52

Determination of Probability of communication Failure due to Interfering Signals, by V. Zhitomirsky. "Radiotek." Oct. 1955. 8 pp. The effect of a fading signal from an interfering station on a frequency shift telegraphy receiving installation is examined. The probability of communication failure due to fading sinusoidal interference is determined for cases of ordinary diverse reception. Source 3/6-53

Asymmetry in Communication Equipment, by E. Ganitta. "Nach. Z." Dec. 1955. 7 pp. Measuring equipment used by the German Post Office, based on recommendations of the CCIF, to establish the effect of the asymmetry in telephone exchange equipment is described and results of tests are presented. Additional tests are recommended. Source 3/6-56

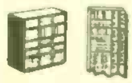
A Method of Decreasing Telemetering Errors in Systems with Time Multiplex Channels, by V. Mikhailov and L. Malets. "Avto. i Tel." Nov.-Dec. 1955. 6 pp. Possibilities for decreasing the metering errors in multichannel telemetering systems with time multiplex channels, by means of using transmitted control (standard) signals corresponding to the zero and maximum values of the metered unit magnitudes. Source 3/6-57

New Microwave Repeater System Using Traveling-Wave Tubes, by N. Sawazaki and T. Honma. "Proc. IRE" Jan. 1956. 6 pp. Microwave relaying system in which gain is increased by amplifying signal through the same traveling wave tube amplifier twice. The second amplification is done after the frequency of the signal has been heterodyned to the second frequency. 4,000 mc TV repeater is described. Source 3/6-58

Bandwidth Requirements of SW Radio Telegraphy, by J. B. Moore. "Tele-Tech." Mar. 1956. 4 pp. A study of the basic characteristics and requirements of both ON-OFF and FSK Telegraphic keying. Source 3/6-59

Design of Studios for Small Broadcasting Stations, by R. Goodsman. "J. BIRE" Jan. 1956. 24 pp. Design and construction of studio buildings, and acoustic design of studios and associated control rooms. Equipment designed for the Trinidad Broadcasting Co. is referred to. Source 3/6-60

Electrical Pulse Communication Systems, Part 3—Transmission and Reception Problems in Pulse Systems, by R. Filipowsky. "J. BIRE" Jan. 1956. 19 pp. Pulse multiplexing principles and methods, followed by a discussion of the transmission medium, and by detection and demodulation principles. Source 3/6-61



COMPUTERS

Tantalum Capacitors for High-Temperature Applications, by D. B. Peck, S. W. Burbisky, and W. W. Schroeder. "El. Eq." Jan. 1956. 4 pp. Foil type, axial lead, tubular, tantalum capacitors, designed for 125°C. operation meet requirements of MIL-C-25102. with added stipulation that 85°C. tests are replaced by 125°C. tests. Source 3/6-64

Performance of Vitreous-Enameled Resistors, by H. Levy. "El. Eq." Jan. 1956. 2 pp. Properties of these resistors and discussion of requirements of MIL-R-26B, the Mil Spec for fixed, wire-wound, power type resistors. Source 3/6-65

Precision Potentiometers — Characteristics and Limitations, by S. Scantzoulis and S. Liss. "El. Mfg." Jan. 1956. 8 pp. Potentiometer types, characterics, and environmental conditions affecting their application. Table gives related definitions and terminology. Source 3/6-66

Artwork Procedures in Printed Wiring, by W. H. Klippel and E. J. Lorenz. "El. Mfg." Jan. 1956. 6 pp. Three procedures for making the masters for printed wiring boards are given. These are single board procedure, short run production procedure, and high production procedure, and are appraised for tolerance, cost, etc., in a "how to do it" approach. Source 3/6-67

Buyers Guide Of Electronic And Communications Equipment-Addenda To 1955 Directory. "El. & Comm." Dec. 1955. 6 pp. Addenda to directory of Canadian electronics industry which appeared originally in Sept.-Oct. 1955 Directory Issue. Source 3/6-68

Parts vs. Systems: The Reliability Dilemma, by D. Hill, D. Voegtlen, and J. Yueh. "El. Eq." Jan. 1956. 5 pp. Equipment does not necessarily meet equipment specs just because its components meet military specs. Component and system specs and present reliability levels are discussed. Source 3/6-70

Continuous Furnace for Curing NBS Tape Resistors. "NBS Bull." Jan. 1956. 2 pp. Closer tolerance tape resistors are made in continuous furnace designed at NBS. Liquid heat exchange medium keeps temperature constant within ±1°C. Capacity is 175 resistor wafers per hour. Source 3/6-71

A Triad for Design Reliability, by F. E. Dreste. "El. Eq." Jan. 1956. 3 pp. Three basic design requirements for reliability are: reliable parts at start of program; realistic operational parts tolerances and a statistical approach to design; thorough model testing. Source 3/6-72

Reliability of Electrical Connectors, by H. M. Neben. "El. Eq." Jan. 1956. 3 pp. Electrical properties of black and mica bakelite and diallyl pthalate, 3 typical connector materials. Handling, assembly, and inspection as they affect reliability. Source 3/6-73

Electromechanical Filters for 100 Kc Carrier and Sideband Selection, by R. W. George. "Proc. IRE" Jan. 1956. 5 pp. Design, materials, and terminations of torsional electromechanical filters, employing mechanically resonant elements mechanically coupled. Two 100 kc filters with bandwidths of 50 cps and 3.1 kc are described in detail. Source 3/6-74

Printed Wiring Techniques Increase Product Reliability, by H. L. Shortt. "El. Eq." Jan. 1956. 3 pp. Description of methods and processes of forming printed wiring assemblies, with accent on reliability. Apparatus will withstand shock and vibration tests considered impossible for wired assemblies. Source 3/6-75

COMPONENTS

A Method for Solving Characteristic Equations of Analog Installations, by I. Eterman and M. Obuvalin. "Avto i Tel." Nov-Dec. 1955. 2 pp. A method which has been successfully tested in practice is developed for solving the equation of the form:

$$\lambda^n + A_{n-1}\lambda^n + \ldots.\ A_1\lambda + A_0 = O$$

which is characteristic for the given regulatory system. Source 3/6-77

Synthesis of Function Generators by Continued Fraction Theory, by Dr. V. W. Bolie. "Tele-Tech" Mar. 1956. 4 pp. The theory of continued fractions is explained and used to synthesize certain nonlinear functions by use of linear potentiometers. Function generator networks are derived from continued fraction theory and a basic knowledge of network theory. Source 3/6-79

Frequency Division by Cascaded Binaries, by I. Gottlieb. "Tele-Tech" Mar. 1956. 3 pp. Methods for obtaining stable frequency division for factors such as 7, 11, 13, etc. In these cases it is not possible to perform the division in 2 steps. Source 3/6-80

Magnetostriction Delay Line Decoder, by A. Tarabella. "Onde" Nov. 1955. 5 pp. Discusses apparatus capable of reading, arranging, and labeling units of information stored in a memory device. The latter, a magnetostriction delay line, works in a closed loop, recording binary code digits. Source 3/6-81

Electrical Analogues for Heat Exchangers, by R. L. Ford. "Proc. BIEE. Part B" Jan. 1956. 18 pp. An extensive theoretical treatment of the analogy between electrical circuits and heat exchangers intended to assist in the solution of automatic control problems of such exchangers. Distributed-parameter systems are considered. An example is included. Source 3/6-82

Practical Circuits for Gating in Digital Computers, by N. Scott. "Con. Eng." Feb. 1956. 6 pp. Basic binary terminology is followed by a discussion of vacuum tube, transistor, diode, reshaping, and magnetic core gates. Source 3/6-83

The Program-Controlled Electronic Computor "Munich" (PERM), Second Installment, by H. Piloty, R. Piloty, H. O. Leidlich and W. E. Proebster. "Nach. Z." Dec. 1955. 9 pp. This second and last installment describes the computing and control circuits. the magnetic memory, and associated amplifiers. The schematic of the memory circuitry is included. Performance data are presented. Source 3/6-84

TELE-TECH's *International Report of* ELECTRONIC SOURCES

Character Recognition for Business Machines, by M. Glauberman. "El." Feb. 1956. 5 pp. Printed Arabic numerals are recognized by a photoelectric scanner and transformed into an electrical output usable in computers. Circuitry, operation, and application are given. Source 3/6-85

Ferrite-Core Memory is Fast and Reliable, by M. Alexander, M. Rosenberg, and R. Stuart-Williams. "El." Feb. 1956. 4 pp. Memory circuits of the JOHNNIAC computer are described, and operation given. Unit has 168,-960 cores. Source 3/6-86

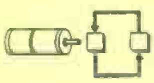
A Transducer for Digital Data-Transmission Systems, by R. H. Barker. "Proc. BIEE, Part B" Jan. 1956. 10 pp. A photoelectric method to indicate the angular position of a datum shaft as a binary number has been developed. An experimental 10-digit scale reader and a high-accuracy 14-digit scale reader are described and the error introduced by this method is discussed. Source 3/6-87

A Servo-System for Digital Data Transmission, by R. H. Barker. "Proc. BIEE, Part B" Jan. 1956. 13 pp. The system has been designed with a view to the particular difficulties encountered in digital data transmission, such as the amplitude quantization of the data which introduces non-linear effects, the presentation of these data as a series of samples, and delays. Source 3/6-88

Transistor Amplifiers for Use in a Digital Computer, by Q. W. Simkins and J. H. Vogelsong. "Proc. IRE" Jan. 1956. 12 pp. Design principles and circuit configurations of transistor pulse-regenerative amplifiers with external timing, for use in a 3 mc digital computer. Source 3/6-89

A Comparison of Large-Scale Calculators, by J. W. Carr III and A. J. Perlis. "Con. Eng." Feb. 1956. 9 pp. Comparison of commercially available and private computers. Table of characteristics of large scale calculators and computer family tree showing development of different computers is given. Source 3/6-91

Glossary of Terms in the Field of Computers and Automation. "Comp." Jan. 1956. 17 pp. Definitions of over 400 terms and expressions commonly used in the field of computers and automation. Source 3/6-92



CONTROLS

Nonlinearity in Control Systems, Basic Principles (Part 1 of 3 parts), by T. M. Stout. "Con. Eng." Feb. 1956. 8 pp. Definition, properties, representation, classification, and importance of nonlinearity in control systems. Source 3/6-93

A Dynamic Root-Locus Plotter, by J. E. Gibson, "Con. Eng." Feb. 1956. 3 pp. Analysis of closed loop servo systems is simplified by continuously plotting the locus of the roots. Construction and operation of the device is given. Source 3/6-94

Max-Min Detector Digests Data for Conventional Recorder, by R. J. Horak, "Con. Eng." Feb. 1956. 2 pp. Maximum, minimum, and average values are compressed, stored, and released after a time interval for plotting by a recorder. Chart time scale is compressed. Schematic diagram is given. Source 3/6-95

Magnetoresistance—New Tool for Electric Control Circuits, by R. K. Willardson and A. C. Beer. "El. Mfg." Jan. 1956. 6 pp. Principles and applications of magneto-resistance (change of resistance due to magnetic field). Applications include voltage and current regulators and galvomagnetic amplifiers. Source 3/6-96

A Simplified Method of Solving Linear and Nonlinear Systems, by R. Boxer and S. Thaler. "Proc. IRE" Jan. 1956. 12 pp. The response of linear and nonlinear systems is obtained without knowledge of the roots of the system characteristic equation. A time series represents the value of the response at equal time intervals. Solution of time varying and time lag systems is given. Source 3/6-97

Investigation of the Movements of a Relay System in an Electronic Model, by A. Malinin, "Avto. i Tel." Nov-Dec 1955. 7 pp. Investigations of electronic model of a relay system by means of which stable movements of various complexities were achieved, and the regions of their existence isolated in the parameter space. Analysis of transfer function, experimental results, and circuit of model are given. Source 3/6-98

Use of Nomograms for Construction of Regions of Stability and Lines of Equal Phase and Amplitude Margins in Automatic Regulatory Systems, by B. Kislov. Avto. i Tel." Nov.-Dec. 1955. 23 pp. Nomograms permit the construction of regions of stability and lines of equal margins of phase and amplitude, according to the linear frequency response of the system. Construction of the boundaries of the region of oscillation, as well as the lines of equal amplitude of oscillation, by examining non-linear systems through the principle of harmonic balance. Experimentally determined characteristics can be used. Source 3/6-99

IRE Standards on Terminology for Feedback Control Systems, 1955. "Proc. IRE" Jan. 1956. 3 pp. IRE standard definitions of 33 terms related to feedback control systems. Source 3/6-100

Magnetic Amplifier Two-Speed Servo System, by J. Suozzi. "El." Feb. 1956. 4 pp. Tube amplifier in 2-speed servo system is replaced by magnetic amplifier with 2 half-wave bridge type stages and full wave slave output. Design and system data are given. Source 3/6-101

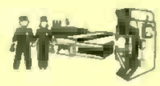
A Functional Analysis of Automatic Logging Systems—Components at Work, by D. McDonald, D. Schover and A. Simmons. "Con. Eng." Feb. 1956. 16 pp. The 8 functions of an automatic logging system (transducer, scale factor correction, derivation of quantities, scanning, analog to digital conversion, programming and control, alarm, and recording) are discussed. Source 3/6-102

Transistor Preamplifier Feeds Tubeless Servo, by H. Zeller, Jr. "El." Feb. 1956. 2 pp. Low-level input is coupled to servo amplifier by 4-stage, high gain transistor preamp. Signal to noise ratio is 60 to 1. Source 3/6-103

Construction of Regions of Stability, by G. Ostrovsky. "Avto i Tel." Nov.-Dec. 1955 7 pp. A method for constructing regions of stability is developed for equations of the fourth, fifth and sixth degree, with the aid of invariants of the quadratic form. A mathematical and graphical analysis is given, beginning with the Hurwitz conditions for the stability of a regulated system. Source 3/6-104

Certain Features of the Investigation of Dynamic Properties of Non-Linear Systems Containing an Unstable Member, by E. Krug and O. Minin. "Avto. i Tel." Nov.-Dec. 1955 6 pp. Using the simplest system as an example, it is shown that judgements concerning the dynamic properties of a system containing an unstable member cannot be based on investigations using the method of harmonic balance. The investigation is carried out on a phase plane. Source 3/6-105

Use Standard Components for Control, by P. Hermann. "Auto. Con." Jan. 1956. 3 pp. Applications of level controllers, photoelectric cells and load cells. Chart gives principal uses and major characteristics of the photocells. Source 3/6-106



INDUSTRIAL ELECTRONICS

X-Ray Intensity Measurements With Counter Tubes, by W. Parrish. "Phil. Tech." Jan. 1956. 16 pp. X-ray diffraction analysis by means of counter tubes. Counting strategy is discussed, and counting rate meters and counting rate computers are described. Source 3/6-107

Electronics. "GE Rev." Jan. 1956. 6 pp. Review of the accomplishments of GE in electronic fields, such as TV, radio, high-fidelity, electron tubes, semiconductors, magnetics, microwave, mobile radio, carrier current, etc. Source 3/6-108

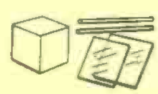
Technical Study of the Electronic Equipment Used at C. E. A.—Statistics of C. E. A. Apparatus Faults, by R. Fabre and R. Viguie. "Onde" Nov. 1955. 8 pp. Characteristics of apparatus used in the Nuclear Physics development of the French AEC. Due to standardization of mechanical equipment and electronic circuits, flexibility and versatility are obtained. Set-ups can be put to work speedily at a great savings in cost. Source 3/6-110

Computer-Prepared Machine Data for Machine Control, "El. Mfg." Jan. 1956. 8 pp. Magnetic tape control of machine motions is simplified when the magnetic tapes are prepared by an electronic computer which receives data punched into paper tape from parts drawings. Machine dry runs are eliminated. Source 3/6-111

Thyratron Inverter Uses Controlled Firing Time, by F. Lawn. "El." Feb. 1956. 4 pp. Regulation of ac output voltage is obtained by using control tube to extinguish power tubes. Cumbersome saturable reactors are eliminated. Source 3/6-112

Electronic Controls for Machine Tools, by D. A. Findlay. "El." Feb. 1956. 8 pp. Discussion of the different types of electronic controls used in automatic production in the machine tool field. Circuit operation is given and reference is made to particular systems of different manufacturers. Source 3/6-113

Universal Shutter Tester, by A. Wessel. "El." Feb. 1956. 2 pp. Speed of between-the-lens and focal-plane shutters of cameras is measured directly by electronic photo-amplifier device. Theory of operation is explained. Source 3/6-114



MATERIALS

Effects of Processing on Magnetic Alloys, by R. H. Trapp. "El. Mfg." Jan. 1956. 4 pp. Close control of variables during chemical and metals processing determines the physical and magnetic properties of magnetic alloys. Test tube products are rapidly converted to commercial materials by pilot plant development. Source 3/6-115

Applications and Techniques for Encapsulation with Epoxy Insulating Resins, by F. J. Davidson. "Insul." Jan. 1956. 6 pp. Properties of epoxy resins and their application in embedding transformers, servo motors, transistors, vacuum tube circuits, etc. Table compares physical properties of different resins. Source 3/6-116

Insulation Storage and Shelf Life, by W. T. McClelland. "Insul." Jan. 1956. 1 p. Correct way to store varnishes and insulating compounds. Main factors are container size and temperature. Source 3/6-117

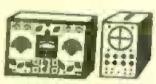
A Survey of the Application of Ferrites to Inductor Design, by R. S. Duncan and H. A. Stone, Jr. "Proc. IRE" Jan. 1956. 10 pp. Properties of ferrites and the progress made in their application to inductors. Advantages offered are smaller size, lower cost, and higher Q. Source 3/6-118

Ferrites—Part III, Limitations and Measurements, by W. P. Ayres, A. L. Aden, and P. H. Vartanian. "Syl. Tech." Jan. 1956. 8 pp. Frequency, bandwidth, and power limitations, unfamiliar measuring techniques, and the future of ferrites are covered. Source 3/6-119

Potting Gives Maximum Reliability, by R. H. Flack and J. O. Mobley. "El. Eq." Jan. 1956. 3 pp. Potting materials and techniques. Potting procedure for miniature and subminiature tubes and resistors is given. 27 likely materials were tested. Source 3/6-120

Microwave Engineering Applications of the Ferromagnetic Faraday Effect, by W. W. H. Clarke. "El. & Comm." Dec. 1955. 5 pp. Application of Faraday rotation (rotation of plane of electromagnetic wave polarization in a magnetic medium) in ferrites. Properties of typical microwave components are explained. Source 3/6-121

How to Plan, Prepare and Produce an Engineering Catalog, by H. W. Weisman. "Tele-Tech" Mar. 1956. 3 pp. Some manufacturer's catalogs, in addition to listing products produced, are masterpieces of technical information. Reviewed are the problems and solutions encountered in printing and writing one of the better catalogs now available. Source 3/6-122



MEASURING & TESTING

Permeability Testing of Nickel Laminations, by F. W. Frazee. "Tele-Tech" Mar. 1956. 2 pp. Permeability of individual transformer laminations is determined by measuring the current drawn by a near resonant circuit whose coil has as the major portion of its magnetic path the lamination to be tested. Source 3/6-126

Apparatus for Measuring a Variable Magnetic Field, by J. Taieb, H. Guillon, A. Gabet, and J. Mey. "Onde" Nov. 1955. 8 pp. Apparatus for measuring the growth of the magnetic field of the electro-magnet of a synchrotron. Unit places search coils in the gap of the electro-magnet. Source 3/6-127

Magnetic Test for Relay Cores, by B. Stauss. "Bell Rec." Jan. 1956. 2 pp. Measurement of the coercive force of relay cores provides reasonable classification of their magnetic properties. Null balance measuring system is independent of fit of relay parts and velocity with which parts are separated. Source 3/6-132

Linear Densitometer Circuit, by P. Hariharan and M. Bhalla. "Rev. Sci." Jan. 1956. 2 pp. Stable densitometer circuit uses 2 photomultiplier tubes operated at constant anode current as a balanced range compressor, followed by a logarithmic difference amplifier. Density range is 2.5; scale is linear to ± 0.01 density units. Theory and circuit details are given. Source 3/6-133

Industrial Measurements of the Temperature Coefficient of Capacitors Having a Ceramic Material as Dielectric, by J. Peyssou and J. Ladefroux. "Ann. de Radio." Oct. 1955. 17 pp. After describing two standard methods of measuring the temperature coefficient, i.e., the double-beat method and the self-synchronized instrument, the C.S.F. analog computor is introduced. It permits automatic and accurate measurement of the temperature coefficient in large scale production. Source 3/6-134

E-Repeater Test Set, by J. O. Smethurst. "Bell Rec." Jan. 1956. 4 pp. Test set for testing negative impedance voice frequency repeaters and for measuring the transmission and impedances of lines used with them. Source 3/6-135

On the Measurement of the Magnetic Permeability of Metals by Means of Cavity Resonators and the Permeability of Iron in the Region of Ferromagnetic Resonance, by K. Reich. "Freq." Dec. 1955. 9 pp. The instrument is described in detail, calibration procedure is discussed and the results are plotted for pure iron and for a commercially available sample. Probable error, advantages and disadvantages of the arrangement as well as possible improvements are discussed. Source 3/6-136

Measuring High Pressure Transients, by W. Davis. "Auto. Con." Jan. 1956. 3 pp. The use of the piezoelectric transducer and resistance wire strain gage as applied in measuring fast rise, high pressure transients. Source 3/6-137

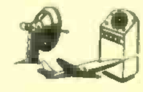
How to Evaluate Shielded Rooms, by E. A. Lindgren. "El. Des." Jan. 15, 1956. 2 pp. Shielded rooms are compared on the basis of attenuation, mechanical construction, the environmental conditions under which they will be used, and cost. Screen room filters are discussed. Source 3/6-138

Evaluation of Electronic Test Equipment, by B. S. Browning. "El. Des." Jan. 15, 1956. 2 pp. Enormous savings by the Air Force are made by combining several test equipments into one composite test set. Savings resulting from a combination of 5 signal generators were 2/3 in weight, 1/3 in cost, and over 16 times reduction in shipping volume. Savings also occur in transportation, shipping costs, etc. Source 3/6-139

A Precision Resonance Method for Measuring Dielectric Properties of Low-Loss Solid Materials in the Microwave Region, by S. Saito and K. Kurokawa. "Proc. IRE" Jan. 1956. 7 pp. Accuracy of 1% in ε and 3% in tan δ is obtained for various samples. Polystyrol and polyethylene samples are tested at 4,000, 9,000 and 24,000 mc. Source 3/6-140

Statistical Techniques for Reducing the Experimental Time in Reliability Studies, by M. Sobel. "Bell. J." Jan. 1956. 24 pp. Three statistical techniques for reducing the average experimental time needed to determine the period during which no failures occur. Source 3/6-141

Measuring R-F Parameters of Junction Transistors, by W. Coffey. "El." Feb. 1956. 4 pp. Triode and tetrode transistors small signal h parameters are measured in the range of 1 to 24 mc. Techniques and instrumentation are described. Source 3/6-142



RADAR, NAVIGATION

Airborne Weather Radar Uses Isoecho Circuit, by F. Ruppert and J. Smith. "El." Feb. 1956. 3 pp. Isoecho contour circuit erases return signals greater than a preselected level. Reversal of illumination shows displays of return signals as black rather than white, i.e., high rainfall is presented as black holes in a light background. Circuit diagram and operational features are given. Source 3/6-143

An FM Radio Altimeter, by G. Collette and R. Labrousse. "Ann. de Radio." Oct. 1955. 12 pp. The AM 210 altimeter commercially produced by the Societe Francaise Radio Electrique is described. Design details are given and performance data presented. Mutual antenna coupling problems are treated. Source 3/6-144

SEMICONDUCTORS

Negative Resistance Regions in the Collector Characteristics of the Point-Contact Transistor, by L. E. Miller. "Proc. IRE" Jan. 1956. 8 pp. In point-contact collector characteristics, negative resistance regions which appear as a measuring circuit instability are the combined result of device properties and the associated circuitry. Three alpha anomalies are discussed. Source 3/6-145

The Dependence of Transistor Parameters on the Distribution of Base Layer Resistivity, by J. L. Moll and I. M. Ross. "Proc. IRE" Jan. 1956. 6 pp. Transistor behavior for any base layer impurity distribution is analyzed. Expressions for frequency cut-off, transit time, emitter efficiency, and transverse sheet resistance are derived. Source 3/6-146

Broadband Microwave Crystal Developments, by E. J. Feldman and S. L. Levy. "Tele-Tech" Mar. 1956. 3 pp. New developments in broadband semi-conductors for use in mixer and video detector applications. Source 3/6-148

Diffused Emitter and Base Silicon Transistors, by M. Tanenbaum and D. Thomas. "Bell. J." Jan. 1956. 22 pp. Diffusion techniques and processes for making transistors with base layers 3.8×10^{-4} cm. thick, for high frequency operation. Design data is calculated and compared with the measured characteristics for the diffused emitter, diffused base structure. Source 3/6-149

A High-Frequency Diffused Base Germanium Transistor, by C. Lee. "Bell. J." Jan. 1956. 11 pp. Fabrication, characteristics, and design considerations of germanium transistors with alphas of 0.98 and alpha-cutoff of 500 mc. High degree of dimensional control is obtainable. Source 3/6-150

A Method for the Measurement of the Surface Recombination Rates in Semi-Conductors due to the Photo-Magneto-Electric Effect in the Sinusoidal Region, by J. Grosvalet. "Ann. de Radio." Oct. 1955. 4 pp. An expression for the phase shift between the photo-magneto-electric and the photo-resistive effects is derived for thin semi-conductors. Theoretical considerations relate this phase-shift to the surface recombination rates. Experimental results are included. Source 3/6-151

Alloyed-Junction Transistor Development, by J. J. Ebers. "Bell Rec." Jan. 1956. 4 pp.

Alloyed-junction transistors, made by alloying layers of highly conductive material onto a body of germanium, are particularly suited to switching applications. A comparison is made of the electrical properties of this transistor and the grown-junction transistor. Source 3/6-152

Diffusion Transistors Raise Frequency Limits, by J. Carroll. "El." Feb. 1956. 3 pp. Transistor operation, with no loss in power handling capabilities, results from thin base regions obtained by solid state diffusion of impurities. Germanium and silicon units operate up to 600 and 120 MC, respectively. Source 3/6-153

Transistor Alpha-Beta Conversion, by R. Turner. "Tele-Tech" Mar. 1956. 1 p. Practical data for converting transistor emitter-collector current amplification factor (alpha) to base to collector current (beta) values, and vice versa. Source 3/6-154

The Hall Effect and its Application to Power Measurement at Microwave Frequencies, by H. E. M. Barlow and L. M. Stephenson. "Proc. BIEE, Part B" Jan. 1956. 3 pp. Experimental results establish the existence of a Hall effect in n-type germanium positioned in an electromagnetic field of 4000 MC. The measuring set-up used permits power measurements with matched load or otherwise where only a small fraction of the power is absorbed. Source 3/6-155

Broadband Transistor Feedback Amplifiers, by J. Almond and A. R. Boothroyd. "Proc. BIEE, Part B" Jan. 1956. 9 pp. A 3-stage common-emitter negative-feedback amplifier is analyzed. It is demonstrated that a gain of about 33 db, with negative feedback of more than 30 db, can be obtained for a frequency range of at least 20 KC. Examples are given. Source 3/6-156

TELEVISION

Status of Standardization of Testing and Measuring Methods in Television Engineering, by J. Mueller. "Tech. Haus.," No. 11/12, 1955. 8 pp. The testing and measuring methods recommended by the sub-committee of the FuBK (German Radio Service Committee), as well as the equipment used, are presented. The methods proposed by the CCIF (1954) and the CCIR (1955) are reviewed. Source 3/6-157

On Black-Level Stability in Television Scanning Apparatus, by W. Dillenburger. "Tech. Haus.," No 11/12, 1955. 7 pp. The black-level of various tubes, such as the super-orthicon, the orthicon, the vidicon, and the super-iconoscope is studied. The effect of the fly-back potential is set forth, and the presence of clamp circuits considered. Automatic control is investigated. Source 3/6-158

Present State of Color Television in the U.S., by C. G. Mayer. "El. Rund." Jan. 1956. 4 pp. This is a review of the technical as well as the commercial aspects of color TV in the U.S. Source 3/6-162

Space-Control Production Area. by S. Cornberg. "BC News" Dec. 1955. 18 pp. New concept in TV studio design allows complete control of production area, space, equipment, audience, etc. Result is increased studio efficiency. Source 3/6-163

The "Scenioscope," a New Television Camera Tube, by P. Schagen, J. R. Boerman, J. H. J. Maartens and T. W. van Rijssel. "Phil. Tech." Jan. 1956. 9 pp. Sensitivity of image iconoscope is improved by replacing target of non-conductive mica with target of glass of certain conductivity. Resulting new tube gives acceptable picture with object illumination of 100 lux and excellent noise free picture with 300 lux. Source 3/6-164

Planning TV Microwave Systems. "BC News" Dec. 1955. 14 pp. Determination of antenna heights, selection of sites and propagational reliability of single and multihop systems. Charts indicate path clearances, Fresnel curves, signal to noise curves, etc. Source 3/6-165

Compatible Color-Television, Part 1—Two Sub-Carrier System, by J. Haantjes and K. Teer. "Wirel. Eng." Jan. 1956. 7 pp. The N.T.S.C. system, having two subcarriers of equal frequency but different phase, is first described. A system using sub-carriers of different frequency is then discussed; the receiver requires no sub-carrier generating and synchronizing circuits, and no synchronized detectors, since synchronized detection is not necessary. Choice of suitable sub-carriers is suggested. Source 3/6-166

TRANSMISSION LINES

Waveguide Investigations with Millimicrosecond Pulses, by A. Beck. "Bell. J." Jan. 1956. 21 pp. Resolution and measuring range of equipment designed to generate, receive, and display pulses about 5 or 6 mμsec. long. Antenna and dominant mode waveguide tests are described. Source 3/6-167

Distribution of the Voltage Induced along a Suspended Line by a Neighboring Line. by M. P. Henriet. "Bull. Fr. El." Dec. 1955. 14 pp. An extensive mathematical investigation of the problem which, although undertaken with a view to power lines, is immediately applicable to communication lines. The effect of neutralizing transformers can be evaluated. Source 3/6-168

Coupled Helices, by J. Cook, R. Kompfner, and C. Quate. "Bell. J." Jan. 1956. 52 pp. Transmission line and field approach to analysis of coupled helices. Basis for approximate calculations for tube designers and microwave engineers is given. Source 3/6-169

A Transmission Line Taper of Improved Design, by R. W. Klopfenstein. "Proc. IRE" Jan. 1956. 5 pp. Extension of the design of optimal cascaded transformer arrangements to the design of continuous transmission line tapers. Performance of sample design is compared with that of other tapers. Source 3/6-170

TUBES

Improved Storage Tube Design, by R. Hergenrother, A. Luftman, and C. Sawyer. "Tele-Tech" Mar. 1956. 3 pp. Newly designed storage tube with the storage surface on the electron gun side of the storage screen provides higher resolution, a more uniform background, and faster writing and erasing speeds. Source 3/6-172

Efficient Heat Removal . . . a Key to Reliability, by O. Schrieber and J. Hohos. "El. Eq." Jan. 1956. 3 pp. Tube failure due to excess internal heat is decreased by knitted-metal wire tube sleeve. Direct contact from tube clamp to case rather than chassis gives maximum heat conduction. Source 3/6-173

Reliable Application of a Tunable Pulsed Magnetron, Part I, by J. Gerling and R. Krough. "El. Eq." Jan. 1956. 4 pp. Magnetron requirements and the criteria underlying these requirements. The effects of modulator design upon reliable magnetron performance is given. Source 3/6-174

Multi-Beam Velocity-Type Frequency Multiplier, by Y. Matsuo. "Proc. IRE" Jan. 1956. 6 pp. Higher r-f output power than available from conventional klystron multipliers is obtained from a two electron beam frequency multiplier. Operation and experimental results are described. Source 3/6-175

A Developmental Wide-Band, 100 Watt, 20 DB, S-Band Traveling-Wave Amplifier Utilizing Periodic Permanent Magnets, by W. W. Siekanowicz and F. Sterzer. "Proc. IRE" Jan. 1956. 6 pp. Reduction in weight and size of the focusing system is obtained using "periodic" magnets in place of conventional solenoids or permanent magnets. Source 3/6-176

Spurious Modulation of Electron Beams, by C. C. Cutler. "Proc. IRE" Jan. 1956. 4 pp. Spurious modulation caused by positive ions and secondary electrons moving in the high current beams of electron tubes may be eliminated by pumping the tube to high vacuum and retarding or deflecting the secondary electrons. Source 3/6-177

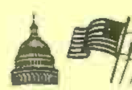
Transverse-Field Traveling-Wave Tubes with Periodic Electrostatic Focusing, by R. Adler. O. M. Kromhout, and P. A. Clavier. "Proc. IRE" Jan. 1956. 7 pp. To realize gain, the electron stream must travel faster than the circuit wave by a substantial margin which is determined by the electron field strength. Effective beam velocity and focusing field, and beam current and gain are experimentally related. Source 3/6-178

Electron-Tube Life and Reliability—Part VIII, by M. A. Acheson. "Syl. Tech." Jan. 1956. 5 pp. Mathematical treatment and graphical presentation of Types W and V life curves. Conclusion of the series of articles. Source 3/6-179

Filamentary Subminiature Tubes Have Long Life, by M. Bassett and R. J. E. Whittier. "El. Eq." Jan. 1956. 3 pp. Results of battery of 500 hour and 10,000 hour life tests on subminiature tubes indicate their great reliability Over 43,000 samples were tested. Source 3/6-180

Study of the Modes of Oscillation of the "M-type Carcinotron," first installment, by M. de Bennetot, "Ann. de Radio." Oct. 1955. 16 pp. A mathematical analysis of this traveling-wave tube is presented. The first approximation space-charge effects are considered which leads to a field equivalent to 3 travelling waves. Source 3/6-181

Electron Trajectories in Coaxial Diodes with Combined RF and Steady Fields, by R. Dehn. "Wirel. Eng." Jan. 1956. 3 pp. Electron trajectories have been computed by means of a digital computor for electron transit times of several rf cycles and for a series of phase angles as parameters. Space charge effects have been neglected and zero initial electron velocity has been assumed. The results are graphically represented and discussed. Source 3/6-183



U. S. GOVERNMENT

The following publications are available from the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. The first 7 volumes list patents which can be utilized on a non-exclusive basis by private interests without payment of royalties to the inventor or to the Government. The last publication brings the first 7 up-to-date by listing all patents acquired by the Government during the period Jan. 1954 to June 1955. Orders may also be placed at the nearest Department of Commerce Field Office.

PB 111464, Instrumentation, $2. Source 3/6-185

PB 111465, Chemical Products and Processes, $3. Source 3/6-186

PB 111466, Food Products and Processes, $1. Source 3/6-187

PB 111467, Metal Processes and Apparatus, Machinery, and Transportation Equipment, $2. Source 3/6-188

PB 111468, Electrical and Electronic Apparatus, $4. Source 3/6-189

PB 111469, Ordnance, $2. Source 3/6-190

PB 111470, Ceramic, Paper, Rubber, Textile, Wood and Other Products and Processes, $1. Source 3/6-191

PB 111854, Patent Abstract Series Supplement, $3.75. Source 3/6-192

The following publications are available upon request from the Armed Services Electro-Standards Agency, Fort Monmouth, N. J. Cite ASESA number (if any) and title.

Armed Services Preferred Parts Lists (Electronic Components). ASESA No. 49-1. Preferred Standard electronic components covered by military specifications. Complete publication or individual lists covering specific components are available. Source 3/6-193

Armed Services Index of R. F. Transmission Lines and Fittings. ASESA No. 49-2. Compilation of technical and other informational data pertaining to the application of R. F. transmission line components such as cable, connectors, waveguides and flanges for which joint Army-Navy nomenclature has been assigned. Source 3/6-194

Application Design Notes (Electronic Components). ASESA No. 51-4. Ready reference notes containing pertinent design data for various standard electronic parts covered by military specifications. Source 3/6-195

Technical Data for Armed Services Preferred List of Electron Tubes. ASESA No. 52-6. For design engineers. The best technical information available on preferred types of electron tubes. Source 3/6-196

Information Bulletin on Quartz Crystal Units. ASESA No. 52-9. Intended to assist the crystal industry in the complete processing and fabricating of crystal units. Also serves the development engineer as a guide in the design of crystal stabilized oscillators. Source 3/6-197

ASESA Information Bulletin. Recent information concerning JAN and MIL specifications. Latest approved changes and additions to existing specs and a general review of the scope of new specs. Published as necessary. Source 3/6-198

Inspection Instructions for Electron Tubes. Source 3/6-199

PATENTS

Complete copies of the selected patents described below may be obtained for $.25 each from the Commissioner of Patents, Washington 25, D.C.

