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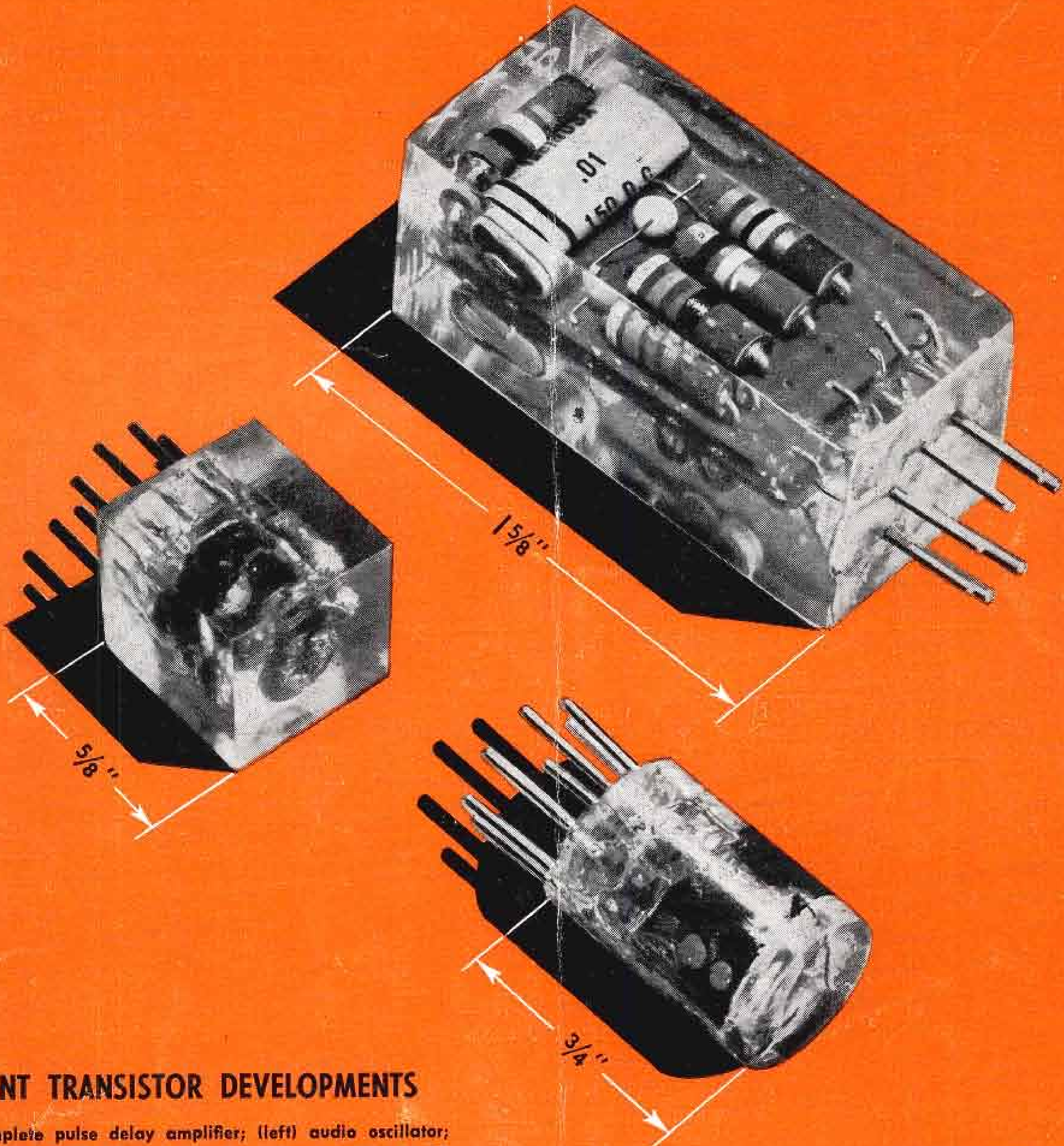
TELE-TECH

RADIO-TELEVISION-ELECTRONIC INDUSTRIES



RECENT TRANSISTOR DEVELOPMENTS

(Top) Complete pulse delay amplifier; (left) audio oscillator; (bottom) two-stage audio amplifier. See pages 36-38

CBS Opens New Hollywood TV Studios

Mode Interactions in Magnetrons

July • 1952

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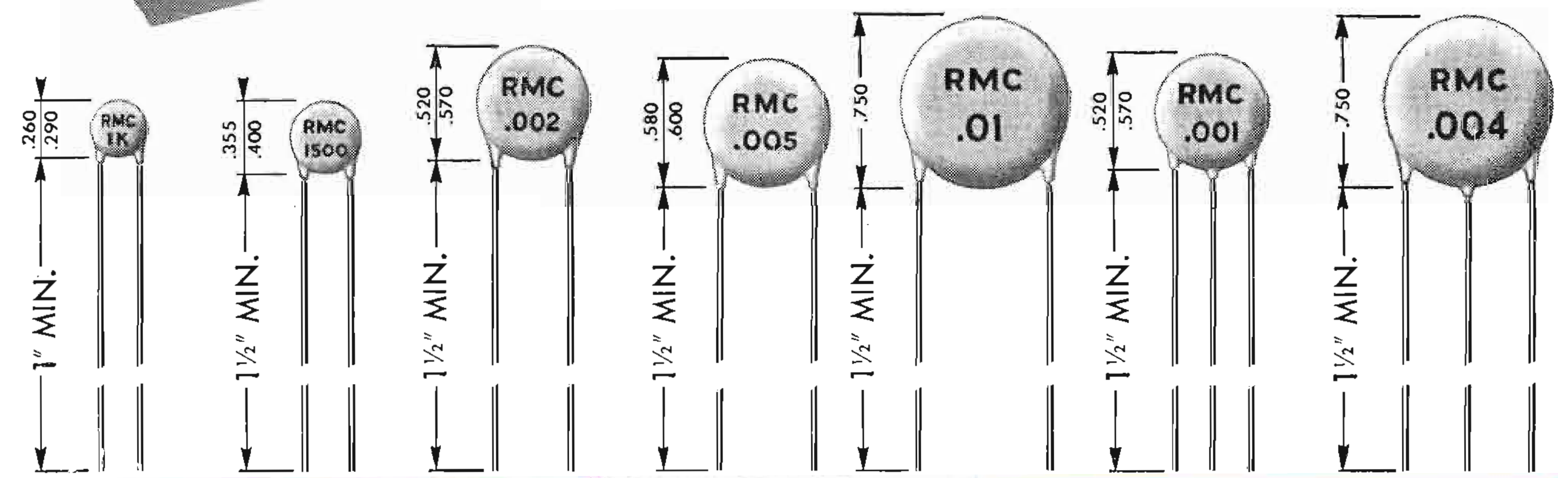
R-MC DISCAPS®

...the standard of performance throughout the entire radio and television industry

APPROVED AND USED BY LEADING MANUFACTURERS

"HEAVY DUTY" By-Pass DISCAPS
GMV Type..Rated at 1000 V. D. C.



SPECIFICATIONS

POWER FACTOR: INITIAL 1.5% @ 1 KC
AFTER HUMIDITY 2.5% @ 1 KC
WORKING VOLTAGE: 1000 VDC—TEST VOLTAGE: 2000 VDC
INSULATION: DUREZ PHENOLIC—VACUUM WAXED

LEAKAGE RESISTANCE: INITIAL 7500 MEG OHMS
AFTER HUMIDITY 1000 MEG OHMS
LEADS: #22 TINNED COPPER (.026 DIA.)
TOLERANCES: ±5%, ±10%, ±20%

When Ordering Specify "HEAVY DUTY" Type DISCAPS

DEPENDABLE RMC HI-VOLTAGE DISCAPS

Molded Plaskon Case

	TYPE F-500	TYPE E-500
CAPACITY	500 MMF +50% −20% at 22° C	500 MMF +50% −20% at 22° C
WORKING VOLTAGE	25,000 VDC	20,000 VDC
FLASH TEST VOLTAGE	37,500 VDC	30,000 VDC
POWER FACTOR	Less than 1% at 1000 CPS	Less than 1% at 1000 CPS
LEAKAGE RESISTANCE	Guaranteed higher than 25,000 Meg Ohms	Guaranteed higher than 25,000 Meg Ohms
BODY SIZE	1" Dia. x 2¼" Long	1" Dia. x 2" Long

DISCAP CERAMIC CONDENSERS

RMC

RADIO MATERIALS CORPORATION

GENERAL OFFICE: 3325 N. California Ave., Chicago 18, Ill.

FACTORIES AT CHICAGO, ILL. AND ATTICA, IND.

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TELE-TECH

RADIO-TELEVISION-ELECTRONIC INDUSTRIES

Edited for the 18,000 top influential engineers in the Tele-communications and Electronic Industries, TELE-TECH each month brings clearly written, compact, and authoritative articles and summaries of the latest technological developments to the busy executive. Aside from its engineering articles dealing with manufacture and operation of new communications equipment, TELE-TECH is widely recognized for comprehensive analyses and statistical surveys of trends in the industry. Its timely reports and interpretations of governmental activity with regard to regulation, purchasing, research, and development are sought by the leaders in the many engineering fields listed below.

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AUDIO AMPLIFYING EQUIPMENT
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Research, design and production of special types

TUBES, AMPLIFIERS, OSCILLATORS, RECTIFIERS, TIMERS, COUNTERS ETC. FOR
LABORATORY • INDUSTRIAL USE
ATOMIC CONTROL

Operation

Installation, operation and maintenance of telecommunications equipment in the fields of

BROADCASTING • RECORDING
AUDIO & SOUND • MUNICIPAL
MOBILE • AVIATION
COMMERCIAL • GOVERNMENT

JULY, 1952

FRONT COVER: COMPLETE TRANSISTORIZED EQUIPMENTS are now being produced in miniature packages. Striking illustrations of excellent performance characteristics obtainable with the plastic-embedded units are exemplified by the audio oscillator and amplifier, which employ junction types. The oscillator maintains stable oscillation with a total power drain of 0.09 microwatt, while the two-stage amplifier boasts a power gain of 90 db and a passband of 100-20,000 CPS. The minute power drain and heat dissipation requirements of the transistors will make even greater size reductions possible as comparable resistors and capacitors are developed. For a complete description of the mammoth strides made in transistor developments to date, see the article starting on page 36.

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Publishers also of RADIO & TELEVISION RETAILING

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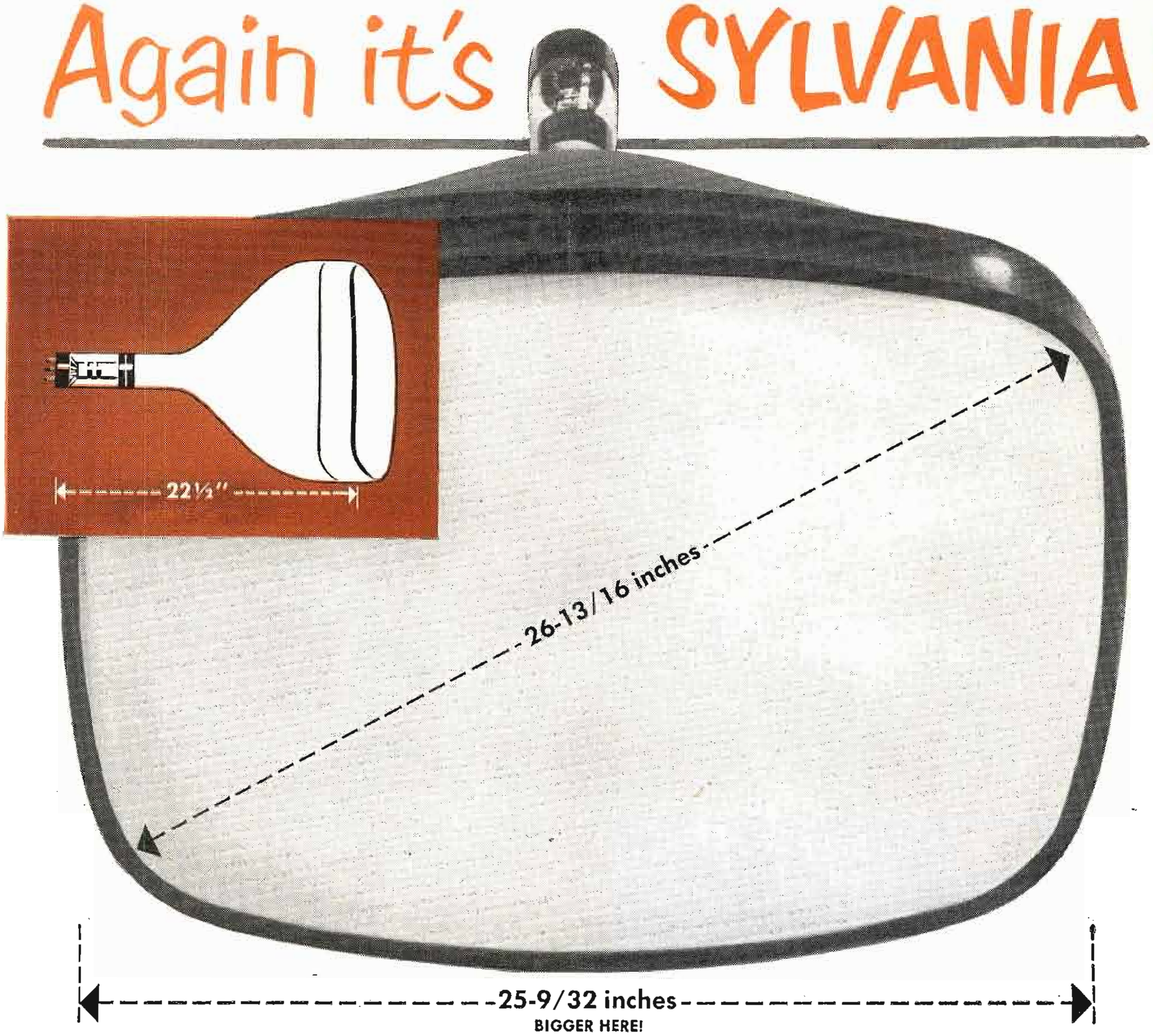


Now with a New 27-inch Rectangular Picture Tube

Again Sylvania steps ahead with a big all-glass picture tube to meet your demands for larger sets and larger screens.

This tube is designed for easier, more comfortable viewing. It employs a neutral-density, gray filter face plate. The tube is magnetically focused and deflected. Equipped with an ion trap gun . . . no external conductive coating.

NEW COMPACT DESIGN

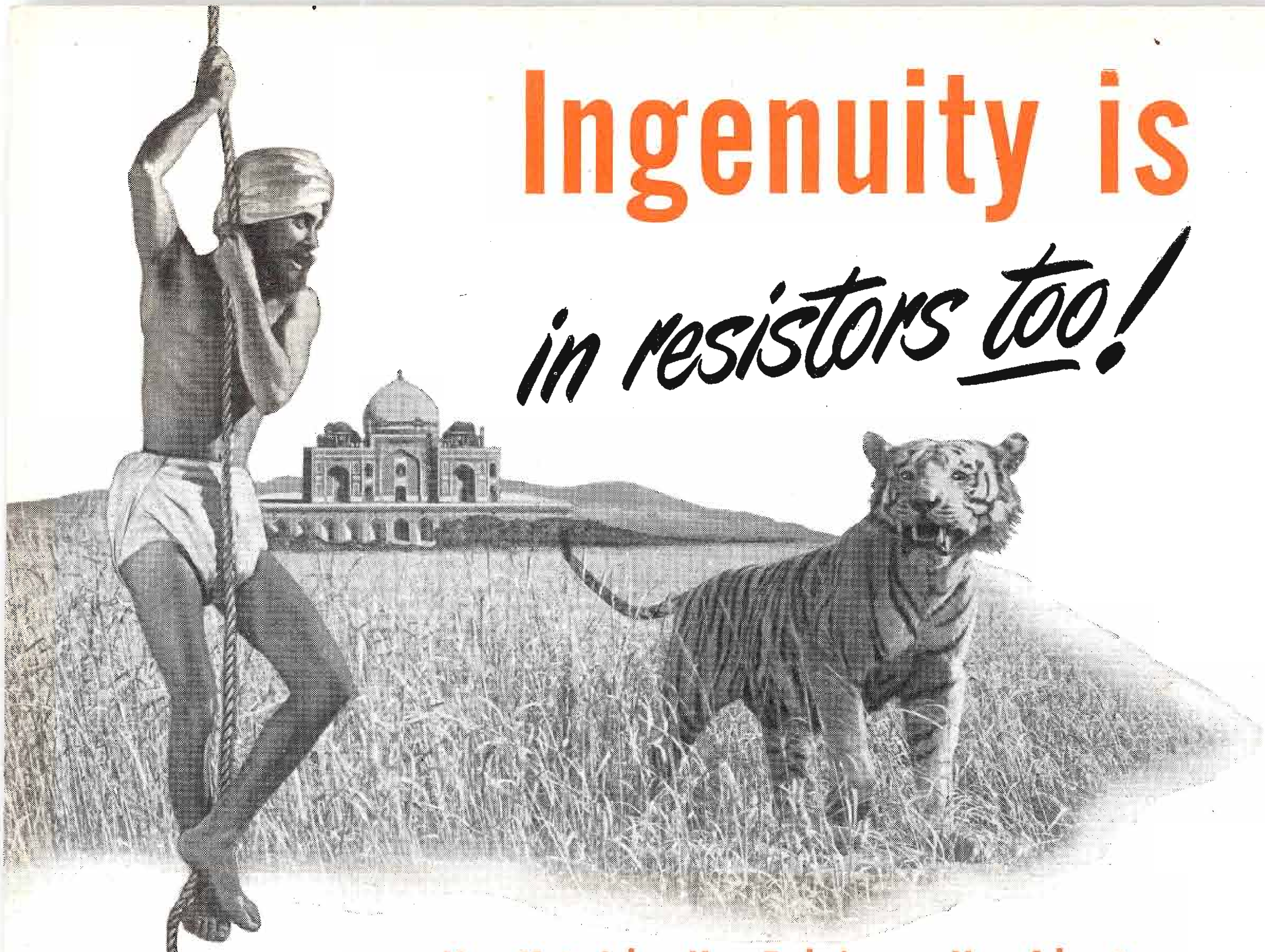
Here is a big tube that's actually shorter in depth to overcome many cabinet design problems. By employing a deflection angle of 90 degrees, the over-all, front-to-rear dimension of this tube has been held to only 22½ inches.

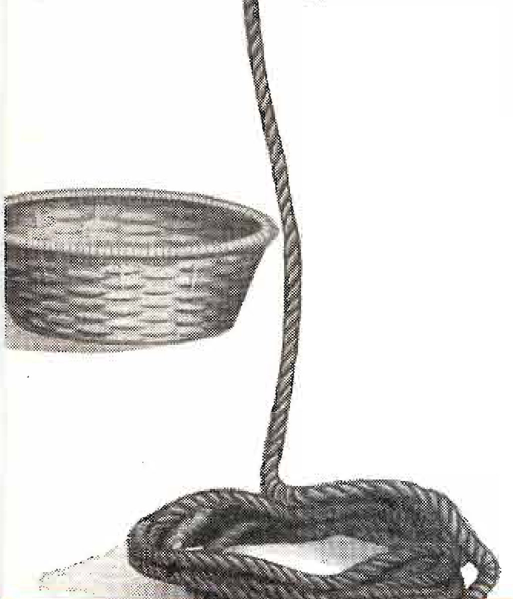
For full detailed data and characteristics of this latest Sylvania picture tube, write today to Sylvania Electric Products Inc., Dept. R-3507, Emporium, Pa.

SYLVANIA

RADIO TUBES; TELEVISION PICTURE TUBES; ELECTRONIC PRODUCTS; ELECTRONIC TEST EQUIPMENT; FLUORESCENT TUBES, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; PHOTOLAMPS; TELEVISION SETS

Ingenuity is *in resistors too!*

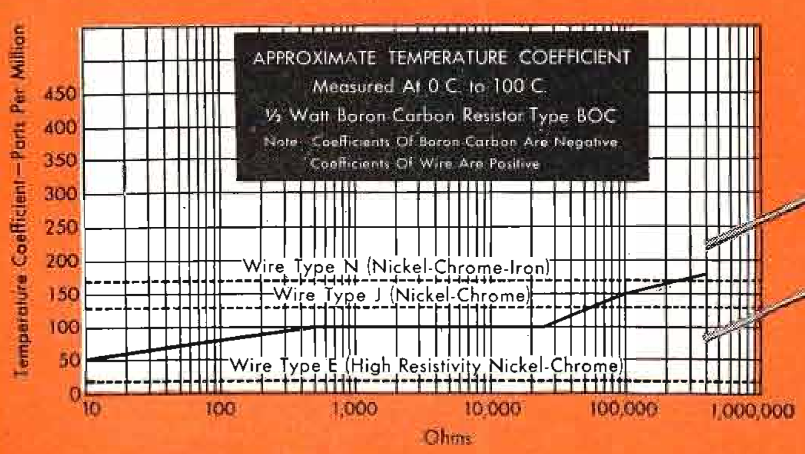


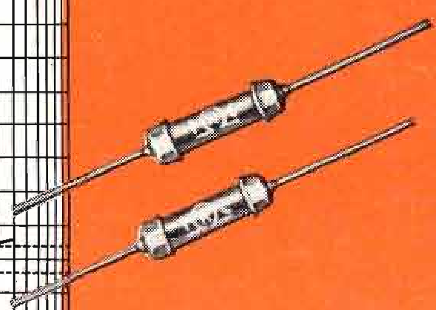


New Materials — New Techniques — New Advantages
Features in 4 New IRC Resistors

1 IRC Type BOC Boron-Carbon ½-Watt PRECISTOR Meets All Requirements of MIL-R-10509 Specification

No other non-wire-wound resistor combines the advantages of this all-new Boron-Carbon unit. Type BOC reduces the temperature coefficient of conventional deposited carbon resistors—provides high accuracy *and* long-time stability—replaces high value wire wound precisions at savings in space and cost. You'll find it adaptable to a host of critical circuitry needs—in electronics and avionics, communications, telemetering, computing and service instruments. Send for full details in Catalog Data Bulletin B-6.





Type BOC conforms to *all* requirements of MIL-R-10509. Exposed to a temperature of 65°C. for one hour, the new BOC shows a resistance change of less than .2%. High temperature operation with reliability is now possible. Voltage coefficient is less than 20 parts per million per volt. Load life is outstanding; on a 500-hour test at ambient temperature of 40°C., resistance change will not exceed 2%.

Good TV installations deserve this

AUTO-DRYAIRE* DEHYDRATOR

MODEL 105-507

AUTO-DRYAIRE* DEHYDRATOR

SPECIFICATIONS:

- Fully automatic—dry air available without interruption. Capacity 3 CFM
- Dewpoints below — −40° F.
- Floor model—26" W x 22" D x 66 7/8" H
- Operating pressure adjustable up to 50 PSI
- Serves up to:
  40,000 ft. 1 5/8" Transmission Line.
  10,000 ft. 3 1/8" Transmission Line.
  3,500 ft. 6 1/8" Transmission Line.