Small Amplitude Measuring System, #2,730,-675. Inv. K. Singer. Assigned RCA. Iss. Jan. 10, 1956. Signal varying in amplitude is limited, shifted in phase 180°, and combined with the original wave. Differential wave is indication of amplitude variations. Source 3/6-202

Wave Transmission Network Using Transistor, #2,730,680. Inv. J. Bangert. Assigned Bell Labs. Iss. Jan. 10, 1956. A negative resistance network comprising 2 terminals between which the negative resistance is effective. 2 transistors are used. Source 3/6-203

Amplitude Recording System Utilizing Saturable Core Reactors, #2,730,694. Inv. D. Williamson. Assigned Ferranti Ltd. Iss. Jan. 10, 1956. Amplitude variations of electrical signals are recorded on electro-responsive paper by styli arranged near a different unit area of the paper and each identified with a different level of amplitude of the signal. Amplitude discriminating system consists of saturable transductors, one for each stylus. Source 3/6-204

Magnetic Shift Registers, #2,730,695. Inv. G. Ziffer. Assigned American Machine Foundry. Iss. Jan. 10, 1956. Magnetic shift register consists of line of permanent and temporary storage cores. Shift pulse goes to either line of cores depending upon position of selector switch. Source 3/6-205

Telemetering System, #2,730,699. Inv. J. Gratian. Assigned General Dynamics. Iss. Jan. 10, 1956. A magnetic pick-up coil is mounted on a rotating scanner, along with a permanent magnet. The coil gets a pulse every time it passes a permanent magnet mounted on a rotating index. Stationary reference coil gets pulse from magnet on scanner. Pulses are compared on scope with circular sweep. Source 3/6-206

Frequency-Modulation Detection System, #2,730,564. Inv. B. Loughlin. Assigned Hazeltine Research. Iss. Jan. 10, 1956. Variations in impedance caused by an FM signal are used to AM external oscillator which is then detected. Source 3/6-207

Automatic Frequency Control System, #2,-730,614. Inv. J. Wheeler. Assigned Stromberg-Carlson. Iss. Jan. 10, 1956. Center frequency is maintained by separating the signal into 2 channels, detecting the 2 signals and feeding back the positive and negative voltage obtained into a frequency controlling element. Source 3/6-208

Record Scrambling and Unscrambling Means for Systems Using Magnetic Record, #2,730,-569. Inv. C. Street. Assigned Conger-Groves. Iss. Jan. 10, 1956. Reciprocating element continually and periodically increases and decreases record transit past the sound head. Source 3/6-209

Circuit Arrangement for Reducing Pulse Interference in Radio Receivers, #2,730,615. Inv. M. Mantz. Assigned Hartford National Bank. Iss. Jan. 10, 1956. A biased diode detector as the output of a cathode follower passes desired signals, but cuts off when higher frequency pulses appear. Source 3/6-210

Microwave Amplifier, #2,730,647. Inv. J. Pierce. Assigned Bell Labs. Iss. Jan. 10, 1956. Cathode is placed along path between electron gun and plate. Second plate is coaxial to emitter. Signal supplied between gun and cathode is amplified and picked off at first plate. Source 3/6-211

Low Voltage Photoelectric Control Circuit, #2,730,629. Inv. C. Atkins. Assigned Tung-Sol. Iss. Jan. 10, 1956. Photoelectric currents generated by light incident upon a phototube, whose plate is connected to the grid of a gating tube by a shielded lead, are accumulated by the distributed capacity, and intermittently discharged through the gating tube to produce pulses varying in amplitude with the intensity of the incident light. Source 3/6-212

Color Television Picture and Pick-Up Tubes, #2,728,011. Inv. A. Goldsmith. Assigned RCA. Iss. Dec. 20, 1955. TV transducer consists of a light transmissive lamina having many systematically arranged apertures and an active coating on the unapertured surfaces. Second light transmissive lamina has an active coating accessible to electrons transmitted through the apertures in the first lamina. Source 3/6-214

Apparatus for Converting Digital Information to an Analog Voltage, #2,729,812. Inv. D. Jahn. Assigned Sperry Rand. Iss. Jan. 3, 1956. In a binary system, a condenser is charged to a fixed potential in response to a one digit pulse, except the last digit. Condenser is discharged in response to zero digit no-pulses, except the last digit. Last zero digit charges condenser; last one digit discharges condenser and connects it in parallel with second condenser. Source 3/6-215

Secondary Electron Emitting System, #2,730,-640. Inv. L. Koller. Assigned GE. Iss. Jan. 10, 1956. System consists of a transparent plate having an electrically conductive transparent coating. A transparent film of high secondary emissive material is superimposed on the coating. Adjacent screen grid has phosphor coating on side facing the film. Source 3/6-216

Radio Transmitter of the Kind Comprising a Magnetron Tube Energized by a Synchronized Pulse Generator, #2,730,621. Inv. S. Hellings and F. Krienen. Assigned Hartford National Bank. Iss. Jan. 10, 1956. Synchronizing pulses are used to control the recurrence rate of a pulse generator which in turn controls a magnetron. Source 3/6-217

Pulse Time Modulated System, #2,730,696. Inv. J. Davis. Assigned Sylvania. Iss. Jan. 10, 1956. Pulse time modulator initiates time reference and synchronizing pulses between which data conveying pulses are initiated. Time interval spacing of pulses is controlled. Source 3/6-219

Synchronizing System, #2,730,711. Inv. A. Varela. Iss. Jan. 10, 1956. In a Radar system, triggering of the transmitter is delayed until the echo pulse from the previous transmission has returned to the receiver. Source 3/6-220

Frequency Modulated Radar System, #2,730,-712. Inv. L. Dawson. Assigned Marconi Wireless. Iss. Jan. 10, 1956. Resonant circuit tuned to one end of frequency swing of swept oscillator is used to prevent swept oscillator from passing limiting frequency. Source 3/6-221

Radio Location System, #2,730,714. Inv. E. Mahoney. Assigned Seismograph Service Corp. Iss. Jan. 10, 1956. Three spaced receivers radiate 2 carrier waves to a receiving point. Reference receiver heterodynes one wave from each of the 3 transmitters in pairs. Reference signals which are related to the beat notes produced are sent from the reference receiver to the receiving point. Source 3/6-222

Inductive Coupling Circuits for Pulses, #2,-729,793. Inv. W. Anderson. Assigned IT&T. Iss. Jan. 3, 1956. Inductive reaction of a circuit (upon pulses) is reduced by connecting a transmission line, terminated in its characteristic impedance, across the output terminals of the circuit. Diode connected across transmission line termination short circuits pulses of given polarity, reflecting them back to output; open circuit presented to pulses opposite to given polarity are suppressed. Source 3/6-228

New Tech Data for Engineers

Resumes of New Catalogs and Bulletins Offered This Month by Manufacturers to Interested Readers

Photosensitive Devices

RCA, Harrison, N. J., Form No. CRPD-105, a 24-page catalog, contains tech data on 45 types of phototubes, 6 types of TV camera tubes, and 56 types of cathode-ray tubes. Representative tube types are illustrated. (Ask for B-3-101)

Save Drafting Time

A new booklet, "11 Ways to Save Drafting Time," is available, without charge to engineers and draftsmen, from Frederick Post Co., 3666 N. Avondale Ave., Chicago 18, Ill. (Ask for B-3-102)

Analog-Digital Converters

6-Page Bulletin EDO309-1, from Electronics Corp. of America, Cambridge 42, Mass., describes the operation of the 13-Digit, and 16-Digit Direct-Reading Systems. (Ask for B-3-103)

Spring Testing Servo

Bulletin Vol. 1, No. 2, from Rockwell Engineering Co., 4063 N. New Jersey St., Indianapolis, Ind., relates to that company's Spring Testing Servo, designed primarily for industrial use. (Ask for B-3-104)

Miniature Recorder

AEG (Germany) Measurements Section has available an 11-page bulletin describing Miniature Recorder, type RK 5. International Sales & Engineering Corp., P.O. Box 281, Wilmington 99, Del., can be contacted for copies. (Ask for B-3-105)

Analog Computer

Specifications and operations of the Weber Aircraft Corp., 2820 Ontario St., Burbank, Calif., Analog Computer are attractively recorded in a 2-color, 6-page catalog, just released. (Ask for B-3-106)

Nucleonic Equipment

A 72-page illustrated catalog on nucleonic equipment is available from Radiation Counter Laboratories, Inc., Skokie, Ill. (Ask for B-3-107)

Power Supplies

Technical Apparatus Builders, 109 Liberty St., New York 6, N. Y., has just released Catalog PR156, which lists complete specs, ratings, and prices for its new line of dc power components, "Tabtron" selenium rectifiers, dc power supplies, "Tabtran" chokes and transformers. (Ask for B-3-108)

UHF Attenuators

An 8-page brochure, "UHF Attenuators," is available from Stoddart Aircraft Radio, Inc., 6644 Santa Monica Blvd., Hollywood 38, Calif. Stoddart's full line of coaxial attenuators and coaxial line terminations is illustrated with full description and complete specs. (Ask for B-3-109)

Hermetic Terminals

Bulletin 553, from American Lava Corp., Chattanooga 5, Tenn., illustrates and describes the AlSigMag metalized terminal line. (Ask for B-3-110)

Silver Plating

SEL-REX Precious Metals, Inc., 229 Main St., Belleville, N. J., have just published a 4-page booklet fully describing the features and advantages of their High Speed Silver Plating Process, for industrial applications. (Ask for B-3-111)

Design Engineering

4-page, 2-color brochure, from El Mec Laboratories, Inc., 730 Blvd., Kenilworth, N. Y., describes the design, development, and production activities of this company. (Ask for B-3-112)

Transistors and Rectifiers

8-page Brochure ECG-95 containing condensed spec. and rating data on transistors and rectifiers has been published by the Semiconductor Products Section, General Electric Company, Electronics Park, Syracuse, N.Y. (Ask for B-3-30)

High Temperature Rectifiers

Bulletin HT-1, from Sarkes Tarzian, Inc., Rectifier Div., 415 N. College Ave., Bloomington, Ind., shows ratings and characteristics of that firm's full line of selenium rectifiers that are capable of operating at plate temps. of 150°C without derating. (Ask for B-3-31)

Hermetic Terminals

20-page catalog, containing specs. and general information on glass-to-steel hermetic terminals, is available from The Fusite Corp., 6000 Fernview Ave., Cincinnati 13, Ohio. (Ask for B-3-32)

Pulse Transformers

Bulletin 10A80, from Aladdin Radio Industries, Inc., 704 Murfreesboro Rd., Nashville, Tenn., contains tech. data on a line of miniature pulse transformers, housed in porcelainized ferrite sleeves, developed by that company. (Ask for B-3-33)

Radar Target

Tech. Bulletin 6-2-3A, from Emerson & Cuming, Inc., 869 Washington St., Canton, Mass., describes the Ecco Reflector radar target, and gives suggested applications. (Ask for B-3-34)

Resistors

New 159-page catalog, from The Daven Company, 191 Central Ave., Newark 4, N.J., describes many Daven items, and contains engineering and application data, as well as special charts (Ask for B-3-35)

Tapes

Polyken Products, 222 W. Adams St., Chicago 6, Ill., has available a new brochure describing Polyken Tapes (T Series), TD-14-2 and TA-44-2 each combining proper combination of adhesive and backing material for a specific taping job. (Ask for B-3-36)

Cathode-Ray Tube

Literature and detailed specs on the Cossor 1CP1, a new flat-face 1 in. self-focusing crt is available from Beam Instruments Corp., 350 Fifth Ave., New York, N.Y. (Ask for B-3-37)

Connectors

Miniature quick-disconnect electrical connectors that incorporate 16 industry requirements and meet latest MIL-C-5015 AN "E" specs. for full instrument rating are described in bulletin available from the Deutsch Company, 7000 Avalon Blvd., Los Angeles, Calif. (Ask for B-3-38)

Micro-Wave Tower

Catalog Sheets and specifications covering engineering and installation information on the new Rohn No. 40 heavy duty and microwave tower may be obtained from Rohn Manufacturing Co., 116 Limestone, Bellevue, Peoria, Ill. (Ask for B-3-39)

Custom Electronic Equipment

An 8-page illustrated brochure of the custom-built line of transformers, reactors, amplifiers, power supplies, and special equipment by Langevin Manufacturing Corp., 47-37 Austell Pl., L.I. City, N.Y., is now available. (Ask for B-3-1)

Germanium Rectifier

Standard models of Sel-Rex Germanium Rectifiers from 50 to 50,000 a. capacity are illustrated and described in a 4-page folder published by Bart-Messing Corp., 229 Main St., Belleville, N.J. (Ask for B-3-24)

Epoxy-Glass

Literature covering the first cold, noncrazing, punching grade of epoxy-glass in the history of the industry is available from the Mica Corporation, 4031 Elenda St., Culver City, Calif. (Ask for B-3-25)

Electronic Components

A 60-page illustrated catalog, containing full information, drawings, and specs. on molded and laminated tube sockets, terminal strips, lugs, plugs, and other products manufactured by the firm, has been published by Mandex Manufacturing Co., Inc., 2608 W. 16th St., Chicago 8, Ill. (Ask for B-3-26)

Regulators

A 4-page bulletin from Sorensen & Co., Inc., 375 Fairfield Ave., Stamford, Conn., describes the firm's line of MVR ac line voltage regulators. (Ask for B-3-27)

Transformer Products

A comprehensive description of their line of transformers, reactors, and filters is contained in 36-page Catalog 56 from United Transformer Co., 150 Varick St., New York 13, N.Y. (Ask for B-3-28)

Standing Wave Detector

Data sheet from Polytechnic Research & Development Co., Inc., 202 Tillary St., Brooklyn 1, N.Y., supplies technical information on the Type 219 Standing Wave Detector. (Ask for B-3-29)

Casting

24-page booklet, "Castability—Its Effect on Alloy Selection for the Investment Casting Process" is available from Engineered Precision Casting Co., Box 68, Matawan, N. J (Ask for B-3-27)

Metal Powder

The Metal Powder Association, 420 Lexington Ave., N. Y., N. Y., has made available Data Sheet No. 4, entitled "Standards, Specifications and References for Metal Powders and Metal Powder Products" (Ask for B-3-88)

Selector Switch

Electro Tec Corp., South Hackensack, N.J., has available a 4-page bulletin describing Type CQ-4082 Precision Selector Switch designed to withstand high speed operation, shock and vibration. (Ask for B-3-29)

Delay Lines

Technical Paper No. 491, "Criteria and Test Procedures for Electromagnetic Delay Lines" is available thru Helipot Corp., 916 Meridian Ave., South Pasadena. Cal. (Ask for B-3-80)

Cork

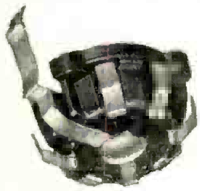
Bulletin issued by Dodge Cork Co., Inc., Lancaster, Pa., describes properties and specifications of both natural and composition cork. (Ask for B-3-81)

Nuclear Reactors

Copies of a 20-page pamphlet listing all significant data on every nuclear reactor anywhere in the world, including six in Russia, are available at 50c each from the Nuclear Power Group, Raytheon Manufacturing Co., Waltham 54, Mass. (Ask for B-3-3)

AT THE I.R.E. SHOW— VISIT BOOTH No. 394-396

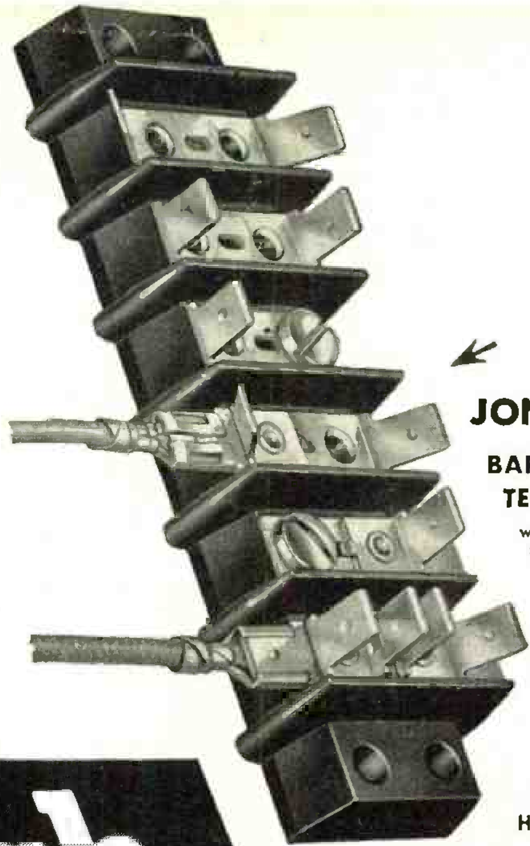
" . . . the component you need *when* you need it."



CINCH will design, or re-design, components to fit specific needs, and will assist in the assembly of components through proven automation technique.

CINCH AUTOMATICALLY ASSEMBLED SOCKETS

assure the uniformity and quality mandatory for use in AUTOMATION in the end users equipment.



JONES

BARRIER TERMINAL STRIPS

with terminal to take the solderless "Faston" and "Quick Connect" terminals. Illustration shows different angles terminals can be supplied.

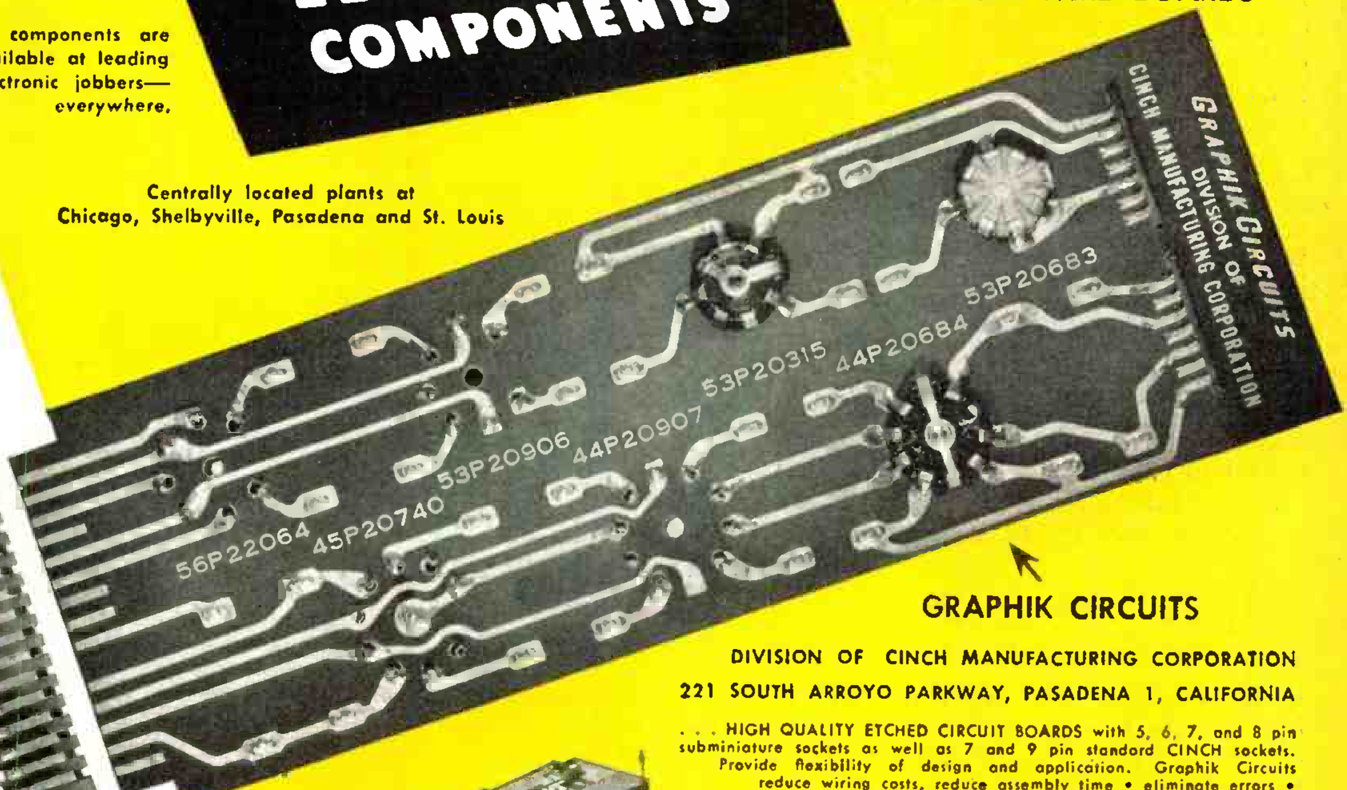
HOWARD B. JONES
Division of
CINCH MANUFACTURING CORPORATION
1026 S. Homan Ave. Chicago 24, Ill.

Cinch ELECTRONIC COMPONENTS

CINCH components are available at leading electronic jobbers— *everywhere.*

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

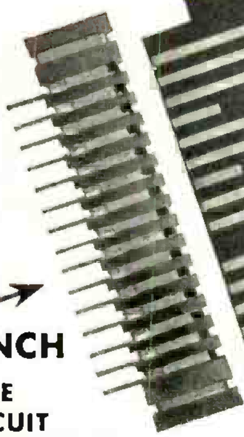
PRINTED WIRE BOARDS



GRAPHIK CIRCUITS

DIVISION OF CINCH MANUFACTURING CORPORATION
221 SOUTH ARROYO PARKWAY, PASADENA 1, CALIFORNIA

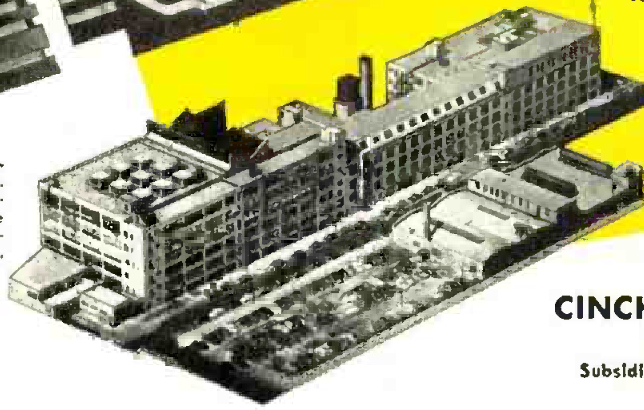
. . . HIGH QUALITY ETCHED CIRCUIT BOARDS with 5, 6, 7, and 8 pin subminiature sockets as well as 7 and 9 pin standard CINCH sockets. Provide flexibility of design and application. Graphik Circuits reduce wiring costs, reduce assembly time • eliminate errors • miniaturize. Sockets, terminals and other hardware installed to specifications.



CINCH

EDGE CIRCUIT CONNECTOR

provides, quick, easy assembly. Eliminates moisture trap. Allows more flexible tolerances. Lower cost. Available in materials for both Military and Commercial use.



Cinch ELECTRONIC COMPONENTS

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.

WASHINGTON

News Letter

Latest Radio and Communications News Developments Summarized by TELE-TECH's Washington Bureau

NEW REALLOCATION PLAN—In an unprecedented move the Senate Interstate & Foreign Commerce Committee which has jurisdiction over communications and radio legislation is planning to undertake a study of reallocation of the nation's television system. The ad hoc 12-member engineering committee which was organized by the Senate Committee in June, 1955, has been asked by Committee Chairman Warren Magnuson (D., Wash.) to formulate a national television allocation to solve the problems of the FCC allocation plan promulgated in July, 1952. The ad hoc committee is headed by Dr. Edward Bowles, consulting professor for industrial management of Massachusetts Institute of Technology and general consultant to the president of Raytheon Manufacturing Co. The committee membership includes consulting engineer C. M. Jansky, Jr., former IRE president Haraden Pratt, Dr. Allen B. DuMont, Westinghouse engineering vice president Ralph N. Harmon, CBS engineering vice president William S. Lodge, NBC allocations engineer W. S. Duttera and Philco research director Donald G. Fink.

TO REMAIN HIGH—The budget message of President Eisenhower to Congress did not break down the recommended expenditures by the military services for electronics for the fiscal year commencing next July 1, but the statement of the Department of Defense indicated that the procurement in this field will remain high. The figures will be made public after they are presented by the three armed services to the House Appropriations Committee. The Defense Department stated in the budget message that "electronics procurement for the continental defense system and for electronics countermeasures will remain high."

CAA AND FCC FUNDS—For civil aviation the President proposed expenditure of $40 million for air navigation and traffic control facilities. In the case of the FCC the budget recommended an increase of around 10% for the safety and special radio services bureau handling mobile and industrial radio and microwave services. The budget message estimated 218,500 stations, excluding amateurs, at the close of the 1957 fiscal year (June 30, 1957) and 173,600 applications for licenses during the next fiscal year.

LEASE-MAINTENANCE—The antitrust consent decree, besides the patent licensing mandate, between the American Telephone & Telegraph Company and the Department of Justice contained a most significant ruling in the case of private microwave and radiocommunications systems. The Bell System is enjoined under the decree from leasing and maintaining facilities for private communications systems where the charges are not subject to public regulation. Existing lease-maintenance arrangements and those entered into within 45 days after the date of the decree (Jan. 24) can be continued for five years, it was ruled in the decree.

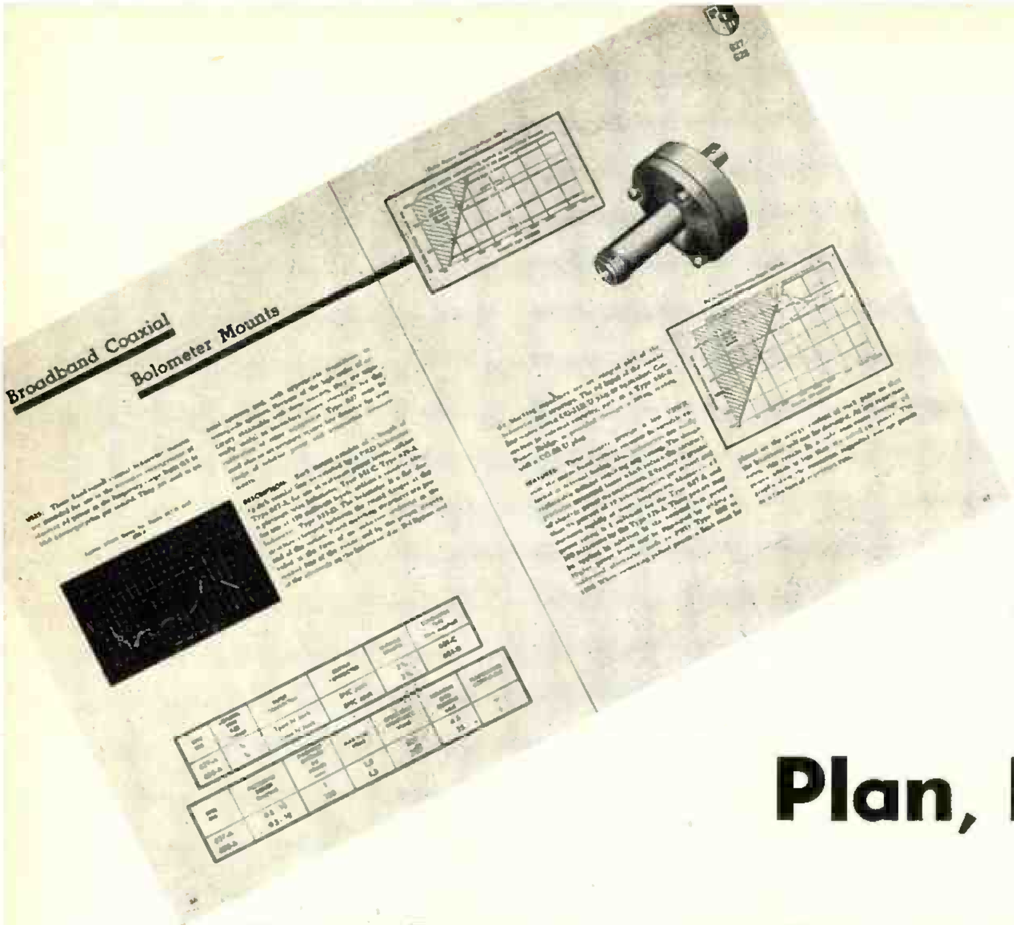
TV ROAD CONTROL—As the result of demonstrations in Detroit on the value of industrial television as a traffic control tool, the Highway Research Board in Washington has launched an intensive study of this medium. The tests of industrial television were conducted under the direction of Detroit streets and traffic director Alger F. Malo and Michigan Bell telephone radio engineers. The TV system was installed on Detroit's new high-speed express highway and was reported to be of substantial value in spotting and breaking up traffic jams.

MICROWAVE COUNCIL—The Operational Fixed Microwave Council has planned its annual meeting in March, TELE-TECH's Washington bureau has been advised by the council's officers. The membership was polled to determine whether the meeting would be in Washington on March 15 during which members could combine the session with discussions with government agencies; Houston, Texas, on the same date which would afford a central location for midwestern and southwestern members with inspection of microwave systems in that area; or in New York, March 20 during the Institute of Radio Engineers convention.

SAGE FOR CIVIL AVIATION—The Defense Department's semi-automatic ground environment system (SAGE) for air defense "could be adapted to provide the main elements of safe and efficient aircraft separation and traffic control" in civil aviation, a special study committee, formed to aid President Eisenhower by the Budget Bureau, on the problems of civil aviation, has reported. The present manual system of air traffic control, the committee stated, is far too cumbersome and slow to handle today's high speed and high-density air traffic and future "jet" flying operations. The SAGE system was developed at the Lincoln Laboratories of the Massachusetts Institute of Technology. The computer equipment is being supplied by the International Business Machines Corp. and Burroughs Co. Western Electric Co. is installing and maintaining the equipment, the Bell System the telephone and communications links interconnecting the SAGE installations and Bendix Radio and Hazeltine the radar and other electronic devices.

National Press Building
Washington, D.C.

ROLAND C. DAVIES
Washington Editor



By H. W. WEISMAN

How to Plan, Prepare and Produce An Electronics Catalog

The catalog will be a show place for both the firm and its products. Here is a step-by-step procedure that will ensure it a professional, attractive appearance.

IN the electronics buying market, the catalog is the basic sales tool. It wraps up in a single package the full details about products and services, so that those who wish to obtain such information can do so quickly and without the trouble of calling in a salesman until they are ready to place an order. Most electronic purchases are initiated by in-plant requirements rather than by the pressures of suppliers who have something to sell, as often occurs in the consumer market. After a need has arisen and before a buying decision has been made, the electronics catalog helps the buyer decide where he will go to satisfy his requirements. Studies by the National Advertising Council have shown that a comparison of printed literature is the basis most often employed in deciding which salesman is called.

A well-accomplished catalog can play an important role, then, in reducing distribution costs. It can do this by cutting the manufacturer's cost of selling and the customer's cost of buying in that it expedites product selection, reduces the number of personal sales calls, and cuts down on correspondence between seller and possible buyer.

H. W. WEISMAN, Polytechnic Research & Devel. Corp., 202 Tillary St., Brooklyn 1, N. Y.

The results of a 1953 survey by the Sales Executive Club of New York provide some significant data in this respect. Sales executives in firms selling in the product design, plant engineering, metal working and other related industrial markets were polled on the cost of their sales. The survey established an average cost per sales call of $17.24, and three different rates of order consummation (per 100 calls) depending upon conditions which occasioned the sales call. Cold-call selling resulted in 9.2 orders per 100 calls; 16 orders per 100 calls resulted when the salesman followed up an inquiry from publication advertising; and 38.4 orders per 100 calls resulted when calls were made upon invitation after the prospect had studied the company's products in a catalog. Accordingly, the costs per order could be reduced as follows: $187.39 for salesman calling cold; $107.75 for salesman following ad inquiries; and $44.89 for salesman calling on invitation after a catalog had been studied.

The catalog, then, adds sales power by raising the percentage of invited calls and sales. When well planned, properly designed and produced, and appropriately coordinated with advertising and selling, the catalog is an effective sales maker.

Planning The Catalog

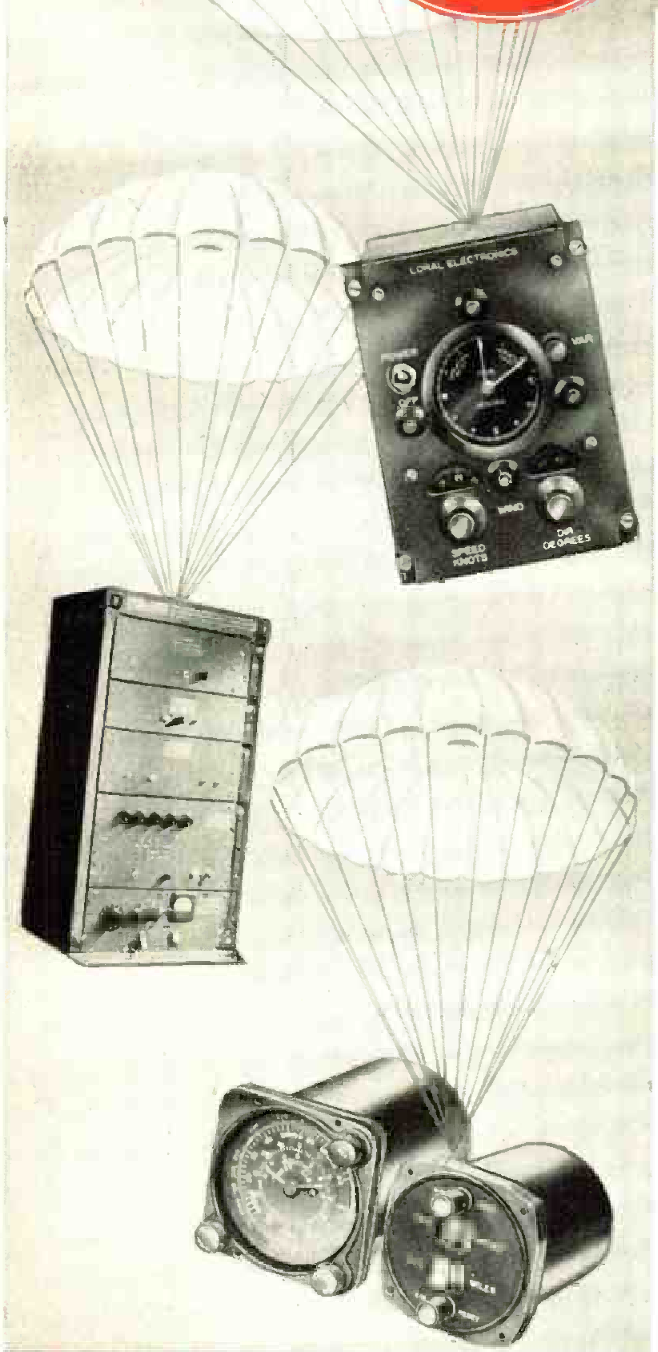
The building of an electronics catalog is the teamwork of a number of people, representing various company functions. Whether a company hires outside specialists or decides to accomplish the catalog internally it is advisable to appoint a committee for planning, advising, and seeing the project carried through to the conclusion. A "good" catalog has ramifications other than the very important ones of getting inquiries, making sales, and building confidence in the company; its data serves as a product standard and bible not only to the sales department but also to the engineering and manufacturing functions.

Printingwise, the catalog deserves the best within a company's means, but production costs are usually less than the costs incurred to provide accurate, full graphic, and interest-

(Continued on page 110)

NEW CONCEPTS in

AVIONICS!



NEW in TECHNIQUE!

NEW in DESIGN!

NEW in SIZE!

Built for PRECISION, ACCURACY, and PERFORMANCE

Among recent developments are:

- the LORAL AIRBORNE NAVIGATION COMPUTER. A compact and accurate system that computes and indicates ground displacement of aircraft in rectangular coordinates, from an initial fix.
- the LORAL AUTO-CAL. A frequency calibrator which automatically calibrates and records over 1,000 frequencies per hour within an accuracy of .005%.
- the LORAL AUTOMATIC SHORT RANGE GROUND POSITION INDICATOR. An 18 pound navigational computer automatically indicating ground position — derived from airspeed, heading and wind.

Contributing to the ever-increasing use of ELECTRONICS in AIRCRAFT Instrumentation, LORAL is continuing the development and production of Airborne Equipment — new in concept, miniaturization and combined with high accuracy.

We welcome any opportunity to assist in your engineering problems related to airborne equipment.

LORAL has delivered annually many millions of dollars of ELECTRONIC EQUIPMENT

.... on time!

Dept. T-3

LORAL ELECTRONICS CORPORATION
794 EAST 140th STREET • NEW YORK 54, N. Y.

Electronics Catalog

(*Continued from page* 108)

ing product data. Establishing the budget may be beyond the power of the catalog committee; however, it is advisable that its educated judgment be consulted before the matter is closed. Before the budget is set, the company should survey the various complex factors and activities which become items in the total cost. These may include: 1) market research by sales; 2) questionnaires to customers; 3) company analysis; 4) engineering time to help organize and check product data, as well as check and test data of new products; 5) writing and editing catalog copy; 6) illustrating; 7) photography and art; 8) catalog design (format); 9) size, binding, color, paper, cover; 10) printing; 11) distribution.

The budget is closely tied to the time schedule for the catalog. After the budget is set, equitable allocations in hours and/or dollars for each operation should be made. Keeping job cards or sheets for each operation on which time is recorded is a convenient means of checking time expenditures. A contingency allowance is a wise forethought in the budget.

The well planned catalog can be compared to the experienced salesman. A good salesman has the answer to every question raised by the buyer. Somewhere in the electronics catalog there should be answers to every question raised by the reader. If arrangement is orderly and complete, the catalog will provide the answers sooner or later, as the buyer goes through the book. Proper indexing will help lead the reader to the page where the question of the moment can be speedily answered.

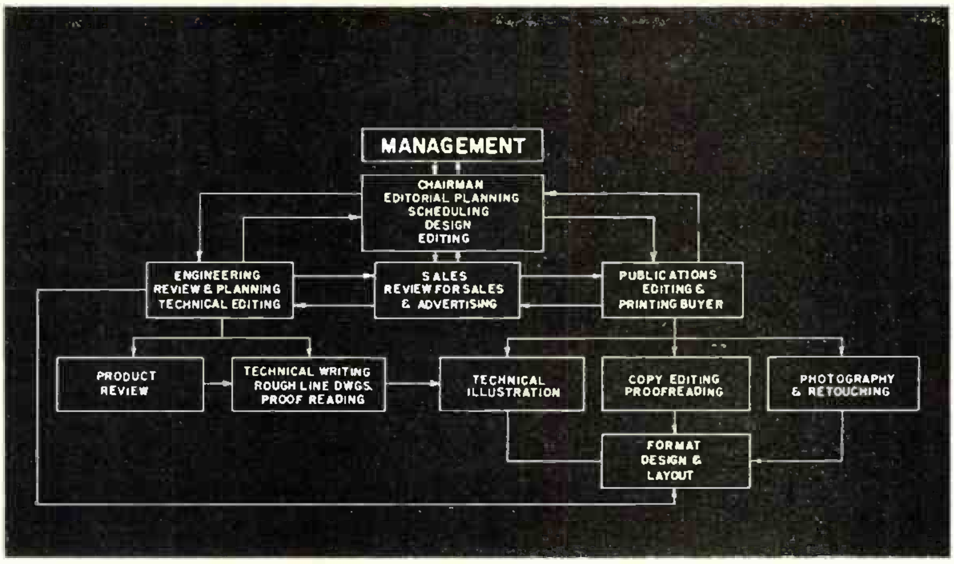


Fig. 1: Catalog's preparation calls for close coordination between different departments

Before work is started on the catalog proper, the catalog committee planners should make a twofold analysis—company and products. Introspection into company history, philosophy, and objectives provides the proper color for presenting company products. Some questions the planners should ask themselves are:

1. What do our customers and prospects want to know about our products, and in what order should we present the information to make the catalog most effective?

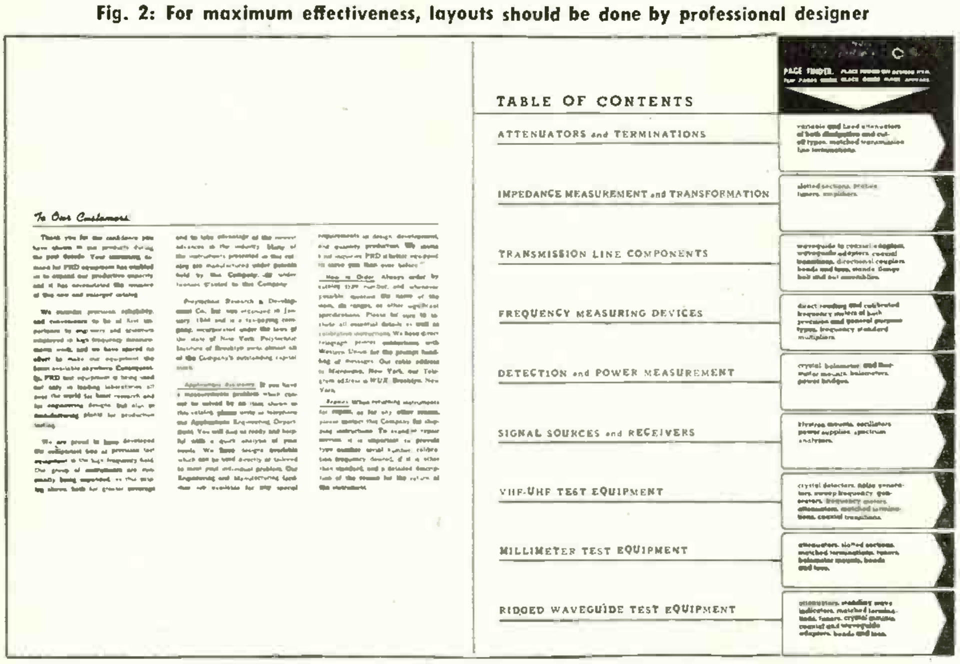
2. Will a potential customer want to know about the experience and industrial position of the company?

3. What uses can be made of the products? What are their advantages (major and minor)? Have the products features that are exclusive? What about applications, ease of operation, construction, specifications convenience, economy?

4. How can product data best be presented and described so that prospective buyers may inform themselves fully? With use of photos, diagrams, tables?

5. In what circumstances and environment will the catalog be used? Will it be kept in a desk drawer or in an office file cabinet, or on a shelf? Will it find use in laboratories? What kind of cover for protection?

Fig. 2: For maximum effectiveness, layouts should be done by professional designer



Pricing

While there is no arguing about the convenience to a customer in having the price included in the catalog, some believe that a separate price list is more advisable, especially for highly engineered, precision products like microwave and VHF-UHF test equipment. At PRD we printed a separate price list combined with an abbreviated catalog.

The maximum effectiveness in catalog layout is attained when the catalog planners and a professional designer combine their efforts. Such talent may be found within a company's own design or publications sections. The catalog planner supplies knowledge of the relative importance of the various elements—the pictures, diagrams, tables, and text. The designer supplies the art and skill for composing the elements to achieve balance, emphasis, and harmony. The combining of the two viewpoints facilitates making the catalog an effective presentation of products and a convenient reference book for the user.

Layout

Layout determines whether a catalog can or cannot be printed economically. The catalog production staff should include a member familiar with the practicalities of printing. It is helpful to select a printer before or early in the design process to help guide the planning for effective and economical produc-

(*Continued on page* 124)

New Laboratory Equipment

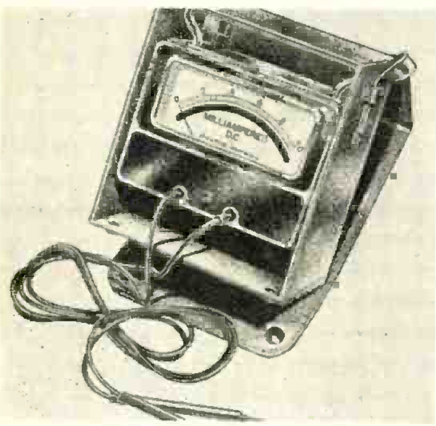
AUTOMATIC LINE REGULATOR

The Model 260-A Automatic AC Regulator operates for either 115 or 230 v. mains without de-rating. Voltage

change-over is accomplished in the field. The control tolerance is better than 1%; power rating is 6 KVA, and input range is 100 to 130 or 200 to 260 v. at line frequencies from 47 to 63 cycles. The wall or floor mounted unit is 18½ in. high x 13 in. wide x 8¾ in. deep overall. Rack unit is 19 in. x 8¾ in. x 13 in. deep Weight is 90 lbs. **Electronic Measurements Co., Lewis St., Eatontown, N. J.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 3-113)

PORTABLE LAB. INSTRUMENTS

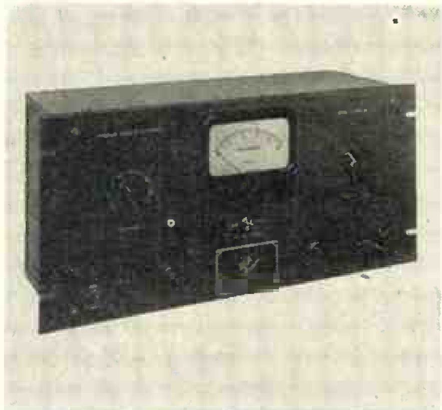
These completely self-contained, ready-to-use, precision portable instruments are available in 38 standard ranges with a rated accuracy of either 0.5% or 1% of full scale deflection. An incorporated overload network provides meter protection up to 500 times full scale value for short periods. Multi-range portable instruments are available which provide up to 6 ranges with a multiplier switch. This switch also protects the meter movement when set in



transit position by damping the meter movement and thereby giving additional protection during storage and transit. **Phaostron Instrument and Electronic Co., 151 Pasadena Ave., S. Pasadena, Calif.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 3-24)

CONSTANT CURRENT GENERATOR

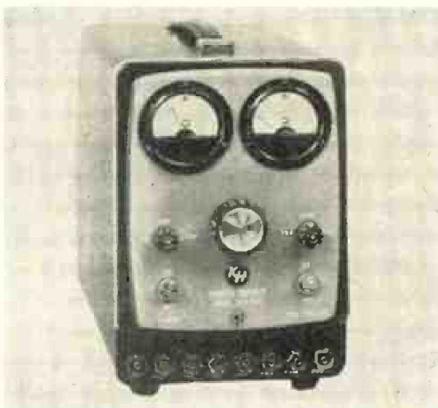
Model CC 250 consists of a source of dc power, and an electronic current regulator, which maintains the current



drawn from the dc source substantially constant with changes in load resistance, as well as input line voltage. It operates from a 95-125 v. ac, 60 cps. source, and is regulated to within 1% for this range of input. Output current is continuously adjustable in vernier steps from 5-250 MA, and is maintained constant within 2% for conditions of short circuit output to a load voltage in excess of 250 v. Ripple is less than 0.05%. **Electronic Research Associates, Inc., Nutley, N. J.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 3-111)

REGULATED POWER SUPPLY

Model UHR-225 Ultra-High Regulation Power Supply, has 0.002% regulation and 100µv. ripple over the operating range (150-500 v. and 0-200 ma). For line voltages between 105 and 125 v., full rated current can be drawn continuously with a substantial margin of safety. The internal impedance is less than 0.02 ohms for dc and low frequencies and less than 0.1 ohm for frequen-



cies as high as 100 KC. Transient response is 0.001 millisecond. Typical ten-hour drift is 500 ppm. Price: $250 f.o.b. factory. **Krohn-Hite Instrument Co., 580 Massachusetts Ave., Cambridge 39, Mass.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 3-106)

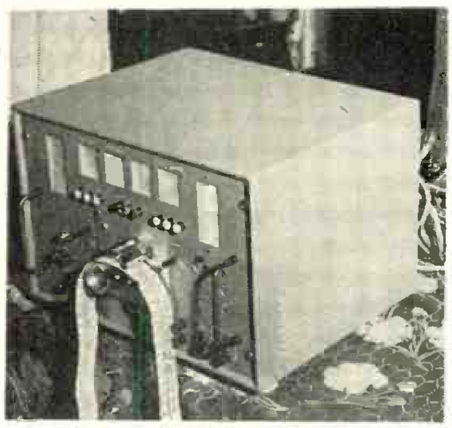
RESISTANCE STANDARDS

Series "1000" Standard consists of resistances connected in series, adjustable to desired value by selective shorting by means of push buttons or by banana connectors of standard design.

Specs: Nominal rating of individual resistances, ½ w.; Temp. coefficient, 20 ppm/°C; Frequency response, non-inductive at audio frequencies. Resistance range without rheostat, 0 to 10 meg. in steps of 1 ohm; Resistance stability under normal use conditions, up to ± .002%. Max. resistance accuracy at 25°C, ±(.01% + .005 ohms). **Consolidated Resistance Co. of America Inc., 44 Prospect St., Yonkers, N. Y.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 3-107)

AUTOMATIC TESTER

Using a punched tape to program test points and parameters, the Robotester performs up to 120 complete circuit measurements per minute and has a capacity of 240 test points per set-up. Between any two of 240 points, there are over 57,000 possible measurements or tests per set-up. It will pick up from 70 to 90% of failures or defective parts,

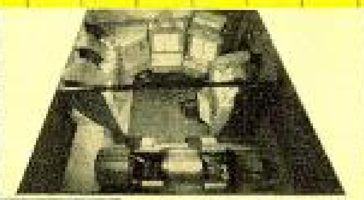


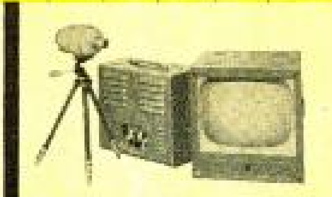
excluding tubes or gross breakage through a dropped or smashed chassis. The tester weighs 45 lbs., is 20 in. wide, 13¼ in. high and 18 in. deep, overall. **Lavoie Laboratories, Morganville, N. J.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 3-131)

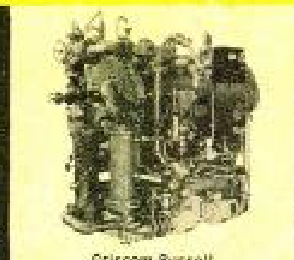
● Manufacturing ●● Manufacturing and product development ●●● Manufacturing, product development and research □●● Pilot manufacturing, product development and research

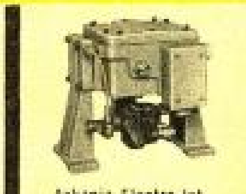
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII
Precision Mechanics, Optical Devices, Ceramics	●●●	●●	●●	□●●	●●	●●●		●●	●●●	●●	●●	●●	●●●
Electrical Equipment and Components	●●●	●	●			●●●		●●●	●●	●	●●	●	●●●
Electronics	●●●	●●	●●●	●●●		●●●		●	●●		●●●	●●	●●●
Hydraulics, Liquids Processing, Heat Exchange		●●			●●●		●●●				●●●		
Television: Studio, Theatre, Business, Institutional, Industrial	●	●		●●●		●					●		
Instruments, Servos, Controls: Hydraulic, Pneumatic, Magnetic, Electronic	●●●	●	●●	□●●		●●●	●●●	●●	●●		●●●	●	●●●
Aircraft and Missile Guidance, Control, Simulation	●●●	●		●●●		●●●		●			●●	●	●●●
Automatic Computers and Components	●●●	●	●	□●●		●●●					●●●		●●●
Radar, Microwave, Ultrasonics	●●●	●	●●	●●●		●●			●		●		
Motion Picture and Audio Equipment		●●●		□●●				●●	●●●	●●●		●●●	
Nuclear Power Components and Controls	●●●				●●						●●		●●●
SYSTEMS ENGINEERING	●●●			●●●	●●●	●●●	●●●				●●●		●●●


Librascope Desk-Size Computer


Link Aviation F-890 Jet Simulator


GPL Industrial-Institutional TV System


Griscom-Russell Shipboard Distilling Plant


Askania Electro-Jet Power Package

GPE → SYSTEMS ENGINEERING

The GPE Companies are leaders in that small, select group in American industry which is broadly qualified to develop and produce the systems needed today for defense and industry. GPE leadership accounts for some of the most advanced systems in use in business, television, aviation, marine, steel, oil, power and other industrial fields.

In Systems Engineering, advanced capacities and resources are prerequisite. Yet, no matter how highly advanced, they are insufficient if limited to a few areas. And beyond that, success requires the application of such *balanced competences* at every stage—beginning with research and extending all the way through development, production, and final testing.

The following basic characteristics and methods of operation of the GPE Companies explain GPE successes in systems work:

- *the exceptional engineering acumen of more than 2500 GPE scientists, engineers and technicians working in depth in the wide range of advanced capacities indicated in the chart above;*
- *the extensive research, development, manufacturing and testing resources of the GPE Companies;*
- *the GPE operating policy, Coordinated Precision Technology, which inter-relates all relevant GPE engineering, research, and production skills and resources;*
- *unremitting insistence on highest quality on the part of every GPE Company, every step of the way.*

No GPE Company is limited by the boundaries of its own specialties. Behind each engineering group working on a specific problem in one GPE company stands the whole group of GPE scientists, engineers and technicians with the answers—or the knowledge that will find the answers—to questions underlying and related to that problem.

To the customers of GPE Companies this means that the concept and development of equipment, components and systems are not restricted or distorted by traditional allegiance to specific competences. The five systems illustrated, while products of different GPE companies, are all examples of the consistent application of balanced competences, achieved through GPE coordination.

For brochure describing GPE Coordinated Precision Technology and the work of the GPE Companies, or help on a specific problem, write: General Precision Equipment Corporation, 92 Gold Street, New York 38.

GENERAL PRECISION EQUIPMENT CORPORATION

THE GPE PRODUCING COMPANIES

I KEARFOTT COMPANY, INC. II INTERNATIONAL PROJECTOR CORPORATION III BLUDWORTH MARINE
IV GENERAL PRECISION LABORATORY INCORPORATED V THE GRISCOM-RUSSELL COMPANY VI LINK AVIATION, INC.
VII SHAND AND JURS CO. VIII THE HERTNER ELECTRIC COMPANY IX THE STRONG ELECTRIC CORPORATION
X J. E. McAULEY MFG. CO. XI ASKANIA REGULATOR COMPANY XII AMPRO CORPORATION XIII LIBRASCOPE, INCORPORATED

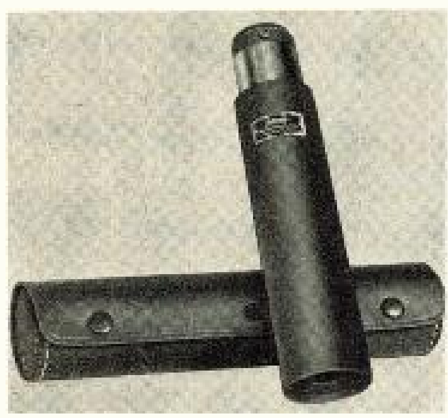
New Products

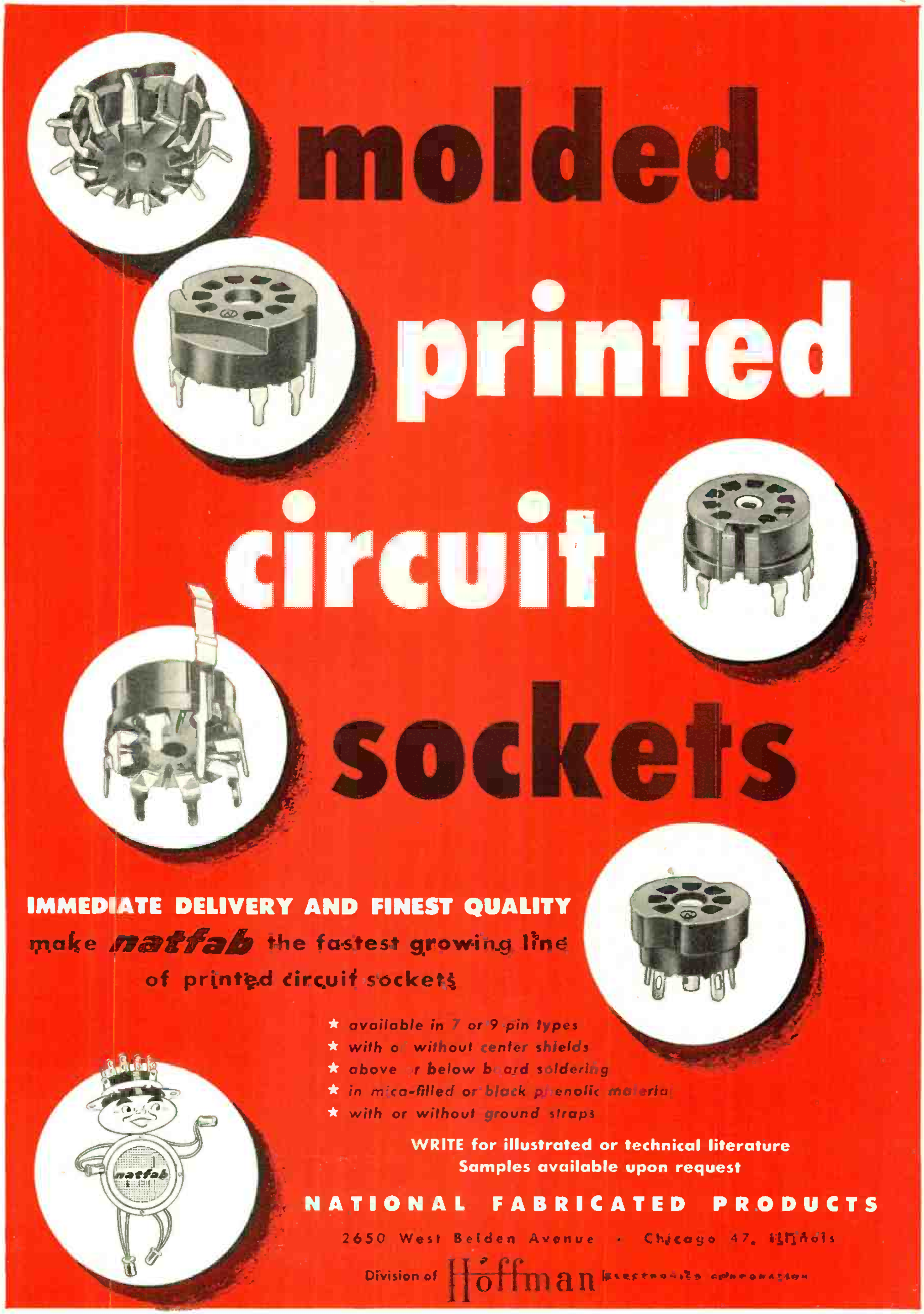
MOBILE RECEIVER

Model 5 Mobile Receiver functions in the 25 to 50 MC range. It provides 2.5 w. audio output and a sensitivity of 1 µv. Exclusive features include: a "Battery Miser" stand-by switch to reduce battery drain and eliminate need for an oversize generator, a highly effective noise limiter, and a dual voltage transformer permitting selection of 6 or 12 v. system operation. The Model 5 Mobile Receiver is entirely self contained. It is 4½ in. high, 6¼ in. wide, 7¼ in. deep, and weighs only 7¼ lbs. **West Coast Electronics Co., 5873 Rodeo Rd., Los Angeles 16, Calif.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 3-109)

COLOR TV TUBESCOPE

The Color TV Tubescope is a microscope designed to assist and simplify alignment of the dot pattern on the picture tube during manufacture and on regular field service calls. The instrument consists of two parts: a main chrome plated optical body housing a cemented achromatic objective lens with the eyepiece, and the outer black anodized felt lined aluminum barrel for focusing. A long working distance of 4¼ in. is ample to view the periphery of the tube. **Edmund Scientific Corp., Barrington 3, N. J.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 3-104)

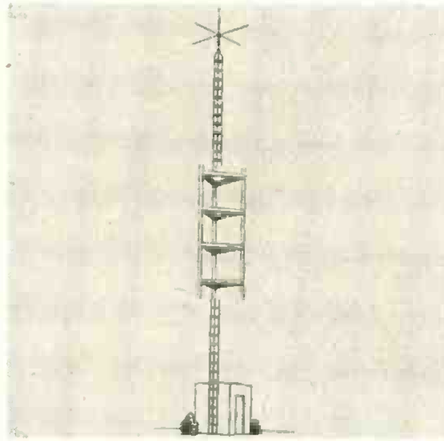



molded
printed
circuit
sockets
IMMEDIATE DELIVERY AND FINEST QUALITY
make natfab the fastest growing line
of printed circuit sockets
★ available in 7 or 9 pin types
★ with or without center shields
★ above or below board soldering
★ in mica-filled or black phenolic material
★ with or without ground straps
WRITE for illustrated or technical literature
Samples available upon request
NATIONAL FABRICATED PRODUCTS
2650 West Belden Avenue • Chicago 47, Illinois
Division of Hoffman ELECTRONICS CORPORATION
natfab

New Products

COMMUNICATION & MICROWAVE TOWER

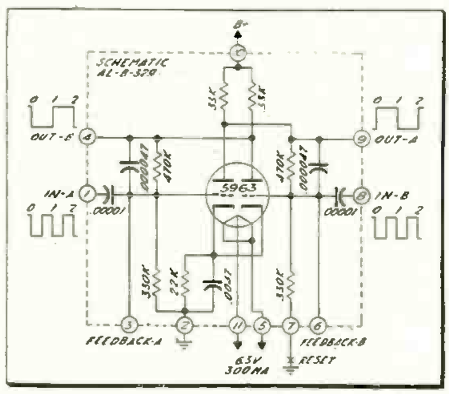
The No. 40 Rohn Tower has an 18 in. equilateral triangular design and is adequate for self-supporting heights to 66'; or guyed to 200' — 300' or more.



The regal No. 40 is designed to support heavy loads at shorter heights; or light loads at greater heights when guyed. The top section is designed to mount all standard communication antennae with special sections available for microwave or other type installations. This tower is available in hot-dipped galvanized finish for lasting protection; or in baked enamel coating if desired. **Rohn Manufacturing Co., 116 Limestone, Bellevue, Peoria, Illinois.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 3-102)

ENCAPSULATED FLIP-FLOP

Universal Flip-Flop AL-B-329 is designed to operate from 0 to 100 KC under various input and load conditions, with provisions made to obtain output from both plates, to reset, to apply triggering to either grid or to both grids simultaneously, and to apply feedback to either stage of the flip-flop. Nominal input requirement is a neg. going pulse of 60 to 80 v. with a rise time under 3 μsecs. and duration of at least 7 μsecs. The circuit provides a

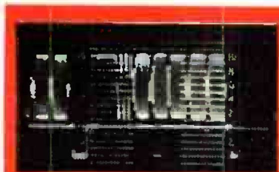


square wave output of up to 104 v. swing with a neg. rise time of 2 μsecs. and a pos. fall time of 8 μsecs. **Alcor Electronics Corp., 180 Lafayette St., New York 13, N. Y.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 3-110)

HE CAN CHECK VIDEO ANYWHERE

HE HAS A *NEW* VIDEO TRANSMISSION TEST SET

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



MULTI-FREQUENCY BURST

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

WHITE WINDOW

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

STAIRSTEP SIGNAL modulated by crystal controlled 3.579 mc for differential amplitude and differential phase measurement. Checks amplitude linearity, differential amplitude linearity and differential phase of any unit or system.

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

MODULATED STAIRSTEP signal thru low pass filter. Checks linearity.

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

TELECHROME Model 1003-A

Video Transmission Test Signal Generator

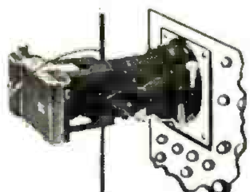
*** Completely self contained * Portable * Multi-frequency burst * Stair-step * Modulated stairstep * White window * Composite sync * Regulated power supply.**

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

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

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

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



DELIVERY 30 DAYS

Literature on these and more than 150 additional instruments for color TV by TELECHROME are available on request.

TELECHROME INCORPORATED

The Nation's Leading Supplier of Color TV Equipment
88 Merrick Road Amityville, N. Y.
AMityville 4-4446

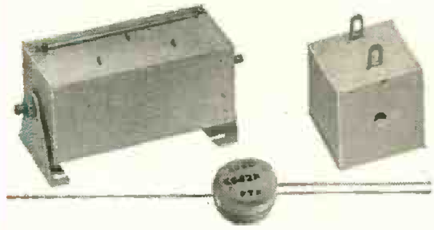
See Us at the I.R.E. Show Booths 181-183

For product information, use inquiry card on last page.

Standard Heavy-Duty Stacks

Extremely long life . . . with no maintenance problems. Thousands of voltage/amperage combinations available. Sizes from 11/16" square cells to giant 6" x 10" plates . . . Federal can provide a power rectifier for almost every type of industrial and military equipment.

Encapsulated Rectifiers

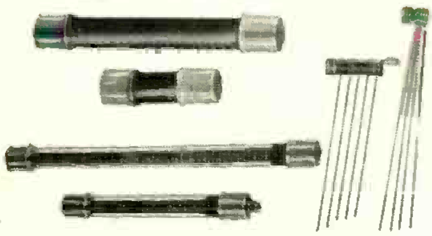


Maximum resistance to impact, acceleration, and vibration. Complete protection from harmful atmospheric conditions. Other electronic components may be encapsulated with rectifier to form a rugged, replaceable "potted" circuit.

Why

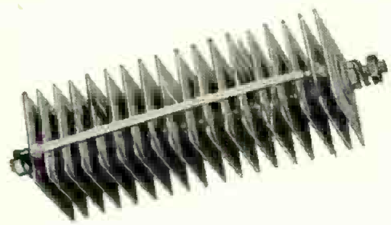
INDUSTRY and DEFENSE LOOK TO *Federal* FOR THE FINEST IN SELENIUM RECTIFIERS

High-Voltage Stacks



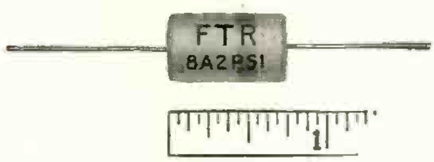
250 to 5000 volts/5 to 40 milliamps. Encased in paper, glass, Bakelite, nylon, or metal tubes. Simple fuse-clip mounting of ferrule terminal types. Also, hermetically-sealed types. Uses: CRT high-voltage supplies, photoflash, insulation testers, etc.

High-Temperature Stacks



For maximum operating life at ambient temperatures up to 150° C. A full range of voltage/current combinations for medium and high temperatures. Ideal for aircraft and military equipment.

Selenium Contact Protectors



Extend contact life by over 1000 times. Used in inductive circuits to prevent erosion of switch contact surfaces . . . to suppress arcing and rf transients. Minimum effect on release time. Hermetic sealing meets JAN specs. For relays, electromagnets, and telephone systems.

Pioneering Leadership

Federal is the *original* supplier of selenium rectifiers in the United States . . . leading the field in research, development and production.

Facilities and Service

Federal's facilities can handle the largest and most complex orders ...satisfy the rush requirements of customer production peaks. Every order—large or small—is processed through a skilled engineering staff.

Magnetic Amplifier Rectifiers

Selenium cells and stacks precisely manufactured, tested, and selected to assure a high degree of stability and very low reverse current. For use with saturable reactors, regulated DC power supplies, etc.

LET US KNOW your AC-to-DC conversion problems. For further information on Federal Industrial Rectifiers, call NUtley 2-3600, or write to Dept. F-866.

Quality and Economy

Federal's modern fabrication methods, mass production, intensive quality control, and rigid testing assure a product of highest quality and greatest economy.

Federal Telephone and Radio Company

A Division of INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

COMPONENTS DIVISION • 100 KINGSLAND ROAD • CLIFTON, N. J.

In Canada: Standard Telephones and Cables Mfg. Co. (Canada) Ltd., Montreal, P. Q.

Export Distributors: International Standard Electric Corp., 67 Broad St., New York

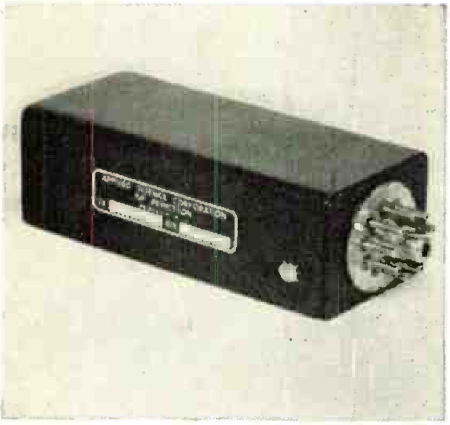
Federal

A DIVISION OF IT&T

New Products

KEYER-OSCILLATOR

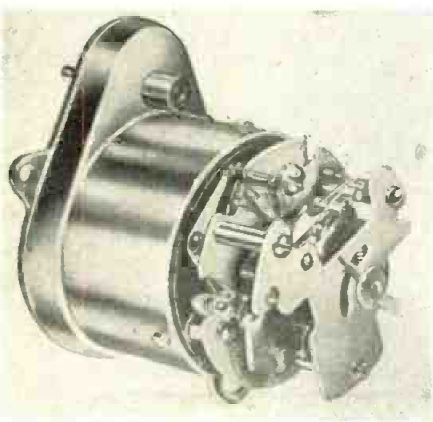
The new type DKO Keyer-Subcarrier Oscillator permits Pulse Width multi-channel coding on a single channel in a standard FM/FM telemetering system. When used with a suitable PW



commutator, this unit permits PW multiplexing and coding of a large number of data channels on a single 40 kc or 70 kc subcarrier channel. The unit requires 25.2 v. .3 a. and 150 VDC 10 ma power and accepts 0 to +5 v. signals sampled a total of 900 times a sec. Model DKO-10 is approximately 4¼ in. l. x 1 7/16 in. h. x 1⅞ in. d. and weighs 8 oz. **Applied Science Corp. of Princeton, Box 44, Princeton, N. J.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 3-36)

DC TIMING MOTORS

These chronometrically governed dc timing motors keep rate independent of load, line and temp. variations. Power pulses at full line voltage are applied to a small motor at intervals controlled by a jewelled escapement, with the pulse duration determined by travel of the motor. This method holds motor travel constant during each time interval regardless of load (within rating). As a result beat rate is held constant



within ±0.1% for line voltage variations of ±20% and load variations from zero to full load. **The A. W. Haydon Co., Waterbury, Conn.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 3-118)

Simple Fail-Safe System Monitors Own Operation

A new technique for monitoring the output of any operating system which also serves to check the monitoring system itself, and which meets the needs of many automation and control systems, has been developed by Scully Signal Co., Melrose, Mass.

The technique is so basic in principle that it can be applied to practically any type of automatic system, including process control systems, aircraft safety systems, fire alarm systems, etc.

A simulated unsafe condition is introduced periodically into a monitor, resulting in a continual safe-unsafe-safe-unsafe-etc. oscillation which holds the alarm off. Failure of the safe condition being sensed or of the monitoring system itself halts the required safe-unsafe oscillation and sounds the alarm. The period of oscillation can be adjusted to meet the requirements of the particular control system.

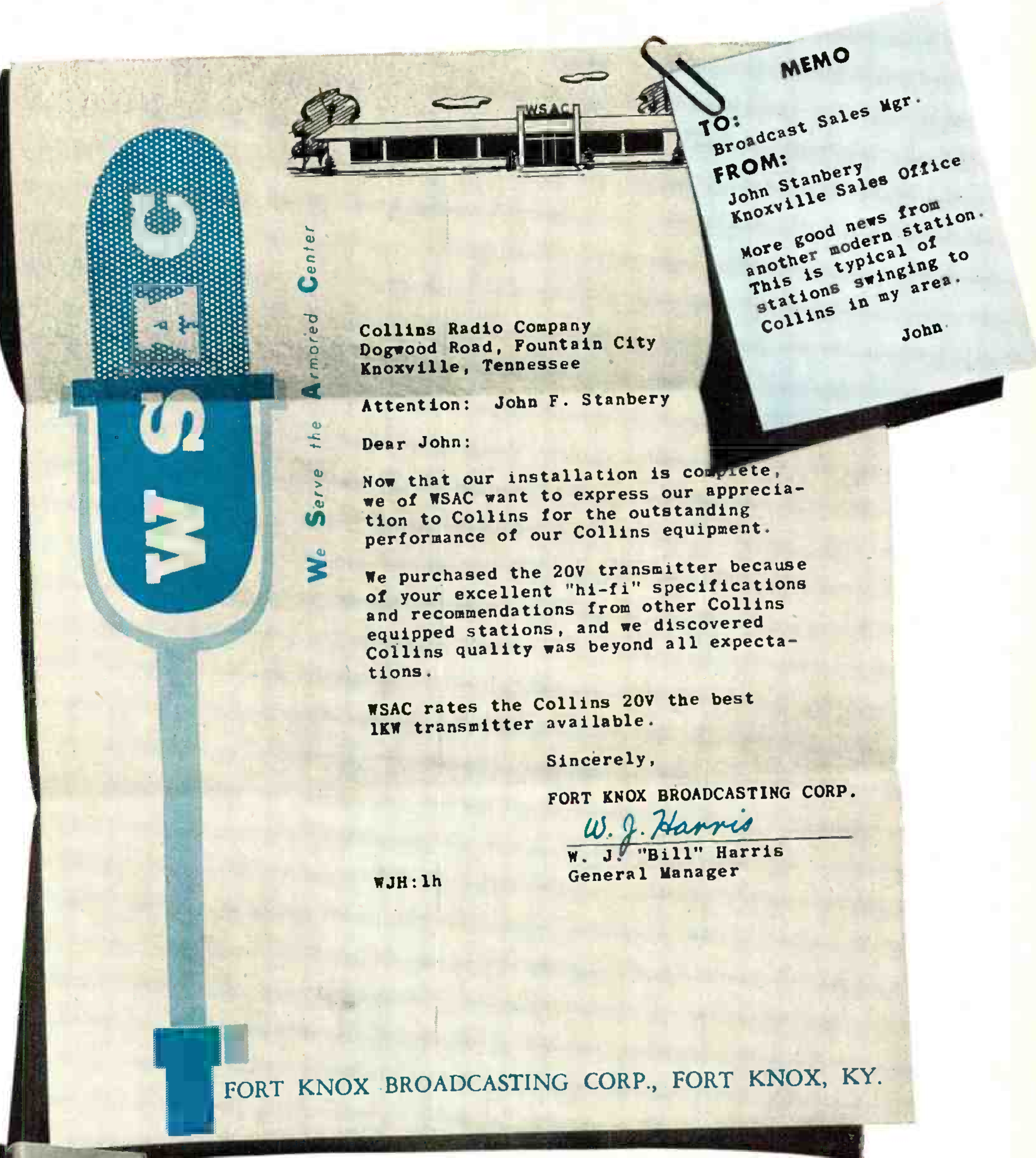
This new Scully-Rowell fail-safe method was invented by William G. Rowell, Scully chief engineer.

"Silver Migration In Electric Circuits"

This article, which appeared in the Feb. 1956 issue of Tele-Tech and Electronic Industries, and which described the conditions under which silver migration occurs and steps to minimize its effects, left room for possible misinterpretation. By failing to describe the exact conditions and applications under which silver migration becomes a problem, the article, as edited, leaves the implication that *all* electric circuits—including those in radio and TV receivers, and similar equipment—are affected. This is certainly not intended.

The fact of the matter is that there is no concern about silver migration failure for the major uses of silvered components. Silver-mica and silver ceramic capacitors have replaced many of the foil-mica and paper capacitors formerly used in radio and television equipment. Due to modern manufacturing techniques, using printing silvers, capacitors can be made more uniform, more reproducible, cheaper, with a predetermined capacity and with smaller physical size for a given capacitance. The decrease in physical size has aided materially in the miniaturization of electronic components. Approximately 50 million television sets have been produced in the past 10 years using silvered components and it is anticipated that with the increased production of printed circuits the use of silver will materially increase. Silvered capacitors have been used in radio sets for 20 years and have proved as reliable and trouble-free as most

(Continued on page 122)



MEMO

TO:
Broadcast Sales Mgr.

FROM:
John Stanbery
Knoxville Sales Office

More good news from another modern station. This is typical of stations swinging to Collins in my area.

John

WSAC

We Serve the Armored Center

Collins Radio Company
Dogwood Road, Fountain City
Knoxville, Tennessee

Attention: John F. Stanbery

Dear John:

Now that our installation is complete, we of WSAC want to express our appreciation to Collins for the outstanding performance of our Collins equipment.

We purchased the 20V transmitter because of your excellent "hi-fi" specifications and recommendations from other Collins equipped stations, and we discovered Collins quality was beyond all expectations.

WSAC rates the Collins 20V the best 1KW transmitter available.

Sincerely,

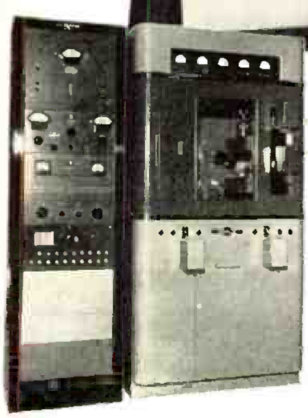
FORT KNOX BROADCASTING CORP.

W. J. Harris

W. J. "Bill" Harris
General Manager

WJH:lh

FORT KNOX BROADCASTING CORP., FORT KNOX, KY.



ANOTHER STATION SWINGS TO COLLINS 20V

Hundreds of stations have swung to Collins 20V since it was introduced, and the pleasant experience Mr. Cowan mentions in his letter is typical of their reaction to this Kilowatt.

The modern, simplified circuit designs of the 20V make this compact transmitter especially suited for unattended, remotely controlled installations such as WSAC.

And the low cost of the dependable transmitter is as pleasant news as its better-than-advertised performance. Contact your nearest Collins representative for a descriptive brochure plus complete price and delivery data.

COLLINS RADIO COMPANY CEDAR RAPIDS, IOWA

COLLINS

261 Madison Avenue, NEW YORK 16, NEW YORK
1200 18th Street NW, WASHINGTON, D.C.
1930 Hi-Line Drive, DALLAS 2, TEXAS
2700 West Olive Avenue, BURBANK, CALIFORNIA
Dogwood Road, FOUNTAIN CITY, KNOXVILLE, TENNESSEE
222 West Pensacola Street, TALLAHASSEE, FLORIDA
COLLINS RADIO COMPANY OF CANADA, LTD.,
11 Bermondsey Rd., TORONTO 16, ONTARIO

For product information, use inquiry card on last page.

(Continued from page 120)

of the other electronic parts now employed.

Migration of silver has been of little concern to the radio and television parts manufacturer for several reasons: First, the high humidity causing migration failure seldom exists where radio and television sets are normally used. Second, failure by silver migration is no more frequent than failure of other parts containing no silver. Third, rapid changes in design, engineering features and new technology rapidly makes radio and new television sets obsolete, resulting in replacement before failure. On the other hand silver migration is of considerable concern to manufacturers of equipment that must function properly without maintenance for periods of 40 years under adverse conditions such as telephone and cable parts.

The intent of the engineering data presented in the article was to show that a liquid water film capable of supporting ion transfer must be formed before migration can take place. This film might be produced by fluctuating temperatures in a very humid atmosphere but would not occur at ordinary humidities.

Revised and expanded reprints of the article, as originally submitted, are being made available to interested readers without charge, by Tele-Tech and Electronic Industries.

"HAM OF THE YEAR"

Robert W. Gunderson, W2JIO, blind radio amateur and electronics designer, earned GE's 1955 Edison Radio Amateur Award for designing special test equipment for the blind

Magnetic Amplifier Conf. Scheduled for April 5-6

A Special Technical Conference on Magnetic Amplifiers, co-sponsored by the AIEE Committee on Magnetic Amplifiers, the IRE Prof. Gp. on Industrial Electronics and the ISA, Central N.Y. Sec., will be held in Syracuse, N.Y., at the Syracuse Hotel, on April 5 and 6. Technical sessions, a manufacturer's exhibit of magnetic amplifiers, components, and associated products, and a banquet on Thursday evening, April 5, are planned. Dr. Oliver G. Haywood, Dir. of Sylvania Electric Waltham Laboratories, Waltham, Mass., will be the banquet speaker.

For product information, use inquiry card on last page.

Electronics Catalog

(*Continued from page* 110)

tion. This enables preparation of layouts, photographs, drawings and typography that allows the potentials of the printing process to be exploited fully.

Physical Appearance

The physical appearance of a catalog can do much to further its use. Good design can be accomplished without resorting to elaborate art work or four-color printing. Logical organization of information—text and illustration—is the keystone of good catalog design. If the information is arranged so that the buyer can ascertain with ease whether the product or products meet his requirements or can be adapted to them, and if the arrangement permits easy comparison with competitive products, then the catalog fulfills its sales function of promoting sales inquiries and/or orders.

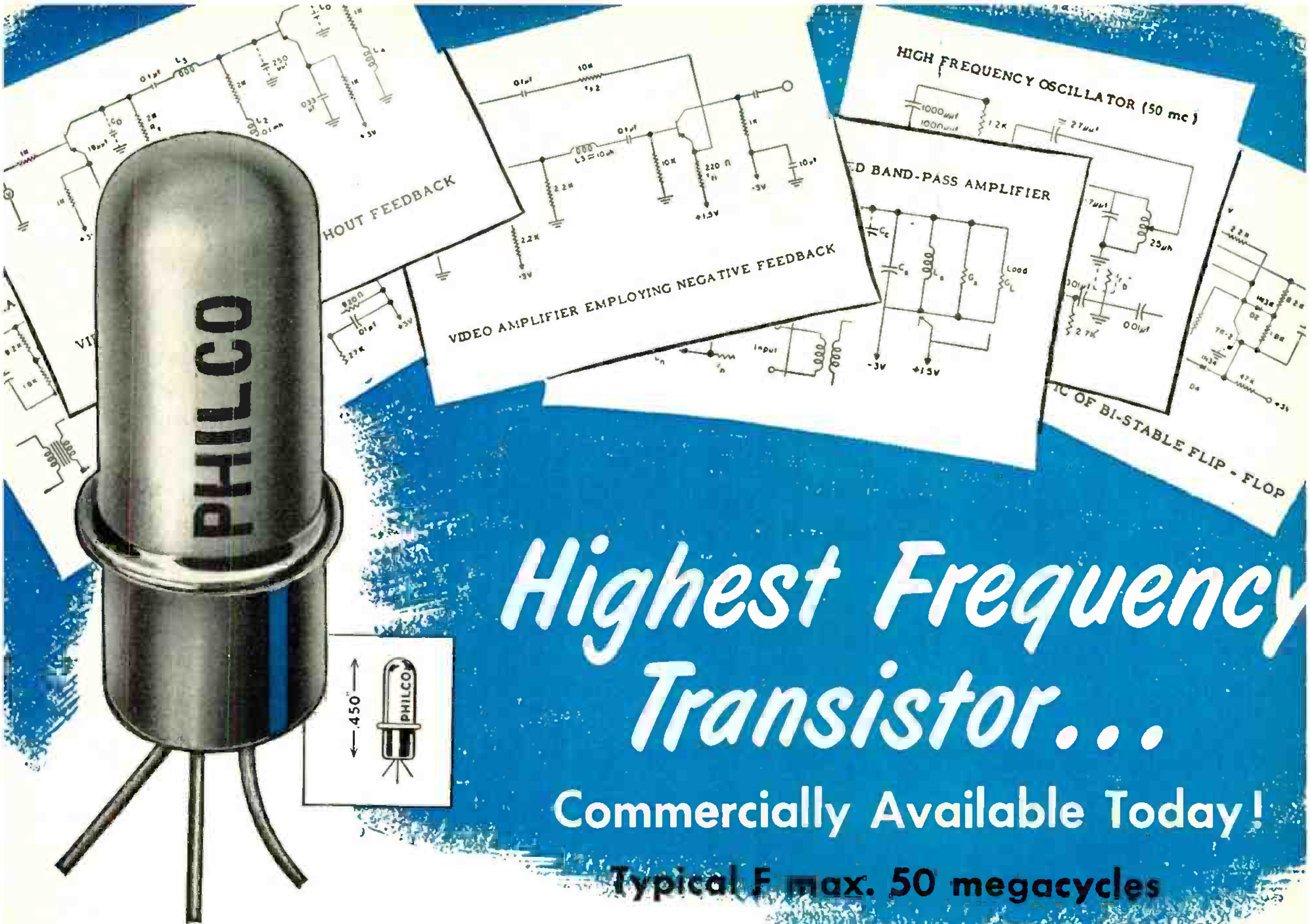
Design

Layouts should be made in pairs so that the two-page spread is used as a single design unit. *See Fig.* 2. Since the eye will see the two open pages of the catalog at once, the double page is considered as a single design unit. Of course, while desirable from a design viewpoint to have one product per double page spread, that is not always practical nor even desirable from the overall point of view. The two product pages facing each other should be designed toward complementing each other visually, with no design element on one page distracting from the other. Good design is the handmaiden of good marketing techniques. Good marketing technique, in this instance, is the presentation of needed information in simple and logical sequence.