Model 105-507 Autodryaire* Dehydrator, illustrated here, is a proper companion for the well engineered TV transmitting installation. It is highly efficient for purging and maintaining gas filled transmission lines. It has sufficient capacity to do the job and do it well for years. Operation is automatic. Clean air, at lowest dewpoints, is supplied continuously.

*REGISTERED TRADE MARK

CHECK NOW! on the complete family of Auto-Dryaire* Dehydrators. Standard models with deliveries from .15 CFM to 3.0 CFM; larger capacities to specifications.

Communication Products Company, Inc.

MARLBORO, NEW JERSEY — Telephone: FReehold 8-1880

Manufacturers of:

SEAL-O-FLANGE* TRANSMISSION LINE • AM, FM and TV TOWER HARDWARE • LO-LOSS SWITCHES • COAXIAL DIPOLE ANTENNAS • AUTO-DRYAIRE* DEHYDRATORS

On Target!

THE TERM "GUIDED MISSILE" TO THE UNINITIATED USUALLY INDICATES AN AIRBORNE PILOTLESS PLANE DEVICE. HOWEVER, TO THE WELL INFORMED, THIS CONNOTES MANY OTHER POSSIBLE FORMS OF MISSILES; SOME OF WHICH ARE PHYSICAL REALITIES AND SOME DRAWING BOARD PROJECTS.
NOT ALL OF THESE "CONTROLLED FLIGHT" DEVICES HAVE SPECIFIC USES AS ATTACK MISSILES. MANY ARE VALUABLE RESEARCH AIDS IN THE ANALYSIS OF THE BEHAVIOUR OF AIRCRAFT UNDER EXTREME OPERATING CONDITIONS. (TELEMETERING).

THE ENGINEERS WHO DESIGN THE CONTROL APPARATUS FOR MISSILES KNOW THAT IN ORDER TO ANTICIPATE THEIR EXACT BEHAVIOUR EVERY TIME AND THE SELECTIVE CIRCUITS AND FILTERS USED MUST BE UP TO THE HIGH STANDARDS OF PERFORMANCE FOR WHICH BURNELL'S TOROIDS AND FILTERS ARE SO WELL KNOWN.

THE NATURAL RESULT OF THIS REPUTATION IS THAT MANY THOUSANDS OF OUR PRODUCTS ARE IN SOME WAY PLAYING THEIR PART IN KEEPING THE MILITARY ELECTRONIC PROGRAM "ON TARGET."

EXCLUSIVE MANUFACTURERS OF COMMUNICATIONS NETWORK COMPONENTS

BURNELL & CO

Burnell & Company
YONKERS 2, NEW YORK
CABLE ADDRESS "BURNELL"

TELE-TIPS

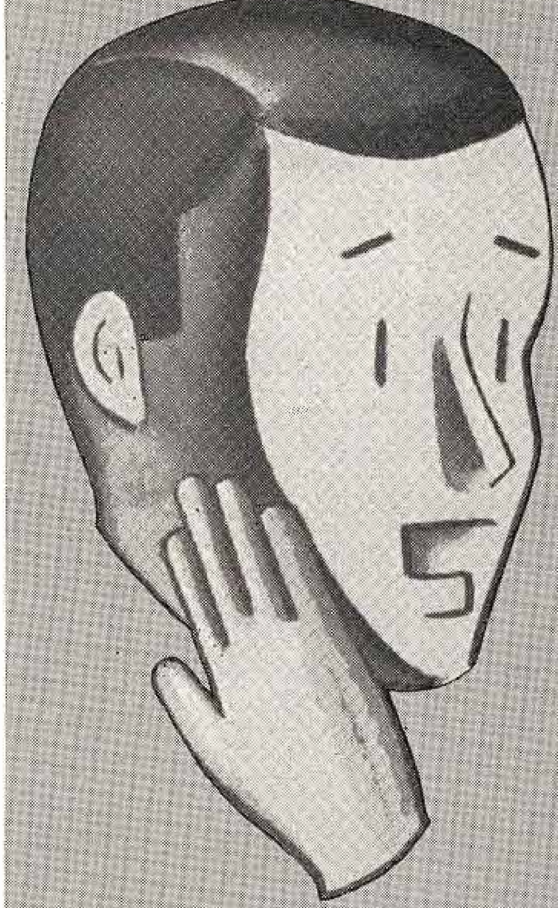
CLOSED-CIRCUIT TV coverage of the July 7 and 21 political conventions in Chicago will be offered to Denver, Colo., Fresno, Calif., and Portland, Ore. Signals will be transmitted over AT&T facilities, and fed to receivers set up in auditoriums as a public service. In addition, 65 interconnected cities with 107 TV stations will receive regular telecasts of the conventions. Only city with a station not connected for simultaneous reception of the programs is Albuquerque.

NEWSMEN for CBS-TV will roam Chicago's International Amphitheatre carrying 450-452 MC transmitters during the Democrat and Republican nominating conventions. The 5.5 lb. portable units will link the bearers with the control or newsroom via a 26 MC lapel pocket cue receiver. Suspended by a shoulder strap, the 1.5 x 6 x 10 in. battery supply is capable of three hours of continuous operation.

GERMANY is planning short wave transmissions for the benefit of Germans overseas. Broadcasts are expected to commence from the Cologne Studios of the NWDR and be transmitted from the Norden-Osterloog transmitters. Broadcasts will be beamed to the Far East, the Near East, Africa, North and South America. Frequencies between 7 and 17 megacycles will probably be used.

TOWER-LIGHT replacements cost about $150 each—at least they do when a steeplejack must climb through a maze of antennas and cable to reach the beacon atop the Empire State TV tower, 1472 ft. above the sidewalks of New York. This expense used to be incurred after every hard rainstorm, the bulbs rarely living out their normal burning lives of 3000 hours. By using a new heat-resistant hard-glass lamp recently developed by GE, the continuously burning bulbs, which do not break when water strikes the hot envelope, need be replaced only at three-month intervals. The 620-watt lamps sell for $5.95 each and are expected to become more widely sought as a source of illumination for warning lights on many kinds of structures which are potential air hazards.

(*Continued on page 12*)



he got the shock of his life when he learned . . .

Heldor SAVED HIM* 37%

on assembly of terminals in can covers!

THIS transformer manufacturer*—as more and more companies are doing today—received a quotation from Heldor on its terminals, and assemblies. He found that Heldor could furnish the terminal plus assembly in his can cover FOR LESS MONEY (37% LESS) than he had been paying for a competitive terminal alone.

He saved important money. Maybe you can, too! It will pay you to investigate Heldor's unique production and assembly facilities on terminals, can covers and cans.

Be Convinced!
MAIL THIS COUPON TODAY!

Heldor Bushing Terminal Co., Inc.,
225 Belleville Ave., Bloomfield, N. J.

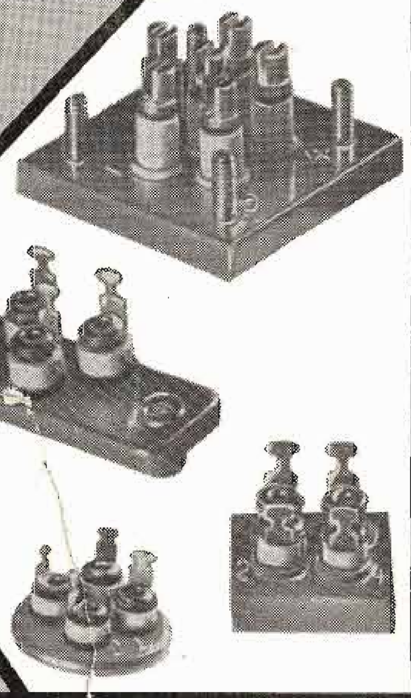
Enclosed is
☐ Print ☐ Specifications for quotation on.................. pieces.
(quantity)

We are interested in assembly of HELDOR TERMINALS in
☐ our can covers ☐ HELDOR can covers.

Name .... Title ....

Company ....

Address ....



Heldor

HELDOR BUSHING & TERMINAL CO., Inc.

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GERMANIUM DIODES

help shrink field radio weight from 14 pounds to 6!

Miniaturization also cuts portable radio-telephone weight in half.

Four G-E Diodes in the new portable radio-telephone!

Made for the Signal Corps by RCA and Admiral Corporation, the AN/PRC-10 is the latest back-pack radio set for armored, artillery, and infantry units. Discriminator can contains 2 G-E diodes, type 1N81, selected for small size, long life and reliability under adverse conditions of military operation.

In World War II, the back-pack radio weighed 30 pounds, a tiring load for a soldier. Careful miniaturization, employing diodes wherever possible, has trimmed this bulk to 15 pounds, and today's radio is stronger, more reliable than its older brother.

- A pair of General Electric 1N81 diodes in hermetically-sealed, self-contained cases are of vital importance in the discriminator assembly of the AN/PRC-6, built for the U. S. Signal Corps.* In the circuit, the diodes make the RF signal intelligible and maintain balance at all times over the normally wide military requirements of ambient temperatures.

- This improvement represents only one contribution of G-E germanium products to military applications where reductions in space and weight are critically needed.

- Our application engineers are prepared to discuss the complete G-E diode and transistor story with your designers, at no obligation. Write: *General Electric Company, Electronics Park, Syracuse, New York.*

**by Utility Electronics Co., Newark, N. J.*

GENERAL ELECTRIC

TELE-TIPS

(*Continued from page 8*)

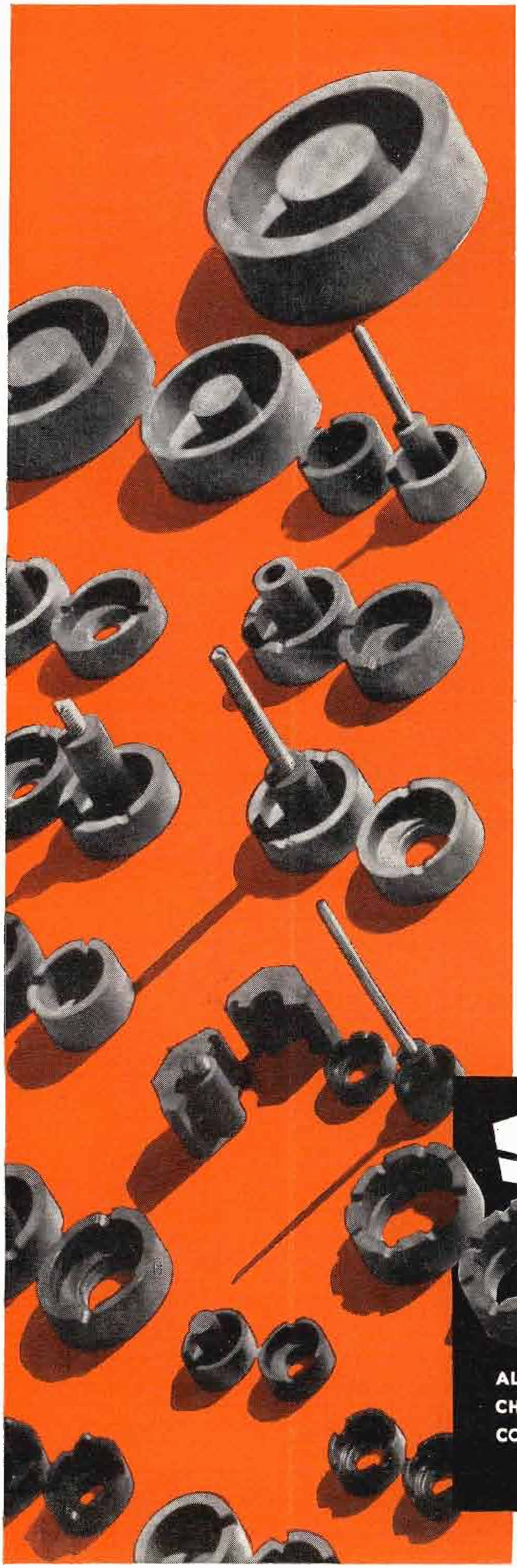
LOW-COST JACKS that are "reliable" should find a ready market in many equipment installations. Currently-available jacks are reported to be either inexpensive and not very reliable for extensive service, or else they are reliable but very costly. What's needed apparently is a middle-of-the-road unit—good reliability at a fair price.

NOT TUBES, but mechanical vibrators and relays, are principal components creating failure problems in the operation of the "Typhoon" computer at Johnsville, Pa. Installation and operation of these items are logged in order to keep a control on the situation. Also, shutting down the equipment for any length of time, for over a weekend say, introduces more problems since it requires a considerable period of time for all of the racks to warm-up to operating temperature.

FREQUENCY TERMINOLOGY is often confusedly applied, particularly where similar terms are used to describe phenomena in relation to the speed of sound. Frequencies above the audio range of 15 to 20,000 CPS should be called *ultrasonic,* the expression *supersonic* being obsolete and only correctly applicable to speeds greater than that of sound. Some aeronautical people, however, incorrectly dub velocities several times greater than the speed of sound as *ultrasonic!* In the frequency range below audio, the word *infrasonic* is preferred to *subsonic.*

FCC TO BOOST FM this year by some relaxations in license requirements, according to latest rumor. Also of interest, sale of new receivers is now being directed toward those areas where, because of local conditions, FM is unquestionably the superior and most practical means of sound broadcasting. Theory is "to plant the seed and let it grow."

LEADERSHIP—No business rises higher than its leadership, says Salesman Sam, and the best kind of leadership is that which produces fellowship . . . . Do not expect perfection in a human being, and be cautious of enthusiasm when the sun shines bright, and slow to dismissal when the clouds hang low . . . . Successful selling is 90% preparation and 10% presentation, but progress always involves a certain amount of risk; you can't steal 2nd base and still keep 1 foot on first.



When it comes to making a *Real Saving* in space...

Stackpole cup cores with their self-shielding characteristic can be mounted close to the chassis or any other metal part for maximum results in extremely close quarters. In some instances, the high Q circuits made possible through their use permit reduction in the number of tubes needed.

Standard types include numerous shapes and sizes, each available in a wide range of permeability possibilities. Highly specialized types to meet the most critical specifications can be engineered and produced from a broad background of experience in this exacting field.

Electronic Components Division

STACKPOLE CARBON COMPANY

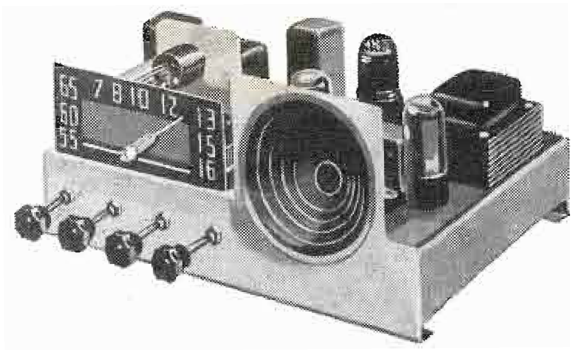
St. Marys, Pa.

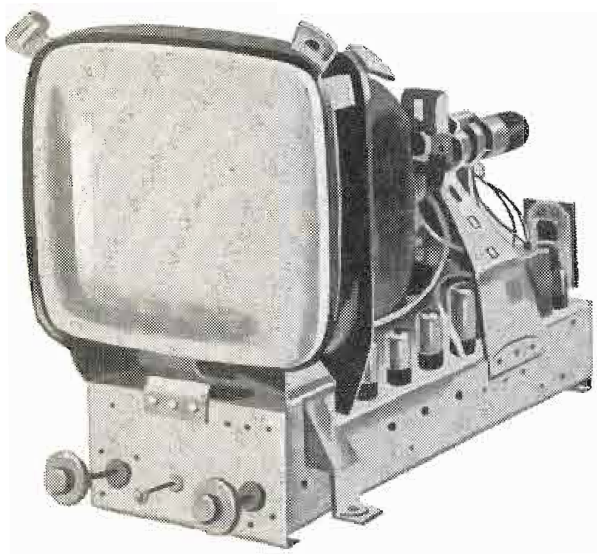
STACKPOLE *Cup Cores*

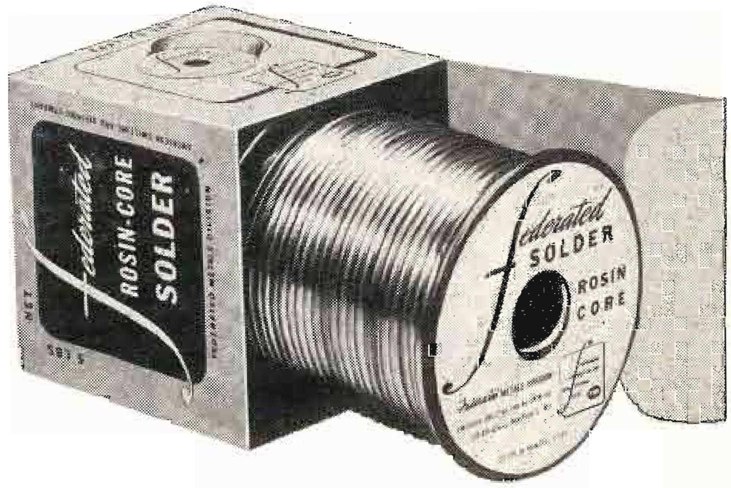
Other Stackpole core types include:

ALL STANDARD MOLDED IRON CORE TYPES, SIDE-MOLDED, CHOKE COIL CORES, SLEEVE TYPES, THREADED TYPES and COIL FORMS . . . also Stackpole CERAMAG® CORES (FERRITES).

Write for Electronic Components Catalog RC-8

FOR RADIO  AND

TV  SOLDERING THAT LASTS...

USE... 

For any soldering job that demands freedom from corrosion and conductive flux residue . . . for ease of working and unequalled consistency . . . there is nothing better than Federated Rosin Core Solder.

Each Rosin Core Solder composition, of which there is a variety for different purposes, is a tin and lead alloy with a rosin flux that is effective but not corrosive. Because the rosin residue is chemically inactive, current leakage at radio and television frequencies is prevented.

Federated Rosin Core Solder is a quality product that is unsurpassed for the permanence of the bond it produces . . . for the consistently easier soldering job it does! Look for it in 1, 5, 20, 25, and 50-pound sizes on the familiar orange and black metal spool. Listed by Underwriters' Laboratories Inc.

Federated Metals Division

Federated First in the non Ferrous Field FMD

AMERICAN SMELTING AND REFINING COMPANY · 120 BROADWAY, NEW YORK 5, N. Y.

KENYON TRANSFORMERS

FOR STANDARD AND SPECIAL APPLICATIONS

KENYON TRANSFORMERS FOR

J A N Applications
Radar
Broadcast
Atomic Energy Equipment
Special Machinery
Automatic Controls
Experimental Laboratories

For more than 25 years, Kenyon has led the field in producing premium quality transformers. These rugged units are (1) engineered to specific requirements (2) manufactured for long, trouble-free operation (3) meet all Army-Navy specifications.

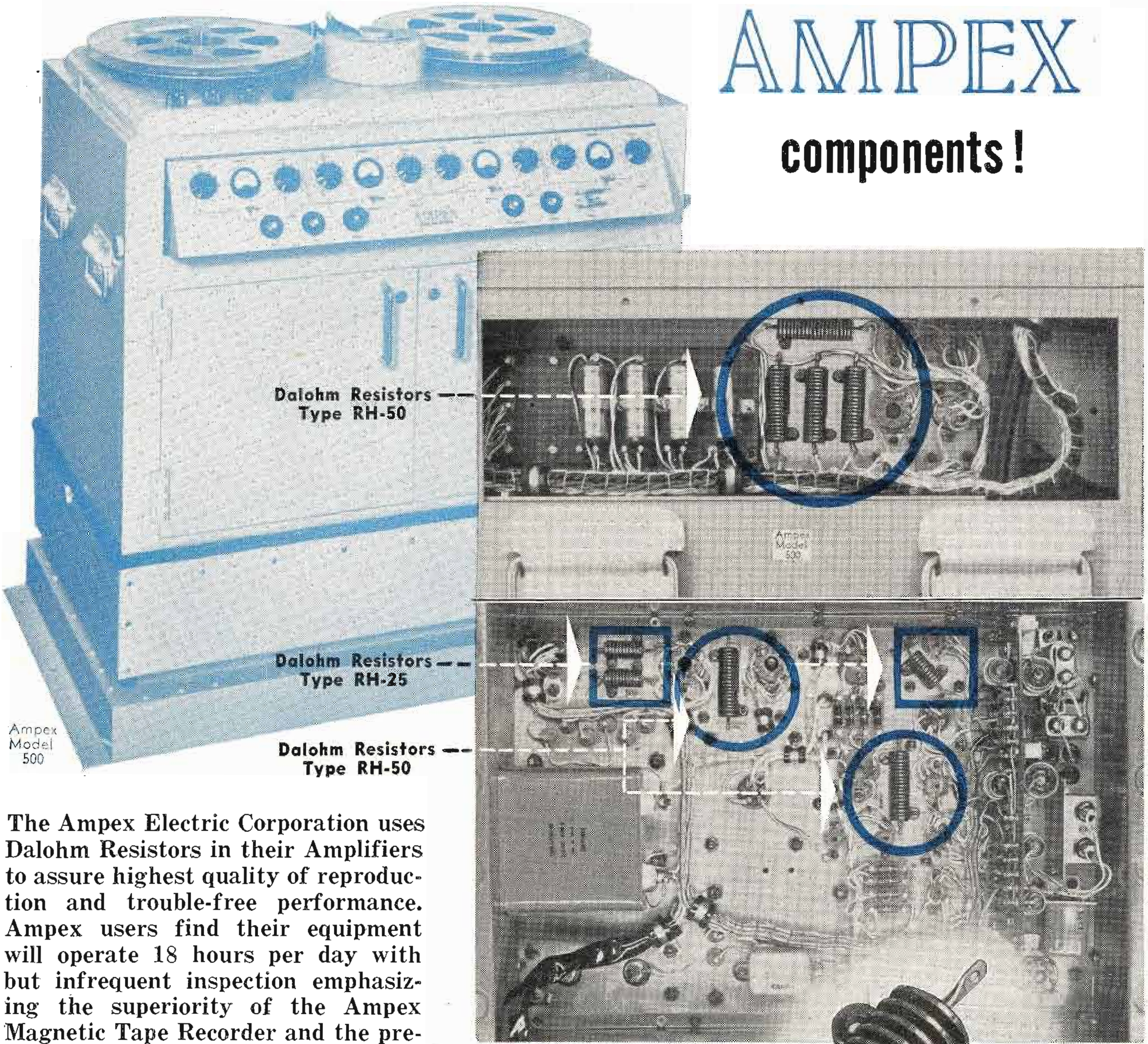
Write for details

KENYON TRANSFORMER CO., Inc.

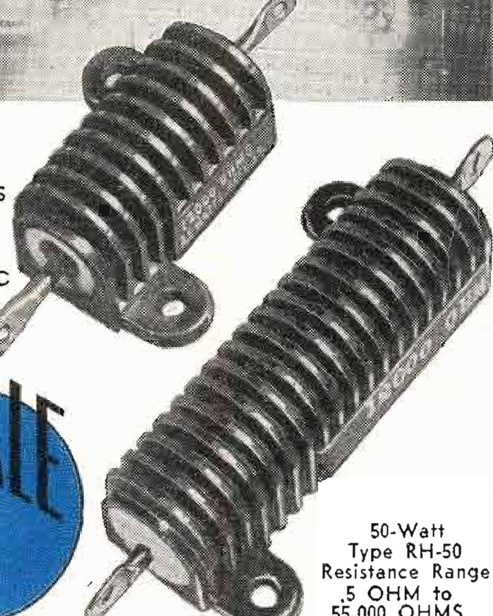
840 Barry Street, New York 59, N. Y.