"Dummy" Catalog

The dummy catalog may be compared to a breadboard model. Its purpose is to organize all of the material in a page by page sequence to provide a means for visualizing the final job, and to serve as a guide for the compositor and printer. For some catalogs, two dummies are prepared; the first in rough form, a sort of preliminary schematic, for design purposes, and the second in more final form, with photostated photos, plus blue line prints of drawings, and galleyed text. Both dummies are

(*Continued on page* 128)



Highest Frequency Transistor...

Commercially Available Today!

Typical F max. 50 megacycles

PHILCO S-B-T (Surface Barrier Transistor)

Available now! . . . in quantity . . . Philco Surface Barrier Transistors are opening entirely new fields for design engineers . . . are being incorporated in high frequency units *now in production!* Commercial, industrial and military thinking is swinging over fast . . . to complete transistorization.

Philco has gained a wealth of experience in the practical application of Surface Barrier Transistors. Put this experience to work for you. Make the Philco S-B-T a part of your forward looking plans—now.

FEATURES

- Lowest Power Consumption
- Hermetically Sealed Resistance-Welded Metal Case with Leads Sealed in Glass
- Long Life and Reliability of Operation
- Uniform Characteristics Insured by Controlled Processing and Complete Testing
- Extremely Low Collector Cut Off Current for Stable Operation
- Extremely Low Output Capacitance for Ease of Neutralization

For complete technical information on the PHILCO SB Transistor

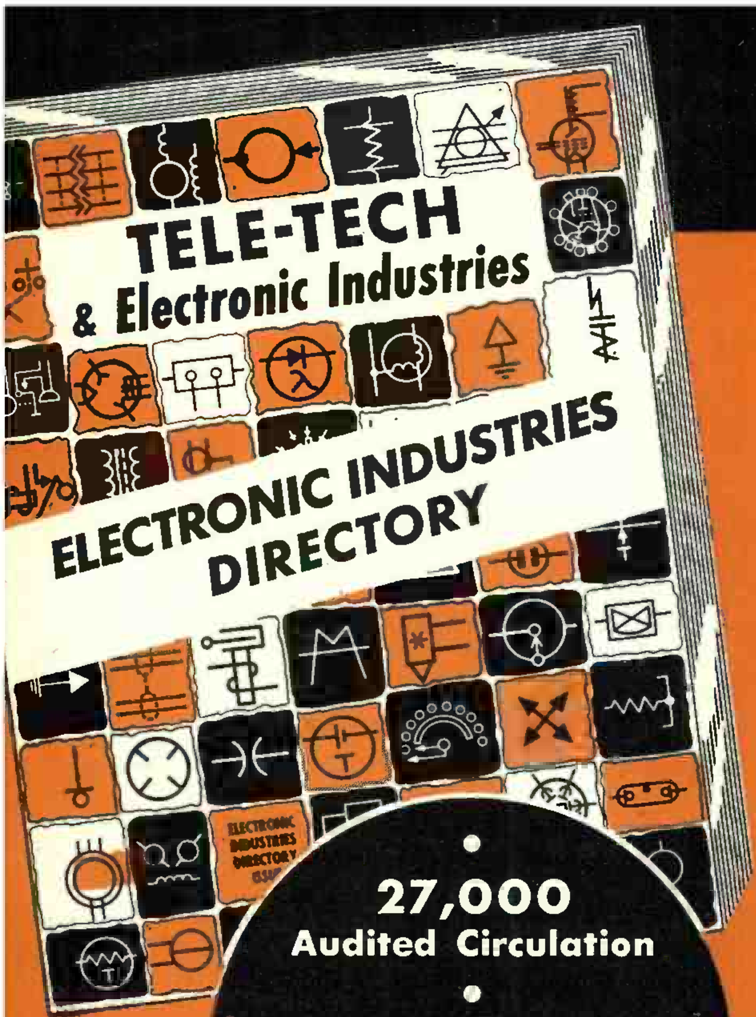
write to: **LANSDALE TUBE COMPANY**
A Division of PHILCO CORPORATION
LANSDALE, PENNA.

PHILCO CORPORATION

LANSDALE TUBE COMPANY DIVISION

LANSDALE, PENNSYLVANIA

Keep your product buyers with the



27,000
Audited Circulation

Lists over 4,000 manufacturers

over 2,000 product categories

Published Annually in the

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TELE-TECH
& Electronic Industries

- Established storehouse of vital data and sources for top engineers in the electronic industry.
- Most complete and accurate, brought up to date each year.
- No other information source can match this directory, nor is any as convenient or practical to use.

Directory features include:

- PRODUCT FINDING INDEX
- PRODUCT LISTINGS (These two sections save time by listing thousands of products with symbols for each, followed by manufacturers' names, addresses and symbols showing types of products they make.)
- BRAND & TRADE NAME INDEX
- DIRECTORY OF CONSULTING ENGINEERS
- DIRECTORY OF ENGINEERING SOCIETIES
- DIRECTORY OF ELECTRONIC DISTRIBUTORS
- DIRECTORY OF ELECTRONIC REPRESENTATIVES
- ALPHABETICAL LIST OF MANUFACTURERS

Because it is so carefully designed for maximum usefulness, the "ELECTRONIC INDUSTRIES DIRECTORY" gives maximum effectiveness to the advertiser of electronic products. It is the most comprehensive and practical directory in the electronic engineering field. It helps your selling because it is referred to constantly by TELE-TECH's 27,000 readers, including the men with responsibility for initiating projects, specifying and purchasing products like yours. Top engineering personnel, purchasing agents, etc. keep the June Directory issue at hand from one year to the next. Your ad, therefore, is your assurance of being on hand when they are ready to buy!

"THE MAGAZINE ENGINEERS READ FIRST!"

before the industry's most influential directory used the year 'round!

CUT COSTS, SPEED UP SALES CONTACTS
With the exclusive LOCALIZER INDEX!

How it works for you!

Paid Localizer Listings localize your selling. This is a sales-building, cost cutting feature because it provides quick and direct contact between local buyer and seller—between the purchaser and the manufacturer's branch office or local representative. Localizer ads cut down on correspondence, phone calls, and red tape, increase inquiries, speed service to customer, for everyone who takes advantage of them.

How to advertise with Localizer Listings

Immediately under your firm name, listed free in either the Alphabetical List of Manufacturers, Distributors, or Representatives, you can purchase space at the low cost of $30 for the first inch, $25 for each additional inch, to include the items of information shown in the sample listings at the right. Note how convenient and important they are. Note too, how easily the buyer can locate the local office or Rep nearest him. Manufacturers may also use space in the Directory of Distributors to show at the end of each state their distributors in that state.

Get maximum sales impact

Display advertising coupled with your Localizer Listings is the surest way to achieve maximum product identification among the greatest number of buyers in the $8 billion electronic market. The ELECTRONIC INDUSTRIES DIRECTORY keeps your product on display so it will be seen and purchased—all year 'round!

FREE ALPHABETICAL LISTINGS

In the alphabetical index of 4,000 manufacturers listings are free to all electronic manufacturers.

EXECUTIVE & SALES PERSONNEL

Listings for manufacturers' executive and sales personnel may be followed by brand names, list of products; branch or regional offices. These are paid listings.

REPRESENTATIVES

Alphabetical arrangement of cities in Localizer section makes it easy for buyers to find local representatives. These are paid listings.

Dover Publications 1780 Bdwy New York NY
Dow Corning Corp Midland Mich
Dow-Key Co Warren Minn
Downing Crystal 191 Shaffer Ave Westminster Md
D & R Ltd 402 E Gutierrez Santa Barbara Calif
Drake Co R L 18 E Central Ave Miamisburg Ohio
Drake Electric Works 3656 Lincoln Chicago 13 Ill
Drake Mfg 1713 W Hubbard St Chicago 22 Ill
Telephone CHesapeake 3-4462
General Manager—H Ken Foute
Director of Sales—Verne E Smith
Chief Sales Engineer—Harry Wasiele
Products
Dial light sockets—miniature lamp assemb
signal lights—jewels
Representatives
Atlanta 6-R—Henry W Burwell Co Inc 1133
DeLeon Ave N W ELgin 7517 Covers Al
Ga-Miss-NC-SC-Tenn
Boston 16-R—Gerber Sales Co 48 Pearl St Bro
46 Mass BEacon 2-2425
Detroit Mich—Grant Shaffer Co 14241 Fenkell
BRoadway 3-5390 Covers Mich
Ft Wayne 5-R—Walter W Bieberich 2817
Dr KEnmore 2928 Covers Ind
Kansas City 2 Mo-R—Myers-Young-Farristal Inc
Main St JEfferson 7221 Covers Kansas-Mi
Cleveland O-R—The Gaary Sales Company
Henry Rd
Los Angeles 5-R—Radio Products Sales Co 15

LOCALIZER LISTINGS FOR DISTRIBUTORS AND REPRESENTATIVES

EXECUTIVE & SALES PERSONNEL

Names may be listed here to quicken sales contacts.

LINES CARRIED

May be listed here to show the availability of certain brands or types of products.

AREA SERVED

May be defined in order to reach and serve more outlets in this expanding field.

NEW YORK, Cont'd
Sanford Elect 157 Chambers DI 9-0550
Slate & Co 2755 Webster LU 4-0614
Stan-Burn Radio 1697 Broadway CO 5-8138
Sun Radio 122 Duane BA 7-1840
Superior Radio & TV 800 W 20 CH 7-1234
President—Nathaniel K Herbert
Vice Pres & Gen Mgr—David Harris
Vice Pres chg Sales—John M Meyer
Controller—Stanley S Jones
Credit Mgr—Michael Haggerty
Chief Counterman—Wm Bullock
Warehouse Mgr—James Q Smith
Principal Lines Carried
Amphenol • Astatic • Atlas • Belden • Capi
CBS-Hytron • Centralab • Cornell-Dubilier •
eready • General Electric • Hallicrafters •
Jensen • JFD • Kester • Littelfuse • Mallo
Mosco • Merit • National Union • Radi
RCA tubes • Recoton • Regency • Shu
Simpson • Sprague • Toco • Ward • Web
Weller.
Area Served
Through its store and warehouse in New York
perior Radio serves TV-electronic customers i
parts of the country. When you "get it from
perior," your selection is facilitated and
service expedited by a comprehensive catalog s
ing the major lines handled.

AN INEXPENSIVE SALES PUNC

Localizer Listing Ads are available by the inch—first inch $30 each additional inch or fraction thereof, $25.

MAKE YOUR SPACE RESERVATIONS—NOW!

TELE-TECH & Electronic Industries

480 Lexington Ave., N. Y. 17 • PLaza 9-7880

Chicago: 201 N. Wells Street • Randolph 6-9225
Los Angeles: Chris Dunkle & Assoc., 3257 W. Sixth Street • DUnkirk 7-6149
San Francisco: Chris Dunkle & Assoc., 3077 Turk Street • EXbrook 2-0377

Electronics Catalog

(*Continued from page 124*)

submitted to engineering, sales, and management for check and approval.

Testing the copy is very desirable at some stage of the development of the catalog. Typical pages of the catalog can be produced and sent out as sales promotion pieces to test customer reaction and at the same time iron out bugs in the printing and production process. The sales office can furnish a listing of customers who may be willing to cooperate in offering valuable criticism of the proposed format material.

The Cover

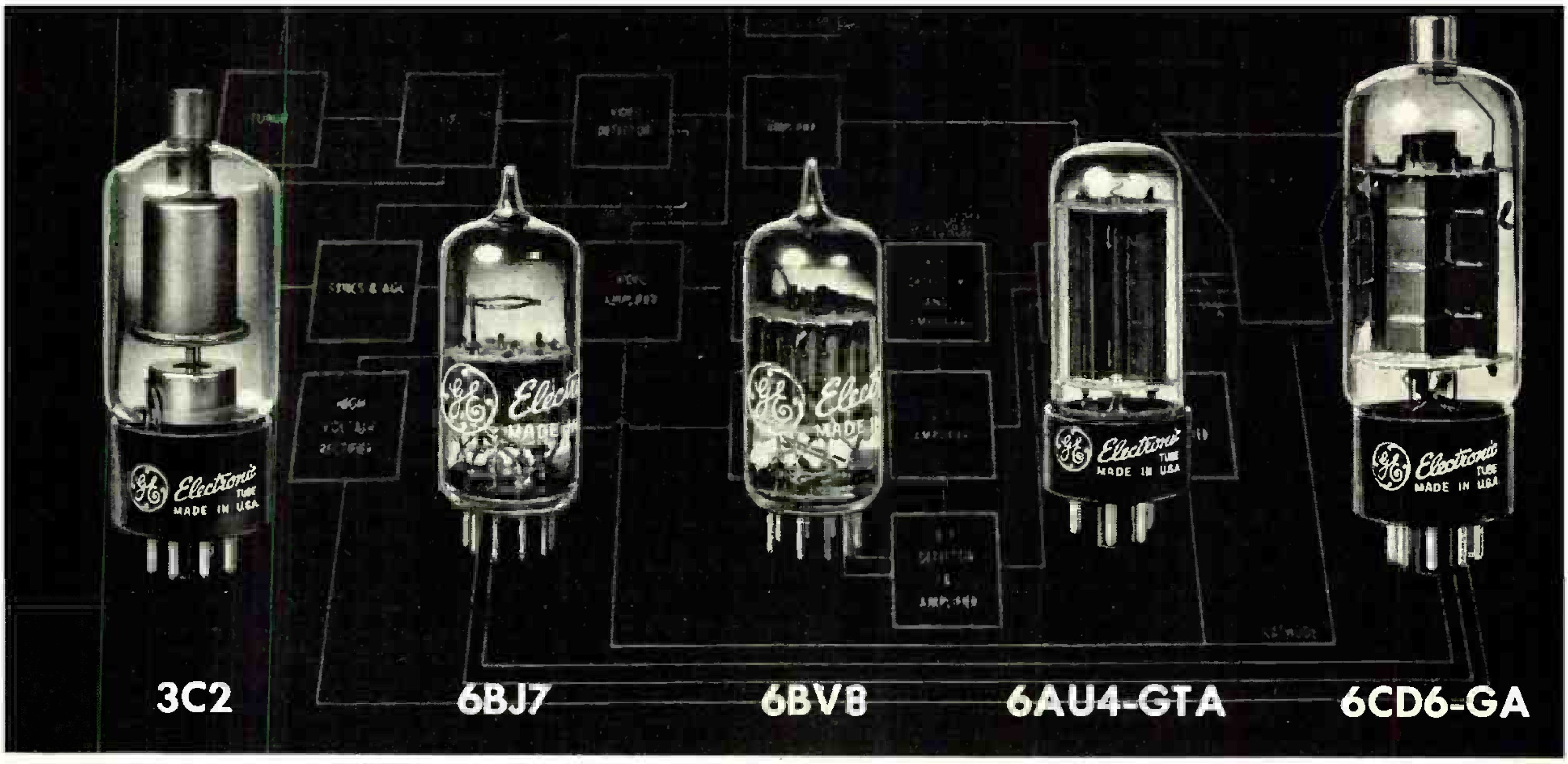
A catalog's cover has three important functions: 1) give adequate protection to the contents both in passing through the mails and in the hands of the customer; 2) compete with innumerable other catalog covers for buyers' attention; 3) enable the reader, at a glance, to identify manufacturer and type of products. In addition, the back cover has the individual duty of exhibiting address and telephone information for the company's main office, branch offices, sales agents, and distributors. The spine or backbone of the cover should have individual and adequate identifying information for the customer to select it off a shelf among many other catalogs.

The actual number of pages depends on the amount of material planners find necessary to cover the products and services to be offered. Economical printing and binding considerations call for the pages of the catalog to be planned in multiples of four, i.e., 4, 8, 12, 16, etc., preferably in units of 16 or 32. The printer should advise in this respect. The selection of the most suitable binding for a catalog is often a compromise of various factors. The determination involves: 1) number of pages; 2) possibility of adding or replacing catalog sheets; 3) how and where the catalog is filed and used; 4) necessity for having the catalog lie flat when open and to stay open; 5) necessity for identifying the catalog on the backbone of the cover; 6) comparative cost of various methods.

Copy

Good copy writing for the electronics catalog is good technical writing. It is more than skimming through the subject matter and setting down points that occur. Good writing comes from study, careful organization, and insight into the re-

(*Continued on page 132*)



NOW . . . FROM GENERAL ELECTRIC . . .
5 COST-SAVING TUBES FOR COLOR TV!

CONSISTENTLY, General Electric tube designers have worked with TV manufacturers to reduce costs of monochrome sets. Now similar G-E cooperation is extended on color . . . to help bring down receiver prices, so that more users can enjoy this new form of entertainment, with the increase this will bring in color-TV popularity and sales.

Five G-E receiving tubes for color . . . ready and available now . . . contribute to simpler, more economical chassis design. The sum of their cost saving, when translated into retail TV price reduction, is substantial.

All 5 tubes, in addition, are specially engineered for stamina and dependability . . . meaning low-reject TV factory production, and set-ownership with minimum service complaints.

Ask for characteristics, ratings, and prices! *Tube Department, General Electric Company, Schenectady 5, New York.*

Progress Is Our Most Important Product

GENERAL ELECTRIC

162-1A2

Saves filament power-supply circuitry!

3C2. High-voltage rectifier for color TV. Center-tapped filament can be used for either series or parallel operation, so permits design and use of most economical high-voltage power-supply circuit. Special mandrel-wound construction minimizes filament pull-out. High inverse voltage rating—33,000 v (d-c and peak). High d-c output current rating—1.1 ma.

Saves by eliminating one tube!

6BJ7. A miniature triple-diode d-c restorer for the three signal channels of TV color receivers. The triple-diode design enables this tube to do the d-c restoration work of two duo-diodes . . . saves the cost of a second tube. Individual cathodes for each diode permit cost-saving circuitry.

Saves over-all circuitry costs!

6BV8. A medium-mu duplex-diode triode for use as synchronous detector and chroma amplifier. Separate cathode and plate for each diode give choice of most economical circuit combinations to cut over-all chassis costs. 6BV8 also is a good high-perveance duplex-diode triode for many monochrome applications . . . saves stocking another tube.

Saves a special transformer winding!

6AU4-GTA. A damping diode for horizontal-deflection circuits. Heater is specially insulated to withstand a high peak voltage of 4,500 v. This saves cost of separate transformer winding. High d-c output current rating—190 ma; low tube drop—25 v at 350 ma. Use for both color and monochrome—keep down tube inventory!

Saves high tube cost; also cuts tube inventory expense!

6CD6-GA. A beam pentode for use as horizontal-deflection amplifier. High positive-pulse plate voltage—7,000 v. Economical in price, also useful for both color and monochrome, with 20 w plate dissipation . . . you stock one tube, not two! Features include high perveance, high pulse current at low plate and screen voltages, and high ratio of plate to screen current.

IRE Show—New Products

(*Continued from page 81*)

AUTOMATIC & PRECISION MFG. CO.
High pressure sealing devices, "Seel-skrews" and "Hexseals". One piece construction, maintain high pressure seal over temp. range of —125° F. to 500° F. Booth 34

UNIVERSAL AVIATION EQUIPMENT INC.
"Elasticable," braided 21-strand conductor, covered with rayon, nylon or rubber. Expansion over 200%. Voltage insulation 1000. Booth 214

MAGNETIC SHIELD DIV., PERFECTION MICA CO.
New Fernetic and Co-Netic magnetic shielding. Extremely high permeable material for low level shielding. Booth 46

P. R. MALLORY & CO.
Variable carbon resistors, tantalum capacitors, printed-circuit capacitors, push-pull switches, line switches, plunger switches. Booth 348

MARION ELECTRICAL INSTR. CO.
New "Mindicator", hermetically sealed miniature indicator, with unique rotating disc dial. Booth 556

MEASUREMENTS CORP.
New standard FM signal generator, covering 50 to 400 MC, with a signal level of .1 to 100,000 uv., internal FM modulation of 400 to 1,000 cps. Booth 749

SPAULDING FIBRE CO.
Cold punching XXXP-730 copper clad laminated phenolic. Also various grades of thermosetting laminates, post forming grades, vulcanized fibre. Booth 741

GLOBE INDUSTRIES INC.
New miniature variable frequency blower. Booth 612

Mc COY ELECTRONICS CO.
Subminiature crystal units in the HC-18/U size, fundamentals from 3 MC to 25 MC, overtone frequencies from 10 MC to 125 MC. Booth 764

SHALLCROSS MFG. CO.
New miniature switch, 1¾" sq., 1" single deck depth. Single or two-hole mounting; potentiometers, precision resistors, d-c bridges. Booths 559, 561

WESTON ELECTRICAL INSTR. CORP.
Panel instruments, induction modulator, test equipment. Booths 682, 684

INDUSTRIAL HARDWARE MFG. CO.
Printed Circuit socket. Booth 637

PREMIER INSTRUMENT CORP.
New low noise balanced mixers, waveguide components, and assemblies. Featuring low noise X-band mixer with overall system NF less than 8.0 db. Booth 374

ANDREW CORP.
Ten-ft. all steel parabolic antenna, new 9¾" pressurized waveguide, vehicular gain antenna for 450-470 MC. Booth 352

NORTH SHORE NAMEPLATE INC.
Line of anodized and etched aluminum foil nameplates. New non-wetting bonding material. Booth 844

PYRAMID technical bulletin

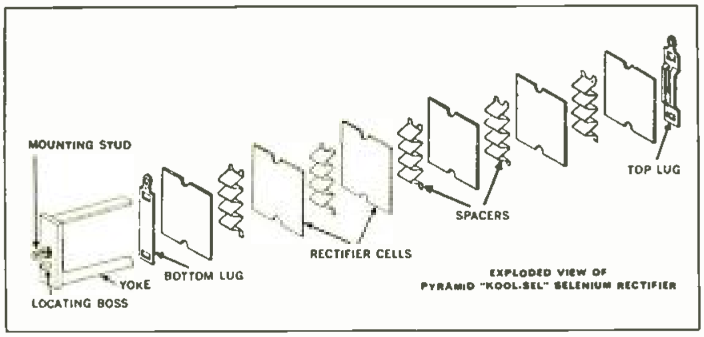
NO. 66

SELENIUM RECTIFIERS

General:

The trend toward component miniaturization with attendent increase in equipment compactness has resulted in a steadily rising ambient operating temperature. Selenium rectifiers are particularly critical in this respect because much depends on their ability to maintain a high output voltage over extended periods of time. A major limiting factor in this respect has been the "Center-support" type of construction of conventional rectifiers and the tendency of this construction to concentrate the generated heat within a relatively small area. The Pyramid patented-type construction, known as the "Kool-sel," is a significant break-through of this heat barrier.

An exploded view of a Pyramid rectifier is shown below. Note that the center support has been eliminated completely; instead, the individual selenium rectifier coils are supported at their outer edges. A molded phenolic yoke forms the main supporting member, with a mounting stud and locating boss molded into the yoke. In this way, they become integral parts of that yoke. The lugs of the rectifier are slotted to accommodate the two arms of the yoke and the rectifier cells and spacers are notched to fit snugly on the yoke arms. Clinching lips are provided on the top lug so that when it is pressed on the yoke, all components are locked together to form a rigid assembly. During assembly, the spacers are flexed slightly to insure that the unit remains tight under all normal environmental conditions.



ADVANTAGES OF "Kool-sel" CONSTRUCTION:

Mechanical:

1. Cells and lugs are locked in place and cannot rotate.
2. Locking together of the components is accomplished without the current pickup contacts exerting excessive pressures on the cell counter electrode. Too much pressure may produce three detrimental effects: First, it may decrease the reverse resistance and thereby lower rectifier efficiency. Second, there is a cold flow of the counter electrode from under the pickup contacts. Third, fracture or damage to the counter electrode adjacent to the pickup contacts may occur.
3. The locating boss, being an integral part of the yoke, is always in the correct position.
4. Pulling on the positive lug cannot crack or break the alley (counter electrode) of the adjacent rectifier cell.
5. This particular mechanical construction results in fewer component parts.

Electrical:

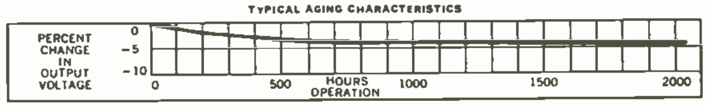
1. There is a high dielectric strength between the "live" components (i.e., cells, spacers, and lugs) and the mounting stud. The normal insulation thickness over the mounting stud is 1/16".
2. There is high resistance to burnouts on current surges.
3. The current pickup points are distributed over the full width of the rectifier cell. This means that heat is dissipated rapidly and the temperature rise of the rectifier cells during the flow of current surges is relatively low.

CHARACTERISTICS:

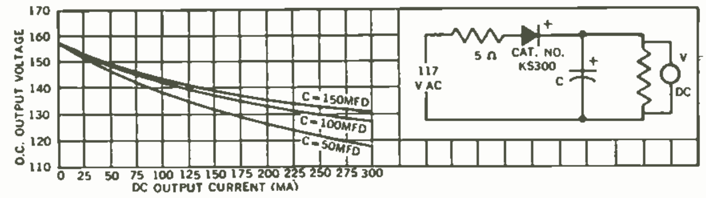
Illustrated below is a typical aging Characteristics Chart, showing percentage change in output voltage vs hours of operation.

CATALOG NUMBER	KS 65	KS-75	KS-100	KS-150	KS-200	KS 250	KS-300	KS-350	KS-400	KS-500
Maximum RMS Input Voltage	130	130	130	130	130	130	130	130	130	130
Maximum Inverse Peak Voltage	380	380	380	380	380	380	380	380	380	380
Maximum Peak Current (MA)	650	750	1000	1500	2000	2500	3000	3500	4000	5000
Maximum RMS Current (MA)	162	187	250	375	500	625	750	875	1000	1250
Maximum DC Current (MA)	65	75	100	150	200	250	300	350	400	500
Approximate Rectifier Voltake Drop	5	5	5	5	5	5	5	5	5	5
Minimum Series Resistance	22	22	22	15	5	5	5	5	5	5
Maximum Operating Plate Temperature	85°C	85°C	85°C	85°C	85°C	85°C	85°C	85°C	85°C	85°C

TYPICAL AGING CHARACTERISTICS



Voltage Regulation: The voltage regulation curves for a 300 ma selenium rectifier in a half-wave circuit with 117-volt rms input shown below. Suitable voltage regulation curves for all Pyramid "Kool-sel" selenium rectifiers are available upon request.



APPLICATIONS:

Radios and Radio-Phonographs: Low-cost, efficient rectifiers for radios and radio-phonograph combinations are "Kool-sel" KS-65, KS-75, and KS-150. The needs of most 5-tube chassis are met by the KS-65, while the KS-75 and KS-150 are used in sets with larger current requirements.

Television Receivers: High-voltage power supplies in television receivers—including color sets—use "Kool-sel" numbers KS-200, KS-250, KS-300, KS-350, KS-400, and KS-500. These rectifiers, used in voltage doubler or voltage tripler circuits provide the proper B-plus voltage, eliminating the size, cost, weight and hum problems of power transformers. "U" shaped brackets are available which permit the rectifiers to be mounted either in vertical or horizontal positions.

Radio Accessories: TV boosters, UHF converters, phonograph oscillators, inter-coms and the like can usually be powered suitably by a "Kool-sel" KS-65 rectifier.

Laboratory Instruments, Power Supplies, Amplifiers: Rectified high voltage through the use of voltage doubler and tripler circuits, for equipment where current requirements run as high as 500 ma, may be provided with "Kool-sel" rectifiers. Types KS-200 through KS-500 will be found useful for laboratory power supplies, DC filament supplies, motion picture projectors, amplifiers, test equipment and other specialized uses.

FOR COMPLETE DATA SEND FOR ENGINEERING BULLETIN—FORM KS-1

PYRAMID ELECTRIC CO. North Bergen, New Jersey

SEE US AT BOOTH 586 AT THE I.R.E. SHOW

PYRAMID IS THE BIG NAME IN CAPACITORS AND SELENIUM RECTIFIERS TODAY!

Electronics Catalog

(*Continued from page* 128)

quirements of the eventual user. The need for understanding what the customers want to know is fundamental. All information must be presented at their reading level. Generalities are to be avoided as are drum beating and superlatives unless they can be backed up by data. Factual engineering curves and drawings should be used in place of words if and when they aid understanding and explanation. The right picture is certainly worth a thousand words. The camera offers the most realistic representation; the line drawing the most technically accurate. Diagrams and curves gauge and pinpoint product performance characteristics. Customers put more faith in such representation than in words. Both should be integrated in the visual unit to make the message clear.

Good typography is measured by the clearness and ease with which the message is conveyed to the reader. The type face should be in harmony with the spirit of the copy and the character and tone of the illustration material. Lean heavily on the advice of compositor and printer.

Select a skilled printer and confer with him early in the planning and at frequent intervals so that his knowledge of design and processing may be brought to bear where it can return a maximum of benefit. Employ photography and retouching of the best professional quality. Photographs should supply a maximum of definition and contrast to compensate for the diluting effect of the screen that will appear in reproduction. Finally, select a printing paper that is designed to record fine detail.

Coordination

Much time, money, and effort can be saved if, from the start, the catalog committee planners keep every member of management informed who will have any say in the catalog's final approval. A meeting should be held with key people before any designing is started. Principles of good catalog design should be discussed, with competitors' copies as well as various other excellent industrial catalogs serving as examples. Comments, suggestions, analysis, and questions from persons attending can be a helpful guide. Preferences should be brought out and much of the substance and approach can be agreed upon, as well as a tentative budget and schedule. Periodic briefing of management will keep everyone in tune. *See Fig.* 1.

INDIANA
PERMANENT MAGNET
DESIGN INFORMATION

published for industrial and consumer product engineers and designers

HOW PERMANENT IS A PERMANENT MAGNET?

Permanent magnets *are* permanent. Proof of permanence is substantiated by many practical applications over long periods of years.

The continued accuracy of some of the most exacting scientific electrical measuring instruments, or of the familiar house-type, watt-hour meter depends upon a permanent magnet.

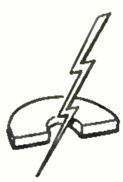
The speedometer in your car, the magneto in your power lawn mower, or your wife's magnetic knife rack in the kitchen may be consigned to the junk pile in time because of mechanical failure or obsolescence . . but definitely not because of magnetic failure.

There is a common belief . . which is incorrect . . that a permanent magnet supports its external magnetic field by dissipating some of its *internal* magnetic energy. This definitely is not the case.

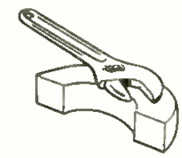
Adverse Factors on Remanent Magnetism. The magnetism of a permanent magnet can be adversely affected by any one, or a combination of, the following:

Elevated Temperatures can cause very appreciable initial losses in magnetism, up to complete demagnetization, even though metallurgical properties are not affected.

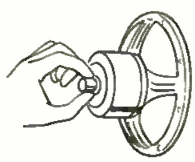
External Magnetic Fields from electro-coils, high electrical currents, or even other permanent magnets can partially or completely demagnetize the permanent magnet, and obviously, if the field is sufficiently strong, completely reverse the polarity.



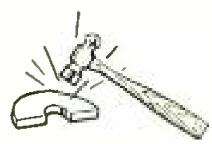
Contact with Ferromagnetic Material by a permanent magnet in such a way that the normal internal field pattern is distorted can adversely affect the remanent magnetism. This is an important condition to avoid in the handling of magnetized magnets.



Changes in the Magnetic Circuit such as to produce a larger air gap than that on which it was initially magnetized, will reduce the strength of the magnet instantly and it is not recovered by reassembly to the original gap. A typical radio loud-speaker magnet, if removed from its associated steel circuit, then reassembled without remagnetizing, may lose as much as two thirds of its initial strength.



Vibration and Shock have little effect in most applications.



In all of these cases where only the remanent magnetism has been affected, losses can be recovered by remagnetization.

This article is a condensed version of a recently published feature article carrying the same title. Reprints of the full length article are available on request.

For assistance in designing the most efficient magnet for your product, consult our design engineers—without obligation, of course.

Magnetic Materials Exhibit at IRE Radio Engineering Show

Members of the magnetic materials design and application engineering staff of Indiana Steel Products Company will man the company's exhibit at the forthcoming IRE Radio Engineering Show in New York, Monday, March 19 through Thursday, March 22.

The exhibit, located in Booths 2 and 4 at Kingsbridge Palace, will feature a full line of permanent magnets including Cast Alnico . . Sintered Alnico . . Indox Ceramic Magnets . . and Cunife.

New manual discusses selection of permanent magnet materials

This newly published, 12-page manual entitled, "Permanent Magnet Materials and Their Selection," discusses physical and magnetic characteristics and the applications of Cast Alnico Magnets (Grades I, II, III, IV, V, VI, XII); Sintered Magnets (Alnico II, IV, V, VI, Indalloy and Indox I); Ductile Magnets (Cunico and Cunife I) and Formed Magnets (Chromium and Cobalt).

Also included is a selector-type chart which lists magnetic characteristics, design factors, material characteristics, and manufacturing methods and limitations of the various magnetic materials. In addition, special sections present a "Glossary of Magnetic Terms" and a list of magnetic "Symbols."

Copies of this publication are available on request. Ask for Manual 5-N-3 on your company letterhead.

THE INDIANA STEEL PRODUCTS COMPANY
Valparaiso, Indiana

WORLD'S LARGEST MANUFACTURER OF PERMANENT MAGNETS

INDIANA PERMANENT MAGNETS

Crystal Developments

(*Continued from page 69*)

and "finished" experimentally. A semi-circular ridge short circuit is created directly behind the center conductor of the coaxial line. The energy is transmitted from the ridge into the coaxial line by a group of concentric, circular steps of diminishing diameter. The outer conductor of the coaxial line is tapered down smoothly. The combined effect is to afford a gradual transition to a 65-ohm characteristic impedance. As a final experimental adjustment, the coaxial body is moved vertically. As can be seen in the assembly drawings, a gap of 0.020 in. was left in the first model holders.

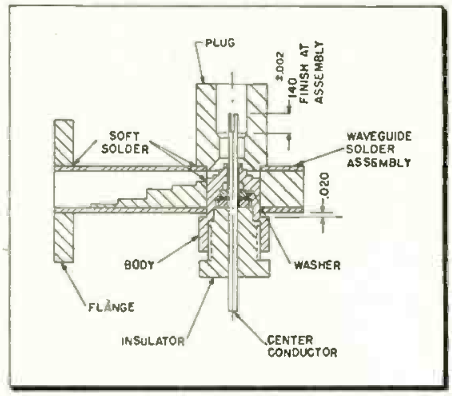


Fig. 6: Assembly drawing of WR-51 crystal mount, Ridge waveguide design is employed, with single ridge to transform to coaxial line impedance

The top height of the center conductor would be adjusted to 0.140 in. regardless of gap dimension to keep a uniform dimension for the center conductor depth of the crystal.

Height Varied

For a fixed ridge width, the height was varied experimentally from the theoretical optimum value to present the best transition from the waveguide to the coaxial line across the 40% bandwidth. The ridge steps were tailored from the theoretical values being measured for VSWR by a specially constructed matched termination for the ridge waveguide. This termination was of Uskon and took the form of a tapered tuning fork. The steps themselves were reduced to a VSWR of 1.15 max. across the waveguide band. The rings for the final transition were fitted experimentally.

Output Terminal

The output terminal contains a Teflon by-pass capacitor, plus a

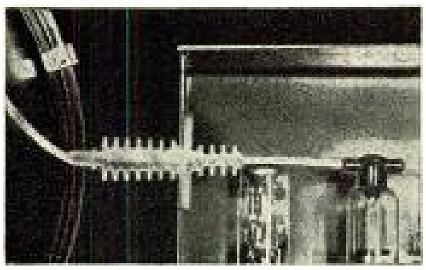
(*Continued on page 136*)

IRE SHOW PREVIEWS

Mechanical packaging components from the computer field now providing means to mount, house, fasten, connect and monitor electronic circuitry of all types as easily accessible, simple to service plug-in units.

NEW TRENDS

Greater reliability in multi-wire connector cabling with simpler construction seen at show



30 KV connector cable for Color TV uses Alden connector technique to provide connector cable with large safety factor at low cost and in volume.

A whole new series of single lead and multi-wire connectors having the connector insulation molded directly to the wire insulation will be shown at the New York IRE Show. This integral molded connector technique encapsulates contacts, completely seals all wire junctions and provides strain relief for all leads in a single one piece molding. Multi-wire unit connector cables using this technique have a tremendous increase in reliability. Simplifies equipment servicing. Enhances equipment appearance.

First used in television to solve the problems of corona suppression and high voltage arc-over where the bonding of the connector and wire insulation eliminated the need of long arc-over paths on the back of connectors—the technique now is expanded to multi-wire connectors. Up to now it has been necessary to pot the leads of assembled connectors to get these features in multi-wire connectors. The Alden molded connectors eliminate this costly and slow operation. They provide this sealing feature by molding the contact and leads as inserts into such materials as polyethylene, nylon, polyvinyl chloride (PVC), and fluorothenes (Kel-F) in one operation. The designer can now pick Alden connector layouts, choose the insulating material best suited for his requirements and have the connectors and cable molded as a unit to his cabling layout.

Single lead high-voltage disconnects, miniature 2 to 5 lead and rugged 7 to 11 lead connectors will be shown along with tube cap connectors using the same technique.

Discuss your molded connector cable applications with Alden engineers at the IRE Show, or write for the new Alden Handbook Section on Connectors.

This and other large scale computers use a new series of Alden mechanical components as simple, direct means of getting reliability of operation, new ease of servicing and simple maintenance of electronic equipment

Front panel "Tell-tales" designed to save space operate at greater efficiency.

A new trend in front panel indicator lights, fuseholders, test point jacks and patch boards that provide the operator efficient means of monitoring equipment operations can be seen at the Alden Booth No. 185-7 at the N. Y. IRE show. New design concepts make these front panel "Tell-tale" components smaller, easier to use, simpler to lay out.

TINY INDICATOR LIGHT

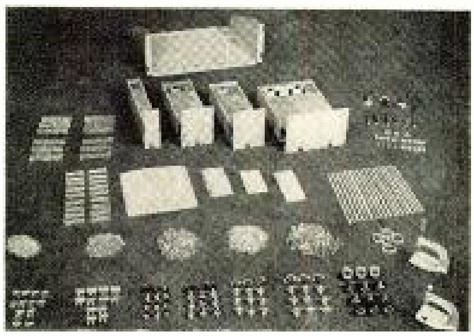
By building a light bulb about one quarter the conventional size and molding it right into the front of panel lens diffuser, Alden "Pan-i-Lite" provides an indicator light of brilliant quality that is visible from any angle, fits tiny hole (11/32" dia.), offers large voltage selection (6V, 12V, 28V, 110V), gives the designer new freedom in making front panel indicator lights work for him.

INDICATING FUSEHOLDERS

Indicators fusing of voltages from 6, 28, 110 to 220V with the Alden Fuselite now enables the engineer to monitor all circuits to reduce and isolate troubles caused by complexity. Tiny "Fuse-lites" give warning flash of fuse trouble and permit instantaneous re-fusing by simple twist of wrist from front of panel.

MINI-TEST POINT JACKS

For solving the problem of getting front panel circuit outputs and check points in small space, a complete series of tiny insulated test point jacks in choice of molding compounds for all environments and voltages, are being shown. Matching molded Patch Cards and Test Points color coded to match jacks make it simple for engineers to design compact, efficient patch boards.



A basic assortment of Alden packaging components developed from computer packaging techniques now being used by design engineers to package many other types of electronic circuitry for plug-in unit construction.

Computer packaging components yielding tremendous advantages in other types of circuitry

Computer-born packaging components that permit division of circuitry into plug-in functions; mount it compactly in vertical planes; package his self-contained planes of circuitry in standard chassis that plug into racks or housings; provide each plug-in chassis with "Tell-tales" that monitor operation and spot trouble instantly; give him central, accessible point of check for all chassis interconnects—will be shown at Alden Products Co. Booth No. 185-7, IRE Show.

IN TEST GEAR

Eastman Kodak Engineers found these Alden packaging components a natural for building up test gear for the Navy.

IN AUTOMATIC ELECTRONIC CONTROLS

Automatic electronic controls for city's lighting system, for automatized milling machine, by large automobile manufacturer for automatized production-line machine, are showing it can be a simple matter to package your automatic electronic control circuitry to insure uninterrupted operation.

IN OFFICE EQUIPMENT

Recognizing the problem of soaring costs of servicing electronic office equipment, a manufacturer of high speed facsimile transmission systems meets the problem head on using the Alden packaging components to get plug-in unit design. He now has equipment that can go anywhere in the world with reliable operation assured.

If not attending the Show write for details to Alden Products Co., 9123 N. Main St., Brockton 64, Mass.

Crystal Developments

(*Continued from page 134*)

radial choke for the prevention of any r-f leakage. Each holder had a maximum VSWR below 1.35 across the individual frequency band.

Tripolar Crystal Design

Sometime after the completion of the above-described contract, an idea was conceived which, it was felt, would lead to even further simplification of broadband crystal and mixer designs. Fig. 8 shows a cross section of what has been termed the "tripolar" crystal concept. This concept involves provision for a second signal terminal on the coaxial crystal.

Essentially, this amounts to insulating the back plug upon which the silicon is mounted, from the outer shell and, at the same time, providing sufficient capacity between the back plug and the outer shell to adequately by-pass the radio frequency. In practice, this back end terminal would be used as the i-f take-off point, whereas the normal center conductor is used to impress both the signal and local oscillator frequencies. This eliminates the necessity for the complicated choking and by-pass arrangements in the mixer that are required to separate i-f from local oscillator and r-f when all three signals appear at a single terminal.

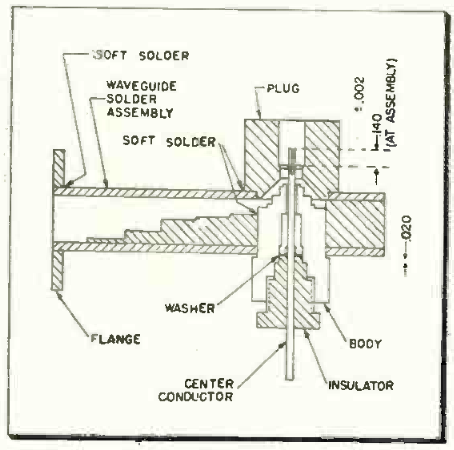


Fig. 7: Assembly drawing of WR-75 crystal mount

With the second terminal available, it is no longer necessary to bring a conducting line completely through the waveguide and out the wall opposite that upon which the crystal is mounted. A simple probe of proper length and location can be inserted into the waveguide. This probe feeds the crystal center conductor. Broadbanding this type of mount is much simpler than broadbanding the mount previously described.

(*Continued on page 138*)

THE LATEST NEWS IN PRINTED CIRCUITS

New HP Series Copper Clad Laminates Give Double Bond Strength—Assure Perfect Circuits In Less Dip Solder Time

Bond strength—12 to 15 pounds! Dip solder temperature resistance—30 seconds at 500°F.! These unique features of National's new HP Series of copper clad laminates may well revolutionize printed circuits.

Base of these laminates is National's Phenolite laminated plastic—most widely used material for printed circuits. To this we apply a new surface conditioning process and a super-strong bonding adhesive. Result; faster processing and fewer rejects—better printed circuits than any made by other methods.

In production, HP Series laminates speed dip soldering and provide cleaner joints. In service, they minimize bridging in the printed circuit. The high heat resistant bonding adhesive also assures unusual retention of bond strength—even after repeated heating and cooling, which occurs in electronic circuits when current is turned on and off.

Manufacturers using automatic assembly machinery will find HP series clad laminates especially useful. The new process uniformly conditions the bonding surface of both electrolytic and rolled copper foil. And the speed-up in soldering, *without* sacrificing perfect connections, permits production line assembly of printed circuits—particularly when cold punching grades of Phenolite are used.

WRITE FOR NEW HP SERIES EDITION—PRINTED CIRCUIT CATALOG. Etchers and users of printed circuits will find the key to better production, reduced costs and improved products in our new HP Series manual "Mechanize Your Wiring." Write for free copy to Dept. F-3.

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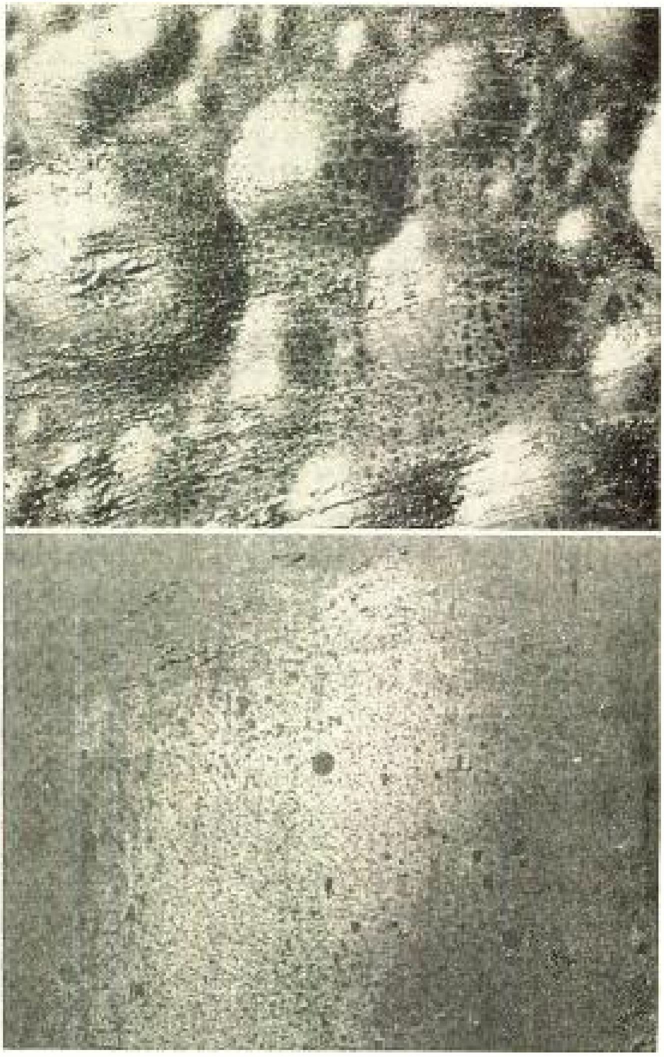
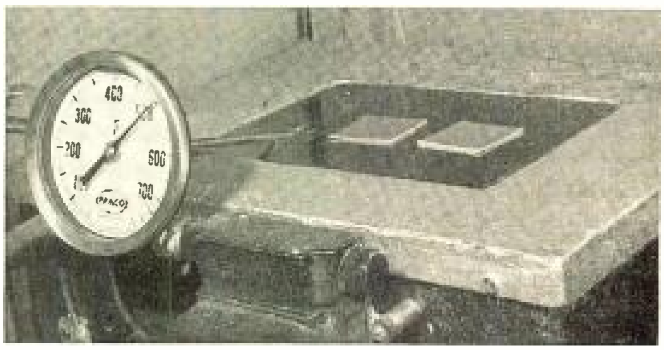


Unretouched photographs show effect of 5 seconds dip soldering at 500°F. on conventional copper clad laminate and 30 seconds at 500°F. on new HP Series laminates made by National Vulcanized Fibre. Note severe blistering of conventional laminate (top) and the virtually unmarred surface of National's HP Copper Clad (bottom).



At 500°F., 5 seconds in a dip solder bath is enough to ruin ordinary printed circuit laminates. Bonds lose their strength. Cladding develops blisters. Production becomes impossible. But *not* with new National HP Series Copper Clads. These take the punishing temperature for up to 30 seconds—without damage.

See the new HP Series Copper Clad Laminates at the IRE Show in New York—March 19 to 22, 1956—Booth 777

For product information, use inquiry card on last page.

Crystal Developments

(*Continued from page* 136)

One new consideration is introduced by this design. This consideration is one of providing a dc or low frequency return path on the r-f side of the crystal. If a probe-type holder, such as just described and illustrated in Fig. 9, is used, then it is evident that a dc return path must be provided somewhere between the probe and the silicon-whisker junction. It has been found possible to include this dc return in the crystal by shorting the center conductor of the crystal to the outer shell, using an extremely fine wire. A dc return of this type can be fabricated which will have relatively small influence on the crystal's performance down to frequencies as low as 1 KMC.

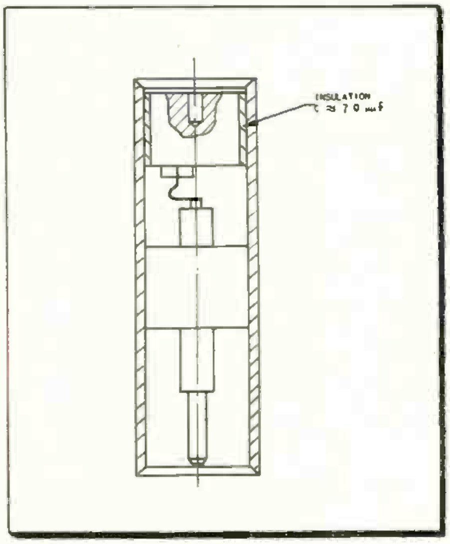


Fig. 8: Tripolar crystal modification provides second signal terminal

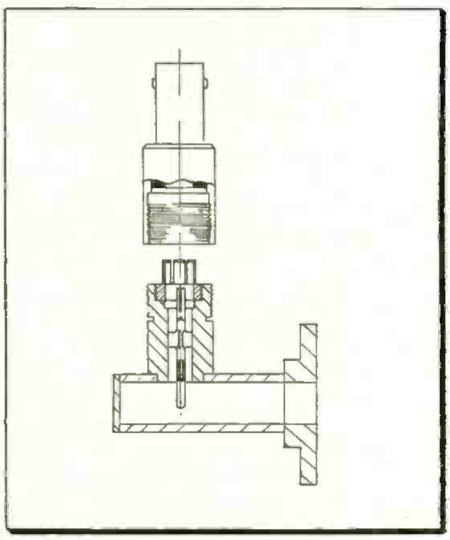


Fig. 9: Broadband waveguide to 65 ohm coaxial adapter and crystal mount

Performance tests on this "tripolar" modification of the broadband coaxial crystal have recently been run. Fig. 10A indicates tangential

(*Continued on page* 140)

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A-L	1,000 to 2,300 mc	3:1
A-S	2,150 to 4,600 mc	2:5
A-R	4,450 to 8,000 mc	2:5
A-X	7,850 to 12,400 mc	2:7
A-KU	12,400 to 18,000 mc	1.5:1
A-K	18,000 to 26,000 mc	1.5:1

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Covering 650 to 13,000 mc. These Polarad Broadband-Pass filters are the first of their kind commercially available. They feature sharp skirt selectivity and low pass band insertion using standard 50 ohm co-axial connections. Curves showing typical bandpass characteristics are available on request.

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F 1800	1,800 — 3,600 mc
F 3500	3,500 — 7,400 mc
F 6100	6,100 — 13,000 mc

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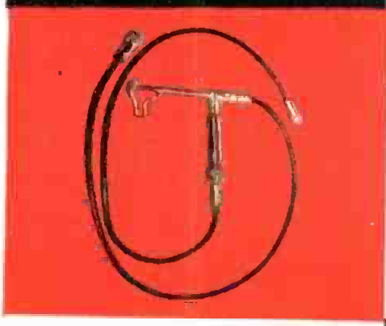
MODEL	FREQUENCY RANGE
FR	500 — 1,000 mc
FL	1,000 — 2,000 mc
FS	2,000 — 4,000 mc



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Attenuation Range:	130 db
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Crystal Developments

(*Continued from page 138*)

signal sensitivity obtainable over the frequency range of approximately 1 to 12 KMC. Over most of this frequency range, a completely coaxial system was used. The crystal was mounted on the center arm of a coaxial Type-N tee fitting. The local oscillator was fed into one of the remaining arms and the r-f signal into the other. The VSWR measured under this mounting condition runs from 3 to 7 over the range 1 to 12 KMC. Additional engineering effort should result in a more satisfactory match over this range. The measured VSWR is plotted in Fig. 10B. At higher frequencies, a probe-type mixer, such as previously described, was used and the conversion loss is shown in Fig. 11.

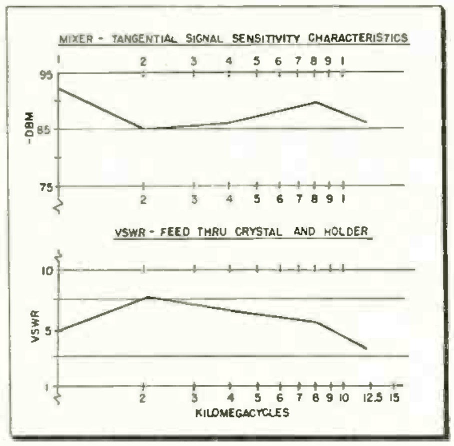
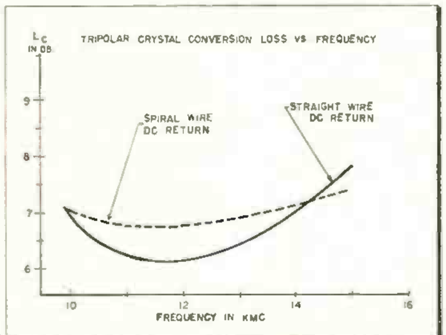


Fig. 10: Tripolar modification performance tests

Fig. 11: Conversion loss at higher frequencies



The performance of the tripolar type crystal as a video detector was also investigated. Here, again, it was found that extremely broadband performance was readily obtainable. The region investigated in detail covered L-band through X-band. It was found possible to obtain tangential sensitivities in excess of 40 dbm over this entire range. The tangential sensitivity is expressed in terms of signal power, below a 1 mw. reference level, required to produce an output pulse whose amplitude is sufficient to raise the noise fluctuation by an

(*Continued on page 142*)

Crystal Developments

(*Continued from page* 140)

amount equal to the average noise level. The measurements were made using a 1μsec. pulse width at a repetition frequency in the order of 100 cps. The 3 db bandwidth of this set-up is aproximately 7 MC. A tripolar crystal has been specified for use as a video detector. The designation of this crystal is 1N358. The specifications call for measurements of figure of merit, video resistance, and tangential signal sensitivity. Table 4 outlines the specification in detail. Since some applications of video detectors also require the incorporation of a dc return on the generator side of the crystal, we have fabricated two additional crystal types, 1N369 and 1N369A, which differ from the above-mentioned crystal only insofar as they include a dc return and the total frequency range covered is slightly influenced.

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2. J. R. Whinnery and H. W. Jamison, "Coaxial-line Discontinuities," *Proc. IRE*, Nov '44, pp 691-709.
3. W. W. Mumford, "Optimum Piston for Wide-Band Coaxial-to-Wave-guide Transducers," *Proc. IRE*, Feb '53, pp 256-261.
4. Final Report, "Low Leakage Mixer Crystal" Contract NObsr-63243, Sylvania Electric Products, Inc.

Cascaded Binaries

(*Continued from page* 93)

cates the "on" condition. The tabulation lists the equilibrium states with and without feedback paths. The symbols enclosed in circles indicate the equilibrium state for a particular count when feedback. The symbols not enclosed in circles indicate the equilibrium state when feedback is not used, or before a feedback pulse has changed the sequence of events. When two binaries are cascaded, it is seen that the input terminal must receive four pulses before the output terminal completes a cyclic change of equilibrium. However, when a feedback path is inserted in the manner indicated, only three input pulses need be injected at the input terminal in order to accomplish the same result. In effect, the feedback pulse constitutes an additional source of triggered pulses. Although the system completes one output cycle when triggered by only three actual signal pulses, the response is nevertheless due to four input pulses, the additional one being supplied via feed-

(*Continued on page* 144)

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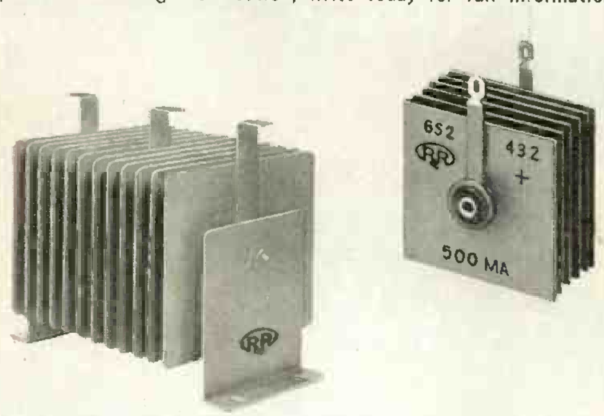

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T

Cascaded Binaries

(*Continued from page* 142)

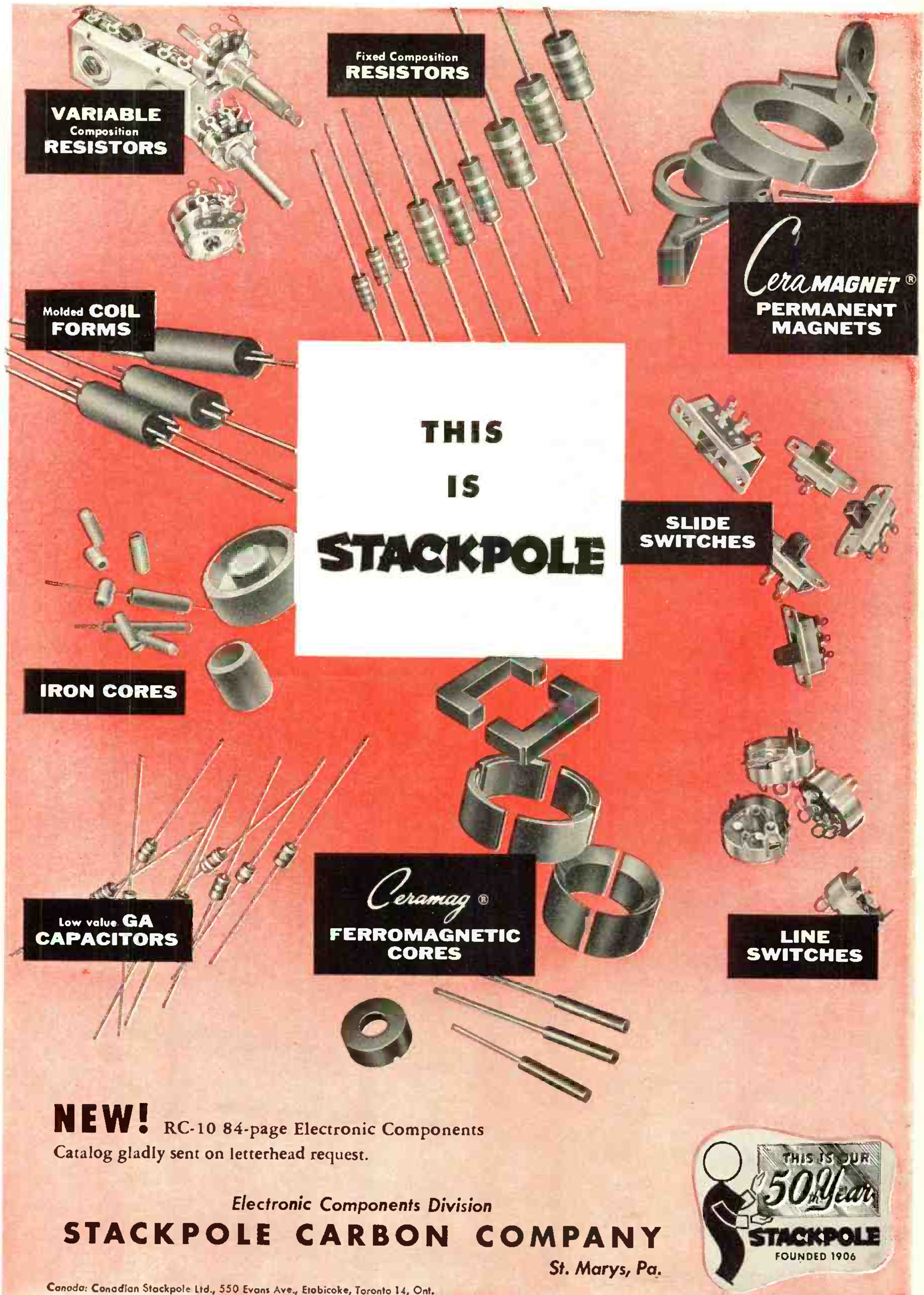
back from the system itself.

In similar fashion, Fig. 2b illustrates the sequence of equilibrium states involved when a three stage system is permuted by feedback from a dividing factor of 8, as given by 2^n, to a dividing factor of 5.

Feedback configurations for obtaining any division factor from 2 through 16 are shown in Fig. 3. Family "A" comprises simple cascaded systems without feedback. Family "B" is composed of three systems having in common the fact that feedback takes place from the last to the first stage. In each case, the division is one less than given by 2^n. Family "C" utilizes the systems of the "B" family preceded by one or more stages. For example, division six is obtained by employing a single binary stage ahead of the scale of three system of the "B" family. (The relative positions of the scale of three and the single binary stage are not of great importance. The configuration shown is preferred because the feedback path handles lower frequencies than would be the case if the single binary stage followed the scale of three.) In C_3, division by nine results when two scale of threes are cascaded.

The systems of families "D," "E," and "F" are a little more complex. They can, however, be shown to be combinations of the permutations indicated for the members of the "B" family. Consider, for instance, the scale of eleven of family "E." In order to obtain division by eleven rather than by sixteen, as 2^n would indicate for four stages, it is necessary to combine the patterns of the scale of seven and the scale of twelve. This is so because our desired permutation requires dispensing with five input pulses. (16-11). The scale of twelve dispenses with four input pulses, (16-12) whereas the scale of seven dispenses with one input pulse. (8-7). The working rule here is that scaling factors are selected such, that their difference is equal to the number of input pulses to be dispensed with in the desired permutation. In the example considered, the difference between the chosen scaling factors is five and it is necessary to dispense with five input pulses. This rule precludes the selection of a scaling factor of, say three in place of seven. (Three and seven have in common the fact that one input pulse is dispensed with). A little study of the feedback configuration of the scale of 11 system

(*Continued on page* 146)



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Cascaded Binaries

(*Continued from page* 144)

will reveal the validity of this approach. Once this basic philosophy is mastered, the same principles can be applied to any number of cascaded binary stages.

Driving and Extracting

A few words are in order with regard to the techniques of driving and extracting output from cascaded binary systems. In general, a waveshaper and amplifier tube will be required for these functions. This is likewise true of relaxation type frequency dividers so the number of tube sections required by cascaded binary systems does not compare unfavorably with that needed for relaxation type dividers if any reasonable degree of stability is to be obtained. More important, division factors which are prime numbers are not obtainable with stability from relaxation circuits. It would not be a fair comparison to contrast the number of tubes required by the two approaches to accomplish division by 13, for example.

A Schmitt trigger is an excellent driving source for a system of cascaded binaries. Such a circuit converts sine waves, or those with a slow rise time to pulses with steep leading and trailing edges. The drive, in any case, must consist of negative pulses with a minimum rise time of 1 µsec., a minimum duration of 2 µsec., and a minimum amplitude of 100 v. The maximum frequency obtainable from cascaded binaries with tubes and parameters as indicated in Fig. 1 is somewhat in excess of 120 KC. The exact upper limit depends upon construction, quality of the input pulses, and a number of empirical factors. The frequency can often be extended by experimenting with coupling capacitor and plate load resistor values. There is no low frequency limit. Fig. 4a is a schematic diagram of a Schmitt trigger circuit suitable for driving cascaded binaries as described herein. Fig. 4b depicts a suggested power amplifier output stage. This stage performs the double function of delivering power to the load and providing isolation for the binary output stage. The latter function is an important one inasmuch as the quality of the feedback pulses derived from the output binary must not be degraded in rise time or amplitude. The resonant circuit is, of course, optional, depending whether or not sinusoidal output is desired. In any event, the power amplifier must not be allowed to consume grid current.

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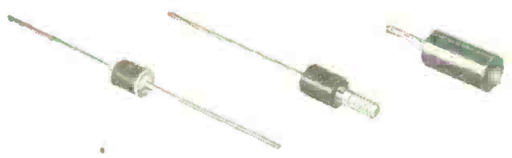

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INDUSTRY NEWS

Andre G. Clavier, Brig. Gen. Peter C. Sandretto (USAF Res.), and Dudley M. Day have been elected vice-presidents of Federal Telecommunication Laboratories, Nutley, N.J., research div. of IT&T.

Russel A. Schlegel has been appointed manager of industrial product sales of the Weston Electrical Instrument Corp., Newark, N.J.

Russel A. Schlegel

Frank L. Randall, Jr.

Frank L. Randall, Jr., has been appointed Sales Manager, Tube Div., Amperex Electronics Corp., Hicksville, L.I.

Walter E. Benoit has been named executive assistant to the manager of the Baltimore Divisions of Westinghouse Electric Corp. **W. I. Bendz** succeeds Mr. Benoit as manager of the electronics division.

Raymond R. Wiese has been named vice-president and director of Hunter Manufacturing Corp., Bristol, Pa.

The appointment of **Dr. Henry M. O'Bryan** as manager of scientific liaison of Sylvania Electric Products Inc., New York, N.Y., has been announced by **Dr. Bennett S. Ellefson,** the company's Technical Director.

Howard K. Morgan has been appointed to the new engineering position of director of commercial aviation systems, at the Bendix Aviation Corp., Detroit, Mich.

Appointment of **Harold Metz** as Director of Personnel and Organization Development has been announced by RCA, Camden, N.J.

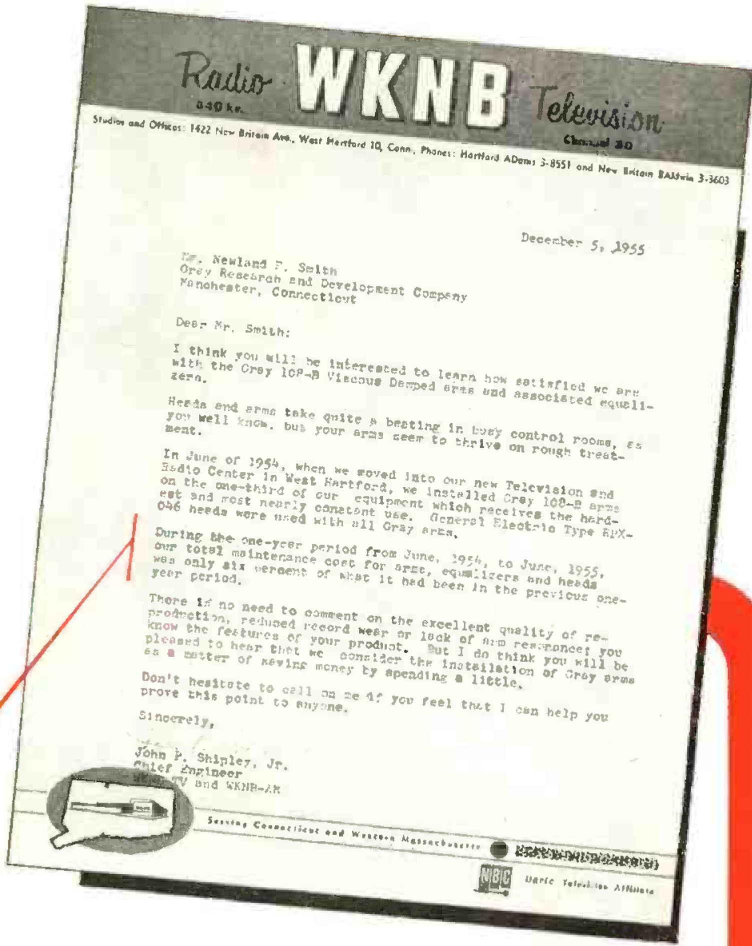
Fred Stricker has been appointed Manager of the Canseal Dept. of Cannon Electric Co., Los Angeles, Calif.

Rese Engineering, Inc., Philadelphia, Pa., has announced the appointment of **Richard O. Endres** as Director of Engineering Development.

Barry J. Hawkins has been appointed to the newly-created post of advertising manager of General Precision Equipment Corp., New York, N.Y.

(*Continued on page* 150)

GRAY tone arm reduces maintenance costs by 94%



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December 5, 1955

Mr. Newland F. Smith
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In June of 1954, when we moved into our new Television and Radio Center in West Hartford, we installed Gray 108-B arms on the one-third of our equipment which receives the hardest and most nearly constant use. General Electric Type RPX-046 heads were used with all Gray arms.

During the one-year period from June, 1954, to June, 1955, our total maintenance cost for arms, equalizers and heads was only six percent of what it had been in the previous one-year period.

There is no need to comment on the excellent quality of reproduction, reduced record wear or lack of arm resonance; you know the features of your product. But I do think you will be pleased to hear that we consider the installation of Gray arms as a matter of saving money by spending a little.

Don't hesitate to call on me if you feel that I can help you prove this point to anyone.

Sincerely,

John P. Shipley, Jr.
Chief Engineer
WKNB-TV and WKNB-AM

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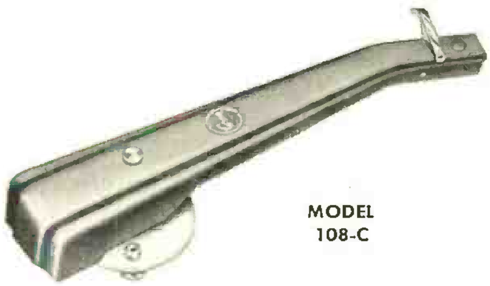
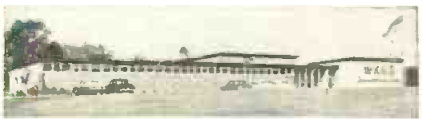
During the one-year period from June, 1954, to June, 1955, our total maintenance cost for arms, equalizers and heads was only six percent of what it had been in the previous one-year period.



MODEL 108-C



WKNB moved into this modern Television-Radio Center in West Hartford, Conn., in June of 1954. WKNB Radio, a 1,000-watt daytime station, has been in operation since 1946 and has a potential audience of 450,000 families. WKNB Television was the first UHF station in New England and began operating in February, 1953. With its 210,000 watts on Channel 30, it reaches more than 350,000 homes. The principal studio in the Television-Radio Center, 40 by 60 feet, is one of the largest TV studios in the country.

Both the Gray 108-B and 108-C High Fidelity Viscous Damped Tone Arms are designed for faithful reproduction of all audio frequencies. Viscous Damping offers the ultimate in cartridge isolation, preventing any mechanical disturbance from reaching the cartridge.

Radio stations everywhere report that cartridges and records last much longer due to the smoother handling capabilities of the Gray Tone Arms. The exclusive "Floating Action" provided by Viscous Damping, allows the Tone Arm to fall on to the record like a feather.

Gray Tone Arms permit perfect arm compliance for both old and new records . . . pre-set precision stylus pressure . . . and instant cartridge change. Used with all standard cartridges. Send for complete descriptive literature.

GRAY RESEARCH
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Manchester, Connecticut
Subsidiary of The Gray Manufacturing Company

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INDUSTRY NEWS

(*Continued from page* 148)

Mark Shepherd, Jr., has been promoted from assistant vice-president to vice-president in charge of the Semiconductor Products div., Texas Instruments, Inc., Dallas, Tex.

R. C. Sprague, founder and chairman-of-the-board of the Sprague Electric Co., North Adams, Mass., has been named chairman of the Federal Reserve Bank of Boston and its fiscal agent.

John C. O'Keefe, formerly field secretary for the Council of Profit Sharing Industries, has joined Ampex Corp., Redwood City, Calif., as an assistant to the president.

John C. O'Keefe

Richard B. Hubbard

Richard B. Hubbard has been appointed president of the ERCO div. of ACF Industries, Inc., at Riverdale, Md.

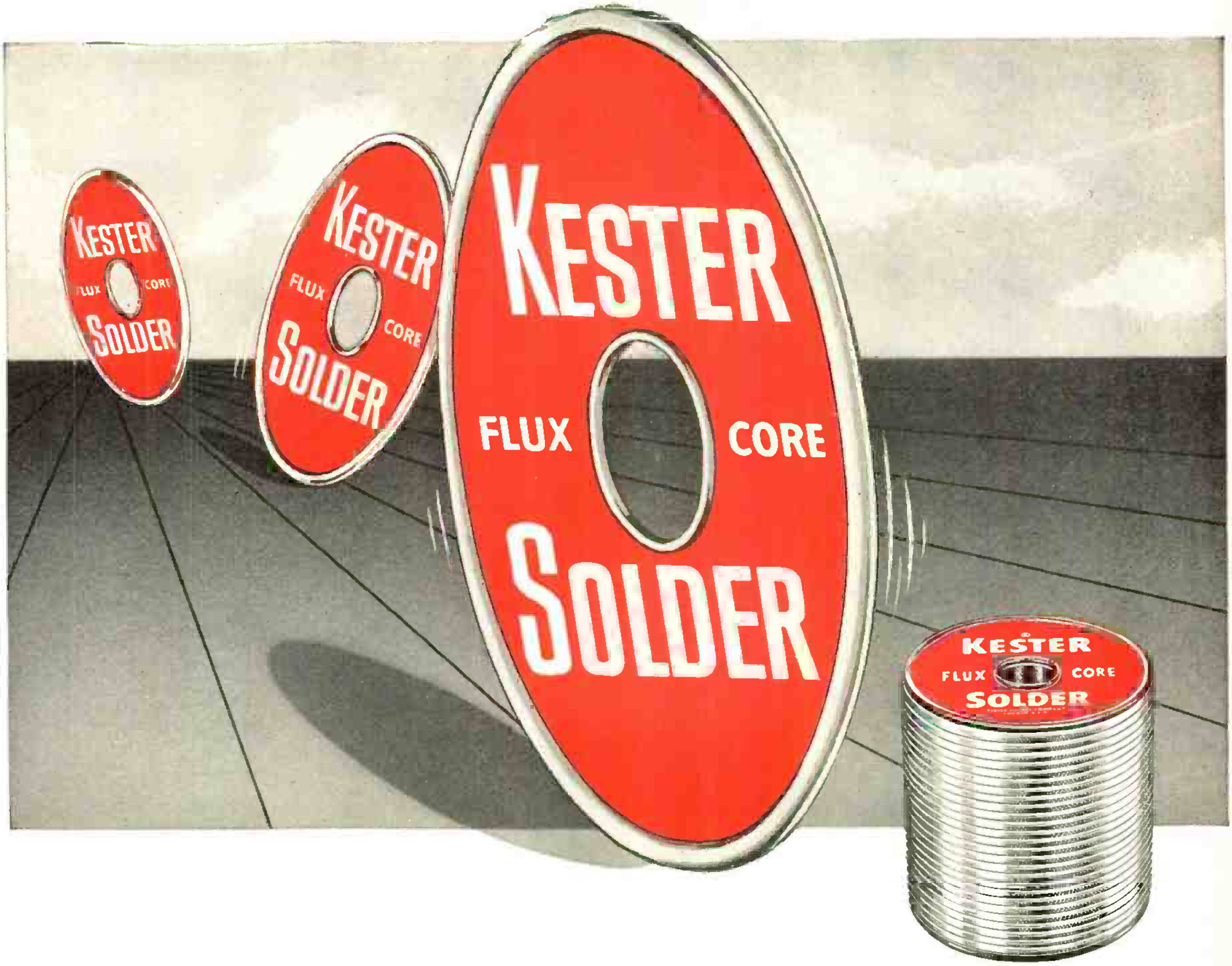
Joseph F. Effinger has been named Manager—Television Sales for GE's television receiver dept., at Syracuse, N.Y. The company has also announced the appointment of **Thomas J. March** as sales manager for the GE Electronic Components Dept. at Auburn, N.Y.

John Chadwell has been appointed to the new post of general sales manager of all sales divisions of Hoffman Electronics Corp., Los Angeles, Calif. **Byron Brown** has been appointed to the new post of color TV sales promotion manager for the Hoffman Radio Div.

Mogens W. Bang, formerly president of Mogens Bang & Co., Inc., Copenhagen, Denmark, has joined Liberty Manufacturing Corp., Youngstown, Ohio, as Director of the company's Research and Development Laboratory.

Berkeley div. of Beckman Instruments, Inc., Richmond, Calif., has announced the addition of **David C. Kalbfell** to its consulting staff for work with special problems concerning digital information handling and high frequency counting.

Ken Hathaway, manager of the electronics distributor div. of Ward Leonard Electric Co., was elected treasurer of the Association of Electronic Parts and Equipment Manufacturers at a Chicago, Ill., meeting of the trade group.



KEEPS 'EM ROLLING!

KESTER "44" Resin, Plastic Rosin and "Resin-Five" Flux-Core Solders keep the production lines moving by providing the exactly right solder for every application. Only virgin metals are used in Kester . . . further assurance of the constant solder alloy control combined with consistent flux formulae . . . all part of Kester Flux-Core Solder quality that'll "keep 'em rolling" for you!

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Canadian Board Discusses Allocation of Frequencies

Canadian Electronic Engineers, assembled for the 11th annual meeting of the Canadian Radio Technical Planning Board, considered recommendations for the allocation of radio frequencies, and the planning and improvement of equipment to profitably use available channels.

One of the prime functions of the CRTPB is to make recommendations to the Gov't. and industry for the conservation and efficient use of the radio spectrum, or the channels of communication. Canadian Deputy Minister of Transport, J. R. Baldwin, in commenting upon the activities of the Board, said: "It is necessary to have some clearing house where the mutual problems of administration and industry may be discussed and conclusions reached which will be in the best overall public interest."

Canadian I.R.E. Meeting

The first, all-Canadian I.R.E. meeting is scheduled to be held in Toronto, Can., October 1st to 3rd, 1956.