DALOHM RESISTORS now standard

AMPEX components!



The Ampex Electric Corporation uses Dalohm Resistors in their Amplifiers to assure highest quality of reproduction and trouble-free performance. Ampex users find their equipment will operate 18 hours per day with but infrequent inspection emphasizing the superiority of the Ampex Magnetic Tape Recorder and the precise workmanship and dependable performance of the Dalohm 25 and 50 watt miniature power resistors. Manufacturers who seek the answer to that space problem find it in the Dalohm Resistor. It's real power in miniature!



25-Watt
Type RH-25
Resistance Range
.2 OHM to 15,500 OHMS
Tolerance
.05%, .1%, .25%,
.5%, 1%, 3%, & 5%
Temp. Coef. 0.00002/Deg. C

50-Watt
Type RH-50
Resistance Range
.5 OHM to
55,000 OHMS
Tolerance
.05%, .1%, .25%, .5%, 1%, 3%, & 5%
Temp. Coef. 0.00002/Deg. C

Write today for full details and information on Dalohm 25 and 50 watt miniature power resistors.

"Also available in 2, 5, and 10 watt sizes."

"A complete line of the deposited carbon resistors is also available for prompt delivery."

For those tight specifications

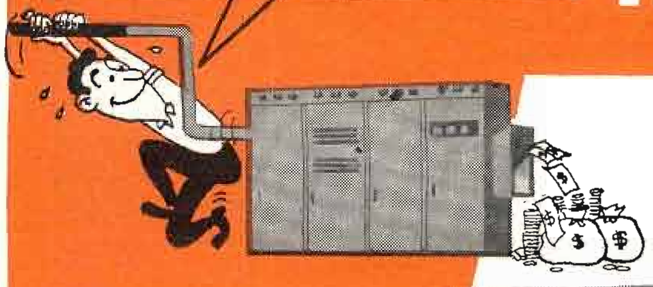
DALE

DALE PRODUCTS, Inc.

COLUMBUS, NEBRASKA U. S. A.

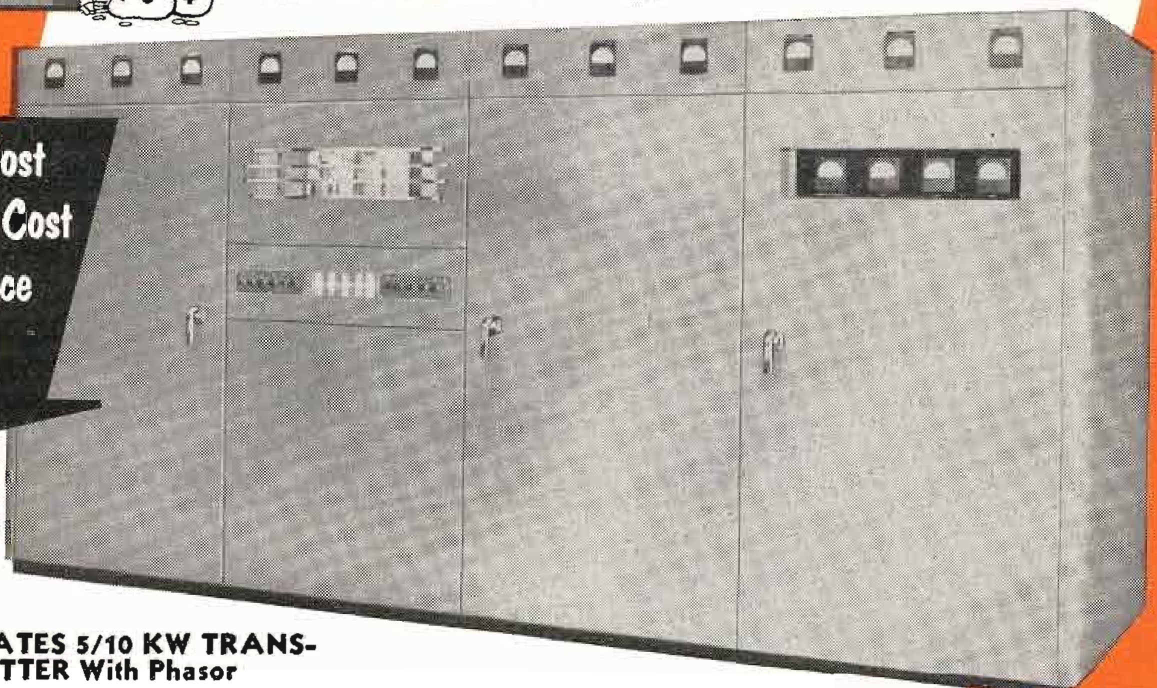
JK
PRODUCTS
keeping communications ON THE BEAM
JK STABILIZED H-17 CRYSTAL
CRYSTALS FOR THE CRITICAL
The small, compact H-17 is designated as a military type crystal for its use in mobile units common to the military. Frequency range: 200 kc to 100 mc. Hermetically sealed holders; wire-mounted, silver-plated crystals.
the JK FD-12
FREQUENCY AND MONITOR MODULATION
Monitors any four frequencies anywhere between 25 mc and 175 mc, checking both frequency deviation and amount of modulation. Keeps the "beam" on allocation; guarantees more solid coverage, too!
"High Gear" Response to High Power Maintenance!
Dawn or dusk, it doesn't matter. These heroes of the high wires arrive to stop power trouble before it starts. Their "nose for disaster" is in the service truck, in the mobile radio unit which often relies on JK crystals and monitors to keep their assigned radio frequency on the beam!
THE JAMES KNIGHTS COMPANY
SANDWICH 2, ILLINOIS

SLASH COSTS... INCREASE PROFITS!



GATES

5KW and 10KW AM TRANSMITTERS



- ✓ Lower Initial Cost
- ✓ Lower Operating Cost
- ✓ Proven Performance

MORE BONUS FEATURES

GATES 5/10 KW TRANSMITTER With Phasor

Here's good news, indeed, for performance conscious broadcasters who want quality equipment and who appreciate the many bonus advantages this better engineered broadcast transmitter offers.

Check These Features

1. Popular new 3X2500F3 tubes used both as power amplifiers and modulators. As modulators, these low impedance tubes provide lower distortion—higher broadcast fidelity. They operate at lower plate voltage, provide greater safety factor and better circuit constants.
2. More effective and efficient cooling system employs a single .44 H. P. blower motor instead of usual three 1/3 H. P.
3. Separate meters provided for every important circuit. No multimetering employed.
4. Sixty second or less accessibility to any part regardless of location.
5. No saving at sacrifice of quality. All transformers fully cased, abundance of circuit protection, including ten over/underload relays and five magnetic circuit breakers plus average two cycle frequency stability.
6. Handsome appearance — modern design, easy accessibility.
7. Lower primary power consumption (15½ KW at average modulation). One broadcaster reported actual savings of $100.00 monthly in power bill after replacing older 5 KW with new GATES BC-5B.

SPECIFICATIONS

- 5 R. F. stages with 3X2500F3 power amplifiers.
- 4 audio stages with pair 3X2500F3 Class B modulators.
- Inverse feedback employed but will meet full F. C. C. requirements when omitted.
- Response 30—10,000 cycles 1.5 Db. Noise consistently way below 60 Db. at 100% modulation.
- Average distortion 2½% or less at 50 and 7500 cycles.
- Power consumption at average modulation only 15.5 KW at 5 KW or 23 KW at 10 KW, carrier power.

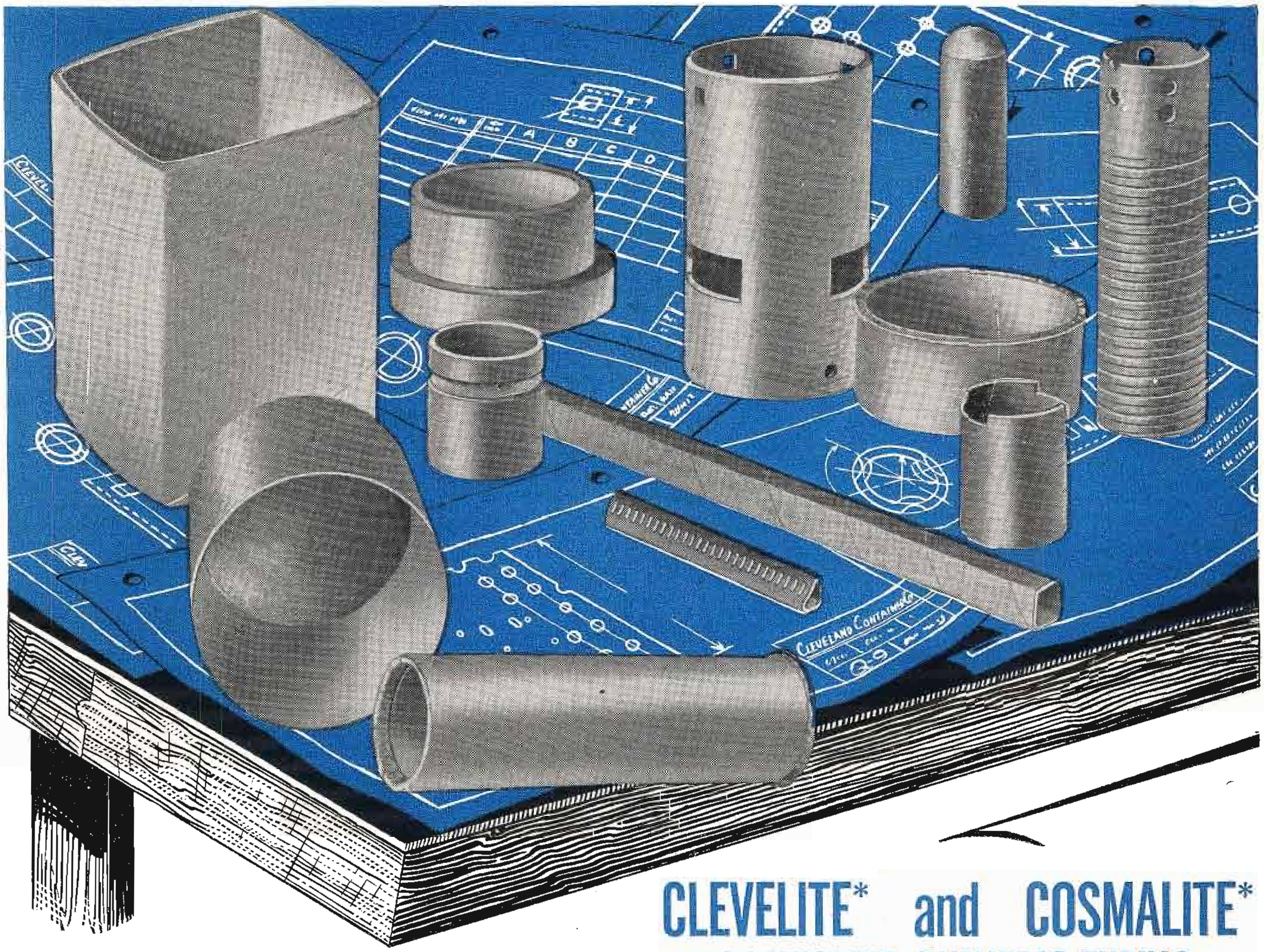
Join GATES equipped broadcasters everywhere who are slashing initial and operating costs, increasing quality of broadcasts and building profits. Write today for descriptive literature and engineering data on these modern GATES 5/10 KW Transmitters. See for yourself why there is no wiser nor more profitable investment in broadcast transmitters than in GATES!

GATES

GATES RADIO COMPANY, QUINCY, ILLINOIS, U. S. A.

MANUFACTURING ENGINEERS SINCE 1922

2700 Polk Avenue, Houston, Texas • Warner Building, Washington, D. C. • International Division, 13 E. 40th St., New York City
Canadian Marconi Company, Montreal, Quebec



CLEVELITE* and COSMALITE*

LAMINATED PHENOLIC TUBING

are more than ever before—the first choice in the electronic and electrical industries.

They combine proven performance with low cost and excellent service!

Wherever high dielectric strength, low moisture absorption, physical strength, low loss and good machineability are of prime importance . . . the combined electrical and physical properties of

CLEVELITE and COSMALITE

are essential.

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IMMEDIATELY AVAILABLE!

Tell us your needs.

*Reg. U. S. Pat. Off.

A GRADE FOR EVERY NEED!

Diameters — wall thicknesses and lengths to meet regular or special adaptations.

IN RADIO AND TELEVISION their use is almost universal. They have high insulation resistance and low moisture absorption. Their low dielectric loss is suitable for ultra high frequency applications.

IN ELECTRIC MOTORS for armature shaft spacers, insulators, brush holders, and many similar force-fit applications requiring easy machining, Clevelite is particularly suitable.

IN RELAYS, CONTROLS, SELENIUM RECTIFIERS, the various grades of Clevelite Phenolic Tubing have special properties that guarantee complete satisfaction.

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ABRASIVE DIVISION at Cleveland, Ohio
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MYCALEX the ideal insulation

INJECTION MOLDED GRADES:

MYCALEX 410

MYCALEX 410 IS APPROVED FULLY AS GRADE L-4B UNDER NATIONAL MILITARY ESTABLISHMENT SPECIFICATION JAN-I-10 "INSULATING MATERIALS, CERAMIC, RADIO, CLASS L." CAN BE INJECTION MOLDED, WITH OR WITHOUT METAL INSERTS, TO EXTREMELY CLOSE TOLERANCES.

CHARACTERISTICS

Power Factor, 1 megacycle	0.0015
Dielectric Constant, 1 megacycle	9.2
Loss factor, 1 megacycle	0.014
Dielectric Strength, volts/mil	400
Volume Resistivity, ohm-cm	$1x10^{15}$
Arc Resistance, seconds	250
Impact Strength, Izod ft.-lb./in. of notch	0.7
Max. Safe Operating Temp. °C	350
°F	660
Water Absorption, % in 24 hours	nil
Coefficient of Linear Expansion, °C	$11x10^{-6}$
Tensile Strength, psi	6000
Compression Strength, psi	25000

★ ★ ★

MYCALEX 410X

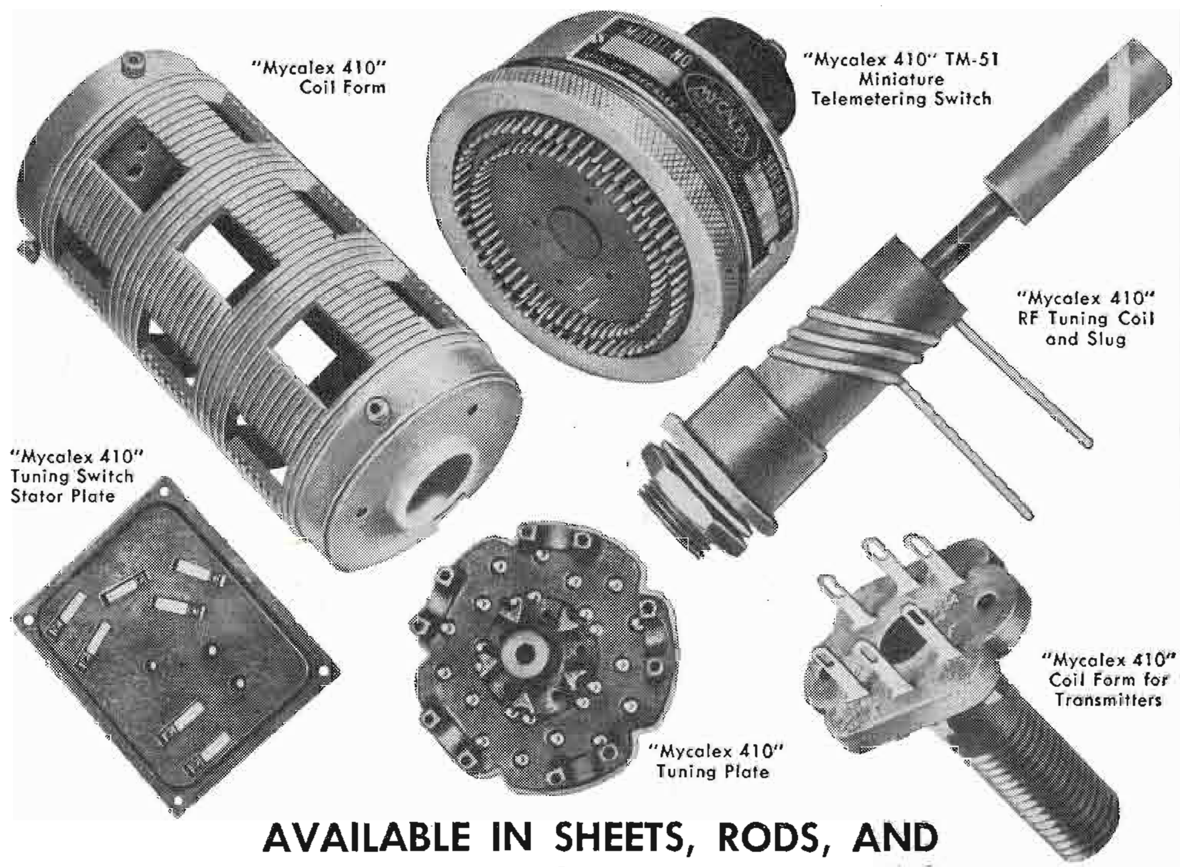
MYCALEX 410X CAN BE INJECTION MOLDED, WITH OR WITHOUT METAL INSERTS, TO EXTREMELY CLOSE TOLERANCES.

CHARACTERISTICS

Power Factor, 1 megacycle	0.012
Dielectric Constant, 1 megacycle	6.9
Loss factor, 1 megacycle	0.083
Dielectric Strength, volts/mil	400
Volume Resistivity, ohm-cm	$5x10^{14}$
Arc Resistance, seconds	250
Impact Strength, Izod, ft.-lb./in. of notch	0.6
Max. Safe Operating Temp., °C	350
°F	660
Water Absorption, % in 24 hours	nil
Coefficient of Linear Expansion, °C	$12x10^{-6}$
Tensile Strength, psi	6000
Compressive Strength, psi	28000

—a superior inorganic glass-bonded mica insulation featuring—

- LOW LOSS — HIGH EFFICIENCY
- HIGH DIELECTRIC STRENGTH
- IMPERVIOUS TO OIL OR WATER
- FREEDOM FROM CARBONIZATION
- PERMANENT DIMENSIONAL STABILITY
- WITHSTANDS HIGH TEMPERATURE
- IMMUNE TO HUMIDITY
- EXCELLENT MECHANICAL CHARACTERISTICS



"Mycalex 410" Coil Form

"Mycalex 410" TM-51 Miniature Telemetering Switch

"Mycalex 410" RF Tuning Coil and Slug

"Mycalex 410" Tuning Switch Stator Plate

"Mycalex 410" Tuning Plate

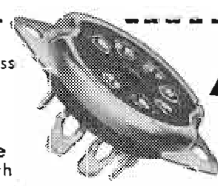
"Mycalex 410" Coil Form for Transmitters

AVAILABLE IN SHEETS, RODS, AND FABRICATED TO SPECIAL SHAPES

MYCALEX

LOW-LOSS MINIATURE, SUB-MINIATURE AND UHF TUNER

TUBE SOCKETS

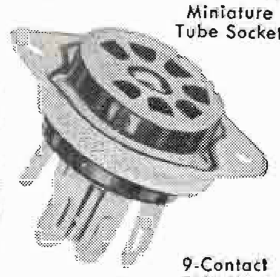


Mycalex Low Loss UHF Tuner Tube Socket

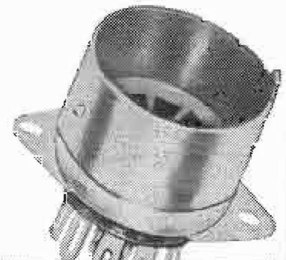
7-Pin Miniature Tube Socket with Four Ground Lugs

9-Pin Miniature Snap Saddle Type Tube Socket

8-Pin Sub-Miniature Tube Socket



7-Pin Saddle Type Miniature Tube Socket



9-Contact JAN Type Tube Socket

These sockets cost no more than ordinary phenolic types yet electrical characteristics are far superior. Dimensional accuracy and uniformity are unexcelled.

PRODUCED IN TWO GRADES

MYCALEX 410 is approved fully as Grade L-4B under N.M.E.S. JAN-I-10 "Insulating Materials, Ceramic, Radio, Class L."

MYCALEX 410X is lower in cost but its insulating properties greatly exceed those of general purpose phenolics.

Both types available in 7- and 9-pin miniature, sub-miniature and UHF. All are injected molded to high precision.

SINCE 1919 MYCALEX THE INSULATOR TRADE MARK REG. U.S. PAT. OFF.

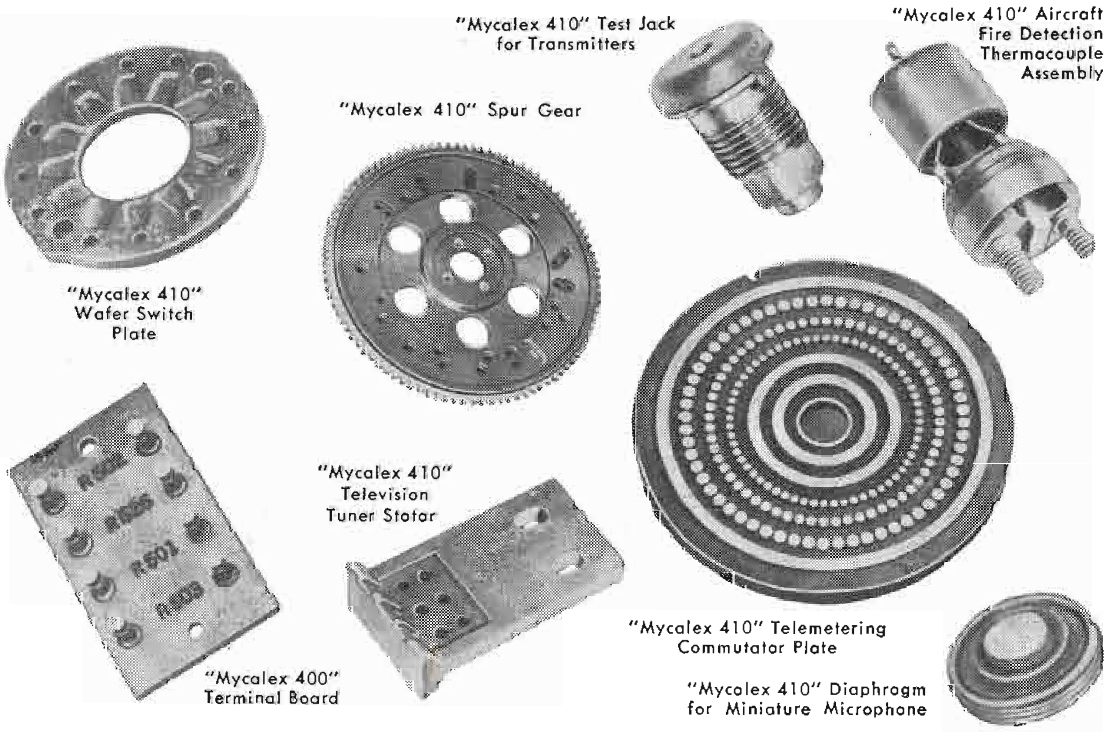
MYCALEX CORPORATION OF AMERICA

Owners of 'MYCALEX' Patents and Trade-Marks

for ALL frequencies MYCALEX

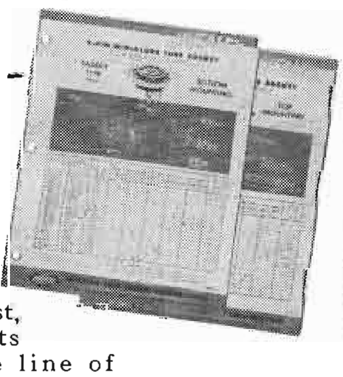
—economical, widely applicable machines and molds to close tolerances

Mycalex is a highly developed glass-bonded mica insulation backed by over a quarter-century of continued research and successful performance. In its present high state of development, MYCALEX combines every important characteristic demanded of a modern, permanent, efficient electrical insulating material. MYCALEX is supplied in sheets or rods, can be injection or compression molded to close tolerance, is readily machineable, and can be fabricated in practically any size or shape. Dielectric losses are very low from 60 cycles to 24 kilomegacycles per second, arc resistance, volume resistivity and other electrical characteristics meet the most rigorous requirements. Physical properties are equally advantageous.



"Mycalex 410" Test Jack for Transmitters
"Mycalex 410" Aircraft Fire Detection Thermocouple Assembly
"Mycalex 410" Spur Gear
"Mycalex 410" Wafer Switch Plate
"Mycalex 410" Television Tuner Stator
"Mycalex 410" Telemetering Commutator Plate
"Mycalex 400" Terminal Board
"Mycalex 410" Diaphragm for Miniature Microphone

CAN BE TAPPED, DRILLED, THREADED GROUND, OR MOLDED WITH INSERTS



MYCALEX
GENERAL CATALOG and ENGINEERS' HANDBOOK

Your copy of the new up-to-the-minute MYCALEX CATALOG and ENGINEERS' HANDBOOK will be sent promptly on request. Tells the entire MYCALEX insulation story — Contains 20 pages of factual information including design, engineering, and practical manufacturing data — types of MYCALEX, characteristics, properties of dielectrics, injection molded grades, design of molded insulators, compression molded grades, design of machined insulators, etc.

Available on request, these data sheets cover the entire line of MYCALEX tube sockets—miniature, subminiature and UHF — available in all types of mountings: regular saddle for top or bottom mounting, snap saddle, four ground lug saddle and JAN types. MYCALEX tube sockets offer outstanding advantages over practically every other type, yet are priced competitively with the cheapest sockets available anywhere. Get the facts today!

FOR LITERATURE, INFORMATION OR QUOTATIONS — CALL, WRITE OR WIRE 180 CLIFTON BLVD., CLIFTON, N. J.

MACHINEABLE GRADES:

MYCALEX 400

MYCALEX 400 IS APPROVED FULLY AS GRADE L-4A UNDER NATIONAL MILITARY ESTABLISHMENT SPECIFICATION JAN-I-10 "INSULATING MATERIALS, CERAMIC, RADIO, CLASS L."

CHARACTERISTICS

Power Factor, 1 megacycle	0.0018
Dielectric Constant, 1 megacycle	7.4
Loss Factor, 1 megacycle	0.013
Dielectric Strength, volts/mil	500
Volume Resistivity, ohm-cm	$2x10^{15}$
Arc Resistance, seconds	300
Impact Strength, Izod, ft.-lb./in. of notch	1.85
Max. Safe Operating Temp., °C	370
°F	700
Water Absorption, % in 24 hours	nil
Coefficient of Linear Expansion, °C	$10.2x10^{-6}$
Tensile Strength, psi	6000
Compressive Strength, psi	35000

★ ★ ★

MYCALEX K-10

CHARACTERISTICS

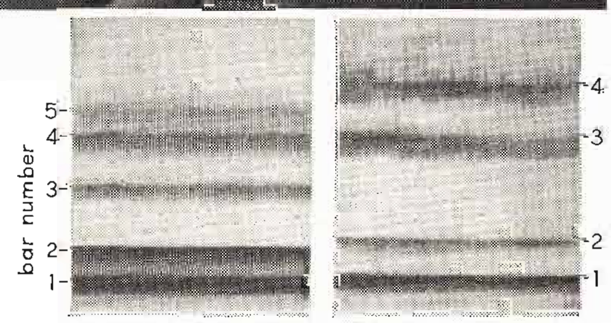
Dielectric Constant, 1 megacycle	10.6
Q Factor, 1 megacycle	310
Loss factor, 1 megacycle	0.034
Volume Resistivity, ohm-cm	$3.0x10^{14}$
Dielectric Strength, volts/mil (0.10 in. thickness)	270
Fractional Decrease of Capacitance with Temperature Change	0.0056
Fractional Increase of Capacitance with Temperature Change	0.0076
Max. Safe Operation Temperature, °C	400

MYCALEX K EMBRACES AN ENTIRE SERIES OF CAPACITOR DIELECTRICS, EACH WITH SPECIFIC CHARACTERISTICS. THESE CAN BE SUPPLIED ON SPECIAL ORDER IN SHEETS 14" x 18" IN AREA AND FROM 1/8" TO 1" IN THICKNESS, ALSO AVAILABLE IN RODS. MYCALEX K CAN BE MACHINED, AND MYCALEX KM MOLDED TO CLOSE TOLERANCES.

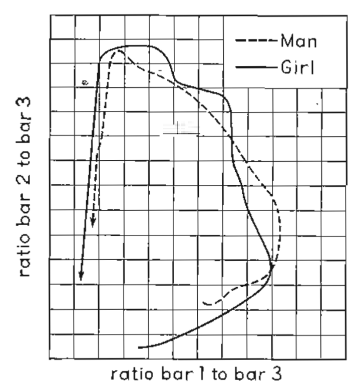
Executive Offices: 30 Rockefeller Plaza, New York 20
Plant and General Offices: Clifton, New Jersey

SINCE 1919 MYCALEX THE INSULATOR
TRADE MARK REG. U.S. PAT. OFF.

In the famous Quiet Room at Bell Laboratories, this young volunteer records speech for analysis. Scientists seek to isolate the frequencies and intensities which give meaning to words . . . stripping away non-essential parts of word sounds to get the basic "skeleton" of speech.



Spectrograms of young girl's voice (right) and man's voice making "uh" sound as in "up." Horizontal bars reveal frequencies in the vocal cavities at which energy is concentrated. The top of the picture is 6000 cycles per second. Pictures show how child's resonance bars are pitched higher than man's.



The word "five." Graph shows ratio of frequency of spectrogram bars. The solid line is for a girl and the dotted line is for a man. Note the similar patterns despite pitch differences. Human hearing extracts the speech sounds from this sort of pattern in the identification of words. Scientists aim at machines that can do the same.

A child or an adult . . . a man or a woman . . . an American or an Englishman—all speak a certain word. Their voices differ greatly. Yet listeners understand the word at once. What are the common factors in speech which convey this information to the hearer's brain?

Bell scientists are searching for the key. Once discovered, it could lead to new electrical systems obedient in new ways to the spoken word, saving time and money in telephony.

Chief tool in the research is the sound spectrograph which Bell Telephone Laboratories developed to make speech visible. Many kinds of persons record their voices, each trying to duplicate an electrically produced "model" sound. While their voice patterns are studied, a parallel investigation is made of the way human vocal cords, mouth, nose and throat produce speech.

Thus, scientists at Bell Laboratories dig deeply into the fundamentals of the way people talk, so that tomorrow's telephone system may carry your voice still more efficiently—offering more value, keeping the cost low.

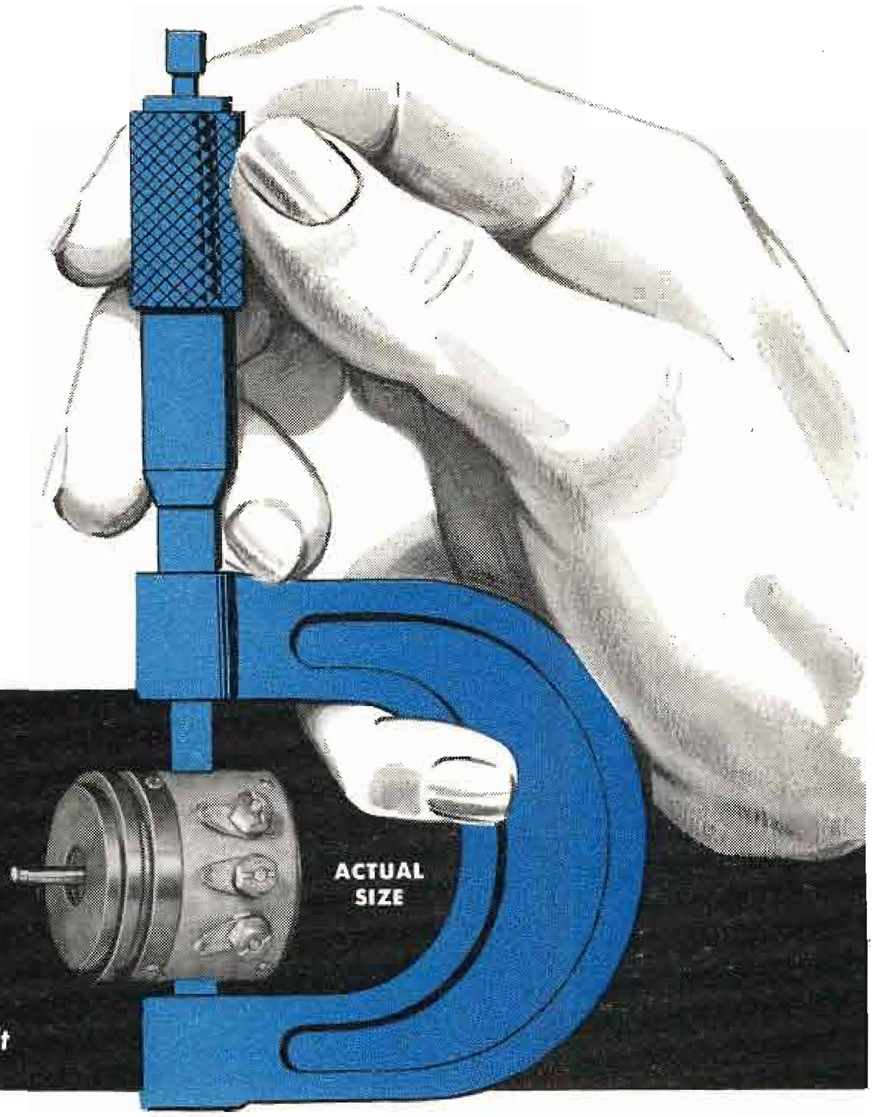
BELL TELEPHONE LABORATORIES

Improving telephone service for America provides careers for creative men in scientific and technical fields.

Another achievement in potentiometer design by **Helipot** *the world's largest manufacturer of precision potentiometers . . . the*

TINYTORQUE

MODEL T

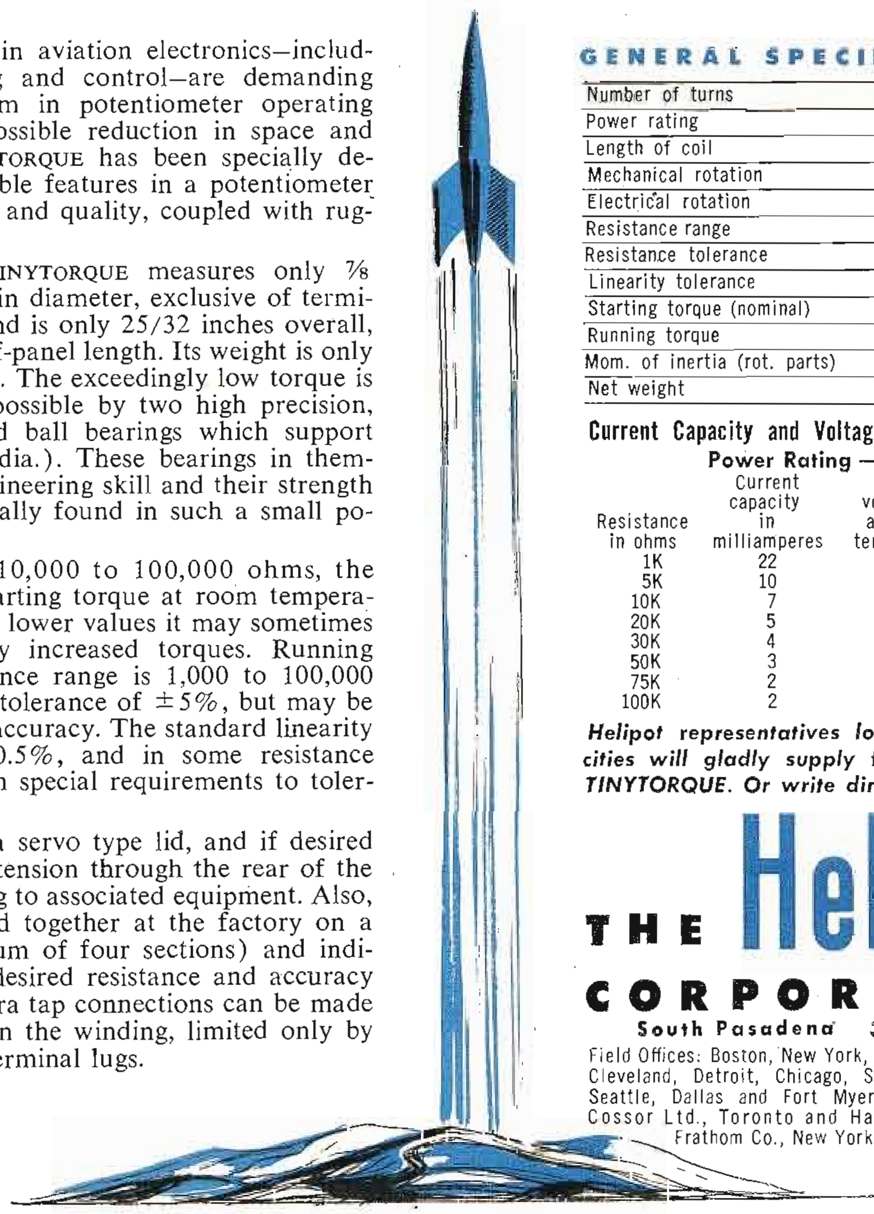


ULTRA-LOW TORQUE
.005 inch-ounce nominal starting torque

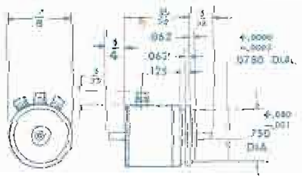
MINIATURE SIZE
7/8" diameter x 25/32" overall length

FEATHERWEIGHT
Weighs only half an ounce (0.56 oz.)

BALL BEARING CONSTRUCTION
Two miniature ball bearings support shaft



Current developments in aviation electronics—including guided missile telemetering and control—are demanding not only the absolute minimum in potentiometer operating torque, but also the greatest possible reduction in space and weight requirements. The TINYTORQUE has been specially developed to combine these desirable features in a potentiometer of the highest possible precision and quality, coupled with rugged dependability and long life.



The TINYTORQUE measures only ⅞ inches in diameter, exclusive of terminals, and is only 25/32 inches overall, back-of-panel length. Its weight is only 0.56 oz. The exceedingly low torque is made possible by two high precision, shielded ball bearings which support the stainless steel shaft (5/64" dia.). These bearings in themselves are an achievement in engineering skill and their strength provides a ruggedness not normally found in such a small potentiometer of ultra-low torque.

In resistances from 10,000 to 100,000 ohms, the TINYTORQUE has a maximum starting torque at room temperature of only .005 inch-ounces. In lower values it may sometimes be necessary to permit slightly increased torques. Running torque is negligible. The resistance range is 1,000 to 100,000 ohms with a standard resistance tolerance of ±5%, but may be maintained or selected to closer accuracy. The standard linearity accuracy of TINYTORQUE is ±0.5%, and in some resistance values accuracies can be held on special requirements to tolerances as low as ±0.25%.

The TINYTORQUE has a servo type lid, and if desired can be provided with a shaft extension through the rear of the unit to allow mechanical coupling to associated equipment. Also, separate sections may be ganged together at the factory on a common shaft (up to a maximum of four sections) and individual sections may be of any desired resistance and accuracy within the respective ranges. Extra tap connections can be made at almost any specified points on the winding, limited only by the physical space occupied by terminal lugs.

GENERAL SPECIFICATIONS:

Number of turns	1
Power rating	½ watt
Length of coil	2"
Mechanical rotation	360° continuous
Electrical rotation	355° +0° −5°
Resistance range	1000 to 100,000 ohms
Resistance tolerance	(std.)±5.0%
Linearity tolerance	(std.)±0.5%
Starting torque (nominal)	.005 oz. in.
Running torque	Negligible
Mom. of inertia (rot. parts)	.000377 gm. cm.²
Net weight	0.56 oz.

Current Capacity and Voltage Limits of Model T

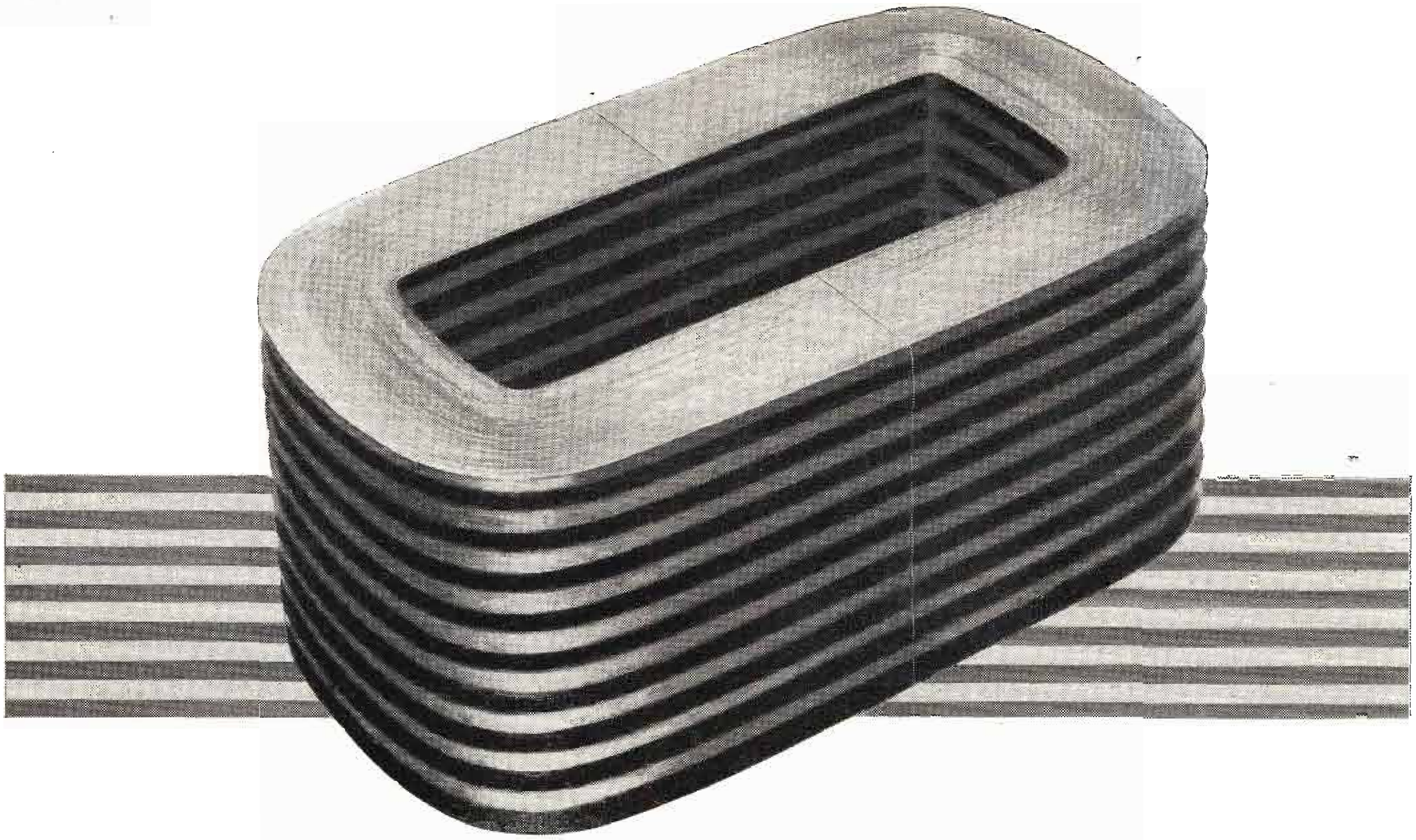
Power Rating — ½ watt

Resistance in ohms	Current capacity in milliamperes	Max. voltage across terminals	Temperature Coefficient
1K	22	23	various
5K	10	50	various
10K	7	72	.00002
20K	5	100	.00002
30K	4	125	.00002
50K	3	160	.00002
75K	2	200	.00002
100K	2	200	.00002

Helipot representatives located in all major cities will gladly supply full details on the TINYTORQUE. Or write direct!

THE Helipot CORPORATION
South Pasadena 3, California

Field Offices: Boston, New York, Philadelphia, Rochester, Cleveland, Detroit, Chicago, St. Louis, Los Angeles, Seattle, Dallas and Fort Myers, Florida. In Canada: Cossor Ltd., Toronto and Halifax. Export Agents: Frathom Co., New York 18, New York.



NEW RIBBED DESIGN

stabilizes core performance!

Latest in a long line of transformer core advancements, ribbed design gives additional stability to the inherent high level of Hipersil® Core performance.

Because this improvement adds to the mechanical strength of the core, it minimizes the possibility of springing the sections, thus keeps the matching etched core surfaces in intimate contact. This assures the best in a low-reluctance, low-loss butt joint. Ribbed cores have the same sizes and tolerances as superseded non-ribbed cores.

You can cut size, weight and assembly costs in all types of electrical and electronic transformers with Hipersil Cores. They combine highest permeability with lowest losses in a wide range of sizes, for all frequencies (1 through 12 mil cores). Greater flux-carrying capacity, increased mechanical strength help make them the best core on the market. For specific information on how to apply them to your product, write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-70629

YOU CAN BE SURE...IF IT'S

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You'll find more Career Opportunities at RCA

UNUSUAL career-building openings await experienced

ELECTRONIC ENGINEERS . . .
ELECTRICAL ENGINEERS . . .
MECHANICAL ENGINEERS . . .
COMMUNICATION ENGINEERS . . .
COMPUTER ENGINEERS . . .
PHYSICISTS . . .
and METALLURGISTS

Positions open offer lifelong career opportunities to men who expect more from their work than is provided by an ordinary engineering assignment.