New 1956 IRE Officers

The IRE Board of Directors, at its January meeting, appointed six members to the Board for 1956.

Reappointed as Treasurer of the IRE was W. R. G. Baker, vice-president of Electronics, General Electric Co; Haraden Pratt as IRE Secretary and Donald G. Fink, Director of Research of the Philco Corp. and former Editor of Electronics, as Editor of the IRE, succeeding John R. Pierce.

Appointed as Directors were Alfred N. Goldsmith, Consulting Engineer and Editor Emeritus of the IRE; T. A. Hunter, president of Hunter Manufacturing Co. and Editor of the IRE Student Quarterly; and J. W. McRae, president of the Sandia Corp. and past President of IRE.

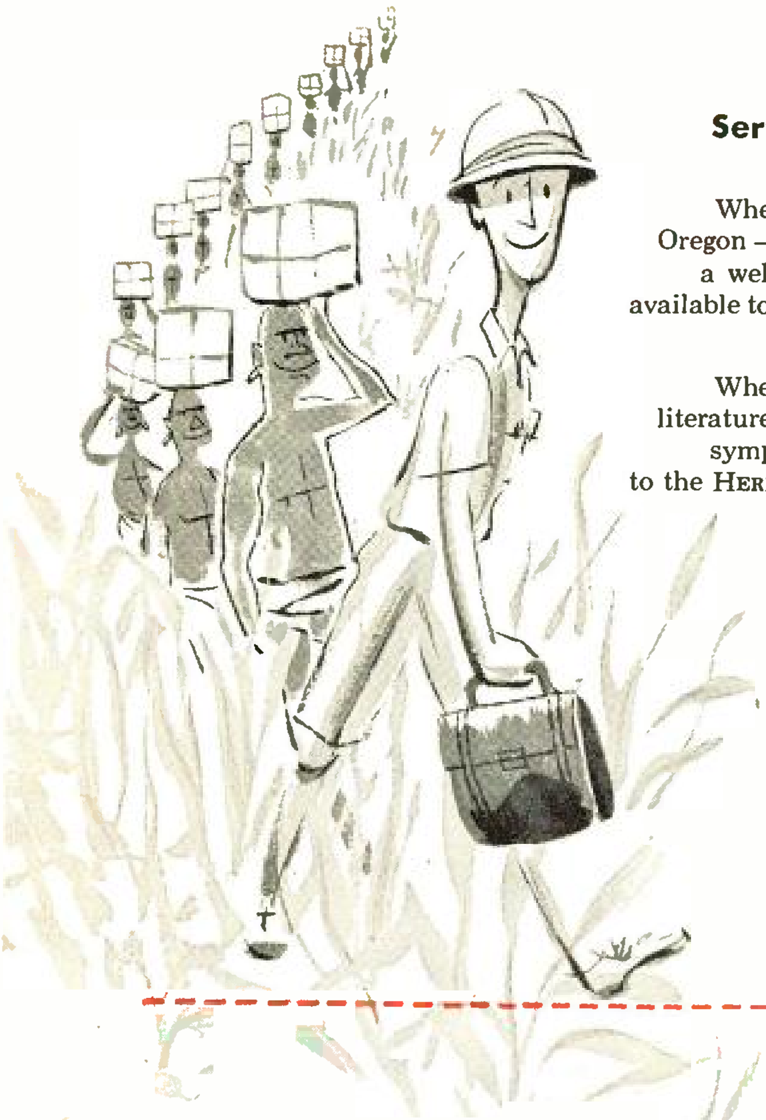
U. S.-Persian Gulf Link

Telephone service is now available between the U. S. and Kuwait, a British Protectorate in the Persian Gulf area, the Long Lines Department of AT&T announced.

The service is handled via radiotelephone through the Bahrein Islands in the Persian Gulf to Kuwait.

Rate, excluding tax, for a 3-minute call to Kuwait from any point in the United States is $15.

Hermetic's men are everywhere



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Puerto Rico	PAUL FREEMAN Hermetic Seal Products Co. Box 956, Rio Piedras, Puerto Rico
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Eastern Pa., Md.	VICTOR S. MALTA 1135 Slocum St., Philadelphia, Pa.
New England	GERALD J. MANGIACOTTI 33 Brandford Rd., Natick, Mass.
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Ohio, Tenn.	AUGEY NATALINO 363 W. First St., Dayton 2, Ohio
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FIRST AND FOREMOST IN MINIATURIZATION

Cues for BROADCASTERS

(*Continued from page* 91)

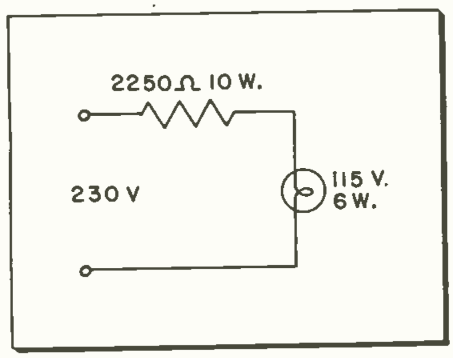
shifting devices are added to get the resulting voltage exactly out of phase with the hum voltage of the carrier. A variable resistor controls the amplitude in the region of 0.3v., and this is fed into the transmitter audio input via a bridging transformer.

The hum bucker reduces carrier hum by 12 db. It has allowed us to throw out our overall feedback system and its associated linearity compensating network, an arrangement that had been responsible for a hum reduction of 8 db. This gives us a net improvement of 4 db and allows the transmitter to take the occasional over-modulation peak in its stride.

Substitute for 230 v. Lamps

RALPH W. HANEMAN, Ch. Engr.
WCRE, Cheraw, S.C.

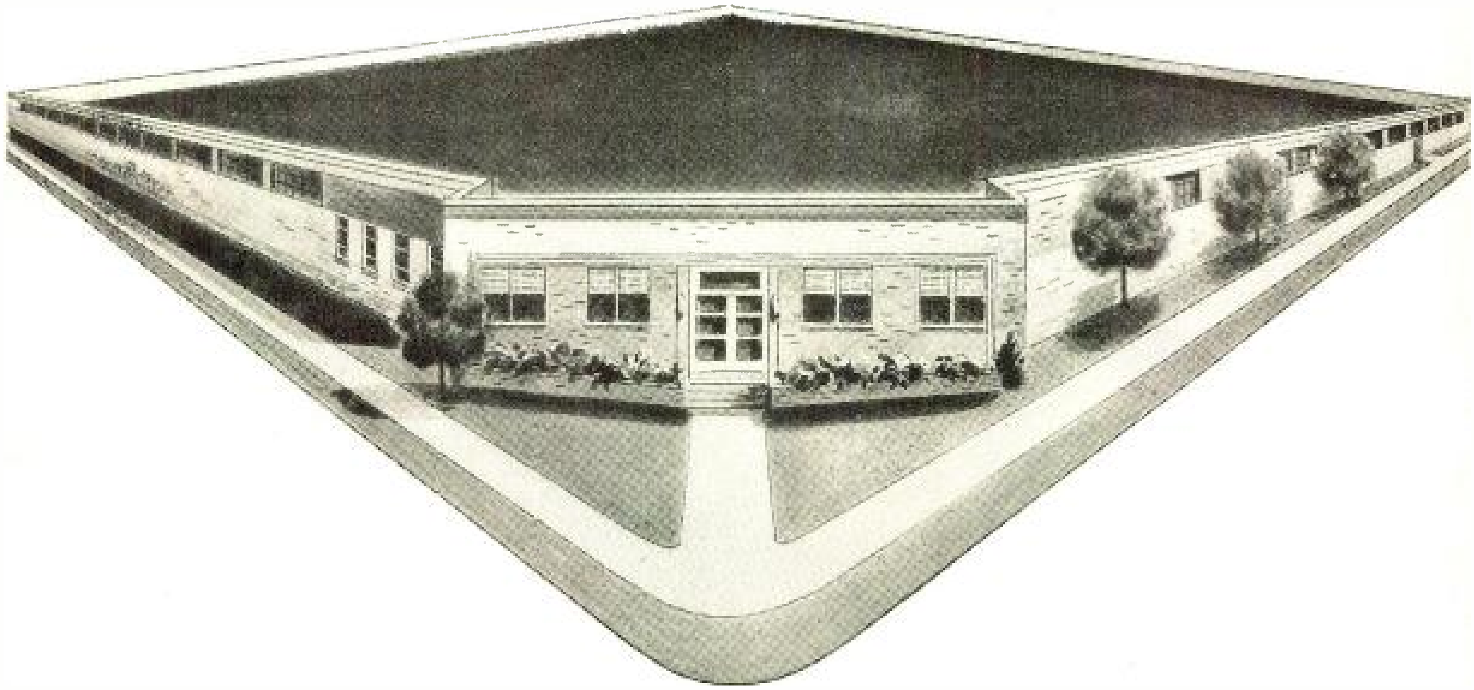
At WCRE we use a Collins 20V Transmitter which is designed to use 230 v. panel bulbs for the filament and plate "on" indicators. When our supply of these bulbs was exhausted, it was decided to insert a 2250 ohm, 10 w resistor in series with one leg of the 230 v. going to the panel light socket, and substitute a Type S6, 115 v., 6 w bulb in place of the original 230 v. bulb.



This arrangement has worked fine, and is much less expensive than purchasing the original bulbs.

GREEN-YELLOW SLIDE RULE

New light-alloy slide rules made in green-yellow, thus eliminating violet and red rays which focus in front of and behind the retina, are now available. The non-corrosive, non-rusting metal consrtuction eliminates warping, swelling and binding. Made in 6 in. and 10 in. Trig, Log-Log standard rules, or in rules made to special order, by Pickett & Eckel, Inc., 1109 S. Fremont Ave., Alhambra, Calif. TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 3-130)



here's what's behind the  crystal that's so far ahead

The Midland Factory shown above is the world's largest plant devoted exclusively to producing crystals for frequency control. It is equipped with the finest and most complete production and testing machinery ever developed for this purpose. Here Midland pioneered development of crystals for color television, and in all-glass holders of which one type is pictured above.

All this is important to you for just one good reason: Every Midland crystal you use has been produced by such advanced techniques and under such rigid quality controls that you can be sure it will prove its completely reliable quality under every operating stress.

Midland Critical Quality Control extends through every step of crystal production, and includes precise angular control by X-ray. Uniform accuracy is maintained to the millionth part of an inch.

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PERSONAL

Donald B. Nason, who joined the Crosley Division, AVCO Manufacturing Corp., Cincinnati, Ohio, in 1941, has been appointed vice-president and director of Crosley's gov't. products engineering.

Dr. Louis G. Dunn has been elected a vice-president of The Ramo-Wooldridge Corp., Los Angeles, Calif.

Henry Dabrowski has been appointed technical director of engineering for TV station WATV and radio station WAAT and WAAT-FM, Newark, N. J.

The Packard-Bell Company, Los Angeles, Calif., has announced the appointments of **Sam F. Arm** to the position of chief engineer, and **Hugh L. Vick** to chief, sales and contract administration. Both men will report to **Richard B. Leng,** vice-president in charge of the technical products div.

Wellesley Dodds and **Winfield Wegener** have joined the staff of Varian Associates, Palo Alto, Calif.

Allen S. Dunbar has been appointed to the newly-created position of Manager, Advanced Technical Planning Dept. for Dalmo Victor Co., San Carlos, Calif.

Dr. Clay L. Perry of the U. S. Naval Post-graduate School at Monterey, Calif., has been named head of the Stanford Research Institute program using the new SRI-Stanford University joint computer facility.

Robert J. Larson has become senior development engineer, and **James F. Novak** has been promoted to senior design engineer, at the Jensen Manufacturing Co., Chicago, Ill.

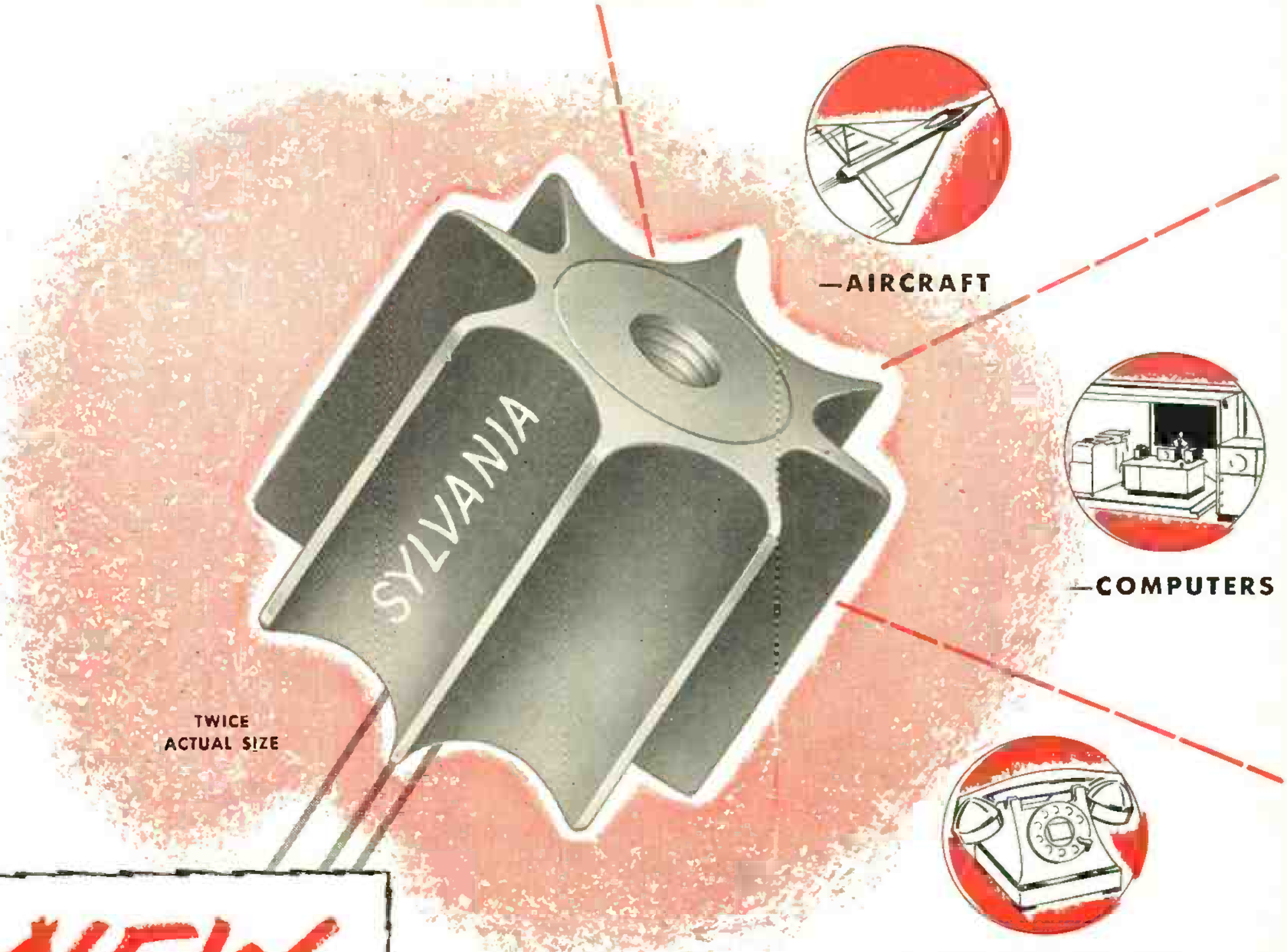
Arthur Hertzberg has been appointed Resident Field Engineer for Calif. by the Engineering Products Div. of the Radio Receptor Co., Inc., Brooklyn, N. Y.

Raytheon Manufacturing Co., Waltham, Mass., has announced the appointment of **Niles P. Gowell** as chief engineer of its receiving tube division.

The appointment of **Robert W. Fisher** as field sales engineer for Mobile Radio Sales of Allen B. Du Mont Laboratories, Inc., Clifton, N. J., has been announced.

Donald R. Proctor has been appointed assistant engineering manager in the Los Angeles Div. of the Electronic Engineering Co. of California.

Henry W. Patton has joined Airpax Products Co., Baltimore, Md., as project leader in the engineering dept.



NEW 60-VOLT power transistors

For circuits and systems where you need higher voltage ratings

—offers all the important advantages which made its 30-volt counterpart so popular

- **high current gain**
- **low thermal resistance**
- **4 watts average dissipation with heat sink**
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Here is an exclusive Sylvania Transistor development designed to broaden power transistor applications in circuits operating from power supplies up to 60 volts.

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Like its 30-volt counterpart, the new 60-volt power transistor provides high current gain over a wide range of operating conditions and high current switching for computer applications.

Write for complete details on these new 60-volt power transistors as well as the popular 30-volt series

60-volt power transistors	30-volt power transistors
*Type 2N141 (PNP)	*Type 2N68 (PNP)
Type 2N143 (PNP)	*Type 2N95 (NPN)
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Storage Tube Design

(*Continued from page* 83)

The final equation is valid when the secondary emission current is all collected and the operating region in the curve is small. These conditions are met satisfactorily in the write and erase operations.

It can be seen that the factor (d), which is the thickness of dielectric material and thus determines the capacitance between the storage surface and the conducting screen, and the factor $(1-\alpha_2)$, which is in effect the ratio of the area of the storage surface to the area of the apertures in it, both affect the charging speed in a direct proportion. Since the evaporation of additional storage material on the storage screen increases both these factors, it is apparent that priming and writing speeds can be sizably increased in the manufacture of the QK464 over the QK357 by increasing the amount of storage material evaporated on the storage screen.

It should also be noted that the current impinging on the storage surface (I_p in the last two equations) was reduced by an additional factor (α_2) in the early storage tubes since the beam current had to pass through the storage screen before striking the dielectric surface. Since α_2 is usually approximately 50%, the charging speeds for QK464's is directly increased by an additional factor of approximately 2 to 1 by the reversal of the storage screen.

Empirically derived curves of writing speed for various beam currents (Fig. 3) indicate that saturated writes are now attainable at a rate in excess of 0.05 µsec. per storage element with only 3 µa of beam current. Since the tube is capable of beam currents in excess of 25 µa with only a slight loss in spot size, it follows that writing speeds in excess of 0.02 µsec. per spot element are now obtainable.

The general plot of secondary emission as a function of the velocity or voltage of electrons striking a surface (Fig. 4) indicates that the factor (ρ) in the general equation for writing speed can be varied over a considerable range simply by the choice of the storage screen write voltage. Voltages near the critical potential of the storage surface will result in slow charging speeds since the secondary emission ratio will be close to unity. Fig. 5 shows the relationship obtained empirically between storage screen voltage and writing speeds, and indicates that a marked reduction in charging speed is obtainable by operating the stor-

(*Continued on page* 160)

Wraps coming off!

a presentation of
new magnetron,
klystron and
special microwave
tube types

RAYTHEON

MICROWAVE AND POWER TUBE OPERATIONS, WALTHAM 54, MASS.

Storage Tube Design

(*Continued from page* 158)

age screen slightly above critical potential during the write operation.

This feature is of definite value in applications where very slow scanning speeds are used during write, since control of charging speed solely by reducing the signal current may require such small input signals in extreme cases as to make the voltage regulation requirements on the electron gun excessively severe. Although it might be assumed that by operating very close to the critical potential during write, much slower charging speeds would be obtainable, there is a practical limit in that fixed pattern noise due to the inhomogeneities in the dielectric surface becomes more pronounced as the critical potential is approached.

The curves of priming speed vs. storage screen voltage (Fig. 6) show that there is an optimum setting of the storage screen for a maximum charging rate. By lowering the priming voltage to increase charging speed, the voltage range over which modulation can occur is diminished and so the dynamic range of storage is somewhat reduced. However, where priming speeds faster than can be obtained by simply increasing the beam current are desirable, a suitable compromise condition can usually be found.

Thus, with the QK464, an immediate gain in writing and priming speeds in the order of 2 to 1 is obtained by the reversal of the storage screen and the resultant increase in the portion of the beam current which strikes the dielectric surface. Further increases in charging speeds are also obtainable by proper choice of the storage screen voltage and, for special applications, by coating the screen with additional dielectric material. Similarly it has been found that for applications where slower writing speeds per unit beam current are in order to ease voltage regulation requirements, operation of the storage screen during write at a voltage near the critical potential will substantially reduce the rate at which the dielectric is charged by the writing beam current.

Beam Collimation

Although the previous recording-tube utilized a collimating lens to reduce nonuniformities in the output signal caused by the electron beam striking the storage surface at an increasing angle as the beam is scanned radially from the center,

(*Continued on page* 162)


STEINMAN STATIONS
top management
and engineering executives
both chose
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for their 480-foot
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NBC • CBS • DuMont
Stainless, inc.
North Wales, Pennsylvania
Clair McCollough
President
WGAL-TV
J. E. Mathiot
Technical Director
WGAL-TV

Storage Tube Design

(*Continued from page* 160)

further study of the lens design has resulted in improved collimation and a resultant improvement in background level uniformity of approximately 300%.

Fig. 1 shows field plots of the collimating lenses used in the new tube. The rays shown were constructed to be perpendicular to the decelerator screen and plotted back to determine the focal point of the lens and its aberration. It is noteworthy that the change in design significantly improved the lens characteristics so that rays originating at the center of deflection now strike the screen at right angles regardless of deflection angle. Since the rays drawn from the screen did not intersect at a common point in the QK357, there was no sharp focal point to use as the center of deflection for the deflection yoke and angular irregularities were therefore inevitable.

The improved collimating lens, though vastly improving output signal uniformity, caused new problems relating to an increased rate of ion spot formation on the stored charge pattern. This resulted from the fact that positive ions produced by the primary beam in the region between the center of deflection and the decelerator are sharply focused by the

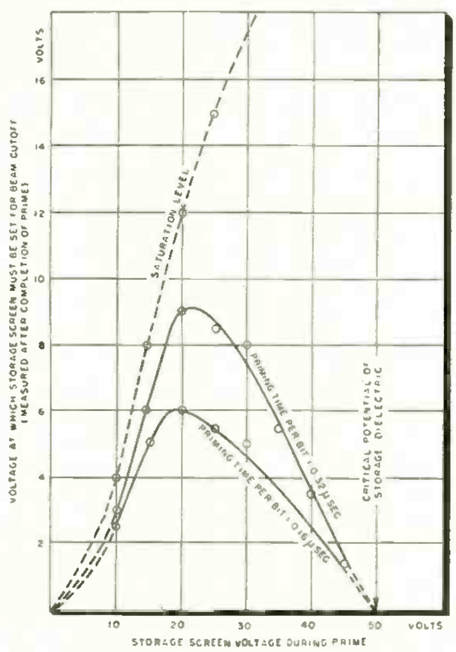
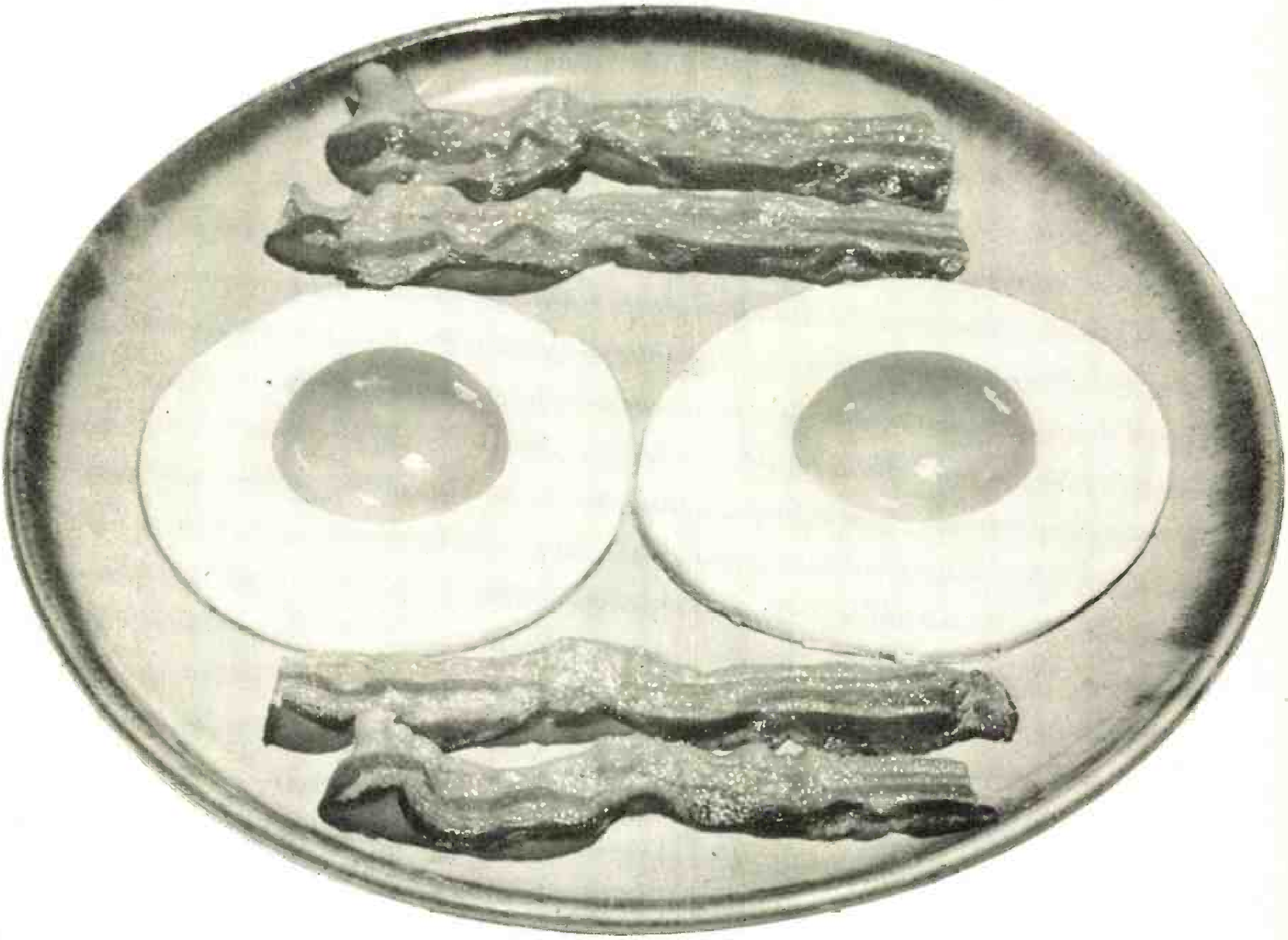


Fig. 6: Priming speed vs. storage screen voltage

field of the collimating lens. In fact, the calculated distribution curve of positive ions at the storage screen derived from electrolytic through field plots indicate, that over 50% of the positive ions produced in the region of the lens will strike the screen in a localized region near the axis of the tube approximately 3%

(*Continued on page* 164)



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Storage Tube Design

(*Continued from page* 162)

of the total screen area in size. Furthermore, with the storage surface on the electron gun side of the storage screen, these ions write a fixed pattern at the geometric center of the storage surface whenever the electron beam is on. This appears as an ion spot in the stored picture which increases in signal amplitude and size with repeated read-outs.

Since the size and rate of formation of the ion spot is a direct function of the gas pressure within the tube, the remedy was to improve the vacuum. Although modifications in exhaust techniques materially improved the vacuum at tube tip-off, pressures lower than 10^{-7} mm. of mercury after tip-off are not feasible in commercial production. A dynamic getter has therefore been provided along with the customary flash-type getters, and a zirconium coil has been inserted within the heater to provide continuous gettering of gases evolved during operation.

The final change has been brought about because the storage and the decelerator screens, which consist of a low-mass, tightly stretched 500-mesh material, are prone to "ring" or vibrate for long periods of time when shock-excited. These screens were still shock-excited by the action of switching the storage screen potential between steps of the operational cycle even after collector switching had been eliminated. By balanced spacing of the storage electrode between the decelerator and the signal electrode, and by use of identical voltages on these two elements, voltage shock excitation has now been prevented, since the forces are balanced when the screen voltage is switched.

The design changes described have successfully overcome the problems hitherto experienced by applications engineers when using recording tubes. Moreover, the new tube design is simpler to manufacture and can be readily mass-produced. An additional feature is that the QK464 can be directly inserted into circuits designed for the QK357, although it may be desirable to eliminate the voltage switching of the collector when replacing the older type.

(*This article is based on a paper delivered at the National Conference on Aeronautical Electronics, IRE, Dayton, Ohio, May 11, 1955.*)

References

1. R. C. Hergenrother and B. C. Gardner, "The Recording Storage Tube," *Proc. IRE*, Vol. 38, p 740, July 1950.
2. R. C. Hergenrother and A. S. Luftman, "Single-Gun Storage Tube Writes, Reads and Erases," *Electronics*, p 126, March 1953.
3. R. C. Hergenrother, "Electric Aperture Lenses," Electron Tube Research Conference, Univ. of Maine, June, 1954.

MALLORY

New 1700 series Mallory split-reed vibrator uses special alloy leaves which serve both as contacts and as springs . . . eliminating usual button contacts. Life is greatly increased, constancy of output improved, and driving power reduced.*

**Patent Applied For*

New Heavy Duty Mallory Vibrator

gives far longer life, constant output

For the peak in dependability and performance, plan to use this newest Mallory vibrator in your communications equipment. A completely new idea in vibrator design eliminates conventional contact buttons. The spring leaves themselves . . . made of special contact alloy . . . act as contacting members. This design provides greatly increased contact area, with these important advantages:

Consistently Longer Life. Tests made on heavy duty cycles prove up to 100% greater service can be expected . . . with a high degree of consistency.

Steadier Output. The decreased rate of erosion means less change in contact spacing, less variation in voltage.

Flare-Proof Starting. The new low-mass design permits wider contact spacing to prevent start-up flare . . . without need for greater driving power.

Exceptional Uniformity of characteristics is made possible by the simplified design.

Minimum Size for heavy duty ratings.

The new design is available in the split-reed type shown here, for 6/12 volt service, and in the Duplex heavy duty model without the split reed construction. For full technical data, and for a consultation on your specific power supply requirements, write or call Mallory.

COMPLETE POWER SUPPLIES

It may be that you can save time and reduce over-all costs by employing a complete Mallory Vibrapack® power supply. Vibrapacks can be engineered around the new heavy-duty 1700 series vibrator to give long, reliable service. Design includes precise balancing of critical components. Normal ratings are conservative. Compact-sized Vibrapacks fit readily into crowded layouts. For further information, advise Mallory of your specific requirements.

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Manufacturers' Assoc. Elects Officers and Directors

The Electronics Manufacturers Assoc. announces that the following officers have been elected. President, Mr. I. A. Mitchell of United Transformer Company; Treasurer, Mr. Hyman Winograd of Presto Recording Corp.; Secretary, Mr. Allan C. Bernstein of Adams Laboratories, Inc.

Elected to the Board of Directors were David Wald of Dewald Radio Mfg. Co., and United Scientific Laboratories, Inc.; I. Walter Wyckoff of Pilot Radio Corp.; Lloyd Hammarlund of Hammarlund Mfg. Co. Inc.; and Arthur Blumenfeld of University Loudspeakers, Inc.

Electronics Manufacturers Association Inc., 598 Madison Avenue, New York 22, N. Y.

IRE Convention

(Continued from page 76)

velopment Center, Griffiss Air Force Base, Rome, N. Y.

An Analysis For Human Flight Control, L. J. Fogel, Stavid Engineering, Inc., Plainfield, N. J.

Enhancement of Aircraft Radar Return by Use of Airborne Reflectors and Circular Polarization, J. J. Panaslewicz, Rome Air Development Center, Griffiss Air Force Base, Rome, N. Y.

A Three-Dimensional Aircraft Visibility Diagram, A. Feiner and F. Diamond, Rome Air Development Center, Griffiss Air Force Base, Rome, N. Y.

TRENDS IN TV EQUIPMENT

Chairman: S. Helt, DuMont Labs., 750 Bloomfield Ave., Clifton, N. J.

High Stability Television Synchronization Generator, F. T. Thompson, Westinghouse Electric Corp., Electronics and Nuclear Physics Dept., East Pitts., Pa.

A Pedestal Processing Amplier for Television, R. C. Kennedy, NBC, RCA B'ldg., N. Y. 20, N. Y.

A New Electronic Masker for Color Television, J. H. Haines, A. B. DuMont Labs., Inc., 2 Main Ave., Passaic, N. J.

Reworking the Network or Remote Video Signal, R. R. Embree, KING-TV, 320 Aurora Ave., Seattle, Wash.

A New Color Camera for Closed-Circuit Applications, L. E. Anderson, RCA, Camden, N. J.

AUDIO TECHNIQUES

Chairman: H. S. Knowles, Knowles Electronics, Inc., 9400 Belmont Ave., Franklin Park, Ill.

A Simplified Procedure for the Design of Transistor Audio Amplifiers, W. W. Wells and A. E. Hayes, Jr., North American Aviation, 12214 Lakewood Blvd., Downey, Calif.

An Audio Flutter Weighting Network, F. A. Comerci, 63 Carleton Terrace, Nutley, N. J.

A Flutter Meter Incorporating Subjective Weightings, M. A. Cotter, Consumers Union of the U. S., Inc., Mount Vernon, N. Y.

Performance Measurements of Magnetic Tape Recorders, J. B. Hull, Audio Div., Ampex Corp., 934 Charter St., Redwood City, Calif.

A 3000 Watt Audio Power Amplifier, A. B. Bereskin, Prof. of Electrical Eng'rg., Univ. of Cincinnati, Cincinnati 21, Ohio

ANTENNAS AND PROPAGATION

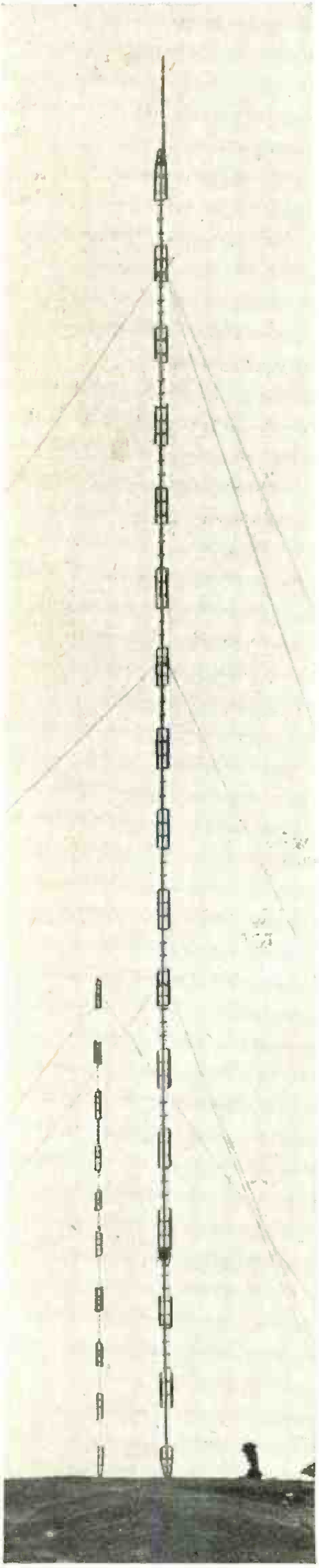
Chairman: G. Sinclair, Pres., Sinclair Radio Labs., Ltd., 70 Sheffield St., North Park P. O., Ontario, Can.

A Theory of Scattering by Non-Isotropic Irregularities with Application to Radar Reflections from the Aurora, H. J. Booker, Cornell Univ., Ithaca, N. Y.

Correlation of Radar Sea Clutter on Vertical and Horizontal Polarization with Wave

(Continued on page 170)

NEW 1282-FOOT TRUSCON TOWER HELPS WWTV REACH 42 COUNTIES



More than 300,000 television sets are now receiving a signal from WWTV in Cadillac, Michigan, thanks to their new cloud-scraping Truscon Tower.

Truscon® designed, built and erected this gigantic steel structure which replaced a 530-foot Truscon tower that had been used since the station went on the air January 1, 1954

One of the tallest in the world, this installation is typical of the Truscon Towers going up all over the country to serve our increasing television requirements. Station executives realize that for year-in, year-out dependability, nothing stands up so well through extremes in wind and weather—in all types of topography—as Truscon Steel Towers.

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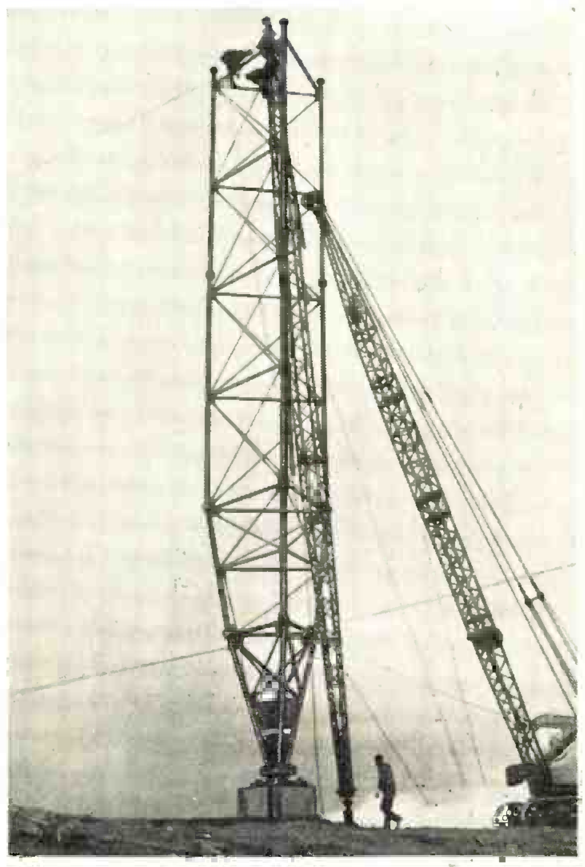
Firmly supported by guy wires, WWTV's majestic 200-ton Truscon Tower measures 1,202 feet, is topped by an 80-foot television antenna. The old 530-foot tower is in the background.

Erection is underway on the big tower. Triangular in shape, the sides measure 11 feet. A glance at the completed tower (left) shows a long way to go.



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NBC, Westinghouse Swap Radio and TV Properties

A two-way swap of broadcast properties between NBC and Westinghouse last month saw the transfer of NBC's Cleveland stations, WNBK, WTAM and WTAM-FM to Westinghouse, and the latter's Philadelphia stations, KYW and WPTZ, to NBC. An additional $3,000,000 was paid by NBC in the transaction.

The call letters of the Philadelphia stations were immediately changed by NBC to WRCV and WRCV-TV, and plans were announced to install facilities for originating local TV programs in color. Lloyd E. Yoder, veteran NBC station manager, was named general manager of the new NBC acquisition.

New Motorola Expansion

Plans for a $3,000,000 addition to their military electronics engineering, research, and production facilities in Phoenix, Ariz. have been announced by Motorola Inc.

The new building, with 150,000 sq. ft. will bring Motorola's lab and manufacturing facilities in the area to 325,000 sq. ft.

The company also announced that they are activating a new $1½ million transistor manufacturing plant in the Phoenix area.

Military Semiconductors Available to Industry

A number of semiconductor products, currently manufactured by Western Electric's Laureldale, Pa. plant and previously made under contract only for the U. S. Army Signal Corps, will now also be sold directly to other government agencies and their contractors working on military development and production contracts, the company has announced.

Point contact transistors, 2N21, 2N21A and the 2N67 are available; also the n-p-n junction triode 2N27, the p-n-p alloy power transistor, 2N66, and the 3N22 n-p-n grown junction tetrode.

Also available is the 1N85 phototransistor which features low dark current, high output, and wide band operation, and the silicon alloy junction varistors 1N330 and the 1N331.

For further data contact: Western Electric Co., Radio Div., Electronics Products Dept., 120 Broadway, New York 5, New York.