RCA IS A GOOD PLACE TO WORK

At RCA you receive recognition for your accomplishments. You work in close collaboration with distinguished scientists and engineers. You enjoy highest professional recognition among your colleagues. You have unexcelled facilities for creative work. The surroundings in which you work are pleasant and stimulating. You and your family enjoy outstanding employee benefits. Opportunities are excellent for advancement in position and income. Unlike "feast-or-famine" businesses, RCA has forged ahead regardless of war or depression.

Immediate Openings in
RESEARCH · DEVELOPMENT · DESIGN · APPLICATION
in the following fields:

RADAR · MISSILE GUIDANCE · SERVO MECHANISMS
ANALOG COMPUTERS · TRANSFORMERS AND COILS
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Send a complete résumé of your education and experience.
Personal interviews arranged in your city.

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Specialized Employment Division,
Dept. 119-G
Radio Corporation of America
30 Rockefeller Plaza, New York 20, N. Y.

RCA

RADIO CORPORATION of AMERICA

Speed up analysis with these Brush instruments

Direct-coupled Amplifier
Model BL-932

AMPLIFIES VERY LOW VOLTAGES. The Brush Direct-coupled Amplifier features high sensitivity and low drift. When used in conjunction with the Brush Magnetic Oscillograph, it gives one chart millimeter deflection per millivolt input. Design features reduce effects of power line fluctuation. Zero signal drift not more than one chart millimeter per hour. Frequency response essentially uniform from d-c to 100 cycles.

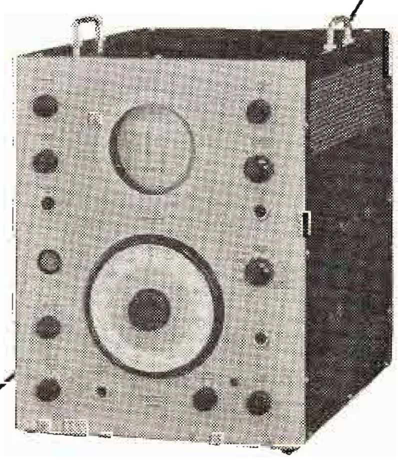
When used with the Brush Magnetic Oscillograph, the Amplifier can be used to record phenomena previously requiring the use of complicated intermediate equipment. Analysis of static or dynamic conditions involving either high or low signal strength is simplified and speeded with this equipment. Below, it is shown recording time constants of a reactor to provide a saturation curve.

PROVIDES IMMEDIATE RECORDING. The Brush Magnetic Oscillograph, used with the proper Brush Amplifier, makes a direct chart recording of physical phenomena which is immediately available. Either direct inking or electric stylus models available. Gear shift provides chart speeds of 5, 25, and 125 mm per second. An auxiliary chart drive is available for speeds of 50, 250, and 1250 mm per hour. Accessory equipment provides event markers where an accurate time base is required, or where it is desirable to correlate events. Photo shows two-channel model for recording of two phenomena simultaneously.

Direct-writing Two-Channel
Magnetic Oscillograph Model BL-202

CHECKS FREQUENCY RESPONSE QUICKLY. The Frequency Response Tracer permits visual examination of frequency response characteristics of radio receivers, amplifiers, transmission lines, filters. Electro-acoustic investigation of loudspeakers, microphones, and telephones can be made. Frequency range is 20 to 20,000 cycles, logarithmic scale. Continuous motor drive scans entire frequency range in 8 seconds.

Write for free copy of Bulletin 618 giving details on these Brush instruments. The Brush Development Company, Dept. FF-24, 3405 Perkins Ave., Cleveland 14, Ohio. In Canada: A. C. Wickman Limited, Box 9, Station N, Toronto.



Frequency Response
Tracer Model
BL-4703

PUT IT IN WRITING WITH A BRUSH RECORDING ANALYZER

THE Brush DEVELOPMENT CO.

PIEZOELECTRIC CRYSTALS AND CERAMICS • MAGNETIC RECORDING
ACOUSTIC DEVICES • ULTRASONICS • INDUSTRIAL & RESEARCH INSTRUMENTS

NEW! SPRAGUE *Blue Jacket*☆ wire-wound RESISTORS

WITHSTAND SEVERE HUMIDITY!

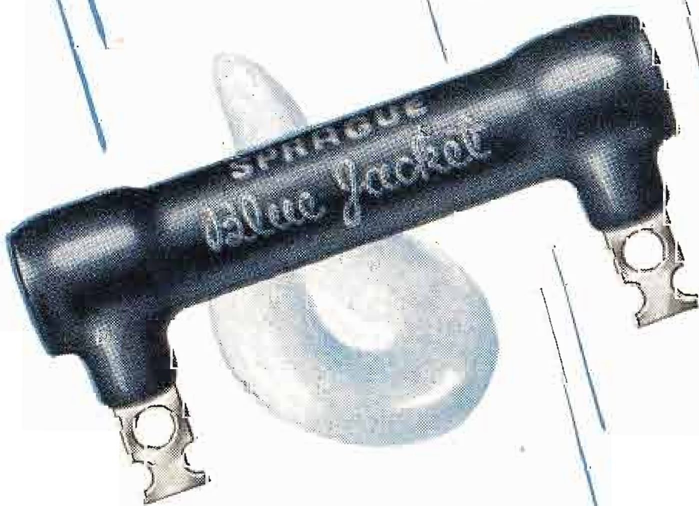
MEET JAN-R-26A!

Designed to withstand the rigid Characteristic G humidity tests of the most stringent specification of them all—JAN-R-26A—Sprague's new Blue Jacket Wire-Wound Resistors give trouble-free service in military electronic and electrical equipment exposed to extremely damp climates!

These outstanding new members of the Sprague resistor family are now available in tab terminal styles RW29 through RW39 in wattage ratings up to 166 watts.

You'll find the complete Blue Jacket Story with performance specifications in Engineering Bulletin 110, just off the press. Get your copy without delay.

YOU'LL KNOW THESE REMARKABLE RESISTORS BY THEIR VITREOUS ENAMEL BRIGHT BLUE JACKETS



SPRAGUE

PIONEERS IN ELECTRIC AND ELECTRONIC DEVELOPMENT

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SPRAGUE ELECTRIC COMPANY • NORTH ADAMS, MASSACHUSETTS

TELE-TECH
RADIO-TELEVISION-ELECTRONIC INDUSTRIES

O. H. CALDWELL, Editorial Director ★ M. CLEMENTS, Publisher ★ 480 Lexington Ave., New York (17) N. Y.

Let's Take a Careful Look at SUBSCRIPTION-TV

ENGINEERS and broadcasters have given little sympathetic consideration to the matter of "subscription-TV,"—systems by which members of the TV audience can select and pay for the programs they desire. No mention whatever of subscription-TV was made on the recent big NARTB Convention program. And so far, most broadcasters and engineers have looked on developments in the subscription-TV field as something remote and unlikely—assuming a sort of "Well-it-can't-happen-here" attitude toward subscriber-paid broadcasts.

STAGGERING COSTS—But already present TV-program costs are becoming so tremendous that even our largest advertisers have had to trim down their schedules by going on alternate weeks instead of every week—or cutting hour-long periods to half hours. Already a baffling money problem to cover even the present limited networks, what will it be when 100 or more of the present stations are hooked up? And how utterly inadequate will be the largest advertising appropriations—for 500 TV stations,—for 1000 stations,—and for the ultimate 2000, only a few years off!

Also, how secure can our present system of sponsored TV broadcasting ever be, if it depends on riding the rises and falls of our mercurial advertising economy? Must home-TV forever react to the "ups and downs" of recurring business cycles?

OBJECTIONABLE PROGRAMS—And on the other hand, if public dissatisfaction with present programs continues to mount, and if public opposition to the kind of TV crime and excessive commercials we are getting, grows to the point where it slows up TV-set sales, the whole industry may have to re-examine its sights and look anew into subscription-TV—as a tonic, if not a life-saver!

FCC & THE RADIO LAW—While it is true that technical legal difficulties may impede the FCC's approval of plans to occupy public channels with signals useful to only those who can pay toll,—the principle is not different from that involved in our many new public toll auto highways which afford superior service at a fee.

So we think the FCC must eventually take the broader view in the "public interest, convenience and necessity" and give full opportunity for commercial tests of the various methods proposed for subscriber-TV.

BROADCASTERS' PROBLEMS—Other operating difficulties may be ahead for the new prepay programming, if it has to come. Will some channels be assigned exclusively to "subscription-TV"? Or will subscriber-paid programs be sandwiched in between regular sponsored shows. Practical broadcasters don't see much merit in this latter plan, since the limited audiences of paid periods would offer little attraction for following sponsors. Others would like to "adjoin" a big sports event!

HOME TV-SETS—And what about "counterfeiting" and unpaid "attendance" on toll periods. We know that local television service men are ingenious and resourceful, and can be expected to accept the challenge to "beat" almost any local combination that is applied to the subscriber's set. As for telephone-actuated systems, the phone company has shown no enthusiasm about having its local lines and complex central exchanges further complicated by TV coding impulses. Nor do the telephone people seem willing to assume the job of recording and collecting TV-subscriber accounts.

So the whole question of subscription-TV, as we see it, is still considerably up in the air.

THREE TV SERVICES—But with our present sponsored-TV so frequently discrediting itself in the public mind, as well as outreaching top advertising appropriations (while all the time dependent on a stop-and-go up-and-down advertising economy), the only alternatives left are:

(1) Subscriber-selected, subscriber-paid TV programs, bringing outstanding plays, films and sports events, and

(2) Educational, discussional, and neighborhood programs of constructive value, financed by public and private endowments, on the UHF channels now provided.

ENGINEER'S STAKE IN TV—Ordinarily our engineer readers concern themselves little with programming operations. But if the whole structure of TV broadcasting is someday to hang in the economic balance, engineers must consider this matter of programs for set-owners, industry support and station income.

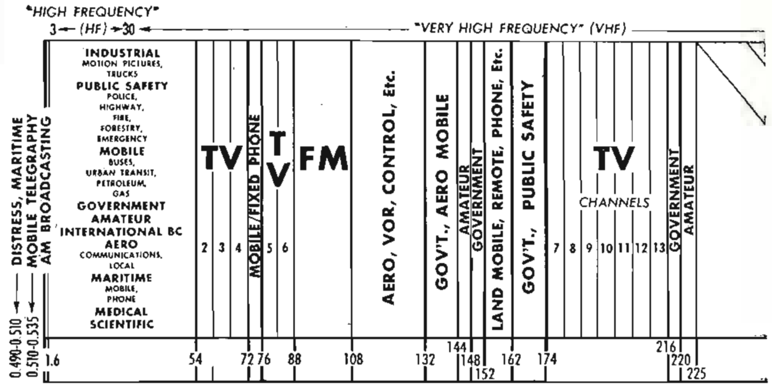
We think engineers can help come up with the answer that will preserve *good TV* for *all* the American people in the *days ahead!*

★★★

(See also "Subscription-TV—Pro & Con," pgs. 66 and 67)

RADARSCOPE

Revealing Important Advances Throughout the Spectrum of Radio, TV and Tele Communications



REARMAMENT

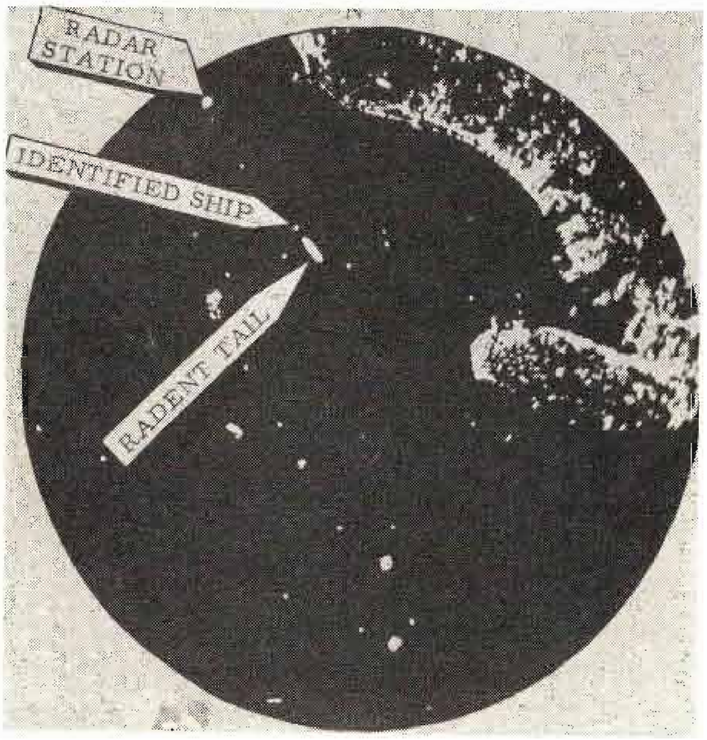
SIMPLIFY RENEGOTIATION—One of the most important subjects before the electronic-radio manufacturing industry, with its huge task of producing equipment and components for the armed services in the national defense mobilization, is the question of renegotiation of military procurement contracts. As a result a most significant address at the annual convention of the Radio-Television Manufacturers Association in Chicago was that of Chairman John T. Koehler of the Renegotiation Board. What the industry leadership desires is a simplification of the renegotiation regulations, full interpretation of the regulations' purport particularly in the case of incentive types of contracts, and a specific ceiling on contracts to be renegotiated. The latter applies to contracts where small payments are made over a long period at different times after shipments for many different items.

Reducing the "red tape" will help!

ALLOCATIONS

TECHNICALITY—An earlier TELE-TECH editorial quoted the old saw "When the great do foolish things, the people suffer." Why must the FCC insist on the letter of the law when it is only a matter of less than one percent. Many features of the new TV allocation plan are excellent, but to deny Pittsburgh an additional VHF-TV channel on a technicality of 0.61 miles (a few city blocks) less than minimum separation, is carrying adherence to rules too far. Can the actual measured or calculated distances be that accurate? Other cases will undoubtedly arise as engineers study the tables.

HOW "RADENT" MARKS SHIPS



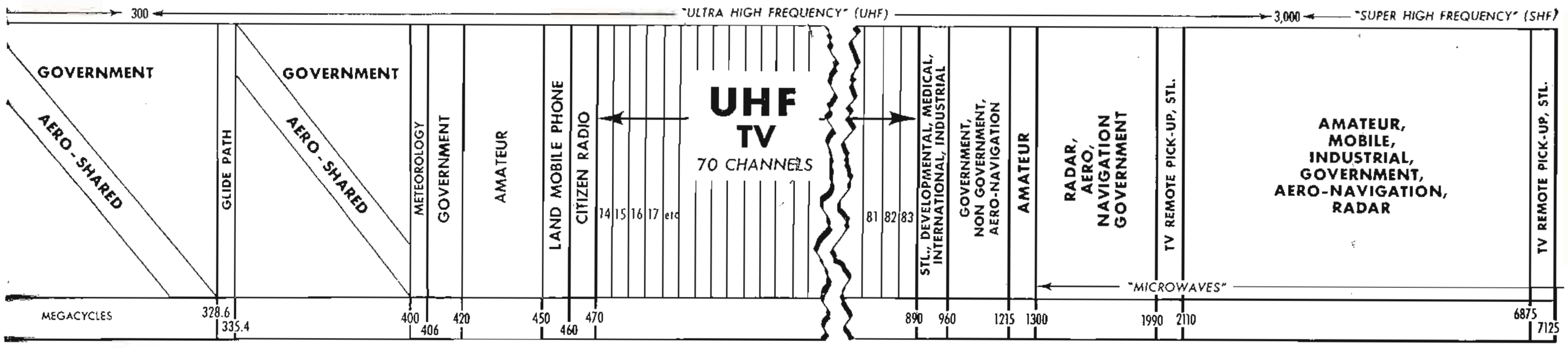
To show which pip is what ship, Sperry's new Radent identification device produces on radar screen a "tail" marker behind ship replying. To identify his ship, officer on ship points a portable microwave horn at radar station, producing reply signal which appears as "tail" on distant radar screen. Radarscope above shows lower New York Bay and Brooklyn shore, with radar station on Staten Island

THEATRE TV

EIDOPHOR IN U.S.—New York public demonstration of Eidophor theatre-TV projection equipment which had been expected in April, was, at latest advices, to be delayed to June 25. Meanwhile private showings to 20th-Century-Fox stockholders and officials were given during May. Large projected pictures were reported to have good brilliancy and contrast. Only color-TV will be shown, using CBS color-disk introduced into light beam which is modulated by opaque oil-film. E. I. Sponable is in charge of introduction of Eidophor into U.S. theatres. Dr. Gretener and Professor Baumann, inventors, were here from Switzerland, for initial installation.

AUDIO

STEREOPHONIC MUSIC—Broadcast stations which operate duplicating AM and FM transmitters have been overlooking an opportunity to bring a new and thrilling realism to their listeners—stereophonic programs. In live orchestra pickups, if one microphone is directed at the left side and feeds the AM transmitter, and the other is directed to the right and feeds the FM transmitter,—then any listener who places his own AM and FM receiver speakers in corresponding corners of his living-room, will enjoy the aural illusion of having the full orchestra spread out right before him! The same applies to plays, debates, etc. Each transmitter listened to singly will present a fully accurate and satisfactory reproduction. But heard together, through properly placed speakers, a new and striking "third dimension" of sound is added. Experimental tests of this kind were broadcast by KOMO, Seattle, and WGN, Chicago, during May. But stations which provide, as regular operating procedure, such a stereophonic arrangement of FM and AM will be creating a new step in radio realism, selling more high quality and FM equipment, and winning new groups of discriminating listeners. In other words,—literally "out-Hi-Fi-ing" even Hi Fi!



EUROPEAN EXPORTS

NOTICEABLE TREND, as the impact of our materials control and "guns and butter" programs expand, is the increase in European components and equipment items being offered for sale in the U.S. A year or so ago products available through import were primarily British and pretty much confined to the high-quality audio field. Now both France and Germany have entered the picture with items ranging from miniature circuit breakers to the sale of patent rights for the manufacture of unusual radio transmitters, transceivers and receivers.

CANADA

MONTREAL & TORONTO will get Canadian broadcast television this August, nearly a year later than the original date set for its introduction to Canadians. At the start there will be two hours of local programs each day, supplemented by tuned-in programs from other stations. Ottawa will be the third Canadian city to get television. The CBC will then extend the hookup to Vancouver, Winnipeg and other parts of the country. The objective, according to J. A. Ouimet, general manager, CBC, will be to introduce a national spirit of culture, to inform and educate the public and to develop Canadian talent. There were 40,000 television sets sold in Canada last year, against 30,000 sets the preceding year, while 550,000 radio sets were sold in 1951, compared with 731,000 in 1950. The combined value of radio and television sets in 1951 was $65,900,000, against $70,000,000 in 1950. F. R. Deakins, president, RCA Victor Co., Ltd., has estimated that 80,000 television sets and 500,000 radio sets will be sold in 1952.

RECEIVERS

TRIANGULAR TV SETS! Rooms are getting smaller as building costs go up—meanwhile TV screens are getting larger, making it more and more difficult for the home viewer to back off to a comfortable viewing distance. Current TV models are invariably designed to be set against a wall. But since any room's diagonal is 30 to 40% longer than that room's width or length, why not design a line of TV sets to *fit into the corner* between two sidewalls. The shape of the CR tube, with its big face and long "neck" is well adapted for this arrangement, and the cabinet could easily be modified into a truncated triangular form. For a "second set" in kitchen, dining room or bedroom, such a triangular TV set would occupy unused space, be out of the way, and afford better viewing from a larger part of the room area.

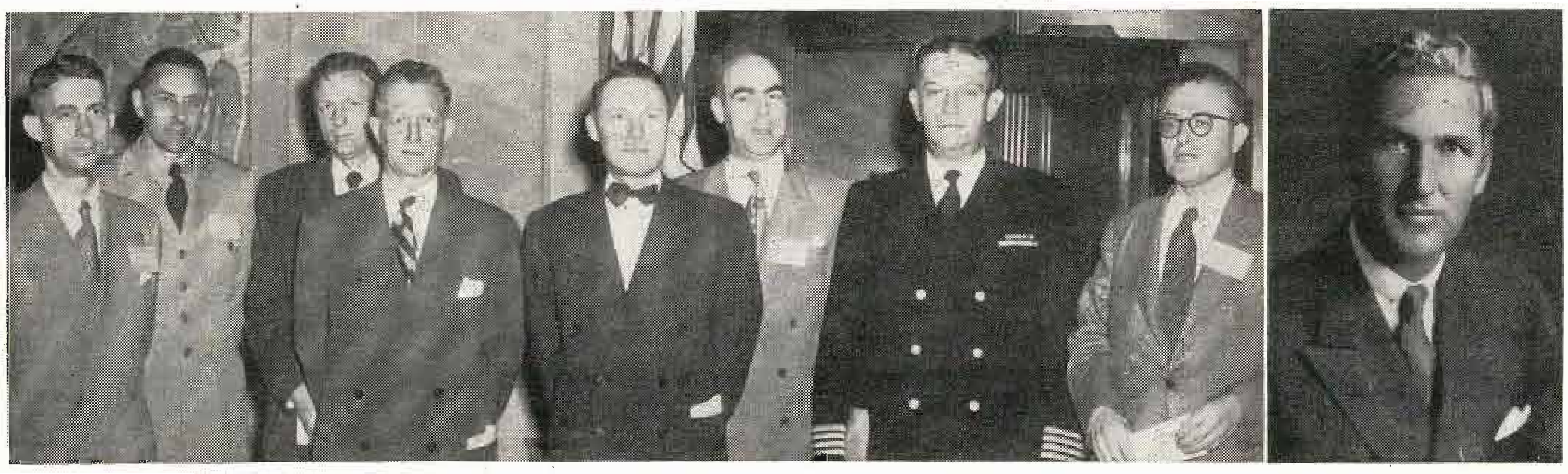
SEASONAL

TV LIKE RADIO has its big output in the fourth quarter of the year, emphasized Robert C. Sprague, board chairman, RTMA, speaking before the New York Society of Security Analysts. In answer to specific questioning, Chairman Sprague quoted the following pattern as coming "from a confidential but very reliable source" One guess, (Dun & Bradstreet, which has recently been conducting surveys for RTMA):

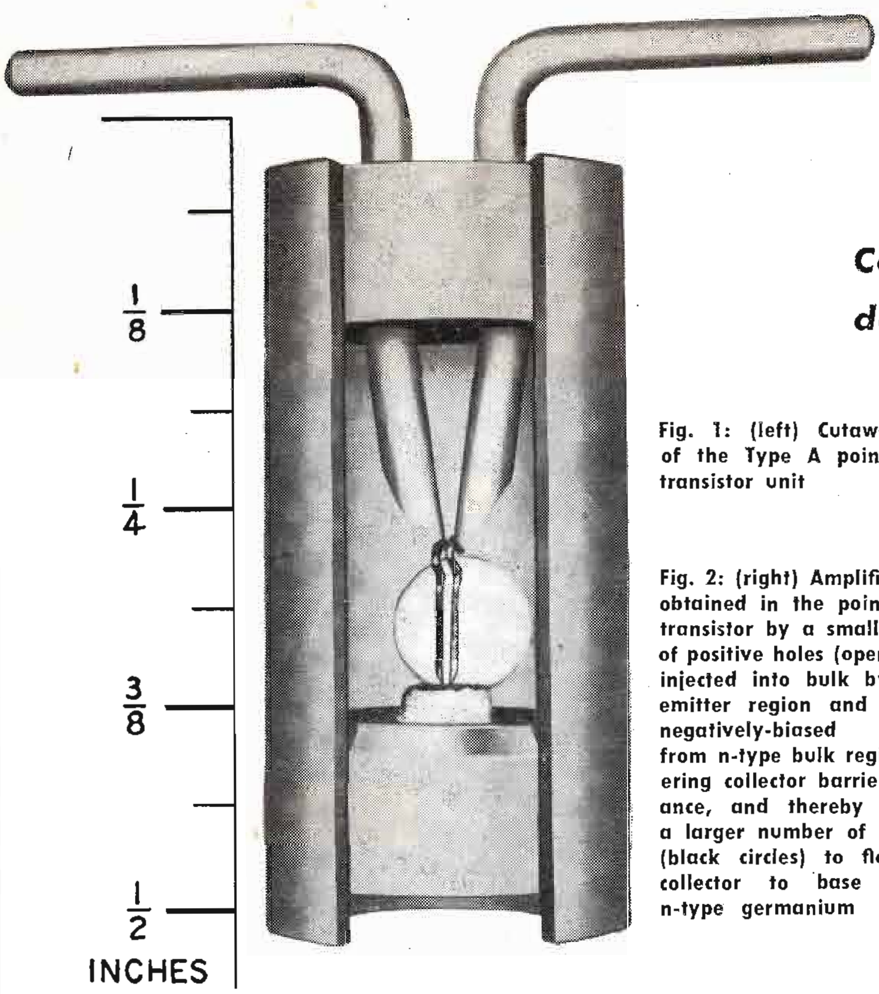
	Radio	TV
First quarter	27%	27%
Second quarter	21%	20%
Third quarter	20%	20%
Fourth quarter	30%	32%

Figures given are to nearest full integer. Odd fractions omitted make up missing balances to add up to 100%.

SYMPOSIUM ON PROGRESS IN QUALITY COMPONENTS, WASHINGTON, D.C.



Speakers at sessions of May 5, left to right—J. G. Reid, Jr., chairman, Joint Symposium; Lt. Col. C. B. Lindstrand, USAF, Electronics Production Resources Agency; A. V. Astin, Director, National Bureau of Standards; J. A. Milling, chairman, Electronics Production Board, DPA; Glen McDaniel, president, RTMA; Edwin A. Speakman, vice-chairman, Research and Development Board, Department of Defense; Capt. Rawson Bennett, USN Bureau of Ships; and W. A. G. Dummer, Telecommunications Research Establishment, London, England. At extreme right, Dr. A. F. Murray, consulting editor TELE-TECH, program chairman for the three-day gathering, May 5-7



Transistors: A

Comparison of characteristics of point-contact designability invite applications in miniaturized

Fig. 1: (left) Cutaway view of the Type A point-contact transistor unit

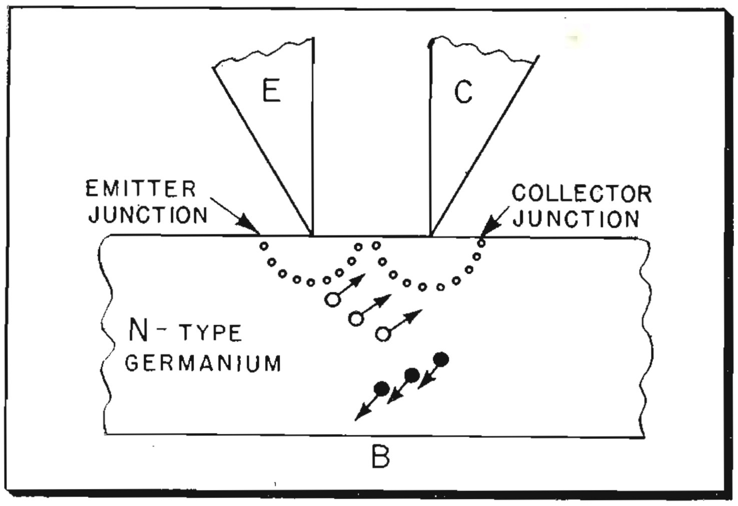


Fig. 2: (right) Amplification is obtained in the point-contact transistor by a small number of positive holes (open circles) injected into bulk by p-type emitter region and entering negatively-biased collector from n-type bulk region, lowering collector barrier impedance, and thereby allowing a larger number of electrons (black circles) to flow from collector to base through n-type germanium

THE announcement four years ago of a mechanically simple device, capable of performing many of the functions almost exclusively executed by the vacuum tube, whetted the interest of engineers engaged in communications and electronic work. While the general operation of the transistor was understood, in a microscopic sense several vital problems proved elusive of solution. As an outline of the salient obstacles encountered in transistor research, and as a report on the present status of the device, Mr. J. A. Morton, in charge of transistor development at Bell Telephone Labs., has generously provided information which authoritatively describes the reproducibility, reliability, performance and applications of germanium triodes to date.

In early units, reproducibility was poor, with considerable variations between transistors intended to have similar performance characteristics. Sudden and inexplicable changes with time and temperature made for limited reliability. A third obstacle was the restricted gain, noise figure, frequency range and power, causing poor designability.

Broader understanding, refined processes and improved germanium materials achieved during the past two years have significantly reduced, but not eliminated, the above three limitations. As a result:

a) Theory has been evolved to explain and predict electrical network characteristcs of transistors in terms of physical structure and material properties.
b) The effects of empirically derived processes have been evaluated and improved methods devised.
c) Transistors can be made in the laboratory to several sets of prescribed characteristics with usable tolerances and satisfactory yields.
d) Reliability has been improved through the extension of life and ruggedness, and a decrease in temperature dependence.
e) Utilizing advanced theory, new performance ranges are indicated for both point-contact and junction transistors.
f) Interchangeability and reliability have made possible more comprehensive studies of circuit and system applications.

The remainder of this article will summarize the recent progress made at Bell Telephone Labs. in reducing the limitations on reproducibility, reliability and performance. As this is an overall view of a number of different types, it should not be inferred that any one type combines all of the virtues any more than such a situation exists in the electron tube art.

Before quantitative data comparing the characteristics of past with present transistors are presented, it will be useful briefly to review physical descriptions of the various types of transistors to be discussed. Fig. 1 shows a cutaway view of the now familiar point-contact cartridge type transistor. All of the early transistors were of this general construction and the characteristics of a particular one, called the Type A, will be used as a reference against which to measure results now obtainable with new types under current development. Fig. 2 is a semi-schematic picture of the physical operation of such a device. Pressing down upon the surface of a small die of n-type germanium are two rectifying metal electrodes, one labelled E for emitter, the other C for collector. A third electrode, the base B, is a large-area ohmic contact to the underside of the die of germanium.

The emitter and collector electrodes obtain their rectifying properties as a result of the p-n barrier (indicated by the dotted lines) existing at the interface between the

TABLE I: REPRODUCIBILITY OF POINT-CONTACT LINEAR CHARACTERISTICS

Element	Range-Sept. 1949	Range-Sept. 1951
α	4:1	± 20%
r_c	7:1	± 30%
r_e	3:1	± 20%
r_b	7:1	± 25%

Summary of Progress in Performance

and junction units from 1949 to 1951. Improvements in reproducibility, reliability and equipment. Different types show 10 db noise figure, 45 db gain, 70,000-hour life

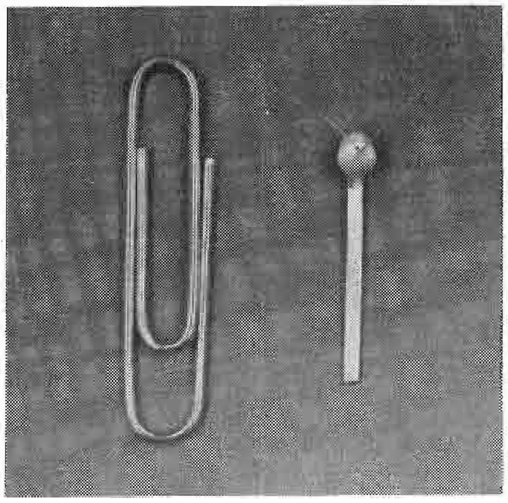


Fig. 3: M1689 point-contact bead transistor

n-type bulk material and small p-type inserts under each point. When the collector is biased with a moderately large negative voltage (in the back direction) so that the collector barrier has relatively high impedance, a small amount of reerse current flows from the collector to the base in the form of electrons as indicated by the small black circles. Now, if the emitter is biased a few tenths of a volt positively in the forward direction, a current of holes (indicated by the small open circles) is injected from the emitter region into the n-type material. These holes are swept along to the collector under the influence of the field initially set up by the original collector electron current, thus adding a controlled increment of collector current.

Because of their positive charge these holes can lower the potential barrier to electron flow from collector to base and thus allow several electrons to flow in the collector circuit for every hole entering the collector barrier region.

This ratio of collector current change to emitter current change for fixed collector voltage, is called alpha, the current gain. In point contact transistors alpha may be larger than unity. Since the collector current flows through a high impedance when the emitter current is injected through a low impedance, voltage amplification is obtained as well.

For use in miniaturized circuit functions, the point-contact transistor has been designed to contain only the bare essentials. This type is represented by the M1689 bead transistor shown in Fig. 3. The family of static characteristics for the M1689 is given in Fig. 4. It should be noted that the collector family which gives the dependence of collector voltage upon collector current with emitter current as parameter is similar to the plate family of a vacuum triode.

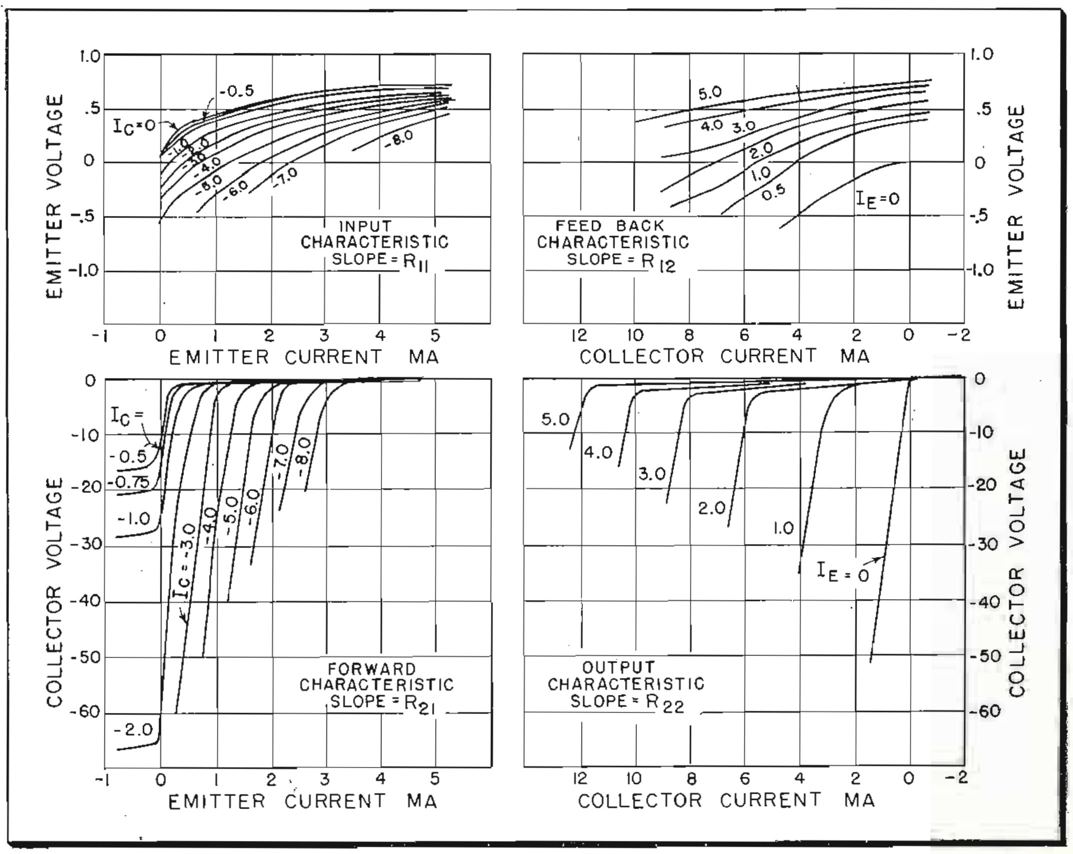
Junction Transistors

The junction type transistor shown in Fig. 5 has a thin layer of p-type germanium in the center of a bar of single crystal n-type germanium. In many simple respects, except for change in conductivity type from p-n-p in the point-contact to n-p-n in the junction, the essential behavior of both units is similar.

If the collector junction is biased in the reverse direction, i.e., electrode C biased positively with respect to electrode B, only a small residual back current of holes and electrons will diffuse across the collector barrier as indicated. However, unlike the point-contact device, this reverse current will be very much smaller and relatively independent of the collector voltage because the reverse impedance of such bulk barriers is so many times higher than that of the barriers produced near the surface in point-contact transistors. Now again, if the emitter barrier is biased in the forward direction, a few tenths of a volt negative with respect to the base is adequate, then a relatively large forward current of electrons will diffuse from the electron-rich n-type emitter body across the reduced emitter barrier into the base region. If the base region is adequately thin so that the injected electrons do not recombine in the p-type base region, practically all of the injected emitter current can diffuse to the collector barrier; there they are swept through the collector barrier field and collected as an increment of controlled collector current.

Hence, again, since the electrons were injected through the low forward impedance and collected through the very high reverse impedance of bulk type p-n barriers, very high voltage amplification will

Fig. 4: Family of static characteristics for the M1689 transitor used in miniaturized circuits



TRANSISTORS (Continued)

result. No current gain is possible in such a simple bulk structure and the maximum attainable value of alpha is unity. However, because the bulk barriers are so much better rectifiers than the point surface barriers, the ratio of collector reverse impedance to emitter forward impedance is many times greater, more than enough to offset the point contact higher alpha. Thus, the junction unit may have much larger gain per stage. Fig. 6 is a photograph of a developmental model of such a junction transistor called the M1752.

The upper part of Fig. 7 is a collector family of static characteristics for the M1752. By way of comparison to those of the point-contact family, note the much higher reverse impedance of the collector barrier (relatively independent of collector voltage) and the correspondingly smaller collector currents when the emitter current is zero.

Linear Characteristics

Considering a generalized four-pole network to represent the transistor, then the input terminals are emitter-base and the output terminals are collector-base. From this network, an equivalent circuit such as the one shown in Fig. 8 may be derived. In this circuit, r_e is very nearly the ac forward impedance of the emitter barrier, r_c is approximately the ac reverse impedance of the collector barrier, r_b is the feedback impedance of the bulk germanium common to both, and a is the circuit current gain, almost equal to alpha, representing carrier collection and multiplication if any. These factors represent linear equivalent circuit elements. The values presented in Table I show the improved reproducibility of linear characteristics for a Type A unit which has been achieved in the past two years. The spreads are comparable in magnitude to those found in vacuum tubes, and hold for practically all classes of point-contact devices now under development for CW transmission. After a suitable period, it is expected that such a situation will also apply to junction transistors.

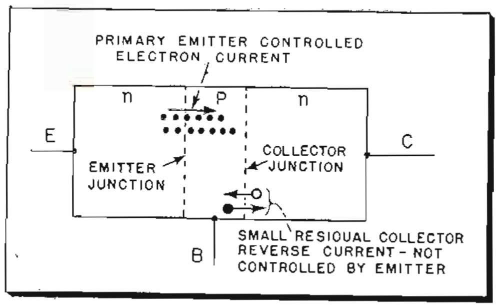


Fig. 5: Junction type uses n-p-n conductivity

TABLE II: TENTATIVE CHARACTERISTICS FOR M1689 POINT-CONTACT COMPUTING AND SWITCHING TRANSISTOR

Test	Conditions	Minimum	Maximum
r_{co}—off collector dc resistance	V_c = —35 v. dc I_e = —0 ma dc	17,500 ohms	——
V_{c1}—on collector voltage	I_c = —2 ma dc I_e = 1 ma dc	——	—3 v. dc
V_{c3}—on collector voltage	I_c = —5.5 ma dc I_e = 3 ma dc	——	—4 v. dc
Off Emitter resistance	V_c = —10 v. dc	50,000 ohms	——
Off Emitter resistance R_{11}	V_c = —10 v. dc I_e = 1 ma dc	——	800 ohms
Alpha (1)	V_c = —30 v. dc I_e = 1.0 ma dc	1.5	——
Alpha (2)	V_c = —30 v. dc I_e = 0.05 ma dc	2.0	——
Alpha (3)	V_c = —30 v. dc I_e = —0.1 ma dc	——	0.3
R_{12}—Open Circuit Feedback Resistance	V_c = —10 v. dc I_e = 1 ma dc	——	500 ohms
R_{21}—Open Circuit Forward Resistance	V_c = —10 v. dc I_e = 1.0 ma dc	15,000 ohms	——
R_{22}—Open Circuit Output Resistance	V_c = —10 v. dc I_e = 1.0 ma dc	10,000 ohms	——

TABLE III: TRANSISTOR PERFORMANCE PROGRESS 1949-1951

Performance Figure of Merit	Type A Sept. 1949	Sept. 1951	New Development Type
Current Gain α	5x	50x	Point-junction
Single Stage Class A Gain	18 db	22 db 45 db	Point-M1729, M1768 Junction-M1752
Noise Figure at 1000 CPS	60 db	45 db 10 db	Point-M1768 Junction-M1752
Frequency Response	5 MC	7-10 MC 20-50 MC	Point-M1729 Point-M1734
Class A Power Output	0.5 watt	2 watts	Junction
Switching Characteristics	None	Good	Point-M1698, M1689 M1734
Feedback Resistance r_b	250 ohms	70 ohms	Point-M1729
Light/Dark photocurrent ratio	2:1	20:1	Junction-M1740

Pulse Applications

In practically all transistor pulse handling circuits examined to date, particularly for computing and switching, one characteristic common to all is the ability of the transistor, by virtue of its current gain, to present various types of two-state negative resistance characteristics at any one or all of its pairs of terminals.

A typical simple circuit and corresponding characteristic is shown in Fig. 9 for the emitter-ground terminals when a sufficiently large value of resistance is inserted in the base to make the circuit unstable. In region I, where the emitter is negative the input resistance is essentially the reverse characteristic of the emitter as a simple diode. In region II, as the emitter goes positive, alpha, the current gain rises rapidly above unity. If R_b is sufficiently large and alpha, the current gain, is greater than unity the emitter to ground voltage will begin to fall because of the larger collector current increments driving the voltage of the node N negative more rapidly than the emitter current drop through r_e would normally carry it. This transition point is called the peak point. If than a $(r_b + R_b)$ is sufficiently large, in this sense, the

(*Continued on page* 102)

Mode Interactions in Magnetrons

Experimental results at 3000 MC contradict stability and change criteria based on concept that strongly oscillating mode will give way to the next higher voltage mode

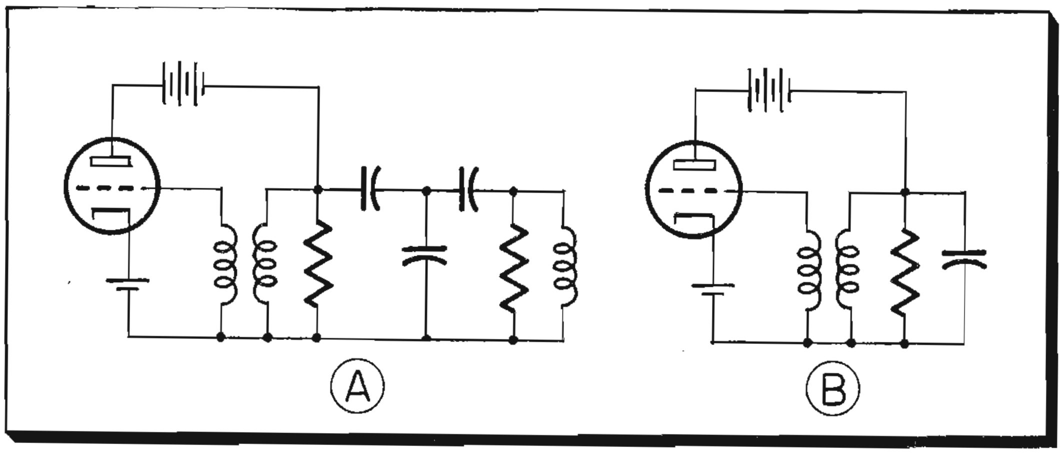


Fig. 1: (a) Nonlinear triode oscillator with two degrees of freedom. (b) Elementary triode oscillator

By R. R. MOATS, *Sylvania Electric Products Inc., Boston, Mass.*

One of the most perplexing problems in magnetron work has been the "moding" problem. This problem arises because of the multiplicity of resonances in the resonant anode structure, and the fact that it is possible for the electron stream to support oscillation in any one of several modes of resonance.

In order to achieve proper operation of a magnetron, it is necessary to establish stable large-amplitude oscillation in only one mode. In pulse operation, stable oscillation in the desired mode must be established quickly, and maintained for the pulse duration. In cw operation, quick starting is not usually a requirement, but stability is as important as in pulse magnetrons. Thus, the first problems to be discussed is that of mode selection in pulse magnetrons, and the second is mode stability in either pulse or cw magnetrons.

Feedback Oscillator

In order to make it possible to describe properly the characteristics of any particular mode of oscillation, the magnetron will be considered briefly here in terms of its properties as a feedback oscillator.

In the cylindrical magnetron, electrons tend to travel in more or less circular paths; if these electrons can be caused to rotate in synchronism with an r-f traveling wave, and to be bunched in the proper phase to give energy to the wave, then energy conversion in the electron stream of the magnetron can take place. In usual magnetron operation, the initial bunching results from one mechanism, and bunching is maintained by another.

Some of the electrons emitted from the cathode will be in the proper phase to give up energy to the r-f rotating wave as they circulate, while others will absorb energy. Those which give up energy remain in the system and convert most of the energy they receive from the dc field into r-f energy. Those which absorb energy from the r-f field are driven back into the cathode, and thus are removed from the system. This kind of electron selection is one part of the feedback system.