IRE Convention

(*Continued from page 168*)

Height and Slope, F. C. Macdonald, Naval Research Lab., Wash., D. C.
Precipitation Particle Impact Noise in Aircraft Antennas, R. L. Tanner, Stanford Research Inst., Stanford, Calif.
Analysis of Conical Scan Antennas for Tracking, J. B. Damonte and D. J. Stoddard, Dalmo Victor Co., 1414 El Camino Real, San Carlos, Calif.
Correction To Current Distribution on Curved Reflectors, R. Plonsey, Univ. of Calif., Berkeley, Calif.

SYMPOSIUM ON AIR FORCE COMMUNICATIONS AND ELECTRONICS PROBLEMS AND PHILOSOPHIES

Chairman: Major General Gordon A. Blake, Director of Communications, Headquarters, USAF
Speakers: Col. G. Gould, Air Research & Development Center, Baltimore, Md.
H. Davis, Technical Director, Rome Air Development Center, Utica, N. Y.
L. M. Hollingsworth, Director, USAF Cambridge Research Center, Cambridge, Mass.

MICROWAVE TUBES

Chairman: G. A. Espersen, Philips Laboratories, Irvington-on-Hudson, N. Y.
An Investigation of a Traveling Wave Tube with an External Slow Wave Structure Using Lumped Circuit Elements, A. R. Matthews, C. T. Soh, K. R. Spangenberg, Stanford Univ., Electronics Research Lab., Stanford, Calif.
Behavior of Hollow Beams in Radial Electrostatic Fields, L. A. Harris, GE, The Knolls, Schenectady, N. Y.
Microwave Transmitter Tuning by Rapid-Interchange, Fixed-Frequency Klystrons, R. A. La Plante, Philips Laboratories, Irvington-on-Hudson, N. Y.
Design and Performance of Low Noise Guns for Traveling Wave Tubes, R. C. Knechtli and W. R. Beam, RCA, Princeton, N. J.
Backward Wave Oscillators, W. Menke, Sperry Gyroscope Co., Great Neck, N. Y.
Backward Wave Oscillators for Low Voltage Operation, W. L. Beaver, Varian Associates, 611 Housen Way, Palo Alto, Calif.

QUALITY CONTROL AND RELIABILITY STUDIES OF ELECTRONIC EQUIPMENTS

Chairman: J. R. Steen, Sylvania Electric Products Inc., 700 Ellicott Street, Batavia, N. Y.
Achieving and Analyzing Operational Reliability with Equipment of Imperfect Intrinsic Reliability, W. F. Luebbert, Electronics Research Lab., Stanford Univ., Stanford, Calif.
Some Reliability Aspects of Systems Design, F. Moskowitz and J. B. McLean, Rome Air Development Center, Griffiss Air Force Base, Rome, N. Y.
Training for Quality Control, C. J. Quirk, Allen B. DuMont Laboratories, Inc., General Quality Control Dept., 750 Bloomfield Ave., Clifton, N. J.
A Bombing System Reliability Program, R. L. Wendt and M. H. Smith, Engineering Div., Sperry Gyroscope Co., Great Neck, N. Y.
A Reliability Department Operation for Production Missiles, E. F. Dertinger, Bendix Products Div.—Missiles, Missile Sec., 400 S. Beiger St., Mishawaka, Mich.

NUCLEAR INSTRUMENTATION

Chairman: M. A. Schultz, Westinghouse Electric Corp., Commercial Atomic Power Div., P. O. Box 355, Pitts., Pa.
Some Transistor Circuits Used in a Magnetic Core Type Kicksorter, F. S. Goulding, Atomic Energy of Canada, Ltd., Chalk River Proj., Chalk River, Ont., Can.
Punch Card Recording of Multiple Counting Data, H. D. LeVine and Henry Sadowski, U. S. Atomic Energy Commission, Health and Safety Lab., 70 Columbus Ave., N. Y., N. Y.
Instrument Opportunities in Nuclear Systems, V. Parsegian, Chairman of the Eng'rg. Gp., Prof., Nuclear Engineering, Rensselaer Polytech. Inst., Troy, N. Y.
Control Aspects of Boiling Water Power Plant, W. C. Lapinski, Argonne National Lab., P. O. Box 299, Lemont, Ill.
Geneva Reactor Control Systems, S. H. Hanauer and E. P. Epler, Oak Ridge National Lab., P. O. Box P, Oak Ridge, Tenn.

NAVIGATION

Chairman: W. T. Carnes, Jr., Manager Electronics Eng'rg., Aeronautical Radio, Inc.,

(*Continued on page 173*)

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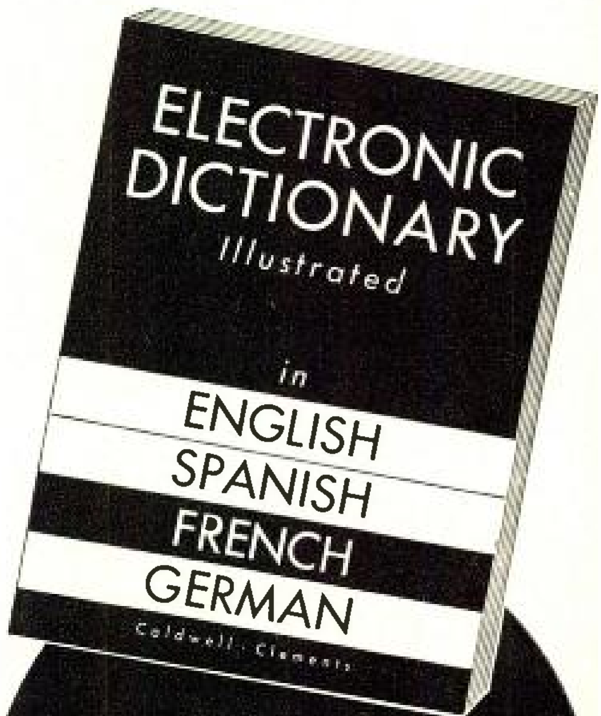

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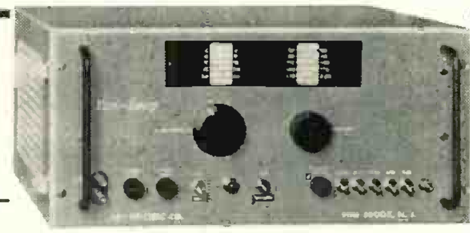

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IRE Convention

(*Continued from page 170*)

1523 "L" Street, N. W., Wash. 5, D. C.
A Radiometric Inertial Reference System, V. W. Bolie, Collins Radio Co., Cedar Rapids, Io.
Analytical Prediction of Missile Guidance Accuracy, W. E. Mathews, Hughes Aircraft Co., Culver City, Calif.
Considerations Affecting the Choice of a Long Range Navigation System, S. Rosenberg, Rome Air Development Center, Griffiss Air Force Base, Rome, N. Y.
Doppler Type High Frequency Radio Direction Finder, J. A. Fantoni and R. C. Benoit, Jr., Rome Air Development Center, Griffiss Air Force Base, Rome, N. Y.
USAF UHF Direction Finding Facility, R. C. Benoit, Jr. and J. A. Fantoni, Rome Air Development Center, Griffiss Air Force Base, Rome, N. Y.
Colocation of Tacan VOR-DME Systems, P. E. Ricketts, Rome Air Development Center, Griffiss Air Force Base, Rome, N. Y.

TV TRANSMITTING EQUIPMENT AND TECHNIQUES

Chairman: J. B. Epperson, Scripps-Howard Radio, Inc., 1816 E. 13th St., Cleveland 14, Ohio.
High-Gain Antenna Arrays for Television Broadcast Transmission Using a Slotted Ring Antenna, A. Alford and H. H. Leach, Alford Manufacturing Co., 299 Atlantic Ave., Boston, Mass.
Self-Diplexing Antenna for TV Transmitters, C. B. Mayer and P. M. Pan, GE, Syracuse, N. Y.
Television Field Intensity Measurements—A Tool in Transmitting Antenna Planning, R. E. Rohrer and O. Reed, Jr., Jansky & Bailey, Inc., 1735 De Sales St., N. W., Wash. 6, D.C.
A New Monitor for Television Transmitters, C. A. Cady, General Radio Co., 275 Mass. Ave., Cambridge, Mass.
A Pack Type Television System, W. B. Harris, RCA, Camden, N. J.

HIGH QUALITY SOUND REPRODUCTION

Chairman: D. W. Martin, The Baldwin Piano Co., 1801 Gilbert Ave., Cincinnati 2, O.
Equalization Considerations in the Design of High Quality Tape Recorders, R. H. Snyder, Ampex Corp., 934 Charter St., Redwood City, Calif.
Design of a High Fidelity 10-Watt Transistor Audio Amplifier, R. P. Crow and R. D. Mohler, Motorola, Inc., 4545 Augusta Blvd., Chicago 51, Ill.
Performance of the "Distributed Port" Loudspeaker Enclosure, A. F. Petrie, Radio and Television Dept., GE, Syracuse, N. Y.
A Phonograph System for the Automobile, P. C. Goldmark, Pres., CBS Laboratories, 485 Madison Ave., N. Y. 22, N. Y.
The Recent History of High Quality Magnetic Phonograph Pickups, N. C. Pickering, Pickering and Company, Inc., Oceanside, N. Y.

TELEMETERING COMPONENTS

Chairman: J. J. Dover, Office of Research and Development, Edwards Air Force Base, Calif.
Calibration Errors in Wire Strain Gage Transducer Systems, W. Harrison, Allegheny Instrument Co., Inc., P. O. Box 1091, Cumberland, Md.
Precision Subcarrier Discriminator for FM Telemetering, W. H. Duerig, Electro-Mechanical Research Inc., 64 Main St., Ridgefield, Conn.
Automatic Tracking Antenna Array for the 217 mc/s Telemetering Band (APOTA), H. G. Oltman, Jr. and B. J. Bittner, Sandia Corp., Sandia Base, Albuquerque, N. Mex.
Subminiature Telemetering Transmitter, L. R. Hendershot, ACF Electronics, 800 North Pitt St., Alexandria, Va.
A Bi-Directional Pulse Totalizer for Control and Telemetry, H. D. Wright, Anatran Engineering Corp., 165 East Calif. St., Pasadena, Calif.

ELECTRON TUBES

Chairman: G. D. O'Neill, Sylvania Electric Products Inc., Sylvania Center, Bayside, N. Y.
Image Orthicon for Pickup at Low Light Levels, A. A. Rotow, RCA, Lancaster, Pa.
Heat-Flow Considerations in the Design of High-Dissipation Receiving Tubes, O. H. Schade, Jr., RCA, Harrison, N. J.
The Hy-Tramp, A Grid Controlled High Transconductance Electron Multiplier, W. E. Hostetler, National Union Electric Corp., 350 Scotland Rd., Orange, N. J.
A Long-Life Cathode for High-Power UHF Transmitting Tubes, M. J. Slivka and R. E.

(*Continued on page 175*)

IRE Convention

(*Continued from page 173*)

Manfredi, GE, Power Tube Sub-Dept., 1 River Rd., Schenectady 5, N. Y.
A Method of Measuring Cathode Interface Impedance, W. U. Shipley, GE, 316 E. 9 St., Owensboro, Ky.

SYMPOSIUM: THE U. S. EARTH SATELLITE PROGRAM—VANGUARD OF OUTER SPACE

Chairman: W. R. G. Baker, Vice-Pres., GE, Syracuse, N. Y.
The Background of the Program, J. P. Hagen, Naval Research Laboratory, Wash., D. C.
The Satellite Program, W. H. Pickering, Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, Calif.
Placing the Satellite, M. W. Rosen, Naval Research Lab., Wash., D. C.
Orbital Changes and Optical Tracking, F. L. Whipple, Harvard Univ., Cambridge, Mass.
Locating the Satellite by Radio, J. T. Mangel, Naval Research Lab., Wash., D. C.
The Telemetering and Propagation Problems, H. K. Ziegler, Signal Corps Engineering Lab., Ft. Monmouth, N. J.
The Scientific Value of the Program, J. A. Van Allen, State Univ. of Iowa, Iowa City, Iowa

COLOR TELEVISION TAPE RECORDING

Chairman: W. W. Wetzel, Minnesota Mining & Manufacturing Co., 900 Fauquier Ave., Saint Paul 6, Minn.
A Magnetic Tape System for Recording and Reproducing Standard FCC Color Television Signals—General Considerations, H. F. Olson, RCA Laboratories, Princeton, N. J.
Electronic System, W. D. Houghton, RCA Laboratories, Princeton, N. J.
The Magnetic Head, J. A. Zenel, RCA Laboratories, Princeton, N. J.
The Tape Transport Mechanism, A. R. Morgan and M. Artzt, RCA Laboratories, Princeton, N. J.
Audio Systems, J. G. Woodward, RCA Laboratories, Princeton, N. J.

Wednesday, March 21, A.M.

MICROWAVES—I—GENERAL

Chairman: W. A. Edson, Applied Electronics Lab., Stanford Univ., Stanford, Calif.
Leakage Radiation from a Braided Co-Axial Cable, E. R. Schatz, M. E. Taylor, R. F. Robl, and K. L. Konnerth, Carnegie Inst. of Tech., Pitts. 13, Pa.
A Trimode Turnstile Wave Guide Junction, R. S. Potter, Naval Research Lab., Wash. 25, D. C.
The H-Guide, A Waveguide for Microwaves, F. J. Tischer, 114 Hillandale Rd., Huntsville, Ala.
Microwave Spectrum Synthesis Using the Traveling Wave Tube, P. D. Lacy, Hewlett-Packard Company, 275 Page Mill Rd., Palo Alto, Calif.
An Orthogonal Mode Transducer, R. L. Fogel, Hughes Research Laboratories, Culver City, Calif.

ENGINEERING MANAGEMENT TECHNIQUES

Chairman: C. N. Kimball, Pres., Midwest Research Inst., Kansas City, Mo.
Words Needn't Fail, P. Beall, Management Consultant, Box 1562, Annapolis, Md.
How Teamwork Brainstorming Solves Problems, W. A. Pleuthner, Vice-Pres., Batten, Barton, Durstine & Osborn, Inc., 383 Madison Ave., N. Y., N. Y.
Strengthening the Recognition of Engineering, G. W. Griffin, Jr., Director of Public Relations, Sylvania Electric Products Inc., 1740 B'way, N. Y. 19, N. Y.
The Motivation of Technical People, L. Spencer, Pres., Science Research Associates, 57 W. Grand Ave., Chicago, Ill.

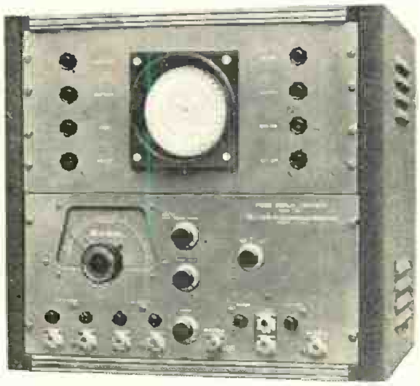
FLIGHT DATA REDUCTION SYSTEMS

Chairman: H. R. Denius, Pres., Radiation, Inc., P. O. Box Q, Melbourne, Fla.
An Improved System for Collecting and Processing Flight Test Data, H. W. Royce, Instrumentation Section, Glenn L. Martin Co., Baltimore 3, Md.
Airborne Data Acquisition System, W. H. Foster, Electronic Engineering Co., 180 S. Alvarado St., L. A. 57, Calif.
Requirements of a High Speed, High Quantity, All-Electronic Data Processing System, F. K. Williams, Rocketdyne Field Lab., Rocketdyne, Canoga Pk., Calif.

(*Continued on page 177*)

Wickes

PHASE DISPLAY EQUIPMENT



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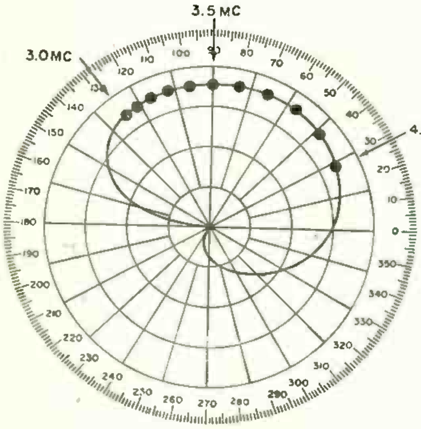
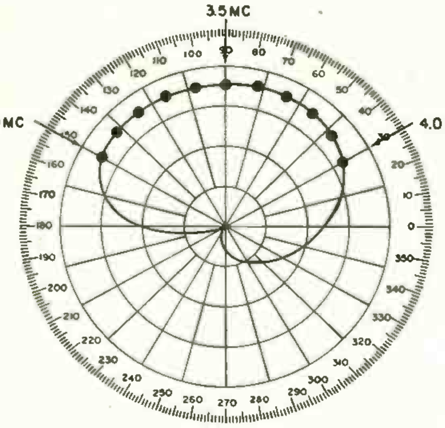


NON-LINEAR PHASE RESPONSE

Response showing poor phase linearity (indicated by non-uniform spacing of markers) in the region of the color subcarrier and sidebands. A system having this non-linear phase response will produce an unsatisfactory color picture.



LINEAR PHASE RESPONSE

Response showing linear phase repsonse (note uniform spacing of markers). A system having this response will produce a satisfactory color picture.

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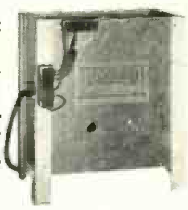

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IRE Convention

(Continued from page 175)

Techniques for a High Speed, High Quantity, All-Electronic Data Processing System, Idiot II, M. L. Klein, Rocketdyne Field Lab., Rocketdyne, Canoga Park, Calif.

BROADCAST AND TELEVISION RECEIVERS

Chairman: L. R. Fink, M'gr., Research Applications Services, Research Lab., GE, Box 1088, Schenectody, N. Y.

Application of Transistors to Battery-Powered Portable Receivers, J. W. Englund, RCA, Tube Div., Harrison, N. J.

Stability Considerations in Transistor IF Amplifiers, D. D. Holmes and T. O. Stanley, RCA Laboratories, Princeton, N. J.

Analysis of Double Tuned Transformers for Transistor Amplifiers, J. Hellstrom, Westinghouse Electric Corp., Television-Radio Div., Metuchen, N. J.

Transient Response Versus Chrominance Bandwidth in Simultaneous Color Television Receivers, C. W. Baugh, Jr., and H. E. Sweeney, Westinghouse Electric Corp., Metuchen, N. J.

A Deflection and Convergence System for Use with the Color Picture, R. B. Gethmann, GE, #2-223, Thermionics, Electronics Lab., Electronics Park, Syracuse, N. Y.

CIRCUIT—I—SYMPOSIUM ON APPLICATION OF RECENT NETWORK IDEAS TO FEEDBACK SYSTEM PROBLEMS

Chairman: J. R. Ragazzini, Prof. of Electrical Engineering, Columbia Univ. Engineering Bldg., N. Y. 27, N. Y.

Network Theory in the Practical Design of Control Systems, J. G. Truxal, Engineering Dept., Polytechnic Inst. of B'klyn., 99 Livingston St., B'klyn. 1, N. Y.

The Stability Concept, J. L. Bower, Electromechanical Dept., North American Aviation, Inc., 12214 Lokewood B'lvd., Downey, Calif.

Root Locus in Feedback System Synthesis, J. A. Aseltine, Systems Research Corp., Calif.

Modulated Control Systems, R. E. Graham, Bell Telephone Laboratories, Murray Hill, N. J.

NUCLEAR EFFECTS ON ELECTRONIC SYSTEMS

Chairman: Brig.-Gen. E. C. Cook, Signal Corps. Eng. Labs., Ft. Monmouth, N. J.

Effects of Nuclear Radiation on Electronic Components, T. Baldwin, Evans Signal Lab., Belmar, N. J.

Nuclear Effects on Communication Systems, J. Eggert, Signal Corps Engineering Labs., Ft. Monmouth, N. J.

Dose Rate Dependence of Dosimeters at Dose Rates up to Two Million Roentgen Per Hour, M. Stein, Evans Signal Lab., Belmar, N. J.

Techniques of Measurement at High Radiation Rates, P. Brown, Signal Corps Engineering Labs., Ft. Monmouth, N. J.

Radiological Instrumentation, J. Carp, Signal Corps Engineering Labs., Ft. Monmouth, N. J.

ANTENNAS AND PROPAGATION—ANTENNAS

Chairman: J. F. Byrne, Motorola, Inc., Riverside Research Lab., 8330 Indiana Ave., Riverside, Calif.

Cross Polarization Effects on Antenna Radiation Patterns, N. Marchond, Marchand Electronic Laboratories, 255 Mill St., Byram, Conn. and W. G. Scott, Melpar, Inc., 3000 Arlington Blvd., Falls Church, Va.

A Vertical Antenna Made of Transposed Sections of Coaxial Cable, H. A. Wheeler, Wheeler Laboratories, Inc., 122 Cutter Mill Rd., Great Neck, N. Y.

Electrically Small Ferrite Loaded Loop Antennas, V. H. Rumsey and W. L. Weeks, Univ. of Ill., Urbana, Ill.

A Wide Band Coaxial Hybrid, A. Alford and C. B. Watts, Jr., Andrew Alford, Consulting Engineers, 299 Atlantic Ave., Boston 10, Mass.

Dielectric Bifocal Lenses, R. M. Brown, Microwave Antennas and Components Branch, Electronics Div., Naval Research Lab., Wash. 25, D. C.

Wednesday, March 21, P.M.

ELECTRONIC COMPUTERS—I

Chairman: D. R. Brown, Lincoln Lab., M. I. T., P. O. Box 73, Cambridge 72, Mass.

A Multiple Input Analog Multiplier, D. D. Porter and A. S. Robinson, Columbia Univ., Electronics Research Labs., 632 W. 125 St., N. Y. 27, N. Y.

(Continued on page 179)

PROBLEM

Design a charging reactor with an inductance of 4.85 henrys (±7%) at 150 ma, DC, and an inductance linearity of 20%. It should operate at 8000 volts DC, be tested at 14,000 RMS volts, and continuously useable in the frequency range up to 2000 cps. It should have a maximum temperature rise of 125°C in a standard ambient, also a maximum effective capacitance of only 60 micromicrofarads when measured in the frequency range between 20 and 25 megacycles. Other prime factors are minimum weight and dimension. Construction to be in strict accordance with the applicable requirements of MIL-T-27.

. . . SOLUTION

Inductance	4.85 henrys ± 5% @ 150 ma, DC
Linearity	10%
Operating Voltage	DC = 8000
Test Voltage RMS	16,000
Useable at F up to	2000 cps
Maximum Temp. Rise	100° C
Ambient Temperature	25° C
Max. Effective Cap.	51 micromicrofarads (measured at 20-25 megacycles)
Weight	2-3/4 lbs.
Dimensions, nominal	H — 3-1/2" + 3/8" terminal W — 2-7/8" L — 3-13/16"

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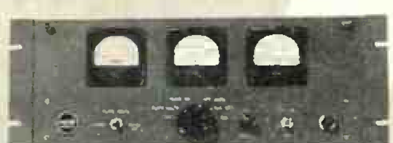

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IRE Convention

(Continued from page 177)

Analogue Multiplying Circuits Using Switching Transistors, K. Chen and R. O. Decker, Westinghouse Electric Corp., E. Pitts., Pa.
Logic Design of the RCA BIZMAC Computer, A. D. Beard, L. S. Bensky, D. L. Nettleton and G. E. Poorte, RCA, Camden, N. J.
Input and Output Devices in the RCA BIZMAC System, J. A. Brustman, K. L. Chien, C. T. Cole and D. Flechtner, RCA, Camden, N. J.
The Burroughs Series G High-Speed Printer, E. M. DiGiulio, Control Instrument Co., Inc., 67 35th St., B'klyn. 32, N. Y.

MICROWAVES—II—FERRITES

Chairman: C. L. Hogan, Harvard U., Pierce Hall, Cambridge 38, Mass.
The Design of Non-Reciprocal Phase Shift Sections, H. N. Chait and N. G. Sakiotis, NRL, Microwave Antennas and Components Branch, Wash. 25, D. C.
Tensor Permeabilities of Ferrites Below Magnetic Saturation, E. G. Spencer and R. C. Le Craw, The Diamond Ordnance Fuze Labs., Wash. 25, D. C.
A Miniaturized High Temperature Isolator, R. F. Sullivan and R. C. Le Craw, The Diamond Ordnance Fuze Labs., Wash. 25, D. C.
Broadbanding Ferrite Microwave Isolators, P. H. Vartanian, J. L. Melchor and W. P. Ayres, Electronic Defense Lab., Sylvania Electric Products Inc., P. O. Box 205, Mountain View, Calif.
Ferrite Microwave Phaseshifters, R. F. Soohoo, Cascade Research Corp., 53 Victory Lane, Los Gatos, Calif.
A Balanced Stripline Isolator, O. W. Fix, Box 915, Holloman AF Base, N. M.

DESIGN APPROACHES WITH PRINTED WIRING

Chairman: F. R. Lack, V. P., Western Electric Co., 120 Broadway, N. Y. 5, N. Y.
Engineering of Printed Circuits to Facilitate Production, R. C. Calcut and C. A. Artz, Admiral Corp., 3800 Cortland St., Chicago 47, Ill.
Principles of Circuit Design for Automation, H. S. Dordick, Engineering Div., RCA, Camden 2, N. J.
Modular Construction—Its Implications to the Design Engineer, R. E. Bauer, ACF Electronics, 800 North Pitt St., Alexandria, Va.
A New Automation Technique For Soldering Components to Foil-Wire Boards, A. A. Lawson, P. E. Ritt, Jr., and H. K. Hazel, Melpar, Inc., 3000 Arlington Blvd., Falls Church, Va.
Printed Circuits Via Xerograph, F. A. Schwertz and E. M. Van Wagner, The Haloid Co., Rochester 3, N. Y.
Cupric Oxidized Copper Foil For Printed Circuit Laminates, L. W. McGinnis, J. S. Tatnall and G. H. Mains, National Vulcanized Fibre Co., Research and Development Lab., Yorklyn, Del.

OVER-THE-HORIZON SYSTEMS

Chairman: K. Bullington, Bell Telephone Labs., 463 West St., N. Y. 14, N. Y.
VHF Trans-horizon Communication System Design, R. M. Ringoen, Collins Radio Co., Cedar Rapids, Ia.
Over-the-Horizon Radio Transmission Tests Between Florida and Cuba, K. P. Stiles, American Telephone and Telegraph Co., 32 Ave. of The Americas, N. Y. 13, N. Y.
A Broadband Over-the-Horizon Link—Florida to Cuba, R. T. Adams, H. Havstad, L. Pollack and W. Sichak, Federal Telecommunication Labs., 500 Washington Ave., Nutley 10, N. J.
An Over-the-Horizon Radio Link Between Puerto Rico and the Dominican Republic, R. E. Gray and R. A. Felsenheld, Federal Telecommunication Labs., 500 Washington Ave., Nutley 10, N. J.
Relative Interference Produced by UHF Scatter and Line-of-Sight Systems, R. M. Ringoen, Collins Radio Co., Cedar Rapids, Ia.

COLOR TELEVISION RECEIVERS

Chairman: H. A. Bass, Appliance and Electric Div., AVCO Mfg. Corp., Crosley Div., Arlington, Cincinnati, O.
The "Chromatron" as the Basis For Low-Cost Television Receivers, R. D'Amato, R. Dressler, A. Jacobs, Chromatic Television Labs., Inc., 1501 Broadway, N. Y. 36, N. Y., and J. R. Papkin-Clurman and S. M. Decker, Telechrome Manufacturing Corp., 88 Merrick Rd., Amityville, L. I., N. Y.
The Optimum Relative Phosphor Efficiencies, S. K. Altes, GE, Electronics Div., Room 114, Building 3, Electronics Lab., Syracuse, N. Y.
A New Color Television Display—the Apple System, J. S. Bryan, R. G. Clapp, E. M.

(Continued on page 180)

IRE Convention

(Continued from page 179)

Creamer, S. W. Moulton and M. E. Partin, Philco Corp., C and Tioga Sts., Research Div., Philadelphia 34, Pa.

A Beam-Indexing Color Picture Tube—the Apple Tube, G. F. Barnett, F. J. Bingley, S. L. Parsons, G. W. Pratt and M. Sadowsky, Research Div. and Lansdale Tube Co., Philco Corp., C and Tioga Sts., Philadelphia 34, Pa.

Current Status of Apple Receiver Circuits and Components, R. A. Bloomsburgh, W. P. Boothroyd, G. A. Fedde and R. C. Moore, Philco Corp., Advanced Development Lab., Television Div., C and Tioga Sts., Philadelphia 34, Pa.

TELEMETERING SYSTEMS

Chairman: H. W. Royce, Instrumentation Section, Glenn L. Martin Co., Baltimore 3, Md.

Automatic Remote Control and Telemetering by Telephone, C. H. Doersam, Jr., Doerco-Consultants, P. O. Box 177, Part Washington, N. Y.

Noise and Crosstalk in Multiplexed FM Systems, R. A. Runyan, Electro-Mechanical Research, Inc., 64 Main St., Ridgefield, Conn.

High Capacity Pulse Code Telemeter and Data Reduction System, G. S. Shaw, Radiation, Inc., Melbourne, Fla.

The Development of a High Speed Electronic Multiplexer and Coder For Use With a PCM Telemeter, R. P. Bishop and R. E. Marquand, Radiation, Inc., Melbourne, Fla.

ELECTRONIC COMPUTERS—II

Chairman: J. H. Howard, Burroughs Corp., Burroughs Research Center, Paoli, Pa.

A Magnetic Drum Sorting System, B. Cox and J. Goldberg, Computer Lab., Engineering Division, Stanford Research Institute, Menlo Park, Calif.

A Magnetic Drum Extension to the Gamma 3 Computer, P. L. Dreyfus, H. G. Feissel and B. M. Leclerc, Compagnie Des Machines Bull, 94 Ave., Gambetta, Paris, France

The UNIVAC Magnetic Computer Part I. Logical Design and Specifications, A. J. Gehring, L. W. Stowe and L. D. Wilson, Remington Rand Univac Div. of Sperry Rand Corp., Philadelphia, Pa.

The UNIVAC Magnetic Computer Part II. Megacycle Magnetic Modules, B. K. Smith, Remington Rand Univac Div. of Sperry Rand Corp., Philadelphia, Pa.

The UNIVAC Magnetic Computer Part III. Drum Memory, V. J. Porter, S. E. Smith and M. Naiman, Remington Rand Univac Div. of Sperry Rand Corp., Philadelphia, Pa.

ANTENNAS AND PROPAGATION—MICROWAVE ANTENNAS

Chairman: L. C. Van Atta, Microwave Lab., Hughes Aircraft Co., Florence Ave. at Teale St., Culver City, Calif.

High Efficiency Microwave Lenses, R. L. Smedes, Sperry Gyroscope Co., Div. of Sperry Rand Corp., Great Neck, N. Y.

Ferrod Radiator Systems, F. Reggia, E. G. Spencer, R. D. Hatcher and J. E. Tompkins, The Diamond Ordnance Fuze Labs., Wash. 25, D. C.

A Design Method For Very Long Linear Arrays, M. G. Chernin and R. W. Bickmore, Hughes Aircraft Co., Microwave Lab., Culver City, Calif.

Some New Antenna Designs Based on the Trough Waveguide, W. Rotman and N. Karas, Antenna Lab., Air Force Cambridge Research Center, ARDC, Laurence G. Hanscom Field, Bedford, Mass.

Future Trends in Radomes For Ground Electronic Equipment, M. V. Ratynski, Rome Air Development Center, Griffiss Air Force Base, Rome, N. Y.

A Toroidal Microwave Reflector, G. D. M. Peeler and D. H. Archer, Microwave Antennas and Components Branch, Electronics Div., NRL, Wash. 25, D. C.

Thursday, March 22, A.M.

Thursday, March 22, A.M.

CIRCUITS—II—DESIGN AND APPLICATION OF ACTIVE NETWORKS

Chairman: W. R. Bennett, Bell Telephone Labs., Murray Hill, N. J.

On the Driving-Point Impedance Functions of Active Networks, N. DeClaris, Research Lab. of Electronics, MIT, Cambridge 39, Mass.

Active Network Synthesis, I. Horowitz, Microwave Research Institute, 55 Johnson St., Brooklyn 1, N. Y.

Some Considerations on the Stability of Active Two-Port Elements and Applications, A. P.

Stern, Electronics Lab., GE, Syracuse, N. Y.
Two Invariants of Noisy Linear Amplifiers, H. A. Haus and R. B. Adler, Research Lab. of Electronics, MIT, Cambridge 39, Mass.
Graphical Analysis of Transistor Circuits by Separation of Variables, D. L. Finn and B. J. Dasher, Georgia Institute of Technology, School of Electrical Engineering, Atlanta, Ga.

ELECTRONIC COMPUTERS—III—SYMPOSIUM ON THE IMPACT OF COMPUTERS ON SCIENCE AND SOCIETY

Chairman: T. H. Bonn, Remington Rand UNIVAC Div. of Sperry Rand Corp., 2300 West Allegheny Ave., Philadelphia 29, Pa.
Allen V. Astin, Director, NBS, Wash., D. C.
R. E. Meagher, 168 Engineering Research Lab., U. of Illinois, Urbana, Ill.
D. Sayre, IBM, 590 Madison Ave., N. Y. 22, N. Y.
J. W. Forrester, Div. Head, Lincoln Lab., MIT, Cambridge, Mass.

COLOR TELEVISION

Chairman: D. G. Fink, Philco Corp., Tioga & C Sts., Philadelphia 34, Pa.
Recent Improvements in the 21AXP22 Color Kinescope, R. B. Janes, L. B. Headrick, J. Evans, RCA, Lancaster, Pa.
GE Post Acceleration Color Tube, C. G. Lob, GE; #-223, Thermionics; Syracuse, N. Y.
Correct Prints of Color Tube Screens, H. Heil, GE; #3-223, Thermionics; Syracuse, N. Y.
The Unipotential Mask-Focusing Colortron, N. Fyler, C. Cain, P. Hambleton, CBS-Hytron, Newburyport, Mass.
Focusing Mask Color Kinescopes, E. G. Ramberg, H. B. Law, H. S. Allwine, D. C. Darling, C. W. Henderson and H. Rosenthal, RCA Labs., Princeton, N. J.

COMPONENT PARTS—I

Chairman: C. G. Walance, Hughes Aircarft Corp., Florence & Teale Sts., Culver City, Calif.
The Power Supply In Military Equipment, S. Perlman, Rome Air Development Center, Griffiss Air Force Base, Rome, N. Y.
The Silver-Zinc Rechargeable Battery, P. Howard, Yardney Electric Corp., 40-46 Leonard St., N. Y. 13, N. Y.
The Wafer Coil Pulse Transformer, A. Babcock & Al. Zack, Sylvania Electric Products Inc., Ipswich, Mass.
Developments in Magnetic Component Packaging, A. Lucic, North American Aviation, Inc., 12214 Lakewood Blvd., Downey, Calif.
A Transistorized Polarized Sensitive Relay, K. H. Meissner & D. Miller, 11680 Bellagio Rd.—Bel Air, Los Angeles 49, Calif.

INDUSTRIAL ELECTRONICS

Chairman: E. W. Leaver, Pres., Electronic Associates, Ltd., 4616 Yonge St., Willowdale, Ontario, Can.
High Frequency Shields, R. E. Lafferty, NBC, RCA Bldg., Radio City, N. Y. 20, N. Y.
Field-Intensity Measurements on Induction-Heating Equipment, T. E. Nash, Tube Division, RCA, Lancaster, Pa.
Basic Considerations in the Design of Electronic Power Supplies for Electrodynamic Shakers, D. J. Fritch, The Calidyne Co., 120 Cross St., Winchester, Mass.
Magnetic Amplifier Industriol Control Techniques for Improved Accuracy and Reliability, H. W. Patton, Airpax Products Co., Middle River, Baltimore 20, Md.

INFORMATION THEORY—II

Chairman: W. Palmer, Sperry Gyroscope Co., Great Neck, N. Y.
Certain Aspects of Coherence, Modulation and Selectivity in Information Transmission Systems, S. Goldman, Dept. of Electrical Engineering, Syracuse U., Syracuse 10, N. Y.
Some Results in Coding Theory, C. Shannon, Bell Telephone Labs., Murray Hill, N. J.
Session Commentary, P. Elios, MIT, Cambridge, Mass.
Factors Limiting the Maximum Impulse Transmitting Ability of an Afferent System of Nerve Fibers, P. D. Wall. J. Y. Lettvin, W. S. McCulloch and W. H. Pitts, MIT, Cambridge 39, Mass.

MICROWAVES—III—FILTERS

Chairman: G. C. Southworth, 19 William Rd., Chatham, N. J.
Directional Channel-Separation Filters, S. B. Cohn and F. S. Coale, Stanford Research Institute, Antenna Systems Lab., Menlo Park, Calif.

(Continued on page 182)

IRE Convention

(Continued from page 181)

A Resonant Cavity Frequency Duplexer, E. O. Bowers and C. W. Curtis, Hughes Research Labs., Microwave Electronics Dept., Culver City, Calif.

Synthesis of Wide-Band Microwave Filters to Have Prescribed Insertion Loss, E. M. T. Jones, Stanford Research Institute, Antenna Systems Lab., Menlo Park, Calif.

Crossed-Mode Tunable Selector for Microwaves, N. A. Spencer, Wheeler Labs., 122 Cutter Mill Rd., Great Neck, N. Y.

The Susceptance of a Circular Iris to the Dominant TE_{11} Mode in Circular Waveguide, M. Handelsman, Rome Air Development Center, Griffiss Air Force Base, Rome, N. Y.

INSTRUMENTATION—II

Chairman: D. Packard, Pres., Hewlett-Packard Co., 275 Mill Rd., Palo Alto, Calif.

A Method for Repetitive Examination of Transient Phenomena, J. W. Dorsett, Jr., Ampex Corp., 934 Charter St., Redwood City, Calif.

A Magnetic Head for the Megacycle Range, O. Kornei, Clevite Research Center, 540 East 105 St., Cleveland, Ohio

Extending the Versatility of a Laboratory Magnetic Tape Data-Storage Device, A. V. Gangnes, Ampex Corp., 934 Charter St., Redwood City, Calif.

A Time Bridge, M. B. Kline and C. E. Webb, Technical Products Div., A. B. DuMont Labs., Inc., 750 Bloomfield Ave., Clifton, N. J.

A Versatile Quadrature Time Base Comparator For Automatic Frequency Measurement, I. J. Weber, Sperry Gyroscope Co., Great Neck, N. Y.

Thursday, March 22, P.M.

CIRCUITS—III—NETWORK SYNTHESIS TECHNIQUES

Chairman: M. S. Corrington, RCA Victor TV Div., Building 204-2, Camden 2, N. J.

Simple and Double Alternation in Network Synthesis, F. Reza, Dept. of Electrical Engineering, Syracuse U., Syracuse, N. Y.

Synthesis of Tchebycheff RC Band Pass Filters, D. Helman, RCA Computing Systems, Building 10-2, Camden 2, N. J.

Pulsed RC Networks for Sampled Data Systems, J. Sklansky, RCA Labs., Princeton, N. J.

An Operational Calculus for Numerical Analysis, S. Thaler and Rubin Boxer, Rome Air Development Center, Attn: RCEAW-2, Rome, N. Y.

Linear Complementary Smoothing Compensated for Sampled Data Lags, J. L. Ryerson, Rome Air Development Center, Griffiss Air Force Base, Rome, N. Y.

SOLID STATE DEVICES

Chairman: J. S. Saby, GE, Syracuse, N. Y.

Electrets, E. G. Linden, Signal Corps Engineering Labs., Fort Monmouth, N. J.

High Frequency Germanium NPN Tetrode, D. W. Baker, GE, Building 7-Room 201, Syracuse, N. Y.

Power Transistor Design Limitations, M. Clark, Bell Telephone Labs., Murray Hill, N. J.