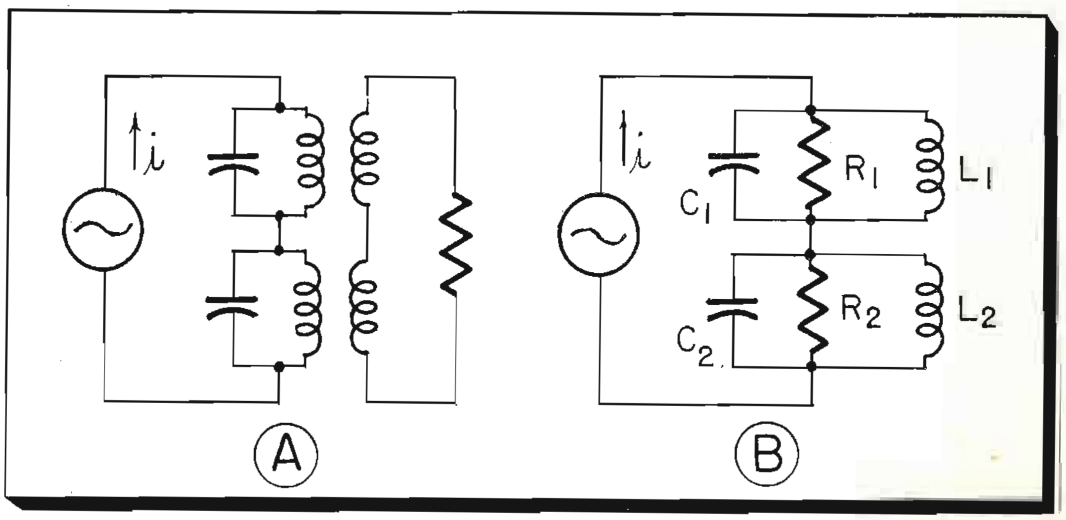
As electrons progress toward the anode, they may tend to lag or lead that position in which they would contribute most to the building up of r-f energy. However, it has been found that the radial component of the r-f electric field tends to keep electrons bunched where they will do the most good. This portion of the feedback system is known as phase focusing.

Mode Strength

The strength of any mode of oscillation may be considered to be a measure of its ability to persist either against possible competition from other modes, or against the destructive effect of excess anode voltage, which would tend to accelerate electrons to a velocity greater than that of the r-f wave. Evidently the principal factor determining the strength of a mode is simply the effectiveness of feedback, as might be expected for any feedback oscillator. For a high degree of stability, it is desirable that the signal fed back be large so that oscillation may be as insensitive as possible to disturbances.

If only one of the r-f traveling wave components of a particular mode is considered in analyzing the magnetron as a feedback oscillator, the analogy between the magnetron and a conventional feedback oscilla-

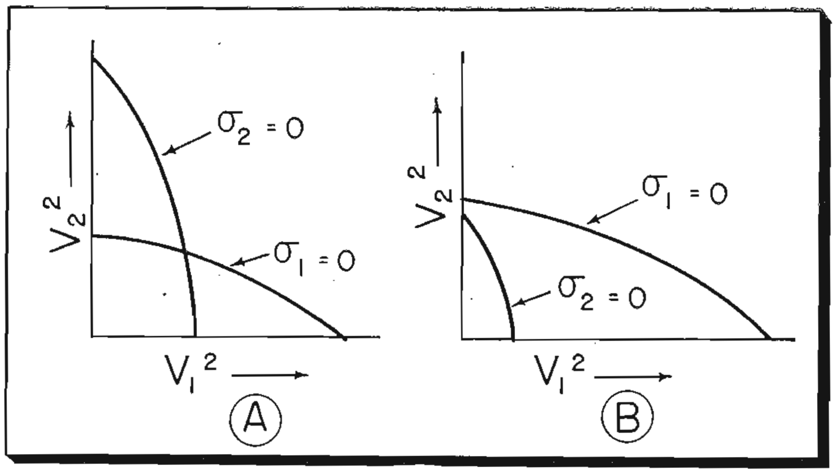
Fig. 2: (a) Equivalent magnetron circuit for two modes resonance. (b) Approximate equivalent circuit



tor is quite straightforward. The feedback mechanisms in a magnetron oscillator with one r-f rotating wave have already been discussed. The assumption that other traveling wave components pass by the electrons so quickly as to have no net effect has tacitly been made. The observed voltages of a large number of various types of magnetrons support this assumption.

A factor which must not be neglected in considering the strength of a mode of oscillation is the loading of the system, including both power to the load and circuit losses. In general, lighter loading leads to greater r-f amplitudes, and greater r-f amplitude leads to a system less easily disturbed by anything outside of that mode of oscillation.

Fig. 4: Build-up and decay in a magnetron with two modes. I-V relation i=a tan h bv



Oscillation Failure

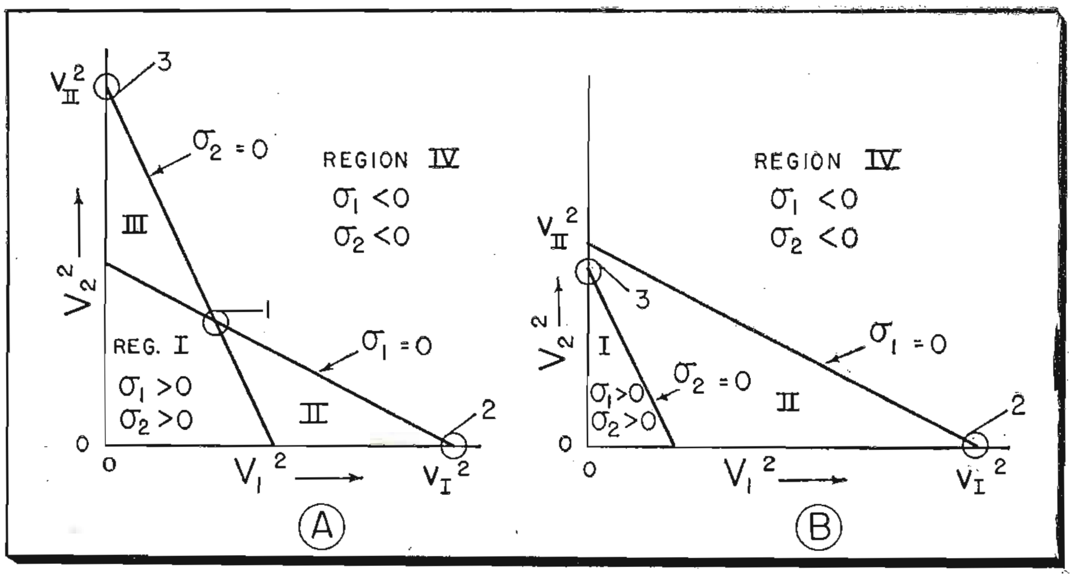
Failure of oscillation in magnetrons, as anode voltage and current are raised, may, in general, be considered to be the result of failure of the feedback mechanisms. The fundamental causes of such failure appear to be: first, the inability of the r-f field to maintain synchronism between itself and the electrons; second, competition from other modes of oscillation; and third, the flow of dc to the anode when dc cut-off is reached, where current can flow to the anode in absence of r-f field.

The preceding discussion has indicated that the principal factor which is most important to establishing and maintaining the desired mode of operation is the effectiveness of the feedback system. The two principal means by which r-f feedback can be made more effective include lightening the external loading and changing the geometry of the system. Lighter loading leads toward an increase in r-f field intensities, but also toward lower circuit efficiency and often to lower electronic efficiency. Another way to increase feedback intensity is to change the geometry of the system by increasing the ratio of cathode diameter to anode diameter. Such a change usually leads to lower electronic efficiency. Furthermore, it must be taken into account that whatever increases feedback in the desired modes may also increase feedback in undesired modes. Thus a compromise which takes all of these factors into account is necessary in magnetron design.

Nonlinear Theory

To study mode interactions, the magnetron is considered in terms of its properties as a nonlinear feedback oscillator. About 30 years ago, van der Pol studied nonlinear triode oscillators, one of which had two modes of resonance. The circuit for his two-mode system is shown in Fig. 1 together with an elementary feedback oscillator. An appropriate equivalent circuit for a magnetron is shown in Fig. 2. The differential equations expressing the operation of van der Pol's two-mode oscillator and the magnetron equivalent circuit are of the same form. Therefore, van der Pol's solution is of interest in analyzing the magnetron.

Fig. 3: Oscillation characteristics for magnetron with two modes show regions of build-up and decay



A simple expression for the nonlinear relationship between instantaneous current and voltage in the active portion of the circuit will be assumed as $i = av - bv^3$. It has been shown by van der Pol that the effect of any even-power terms in a series expression for i as a function of v may be neglected. For simplicity, the fifth and higher power terms are neglected. The sign of the cubic term is negative, a condition necessary if the magnitude of oscillation is to be limited to a finite value.

It is assumed that the voltage across the resonant circuit is of the form $V_1\cos(\omega_1 t + \phi_1) + V_2\cos(\omega_2 t + \phi_2)$. Suppose V_1 and V_2 are taken to be of the form $A_1 e\ \sigma_1 t$ and $A_2 e\ \sigma_2 t$, where A_1 and A_2 are not functions of time. Then build-up or decay of each mode may be expressed in terms of σ_1 or of σ_2. The approximate solution for σ_1 and σ_2 in terms of the respective voltage amplitudes is given by:

$$\sigma_1 = \frac{3b}{8C_1}[V_I^2 - V_1^2 - 2V_2^2] \qquad (1)$$

$$\sigma_2 = \frac{3b}{8C_2}[V_{II}^2 - V_2^2 - 2V_1^2] \qquad (2)$$

V_1 is the steady state value of V_1 in absence of V_2, and V_{11} is the steady state value of V_2 in absence of V_1.

The solution may be illustrated as in Fig. 3, where areas of positive and negative σ_1 and σ_2 as functions of V_1^2 and V_2^2 are shown. Lines of constant σ_1 and σ_2 are drawn, and these are shown in order to separate the plane into regions according to which modes are building up or decaying. Region I, which includes portions of both axes, corresponds to $\sigma_1 > 0$ and $\sigma_2 > 0$. Therefore, if the state of oscillation is such that the magnitudes in each mode, when plotted in the plane, lie in Region I, then both modes are building up. In Region II, V_1^2 is increasing, V_2^2 decreasing; in Region III, V_1^2 is decreasing, V_2^2 increasing; and in Region IV, both are decreasing.

In Fig 3a, three different conditions for which steady-state oscillations are possible. The first point, number (1), is the only point for which $\sigma_1 = \sigma_2 = O$. However, it represents an unstable state of affairs in the system. If V_1^2 and V_2^2 are altered very slightly so that conditions in the system correspond to a point in Region II, the build-up of V_1^2 will continue, accompanied by decay of V_2^2, and the operating point will move toward point (2). Any disturbance into Region III will also lead to the moving away from point (1) by the point representing the operating conditions. Furthermore, any excursion of the operating point into Region I or Region IV will in general be followed by movement of the point into Regions II or III, rather than back to point (1), and conditions will proceed away from point (1).

Points (2) and (3) are similar to each other in character. For example, point (2) represents a condition where $V_1^2 = V_1^2$, $\sigma_1 = O$ and $\sigma_2 < O$. Therefore, V_1^2 is both stationary in magnitude (because $\sigma_1 = O$) and stable (because any disturbance of V_1^2 from this position will change conditions so as to cause it to return). At point (2). V_2^2 is also both stationary and stable, because $V_2^2 = O$, and $\sigma_2 < O$. Thus any oscillation which might appear corresponding to frequency ω_2 would be quickly damped out.

For similar reasons, at point (3), V_1^2 and V_2^2 are both stationary and stable, with $V_1^2 = O$ and $\sigma_1 > O$.

Build-Up Characteristics

Another possible set of conditions may give rise to a set of build-up characteristics which can be represented by Fig. 3b. Here, solution (1) and Region III of Fig. 3a are absent, but what is much more important is that at point (3), σ_1 is still positive. Therefore, even if this point could be reached when V_2^2 at a stationary value the value of $V_1^2 = O$ is unstable, any disturbance would cause it to build up, and the operating point would proceed into a region in which V_2^2 must decay. Therefore, only point (2) is both stationary and stable. This situation is characterized by the fact that $V_1^2/2 > V_{11}^2$. A comparable situation, where the only stable oscillation which can take place corresponds to $V_2^2 = V_{11}^2$, is given by $V_{11}^2/2 > V_1^2$. The preceding results have all been derived from van der Pol's work.

There are some disadvantages in

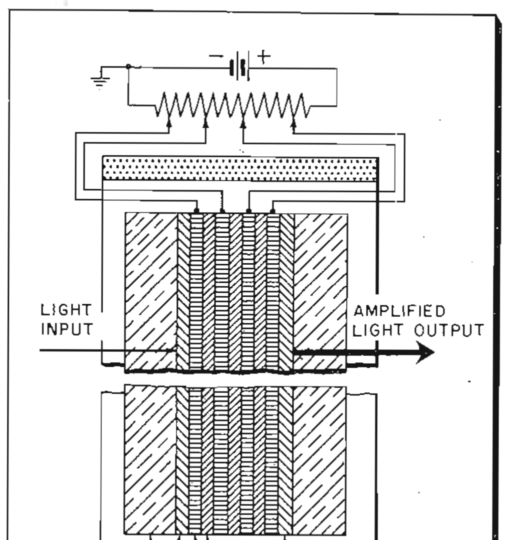
(*Continued on page 78*)

Electronic Light Amplifier for TV

LEE de Forest and William A. Rhodes have been granted Patent 2,594,740, April 29, 1952, for an Electronic Light Amplifier. The invention, particularly suitable for TV, receives a beam of light forming an image, transforms the light into an electron beam duplicating the image, amplifies the electron beam and changes it back to an amplified light beam duplicating the original image with increased brightness.

A cross-section of the circular amplifying cell is shown in Fig. 1. Two layers of a transparent material, such as glass or plastic, protect and support the light-electron sensitive laminae sandwiched between the two window layers. Superimposed on and between the transparent layers are a series of laminae (from 0.0001 to 0.001 in. thick) comprising the following in sequence: a photo-sensitive, electron-emissive lamina; three secondary-electron emissive laminae; and an electron-sensitive, light-emissive lamina. In between each of the above laminae is a very thin conductive layer of metallic foil, each connected to a voltage divider at successively increasing potentials. In actual fabrication, the emissive laminae would be deposited on the conductive layers by a spray or distillation process, producing an overall cell thickness of 0.01 to 0.1 in.

Fig. 1: Light from TV picture tube image enters transparent window (1) and strikes photo-sensitive electron-emissive lamina (2). Emitted electrons are accelerated through conductive layer (3) striking secondary-electron emissive lamina (4). Process is repeated until multiplied electrons impinge on electron-sensitive light-emissive lamina (5). Magnetic coil prevents lateral spread of electrons (6)



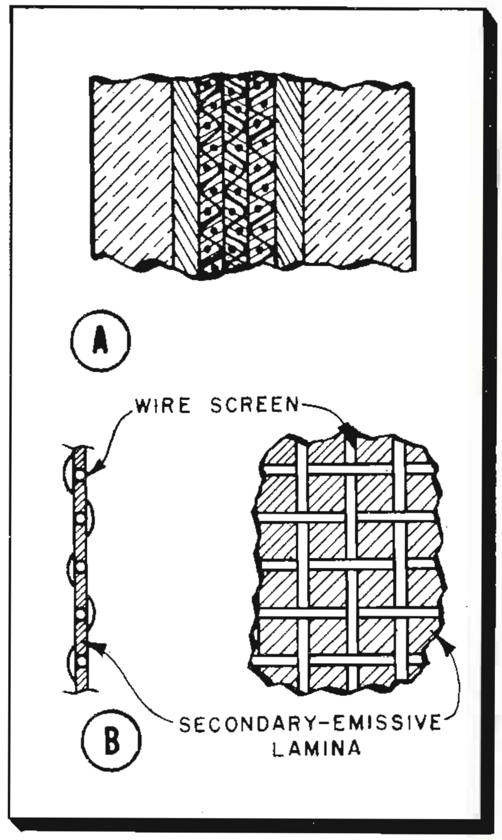


Fig. 2: Modified amplifying cell (A) combines conductive and secondary-electron emissive laminae. Blowup of a center layer (B) shows secondary material filling wire screen spaces

In operation, light from the TV picture tube passes through the transparent material and strikes the photo-sensitive lamina, causing electrons to be emitted in proportion to the intensity of the incident light. Such emitted electrons tend to follow a path which is the extension of the original light beam, and substantially all of them are propelled through the adjacent conductive layer by the positive charge applied thereto. In this manner, the electron beam intensity is increased, and it strikes the secondary-emissive lamina with sufficient energy to produce secondary emission several times greater than the incident electron beam.

Two succeeding sets of conductive layers and secondary-emissive lamina repeat the amplifying process in a similar manner and at increasing accelerating potential increments of from 10 to 200 volts. Thus far, the electron beam has been amplified three times. If a moderate secondary emission ratio of five is assumed for each secondary-emissive lamina, by the time the electron beam enters the last conductive layer, its intensity has increased almost 125 times that of the original electron emis-

(*Continued on page 110*)

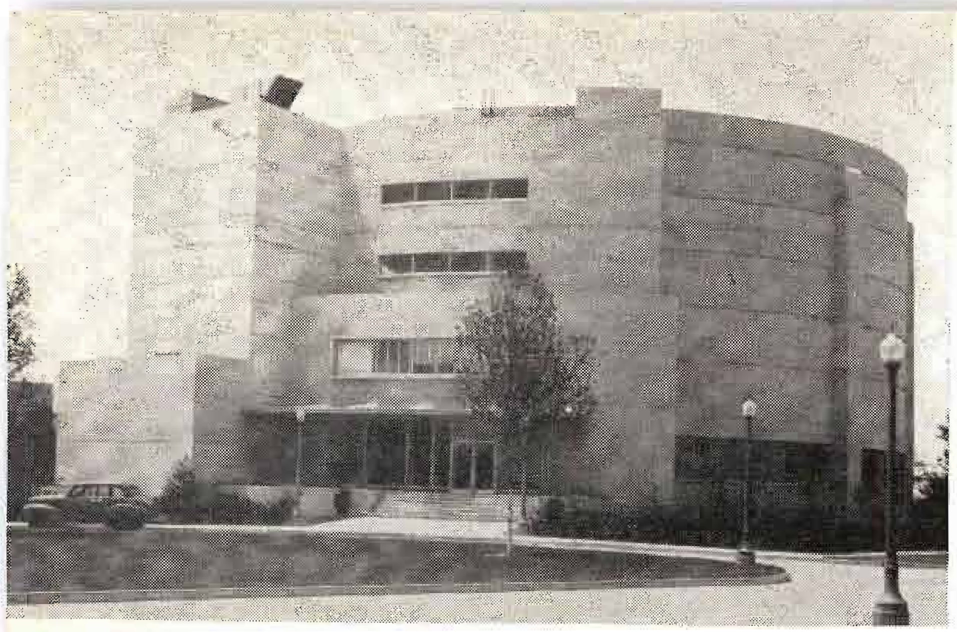


Fig. 1: Cylindrically shaped building housing centrifuge and labs

World's Largest

Dramatic experiments utilize re- stress. $5,000,000 unit uses

High altitude aircraft flying at supersonic speeds tax the endurance of men and materials to the limit. In order to make pre-flight tests of how humans and communications and electronic equipment react to extreme strains caused by high G stresses, the Naval Air Development Center at Johnsville, Pa., has recently constructed the world's largest centrifuge. Equipped for making X-ray movies and TV observations of test subjects, the centrifuge is expected to provide valuable data for the design criteria of aircraft and associated equipment.

The centrifuge, housed in the building shown in Fig. 1, was developed and built at a contract cost of $5,000,000. Fig. 2 shows the unit's gimbal-mounted gondola at the end of an 80 ft. boom. The distance from the rotational center to the outer gimbal is 55 ft., and the diameter of swing to a subject enclosed in the gondola is 100 ft. A 4000 hp GE drive motor with 16,000 hp starting power is mounted in a cylindrical room under the boom in the center of the test room. The subject may be accelerated to 40 G (180 mph) at 48.6 rpm in 6.8 sec.

Ceiling Control Room

The control room suspended from the ceiling affords excellent simultaneous observation of boom movement and telemetered information. The rate of increasing rotational speed may be controlled manually or automatically in this room.

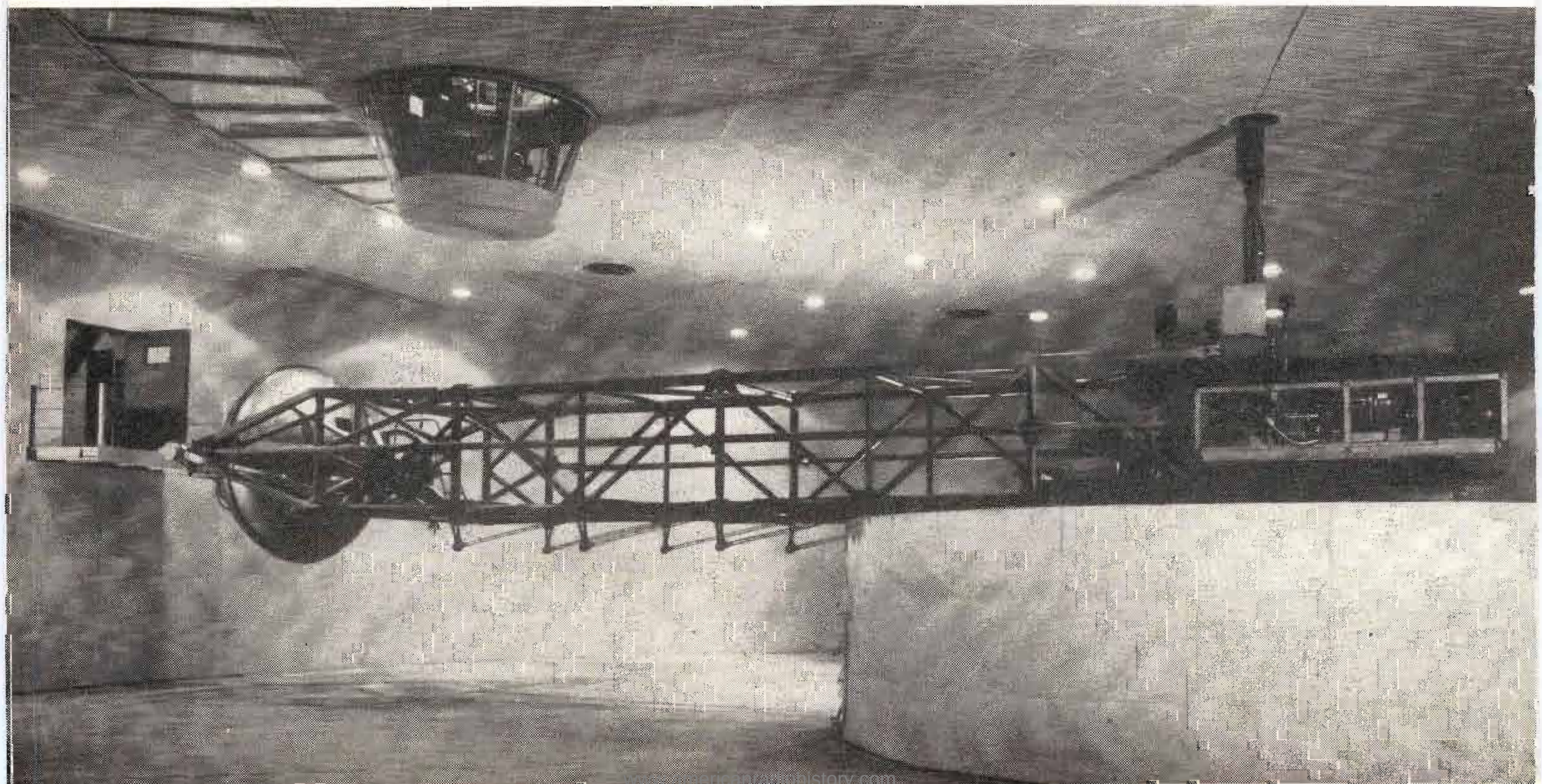
For automatic regulation, an acceleration control rod rides against a step-shaped cam which determines the time pattern of increasing speed.