Investigation of Power Gain and Transistor Parameters as Functions of Both Temperature and Frequency, A. B. Glenn and I. Joffe, RCA, Aviation C&N Engineering, Building 10-1, Camden 2, N. J.

High Frequency Silicon Tetrode, R. F. Stewort and W. A. Adcock, Texas Instrument Co., 6000 Lemmon Ave., Dallas, Tex.

Semiconductor Capacitance Amplifier, F. Dill, Jr. and L. Depian, Carnegie Institute of Technology, Schenley Park, Pittsburgh 13, Pa.

WHERE IS MEDICAL ELECTRONICS GOING?: A SYMPOSIUM IN PREDICTION

Four speakers with experience in widely varied parts of the biophysical, medical, electronic and engineering sciences will compare notes on the present state of the art and will attempt to predict the major directions in which biophysical medical electronics will make future advances.

1. **V. K. Zworykin,** RCA Research Labs., Princeton, N. J. Medical electronics will provide technical facilities with which life scientists will implement their work.
2. **C. L. Taylor,** U. of Calif., Los Angeles, Calif. Medical electronics will coordinate man and his machines.
3. **A. C. Burton,** Biophysics Dept., U. of Western Ontario, Medical School, London, Ontario, Canada
   Biophysics and medical electronics will permit understanding of fundamental life

processes in terms of sound physics and engineering principles.

4. **O. H. Schmitt,** Prof. of Physics and Zoology, U. of Minn., Minneapolis, Minn. Biophysics will evolve into a theoretical science based on physics, engineering, bioogy and medicine but having a set of principles of its own.

COMPONENT PARTS—II

Chairman: G. Shapiro, Electricity & Electronics Div., U. S. Dept. of Commerce, NBS, Wash. 25, D. C.

Preparation of Standards & Test Procedures for Printed Circuits, E. R. Gamson and A. Henesian, Stanford Research Institute, Menlo Park, Calif.

New Ceramic Feedthrough Capacitors With Tremendous Increase in Effective "Capacitance," H. M. Schlicke, Allen-Bradley Co., Milwaukee 4, Wisc.

Performance of Continuous and Discontinuous Tube Feedthrough Capacitors at VHF and Higher Frequencies, E. M. Williams, Carnegie Institute of Technology, Schenley Park, Pittsburgh 13, Penna., and J. H. Foster, Erie Resistor Corp., Erie 6, Penna.

Piezoelectric Ceramic i-f Band Pass Filters, O. E. Mattiat, Clevite Research Center, 540 East 105 St., Cleveland 8, Ohio

Tantalum Solid Electrolytic Capacitors, D. A. McLean and F. S. Power, Bell Telephone Labs., Murray Hill, N. J.

INFORMATION THEORY—III

Chairman: Michael J. DiToro, Polytechnic Research and Development Co., Inc., 202 Tillary, B'klyn, N. Y.

A Prediction Theory Approach to Information Rates, K. H. Powers, Research Lab. of Electronics, MIT, Cambridge 39, Mass.

Reduced-Alphabet Representation of Television Signals, E. H. Kretzmer, Bell Telephone Labs., Murray Hill, N. J.

A Bit-Squeezing Technique Applied to Speech Signals, E. E. David, Jr. and H. S. McDonald, Bell Telephone Labs., Murray Hill, N. J.

On the Design of Systems for Communication Via the Ionosphere, G. L. Turin, MIT, Lincoln Lab., P. O. Box 73, Lexington 73, Mass.

Multipath Distortion of TV Signals and the Design of a Corrective Filter, A. V. Balakrishman, RCA, Building 10-8, Camden, N. J.

MICROWAVE INSTRUMENTATION

Chairman: Eugene G. Fubini, Airborne Instruments Lab., Inc., 160 Old Country Road, Mineola, L. I., N. Y.

An Amplitude Regulator for Microwave Signal Sources, P. Fire and P. H. Vartanian, Sylvania Electric Products, Mountain View, Calif.

Measurement of the Complex Dielectric Constant of Materials From 100 to 1200 MCS Over a Wide Range of Temperature, I. Bady, Signal Corps Engineering Labs., Fort Monmouth, N. J.

The Z Scope—An Automatic Impedance Plotter For Microwaves, J. P. Vinding, Cascade Research Corp., Los Gatos, Calif.

A Swept, Broadband, Microwave, Double Detection System With Automatic Synchronization, D. L. Favin, Bell Telephone Labs., Murray Hill, N. J.

Coaxial Components Employing Gaseous Discharges at Microwave Frequencies, R. H. Geiger and P. E. Dorney, Roger White Electron Devices, Inc., Ramsey, N. J.

High Power Breakdown of Microwave Structures, F. R. Stevenson, Sperry Gyroscope Co., Great Neck, N. Y.

BROADCAST TRANSMISSION SYSTEMS—NEW HORIZONS

Chairman: Raymond F. Guy, NBC, 30 Rockefeller Plaza, N. Y., N. Y.

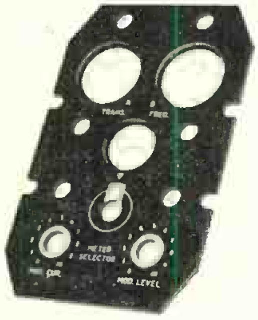
The Technical Boundary Conditions of Subscription Television, A. Ellett and R. Adler, Zenith Radio Corp., 6001 Dickens Ave., Chicago 39, Ill.

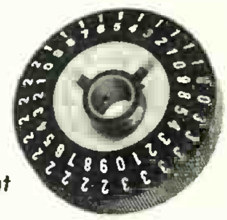
An Intergrated System of Coded Picture Transmission, E. M. Roschke, W. S. Druz, C. Eilers, and J. Pulles, Zenith Radio Corp., 6001 Dickens Avenue, Chicago 39, Ill.

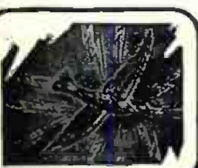
Trichromatic Coefficient-Plotting Photometer, W. H. Highleyman, M.I.T., Lincoln Lab., Room 10-381, 39 Massachusetts Ave., Cambridge, Mass., M. J. Cantella, USN, USS Valley Forge CVS-45, c/o Fleet Post Office, N. Y., N. Y., and V. A. Babits, Prof. of Electrical Engineering, Rensselaer Polytechnic Institute, Troy, N. Y.

Recent Improvements in Black-and-White Film Recording for Color Television Use, W. L. Huges, Engineering Exp. Station, Iowa State College, Ames, Iowa

Design Considerations for a High Quality Transistorized Program Amplifier for Remote Broadcast Use, J. K. Birch, Gates Radio Co., Quincy, Ill.







Fraction Theory

(*Continued from page 90*)

the ladder network.

$$Z = Z_1 + \cfrac{1}{\cfrac{1}{Z_2} + \cfrac{1}{Z_3 + \cfrac{1}{\cfrac{1}{Z_4} + \cfrac{1}{Z_5 + \cfrac{1}{\cfrac{1}{Z_6}}}}}} \quad (14)$$

Functional Generator Networks

The foregoing outline of continued fraction theory and the expressions of input impedances to ladder networks lead to a method of synthesizing certain non-linear functions by means of linear potentiometer networks. For example, the function

$$R(x) = x/\tanh^{-1} x,$$

has the following continued fraction expansion

$$R(x) = 1 - \cfrac{x^2}{3 - \cfrac{(2x)^2}{5 - \cfrac{(3x)^2}{7 - .}}} \quad (15)$$

By comparing the above continued fraction with the corresponding expression for the input impedance to a resistive ladder network, it is found that the function R(x) is represented by the input resistance to the infinite ladder network shown in Fig. 9

In the above network, it is seen that the mutual impedances between successive current loops are those indicated by the successive numerators in the continued fraction representation of R(x). Likewise, the self-impedances of the various current loops in the network are defined by the leading coefficients in the successive denominators of the continued fraction.

When all the terms beyond the nth partial denominator in an infinite continued fraction are discarded, the result is called the nth convergent of the continued fraction. For example, the third convergent $R_3(x)$ of the continued fraction R(x) is

$$R_3(x) = 1 - \cfrac{x^2}{3 - \cfrac{(2x)^2}{5}} \qquad (16)$$

Higher order convergents have forms similar to the above. It is clear that any convergent of an infinite continued fraction can be expressed as a ratio of two polynomials. It is shown in textbooks on continued fraction theory that the sequence of successive convergents of an infinite continued fraction converge to the function represented by the infinite continued fraction.

The above described third convergent $R_3(x)$ of the continued fraction $R(x)$ is synthesized by the network of linear potentiometers shown in Fig. 5.

From the expression for the continued fraction expansion of $R(x)$ and the associated infinite network of linear potentiometers, and from the fact that the fourth convergent $R_4(x)$ of $R(x)$ is more accurate than the third convergent $R_3(x)$, it is seen that the accuracy of the approximation of $R(x)$ represented by the input resistance of the network last shown can be improved by expanding the network to include another loop. The resulting network whose input resistance is the fourth convergent of $R(x)$ as in Fig. 6.

By use of the procedure described above, the function $R(x)$ can be synthesized to any degree of accuracy (subject to the limitation of potentiometer linearities) by expanding the ladder network to include a sufficient number of loops. The correct resistances to be inserted in each loop are easily determined from the regularity of the succeeding coefficients in the infinite continued fraction.

As another example of a function which can be synthesized by the technique just described consider the following continued fraction representation of x/tan x.

$$\frac{x}{\tan x} = 1 - \cfrac{x^2}{3 - \cfrac{x^2}{5 - \cfrac{x^2}{7 - \cdots}}} \qquad (17)$$

This function can be synthesized to any degree of accuracy by including enough loops of the infinite ladder network of Fig. 7. The nth convergent of the continued fraction representation of the function $R(x) =$

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Fraction Theory

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x/tan x is synthesized by the input resistance to a finite ladder network consisting of the first n loops of the above infinite ladder network. For example, the third convergent $R_3(x)$ of the function R(x)=x/tan x is represented by the input resistance to the ladder network of linear potentiometers of Fig. 8.

The article will conclude with the present section which describes a logarithmic function generator network. Consider the continued fraction representation of the function ln(1+x) of Eq. (6). By suitable algebraic manipulation, this continued fraction can be written as in Eq. (7), in which the successive numerators are unity. The successive elements in this continued fraction can be equated directly to the successive shunt admittances and series impedances of an infinite ladder network of linear potentiometers.

The successive convergents of the infinite continued fraction representation of the function R(x)= ln(1+x) are synthesized by the input resistances to the potentiometer networks of Fig. 12.

In order to show how the accuracy of the approximating convergent is improved by using a convergent of higher order (which means using more loops in the ladder network), the first five convergents of the function R(x)=ln(1+x) were calculated for $0 < x < 15$. The graphs of the first five convergents of the function R(x)=ln(1+x), together with the function, are shown in Fig. 11.

Scale factors can be used to increase the order of magnitude of the input resistance to the synthesized network when desirable. For example, the function $f(x) = 10^4 \ln(1+x)$ has the following continued fraction representation

$$f(x) = \cfrac{1}{\cfrac{1}{10^4 x} + \cfrac{1}{\cfrac{2}{1^2}\cdot 10^4 + \cfrac{1}{\cfrac{3}{10^4 x} + \cfrac{1}{\cfrac{4}{2^2}\cdot 10^4 + \cdots}}}} \qquad (18)$$

The network representing the 5th convergent of the above continued fraction is shown in Fig. 10.

$R(x) \cong 10{,}000 \ln(1+x)$ ohms
where $x = 315{,}000\,\theta$ and θ is fractional shaft rotation.

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Microwave Mixers

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includes the phase shift of any elements placed in the plane of symmetry. It will be noted that the even wave passes a discontinuity in traveling from the septated region into the slot. If this discontinuity is described by the complex reflection coefficient Γ, the reflection coefficient for the wave passing from the slotted region into the septated guide is $-\Gamma$. If the slot region is made 270° long for the odd wave and the phase of the even wave is shifted to 360° by the use of centerline elements, the slot reflections will cancel, and hybrid performance will be achieved. If the phase shifting elements are not reflectionless, the length of the slot may be adjusted to compensate for the three points of reflections. While ϕ may be adjusted to any value, hybrid performance will occur only when $\phi = \pm 90°$. If $\phi = 180°$, all energy appears in Arm 4; if $\phi = 0$ or 360°, all energy appears at Arm 3.

Fig. 3b represents the phase relations that exist for the even wave when $\Theta = 90°$ and any even wave reflections are eliminated. The combined waves are shown in Fig. 3c. The relationships shown in Fig. 3c

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may be summarized as follows: *With input to Arm 1, equal outputs exist on Arms 3 and 4, with Arm 4 leading Arm 3 by 90°. In addition, the phase in Arm 3 is advanced 45° ahead of the phase that would have existed, Θ, if the slot were not present.*

Balanced Mixer Operation

A balanced mixer is used in sensitive receivers to cancel the noise that is produced in the local oscillator and applied to the crystal along with the local oscillator signal. In particular, it is the noise sidebands which are separated from the local oscillator frequency by plus or minus the intermediate frequency of the receiver that contribute to degradation of the receiver sensitivity.

In the following the local oscillator noise is represented by a vector. To describe properly a noise voltage appearing across two terminals by a vector, it is necessary to remove all restrictions on the vector's magnitude, rotational velocity and phase.

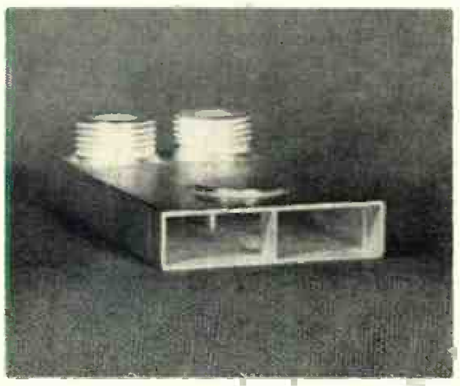

Fig. 6: Short slot hybrid with crystal mounts

Since the network preceding the terminals is always a network of finite bandwidth, the vector parameters are a continuous function of time. It will be shown that cancellation of noise occurs at any arbitrary instant of time and therefore must occur at all instants of time. At some instant of time the noise vector will have a magnitude, N, a rotational velocity, ω_n, and a phase angle, α, with respect to the local oscillator vector. These parameters will assume different values at some later instant of time, but the manner of change, while arbitrary, is continuous due to the finite band pass of a physical network.

In Fig. 7a the local oscillator voltage, L, and the noise voltage, N, are shown applied to Arm 1 and the signal voltage, S, to Arm 2. The vectors have the following characteristics.

L is of large constant magnitude and rotates at a constant velocity ω_o, S is of small magnitude and varies in magnitude and velocity ω_s (assuming relative motion of transmitter and reflectors), and N is of small magnitude and varies in magnitude and velocity ω_n.

After passing through the hybrid, the vectors are shifted by 45° and 135° as illustrated in Fig. 7b. Using the phase relations of Fig. 7b and approximating the law of a crystal by

$$I_o \cong aE + bE^2 \qquad (2)$$

where E is the voltage applied to the crystal and I_o is the crystal current, the crystal currents are found to be:

$$_{o3} \cong aE_3 + bE_3^2 \qquad (3)$$
$$= a\,[L \cos \omega_o t + N \cos(\omega_n t - \alpha) + S \cos(\omega_s t - \beta)]$$
$$+ b\,[L^2 \cos^2 \omega_o t + N^2 \cos^2(\omega_n t - \alpha) + S^2 \cos^2(\omega_s t - \beta) + 2LN \cos \omega_o t \cos(\omega_n t - \alpha) + 2LS \cos \omega_o t \cos(\omega_s t - \beta) + 2NS \cos(\omega_n t - \alpha)\cos(\omega_s t - \beta)],$$

and

$$I_{o4} \cong aE_4 + bE_4^2 \qquad (4)$$
$$= a\,[-L \sin \omega_o t - N \sin(\omega_n t - \alpha) + S \sin(\omega_s t - \beta)]$$
$$+ b\,[L^2 \sin^2 \omega_o t + N^2 \sin^2(\omega_n t - \alpha) + S^2 \sin^2(\omega_s t - \beta) + 2LN \sin \omega_o t \sin(\omega_n t - \alpha) - 2LS \sin \omega_o t \sin(\omega_s t - \beta) - 2NS \sin(\omega_n t - \alpha)\sin(\omega_s t - \beta)].$$

$$I_{o3} \cong a\,[L \cos \omega_o t + N \cos(\omega_n t - \alpha) + S \cos(\omega_s t - \beta)] \qquad (5)$$
$$+ b\left[L^2\left[\frac{1 + \cos 2\,\omega_o t}{2}\right] + N^2\left[\frac{1 + \cos 2(\omega_n t - \alpha)}{2}\right] + S^2\left[\frac{1 + \cos 2(\omega_s t - \beta)}{2}\right]\right.$$
$$+ 2LN\left[\frac{\cos(\omega_o t + \omega_n t - \alpha) + \cos(\omega_o t - \omega_n t + \alpha)}{2}\right]$$
$$+ 2LS\left[\frac{\cos(\omega_o t + \omega_s t - \beta) + \cos(\omega_o t - \omega_s t + \beta)}{2}\right]$$
$$\left. + 2NS\left[\frac{\cos(\omega_n t - \alpha + \omega_s t - \beta) + \cos(\omega_n t - \alpha - \omega_s t + \beta)}{2}\right]\right]$$

$$I_{o4} \cong a\,[-L \sin \omega_o t - N \sin(\omega_n t - \alpha) + S \sin(\omega_s t - \beta)] \qquad (6)$$

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$$+b\left[L\left[\frac{1-\cos 2\,\omega_o t}{2}\right]\right.$$

$$+N^2\left[\frac{1-\cos 2\,(\omega_n t-\alpha)}{2}\right]$$

$$+S^2\left[\frac{1-\cos 2\,(\omega_s t-\beta)}{2}\right]$$

$$+2LN\left[\frac{\cos(\omega_o t-\omega_n t+\alpha)-\cos(\omega_o t+\omega_n t-\alpha)}{2}\right]$$

$$-2LS\left[\frac{\cos(\omega_o t-\omega_s t+\beta)-\cos(\omega_o t+\omega_s t-\beta)}{2}\right]$$

$$\left.-2NS\left[\frac{\cos(\omega_n t-\alpha-\omega_s t+\beta)-\cos(\omega_n t-\alpha+\omega_s t-\beta)}{2}\right]\right].$$

All terms except the difference frequency terms are normally filtered out.

Let I_{03}' and I_{04}' be the filtered current output.

$$I_{03}'=b\,[LN\cos(\omega_o t-\omega_n t+\alpha)+LS\cos(\omega_o t-\omega_s t+\beta)+NS\cos(\omega_n t-\omega_s t-\alpha+\beta)]. \quad (7)$$

$$I_{04}'=b\,[LN\cos(\omega_o t-\omega_n t+\alpha)-LS\cos(\omega_o t-\omega_s t+\beta)-NS\cos(\omega_n t-\omega_s t-\alpha+\beta)]. \quad (8)$$

If the phases of the intermediate-frequency outputs on Arm (4) are inverted (by a transformer or reversal of crystal polarity),

$$I_{04}=-aE_4-b\,E_4^2. \quad (9)$$

After the necessary change of signs in I_{04}' above, the outputs I_{03}' and I_{04}' are added:

$$I_{03}'+I_{04}'=2b\,[LS\cos(\omega_o t-\omega_s t+\beta)+NS\cos(\omega_n t-\omega_s t-\alpha+\beta)]. \quad (10)$$

The major noise term LN has cancelled out, leaving only a noise term NS. In the limiting case of detection in the presence of noise, the noise and signal are of the same order of magnitude but the oscillator term is larger by at least 10^6 times. Therefore, LS is at least 10^6 times larger than the NS term, and essentially perfect local oscillator noise rejection is achieved.

The preceding argument may be shown pictorially by the diagrams of Fig. 5. Assume the same input relationships as before. The vector diagrams for signals at the output of the hybrid may be drawn as in Fig. 5a.

In Arm 4, (S + L) has just passed the maximum; in Arm 3, (S + L) has just passed the minimum. (N + L) in both arms is just approaching a maximum. If detection takes place in one reversed crystal and one standard crystal, one vector diagram will be inverted. Then, while (N + L) will be approaching a maximum as before, the maximum will be of reversed polarity, and a phase inversion will have occurred. This is illustrated in Fig. 5b.

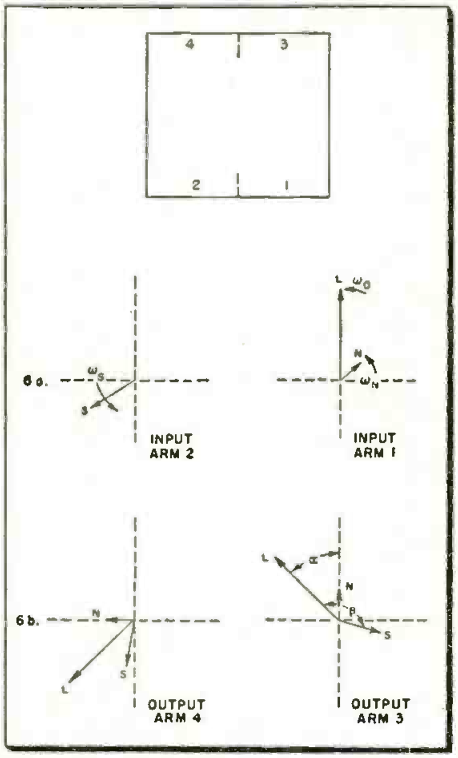

Fig. 7: Phase relationships of voltages

It is thus seen that the ac component of Arm 4 has been inverted, and the relative phase is the opposite of the relative phase in the preceding case. Summarizing:

1. When both crystals are of the same polarity, the noise signals, N + L, are in phase in both arms, and the desired signals, S + L, are out of phase.

2. When one crystal is reversed, the desired signals, S + L, are in phase, and the noise components, N + L, are out of phase.

In either event, subsequent i-f circuitry can separate the desired signal, S + L, from the noise, N + L. The i-f circuitry for the second case merely adds the two outputs.

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Nickel Laminations

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Since it is not practical to measure the permeability for each lamination, it was decided to divide the permeability spectrum for each alloy, thickness and shape into grades A, B, C and D, each grade to cover the normal variation to be expected within one individual 8 or 9 in. box of laminations. Then, by sampling a few laminations from each box, the grade can be determined.

Figure 1 shows the test set developed for grading EI and EE 48% and 79% nickel alloy laminations. The main part of the test set consists of a 200 cycle oscillator, a VTVM, and a 1000 ohm resistor .An adapter for each shape and thickness of lamination is plugged into the test set. This adapter contains the test coil and two capacitors, one for each alloy. To determine the grade of a given lamination, the proper adapter is plugged into the test set and the proper capacitor selected. The input level is then set to give a 40 gauss induction on the test coil, and the voltage read across the 1000 ohm resistor. From limits previously set, the grade of the lamination is determined. As can be seen from Figs. 5 and 6, a variation of 5 or 6 db of E_R/E_{in} can be observed from the rejection limit to the best "A" grade material.

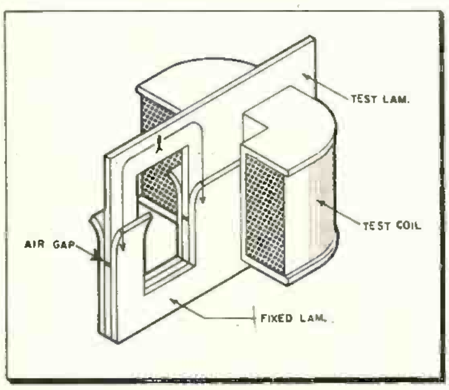

Fig. 7: Lamination and coil relationships

By thus grading all nickel laminations received, the manufacturer achieves three advantages:

First, the minimum permeability guarantee of the lamination manufacturer can be checked at incoming inspection.

Second, the grade of lamination necessary to produce a certain transformer can be determined and that grade specified on the manufacturing specifications. This reduces rejections.Third, development samples of new designs can be designed around and tested with laminations of a grade "C" into which the greatest number of laminations fall. This will allow production of the transformer using an easily available average grade of lamination.

The lamination manufacturer also can use this method of determining permeability to good advantage. Instead of sampling only once per annealing tray or box by laboriously stacking laminations to be tested into test coils, he could economically sample every 8 or 9 in. of lamination. With this information he should be able to maintain a closer quality control at a lower cost. In addition, if the described grading system were adopted by the industry, the grade could be marked on each 8 or 9 in. box of laminations, thus providing the transformer manufacturer with the necessary information to use the laminations to best advantage.

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If now we consider multi-path propagation, we must deduct the multi-path delay time from the total permissible elongation in milli-seconds. For a total permissible value of 6.5 ms, and a multi-path delay of only 3 ms which is but half that experienced at times on some of the long trans-oceanic circuits, the net value which we may allow in the radio equipment is 6.5 − 3 = 3.5 ms. This will require a band width, for the radio system, of approximately 286 CPS. For a multi-path delay of 6 ms, the net is only 0.5 ms; requiring a band width of 2,000 CPS!

The figures cited for multi-path delay are fairly typical of the maximum values experienced on different trans-oceanic circuits. It is apparent, from the resulting calculations, that band-width requirements of the radio transmitter-receiver system can not be determined solely from considerations of the fundamental keying frequency and a few of its harmonics.

To illustrate this statement, consider the start/stop teleprinter used in the foregoing example. Its fundamental keying frequency was taken to be, in round numbers, 25 CPS. The usual recommendation, based on a Fourier series analysis only, would be to pass the 3rd harmonic in each side band. The resulting figure for required band width would be 2 (3 × 25) = 150 CPS. This is approximately the same obtained by assigning the entime 6.5 ms elongation or variation to the frequency characteristic of the radio transmitter-receiver system; and is far less than the band width required to allow for multipath delay.

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2-Computer Combination For Rocket Fire Control

A unique two-computer combination has been developed for the Navy by Ford Instrument Co. to guide rockets fired from shipboard against enemy ground-troop concentrations ashore.

Designated the Mark 91-Mark 92 and installed aboard the U.S.S. Carronade, the U. S. Navy's first new Inshore Fire Support Ship, each computer acts as a unit to perform the required navigational and ballistic calculations involved in the rocket-launching problem.

A key feature of the computer combination is its unprecedented ability to instantaneously switch among several types of rockets, selecting either high or low angle fire as required.

The deck tilt section of Computer Mark 91 automatically corrects for the effects of roll and pitch of the ship.

The Computer Mark 92 computes and transmits rocket launcher orders for various tactical situations. It solves the ballistic problems for several types of rockets and four different modes of fire, the selection being made at will by the computer operator.

New Computers . . .

The **Franklin Institute** in Philadelphia has signed a contract with Remington Rand Univac Div. for installation of a $1.33 million Univac Computing Center.

IBM installed a new Model 650 Magnetic Drum Data Processing Machine at the Ordnance Aerophysics Lab., Daingerfield, Tex. operated for the Bureau of Ordnance, U. S. Navy, by the Convair Div. of General Dynamics Corp.

Engineers at **United Aircraft Computation Lab.**, East Hartford, Conn. are using a small desk-size Burroughs E101 computer to check out the programming instructions being fed into a large computer employed in designing advanced jet engines.

The **Electronic Engineering Co.** has delivered a high speed, high accuracy, digital data transmission set to the Air Force Missile Test Center, Florida.

Univ. of Rochester Computing Center has been established under Dr. Thomas S. Keenan. Their first computer, a Burroughs E101, was delivered last month. Delivery of an IBM 650 is expected in the summer.

IBM will construct manufacturing, engineering and educational facilities on their recently acquired 190-acre site in San Jose, Calif.

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It should be pointed out, in passing, that one practical operating approach to this multi-path problem often has been to make the keying lighter than 50/50 M/S at the transmitter. This, however, requires the transmission of shorter Mark elements and thus requires an increased band width in some portions of the transmitting system and in the radio-frequency spectrum.

FSK Keying

In frequency-shift keying, the frequency of the tone or radio signal is shifted from a lower value (Space) to a higher value (Mark) to provide the two conditions required by the usual telegraph or teleprinter codes. The earlier applications to short-wave radio services employed an 850 CPS value of shift; the Mark frequency differing from the Space frequency by 850 CPS. The system is depicted in Fig. 4.

Note that the amplitude changes of On/Off keying are converted to frequency changes. The case depicted is that of rectangular, or "square," keying. The rectangular Mark-Space plot of Fig. 4 may be replaced by any other keying wave shape such as those shown in Fig. 2. The resulting diagram then depicts the manner in which the frequency of the keyed signal varies with respect to time.

Frequency-shift keying thus is a form of frequency modulation, in which the deviation ΔF is one half the total shift value and the modulating frequency is the fundamental keying frequency and as many of its harmonics as are required to produce the desired shape of keying wave supplied to the modulator (FSK) stage.

Mathematical analysis, of even the simplest case involving only the fundamental of the keying frequency, is more difficult than for On/Off keying. The method is dealt with, in detail, in standard texts on the subject.[2] These give tabulations of side-band amplitudes that make the solution of practical cases quite simple.

As stated, early applications of FSK to short-wave radio-telegraph or radio-teleprinter operation employed a total shift of 850 CPS. This was used even for single-channel start/stop teleprinter services, where the fundamental keying frequency was only some 22 dot-cycles per second. The deviation ratio ΔF/f, in such a case, was 425/22 or nearly 20 to 1. This produces appreciable sidebands out to 5f above the upper shift frequency and to 5f below the lower shift frequency. This considers transmission of only the fundamental of the keying frequency—so-called

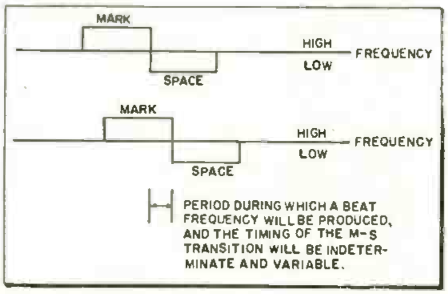

Fig. 5: Difference-frequency beat is produced

sine-wave keying. If we also consider transmission of the 3rd harmonic of the fundamental keying frequency, the deviation ratio ΔF/f becomes 425/66 or approximately 6.5 to 1. Appreciable side-bands then extend out beyond the upper and lower shift limits by about 3f, which now is 3 × (3 × 22) or 198 CPS; the total occupied band being approximately 200 plus 850 plus 200 equals 1250 CPS.

Note that an equivalent fidelity of reproduction in the case of On/Off keying would occupy a band of only 2 × (3 × 22) or 132 CPS. Actually, the use of Class "C" power amplifiers in the transmitter results in further "squaring up" of the On/Off signal and thus produces a greater width of occupied band.

FSK, being a frequency modulation rather than an amplitude modulation, permits the use of Class "C" power amplifiers without the disadvantage of generating additional keying side bands. Therefore, it is desirable to utilize FSK and to reduce the occupied band by reducing the value of shift. This is the present trend: recommended values of total shift running as low as 70 CPS. (CCIR).

It should be noted here that multipath propagation is even more damaging to FSK than to On/Off keying. This is due to the fact that the delayed wave consists not merely of Mark signal but of both Mark and Space frequencies. The delayed-wave Space therefore overlaps, in time, the initial-wave Mark. The result is still more variation in the times of occurrence of M-S and S-M transition, plus the production of a difference-frequency beat between the Mark and Space frequencies when they both are present in the receiver simultanously. (See Fig. 5).

To successfully filter out the difference-frequency beat, yet to pass on the required components of the keying wave shape, makes it neces-

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sary that the Mark-Space difference, or shift value be appreciably greater than the frequency of the highest keying component that must be passed on to the final keying stages in the radio receiver. If we wish to have the 3rd harmonic in the keying wave form, this requires that the value of shift be probably at least 4 times the fundamental keying frequency. If we are content to supply mere sine-wave keying to the final keying stages of the receiver, then we may use lesser values of shift. Because of the design possibilities, and the various possible compromises, there is no hard-and-fast rule.

A further and practical deterrent to the use of very low values of frequency shift is that many existing short-wave transmitters, designed originally for On/Off telegraph service, may contain appreciable amounts of spurious phase or frequency modulation at power-supply frequencies or at harmonics thereof. These may seriously interfere with reception of low values of FSK shift.

The inherent characteristics of linear frequency modulation, as pointed out in preceding examples, produce sidebands lying considerably outside the upper and lower—Mark and Space—shift limit frequencies. A further example will better illustrate this point and bring out another method of reducing the total occupied band.

Let us consider the case of 4-channel time-division multiplex, having a fundamental keying frequency of approximately 85 CPS. If we assume a shift value of 340 CPS, the deviation ratio $\Delta F/f$ is 170/85 or 2. Keying side bands, for the 85-CPS fundamental only, extend out to 2f or 170 CPS above and below the shift limits; occupying a total band of 170 plus 340 plus 170 or 680 CPS. For the 3rd harmonic, if we wish to transmit it, the keying side bands will extend some 255 CPS beyond the shift limits; the total occupied band thus being 255 plus 340 plus 255 or 850 CPS.

The usual low-pass filter ahead of the FSK frequency-modulator stage will limit only the keying wave shape supplied to the modulator stage. Modulation components extending by undesired amounts beyond the shift limits can then be suppressed only by the insertion of suitable selectivity following the linear FSK modulator. Where the frequency shifting is accomplished at radio frequency or at an intermediate frequency such as 200 KC, it generally is not practicable to provide such selectivity. If however the frequency shift is effected at audio or tone frequency, it is possible to provide such suppression by the use of suitable band-pass filters placed after the modulator stage. This procedure is applicable to so-called frequency-division or tone-channel multiplex systems utilizing telephone-type SSB equipment. This would of course require further reshaping, of the keying wave, in the final keying stages of the receiver.

So far, in this discussion of FSK, no mention has been made of multi-path propagation, as regards its influence on receiver band-width requirements. Following the analysis given for the case of On/Off keying, we may apply this to the FSK case by the conversion illustrated in Fig. 4. As will be seen from a study of Fig. 5, the net duration of any Mark interval or Space interval will be highly variable and, in the case of large values of multi-path delay, may at times be very short. To reproduce such greatly shortened Mark or Space intervals, and the steeper slopes thereof, the radio receiver will require an appreciably greater width of pass band.

The usual Fourier-series and Bessel function analysis of On/Off and FSK keying, based solely on the fundamental keying frequency and its harmonics, is sufficient only in those cases where the weight of keying remains at the theoretically optimum relationship of 50/50 M/S throughout the system and the radio path.

When multi-path propagation results in the Mark intervals of On/Off keying being elongated, or the Mark and Space intervals of FSK being elongated, with a consequent shortening of the other intervals, it is necessary to provide a radio-equipment pass band wide enough to satisfactorily pass these shortened signal elements.

Where the indicated widths of pass band are impracticable or unjustifiable, because of interference or the requirements of channel allocation, the teleprinter channels can be expected to fail; the only practical solution then being to choose some more suitable frequency or antenna which will eliminate or minimize the harmful multi-path propagation and thus permit the continued use of more normal values of pass band in the radio equipment.

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Push-Button P.A. System Guides Market Customers

Shopper pushes button to choose product

Bewildered customers, trying to find certain products in the confusion of today's super-market, are getting a helping hand from a new push-button operated electronic directory that not only tells them where the product can be found, but also volunteers a sales pitch on the more attractive features of certain brands.

The "Talking Push-Button Voice Directory" consists of a central recording-reproducing unit, and up to 10 push-button directory panels distributed around the store that enable shoppers to indicate the products they are seeking. The replies are delivered by loudspeakers mounted in the panels.

An added commercial touch is supplied by having taped commercials which follow each announcement and are also timed to repeat at regular intervals.

The system was designed by Joseph J. Muscolino, a professional inventory taker, and electronic engineer W. E. Walters. The systems are presently selling for $5,000. Directory panels are $100.00 each.

First RCA Tape Recorder Goes Into Production

Start of production on a new high-fidelity tape recorder—first to be manufactured by the Radio Corporation of America—has been announced by James M. Toney, Vice President and General Manager, RCA Victor Radio and "Victrola" Division.

Mr. Toney said the model now in production at RCA's Cambridge, Ohio, plant is a 3-speaker, push-button portable that incorporates a number of new engineering advances developed by RCA engineers.

Previous tape recorders that carried the RCA name were manufactured for RCA by another firm.

TELE-TECH ADVERTISERS—MARCH, 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.

Focusing Coils of Aluminum Foil

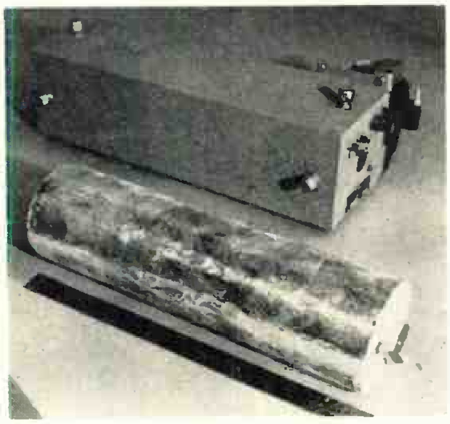


Fig. 1: Foil solenoid, with case and cooling blower. Used for focusing traveling wave tubes

Focusing Coils are wound, by a new process developed by Jobbins Electronic Enterprises, Menlo Park, Calif., by coating aluminum foil with a very thin layer of aluminum oxide and then winding this foil into various kinds of coils. The film formed is estimated to be a few millionths of an in. thick, but is well able to stand the usual turn to turn voltages. A tightly wound coil is nearly a block of solid aluminum.

Operating the coils at hot spot temperatures of 350° C. has no observable effect on the coil or insulation. Coils have been heated to this temperature and quenched in a pan of water with no noticeable effect.

In many coils where large amounts of power may be dissipated, and where weight becomes a problem, the increased space factor for these coils can become quite important. In sharp contrast to the 65% space factors ordinarily found, the microscopically thin film of aluminum oxide has resulted in space factors of better than 95%. The importance of this can be seen by comparing copper wire with aluminum foil in a typical coil.

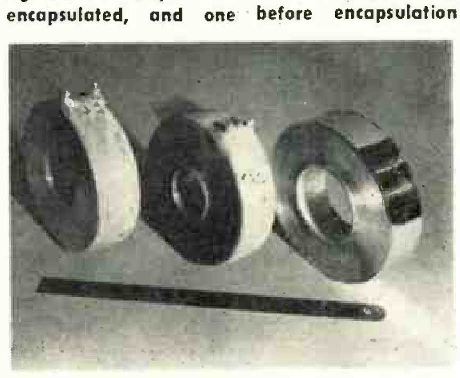
As an example, consider #17 double enamel wire. The space factor of this wire when wound is about 90%. The ratio of diameter of outside of the insulation to the diameter of Copper is .0453/.0481 or .943. Thus the overall space factor can be calculated to be $.90 \times .943 \times .783 = .665$. The ratio of conductivity of copper to aluminum is 0.61

Assuming a winding space factor of 97% for an oxide insulated aluminum foil winding, a coil, with a given number of turns and a given resistance, would be 1.12 times as large as it would be wound with copper wire. This is not quite correct, however, since there are easier ways of disposing of the heat from our foil windings. That is, some space must be consumed in providing cooling for copper wire windings if the winding is fairly large. We have done this by layers of copper tubing through which we circulate water more efficiently, by means of cooling slots through which we blow air. Either of these methods always seems to occupy at least 10% of the winding space. In a typical case, therefore, the total size of a foil winding may be very near to that of a copper winding for the same amount of power consumed.

The above calculation assumes a good enamel insulation. At present, most high temperature insulated wires have very poor space factors —usually about 80% as good as enameled wire. Thus, given required number of ampere turns, and a maximum size, it may well be that an oxide insulated foil winding will require less power than one wound with high temperature wire.

Since the size is nearly the same, and the density of aluminum is much less than that of copper—the weight of a typical coil can be greatly reduced. The exact amount of the gain in weight will be affected by the type of impregnating varnish in the copper wire wound coil, and the exact space factors achieved by the two methods.

Fig. 2: Two klystron focus coils after being encapsulated, and one before encapsulation



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