The gondola shown in Fig. 6 is made of aluminum and balsa, and has an access hatch. Fabricated in the shape of an oblate spheroid of 10 ft. major axis and 6 ft. minor axis, it can carry a test payload of 600 lbs. In addition to riding in the gondola, equipment may be suspended from the offset suspensions in the middle of the boom. Mounted on two gimbals, the gondola can be tumbled and cocked at various angles while the boom rotates by using the electronic gimbal control system illustrated in Fig. 4. To simulate reactions at high altitudes, the chamber may be evacuated to 28 in. of mercury, the equivalent pressure of about a 60,000 ft. height. A convenient feature of the centrifuge is its ability to stop at the loading platform at the end of every test run. Other similar systems often permit the gondola to coast to a halt at any random location.

TV Camera in Gondola

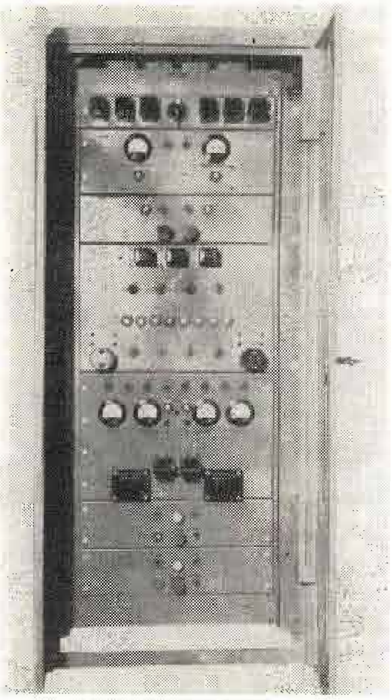
A 330-line TV camera with 3 v. peak-to-peak output is installed in the gondola to allow constant observation by researchers at several picture monitors. Also, suitable equipment for taking X-ray movies

Fig. 2: World's largest centrifuge comprises gondola mounted on 80 ft. boom rotated by 4000 hp drive motor to accelerate to 40 G in 6.8 seconds



Centrifuge Tests Men & Equipment

mote equipment to show reactions of men and communications equipment at 40 G gimbal-mounted gondola; rhodium-plated slip rings for low-noise telemetering



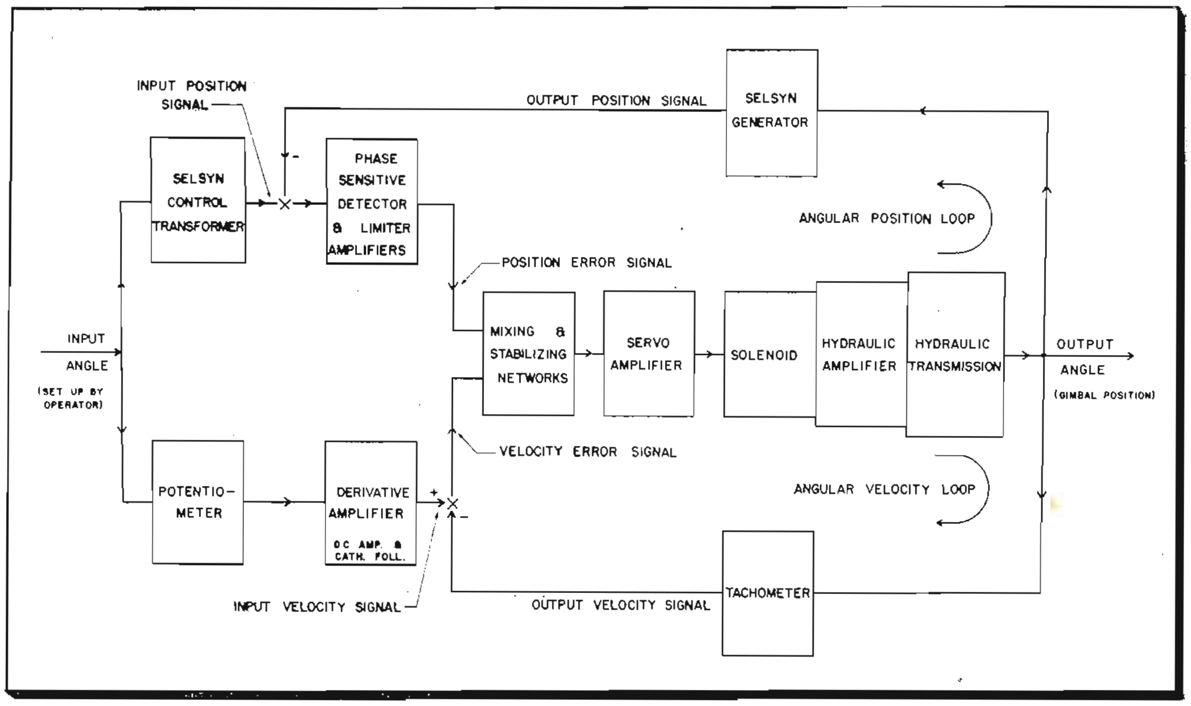


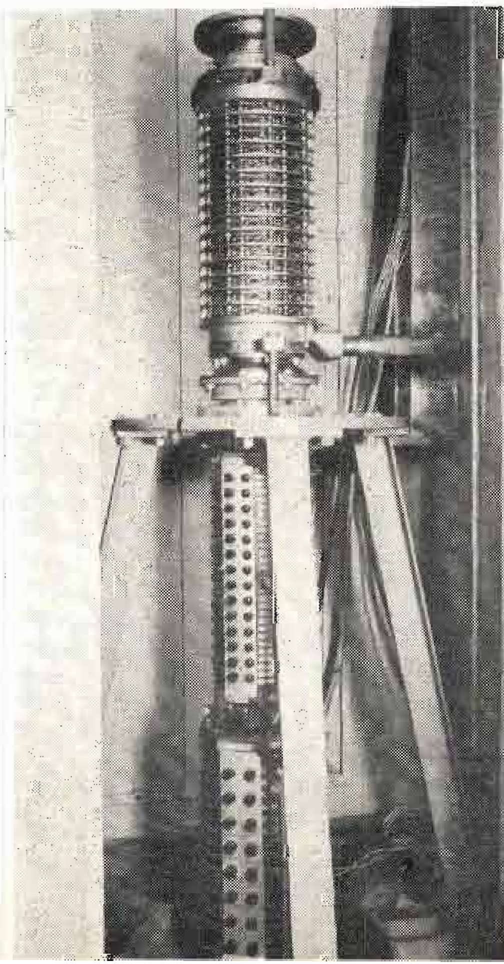
Fig. 3: (l) Inner gimbal control panel. Fig. 4: (r) Gimbal control system employs servo-amplifier circuits to control rotation and position of gondola

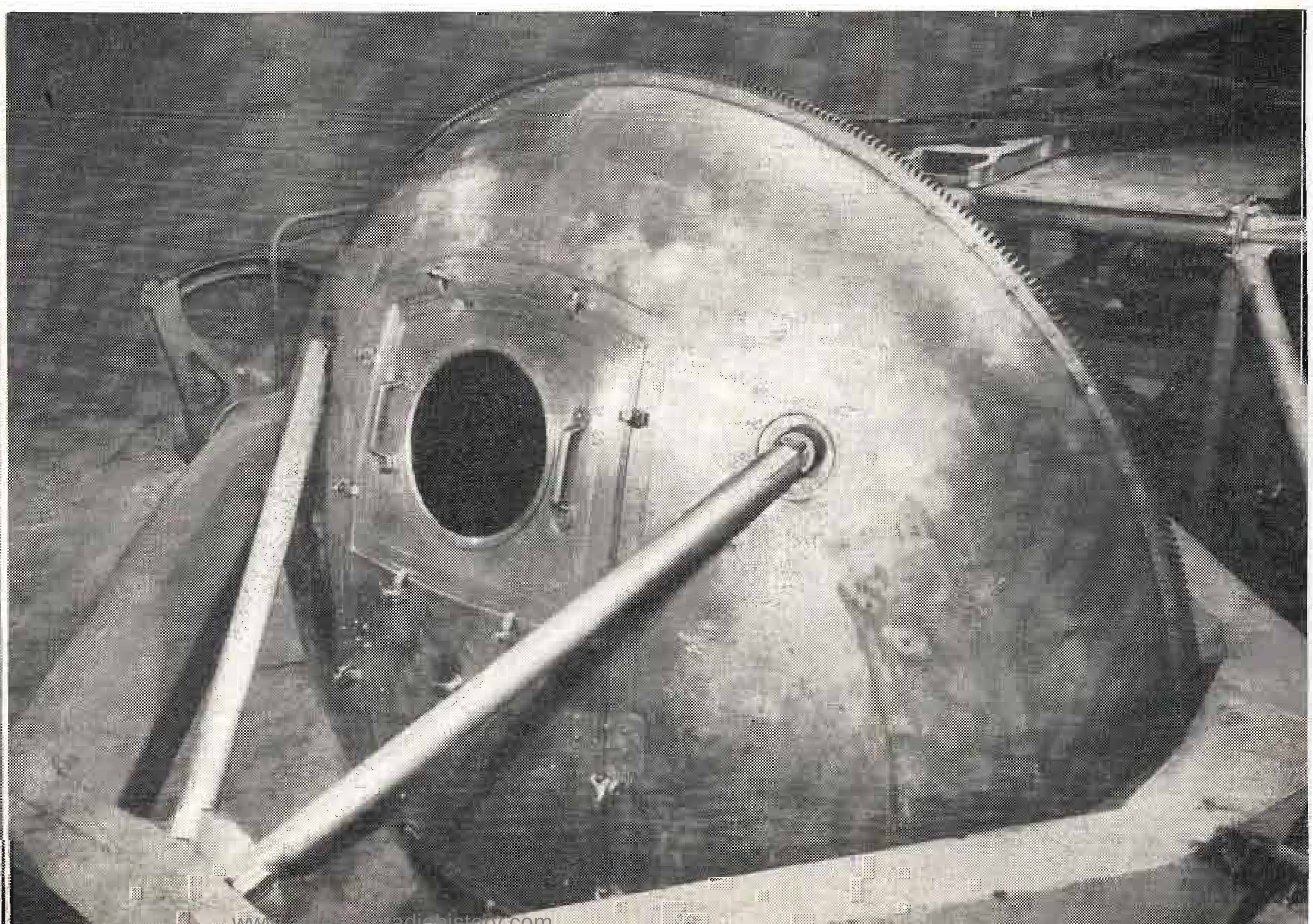
and measuring respiration, heart rate, blood pressure, heart and brain waves is incorporated in the gondola. The instruments making these measurements feed their signals through the rhodium-plated copper slip rings and rhodium-graphite brushes pictured in Fig. 5. This type of ring is believed to reduce noise by about 0.5 mv. For central grounding, a mercury pool slip ring is employed.

The control panel in Fig. 3 controls the gondola's inner gimbal.

To date, a limited number of experiments have been performed with men, animals and equipment, but more work will be required to establish the design criteria which will guide aircraft planners. The future holds an extensive program of experimental study to find out how much men and electronic equipment can take, why they take it, and how equipment should be designed to permit full utilization of their capabilities.

Fig. 5: (l) Slip ring stack for telemetering data from gondola uses rhodium-plated rings for reduced noise. Fig. 6: (r) Gimbal-mounted gondola





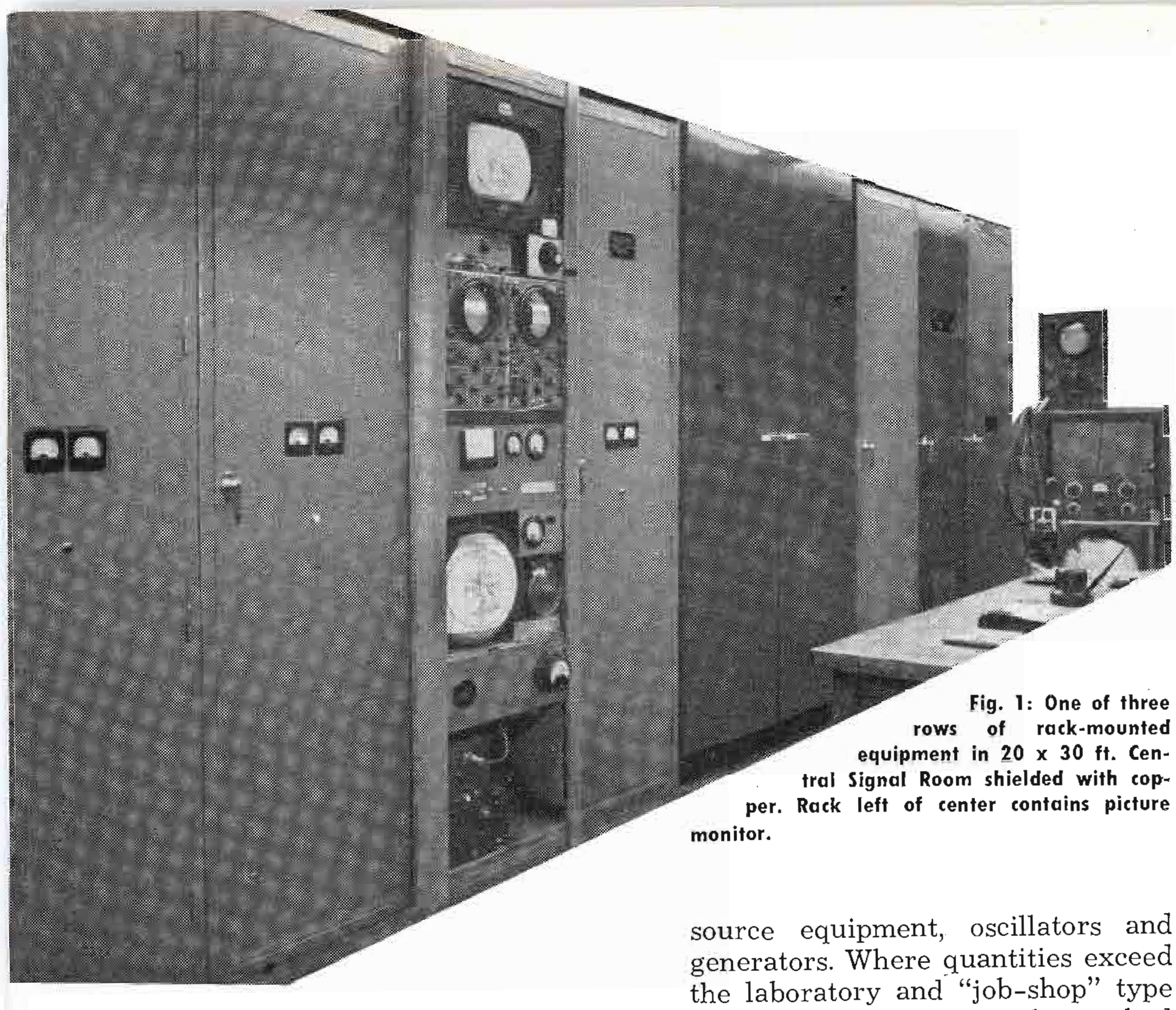


Fig. 1: One of three rows of rack-mounted equipment in 20 x 30 ft. Central Signal Room shielded with copper. Rack left of center contains picture monitor.

A Receiver

Advantages of local and manufacturing examined.

By H. GOLDBERG
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Passaic, N. J.

THERE seems to be a question in the minds of some as to the manner of setting up a test line in the mass production of any electronic equipment. If one is to obtain an economical method of test, the axiomatic goal is to arrive at maximum productivity for a minimum of operational difficulty and time. Within the framework of this goal are numerous interpretations and methods of achievement.

Basically, there are two types of test equipment necessary to align and adjust electronic circuits properly. The first, consisting of bench instruments, oscilloscopes and meters, does not readily lend itself to simplification and codification, for in order to interpret the effect of his adjustments, each test operator must have certain meters. Regardless of whether there is enough work for two or 200 test operators, each man must have a certain amount of equipment. The only exception is that in a mass-produced item with breakdown of test, each man may need fewer instruments.

Another part of the test requirements, usually representing considerably more capital expense, in which codification and simplification becomes a possibility, is the signal source equipment, oscillators and generators. Where quantities exceed the laboratory and "job-shop" type of production, however, the method of signal source is invariably a problem.

As an excellent example of this, the TV industry may be cited. In testing TV sets at the manufacturer, there may be as many as 100 test positions involved. Each would normally require bench instruments and signal sources. The signal source may be one of two types. A signal generator may be provided at each bench and the operator instructed in its handling, or, as is done at many large plants a central signal source may be used. In this central signal source system, the test operator has the privilege of choosing one of a number of fixed signals piped to his bench from a single generator. In some cases he may have control of the signal level. Further than that, he has no choice whatsoever in the adjustment and operation of his test signals.

Separate Signal Sources

The proponents of the separate signal generator technique argue that separate sources allow more flexibility in the hands of the tester, and achieves its economic value by allowing the alignment men to do their own minor adjusting. Moreover, it means that with the flexibility of variable signal generators, the entire line is flexible with regard to engineering changes and modifications in product and technique.

On the other hand, those of us who favor the central signal source of signal distribution for a mass produced item realize that this system can only work efficiently in a mass production organization. The intent here is to eliminate, as much as possible, the human factor from the testing and alignment of the sets. If a test line can be set up where the operator merely pushes a button and a green light or a red light shows up, this is an ideal case. No one has achieved a perfect "GO-NO-GO" test without the necessity of any skill on the part of the operator. In the same vein, once a test has been devised and a set of r-f. signals decided upon, they can be piped from a central source to the test benches. The tester is then freed of the responsibility of insuring the accuracy of signal sources.

Central Signal Operation

There are certain other inherent advantages to the central type of signal operation. In the first place, all sets are tested against one standard source, the only possible difference between positions being signal level. There is no longer the problem of cross-calibrating equipment and of holding one set of generators on "ice" to act as standards. Since a very few generators are needed, they may be of greater stability and cost than if a number of units were used. A further advantage is that radiation and cross modulation effects are minimized, due to the fact that all stations receive identically the same signal frequency.

With proper care, such a system can be expanded to include all types of modulated waves, swept oscillators, TV picture carriers, etc. Moreover, these can be distributed to over 100 separate locations without loss of fidelity.

An example of a central signal system exists at the Allen B. DuMont Lab., Receiver Div., in E. Paterson, N. J. In this system, designed by Mr. K. M. Long, one single set of signal generators provides the testing source for the entire TV line.

All generating equipment is housed in a Central Signal Room, a specially designed and constructed area 20 x 30 ft., shielded to prevent

Production Test Distribution System

remote origination of test signals for radio and television

Detailed description of central source arrangement presented

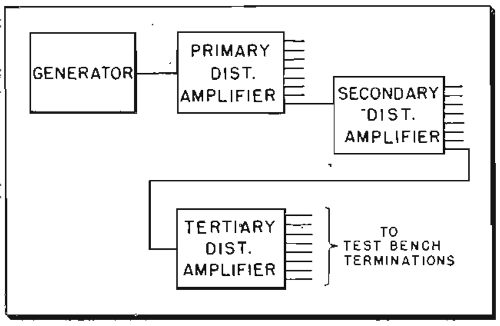


Fig. 2: Broadband signal distribution system

unwanted signals from radiating into the test area and interfering with sensitivity checks. Two wall thicknesses of copper, completely insulated from each other except at one point of common ground, achieve the shielding. R-F and filtered power cables enter the room at the point of grounding through a coarse mesh screen.

The electrical and thermal isolation necessitates the use of an air-conditioning unit built into the system. To prevent an untenable condition, both for equipment and monitoring personnel, a spare unit exists which may be switched into operation for normal filter cleaning and for possible emergency use in the event of breakdown.

Economical Use of Equipment

The centralization of test signal sources in this one room allows the economical operation of far more complex and complete equipment than would be possible at the individual test bench. In this room are the generators and prime amplifiers of:

(a) Monoscope camera chain
(b) Channel 3 transmitter modulated by the composite video output of the monoscope
(c) Sound and video i-f wobbulators with associated marker pulses
(d) Square wave modulated Channel 3 transmitter
(e) Numerous spot frequency generators for trap settings
(f) Complete monitoring equipment

Fig. 1 shows one view of the room.

This, in its simplest form, represents all the equipment necessary to test and align the receiver. Channel 3 is used as the r-f since it is an open channel in the area.

Due to the fact that each generator now feeds each of the test benches in the line, the failure of any one source would be immediately to stop production. For this reason, there exists 100% spare equipment in the Central Signal Room, warmed up for immediate switchover with a monitoring crew on duty at all times.

The square wave modulated signal, not usually considered a TV signal, is used in the pulse testing of all DuMont receivers to trim the video i-f transformers in order to achieve an optimum transient response. If the transient response is correct, the amplitude and phase responses must be also.

It would be repetitious to explain the theory of each of the pieces of equipment existing in the generator room. However, the design and operation of the complex network of transmission lines and distribution amplifiers is unique to this type of operation and will be explained in detail.

Two basic types of distribution systems are used in the DuMont plant. The first is the broadband network necessary for the distribution of signal spectra, such as the Chan-

Fig. 3: Broadband distribution amplifier features internal shielding and symmetrical construction

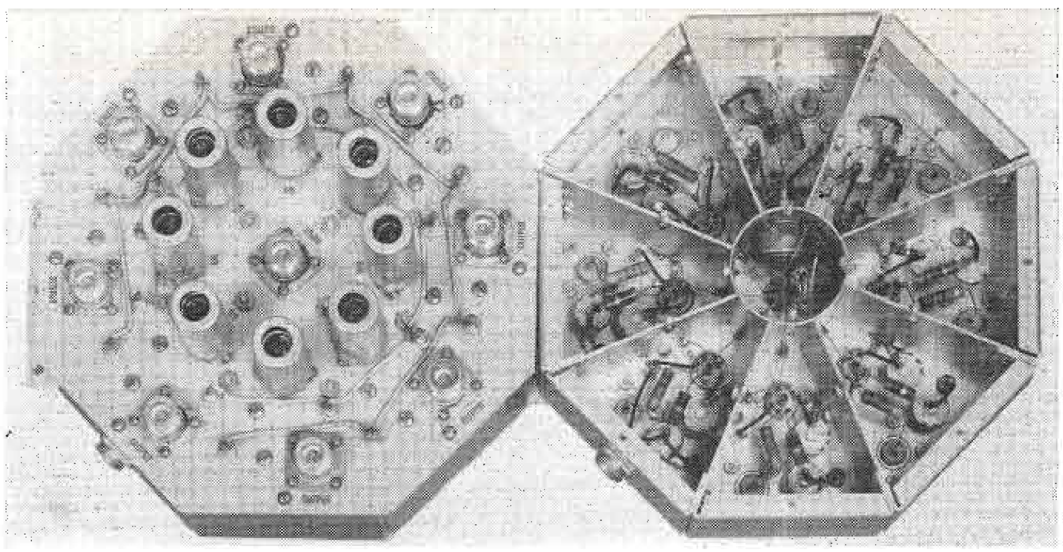
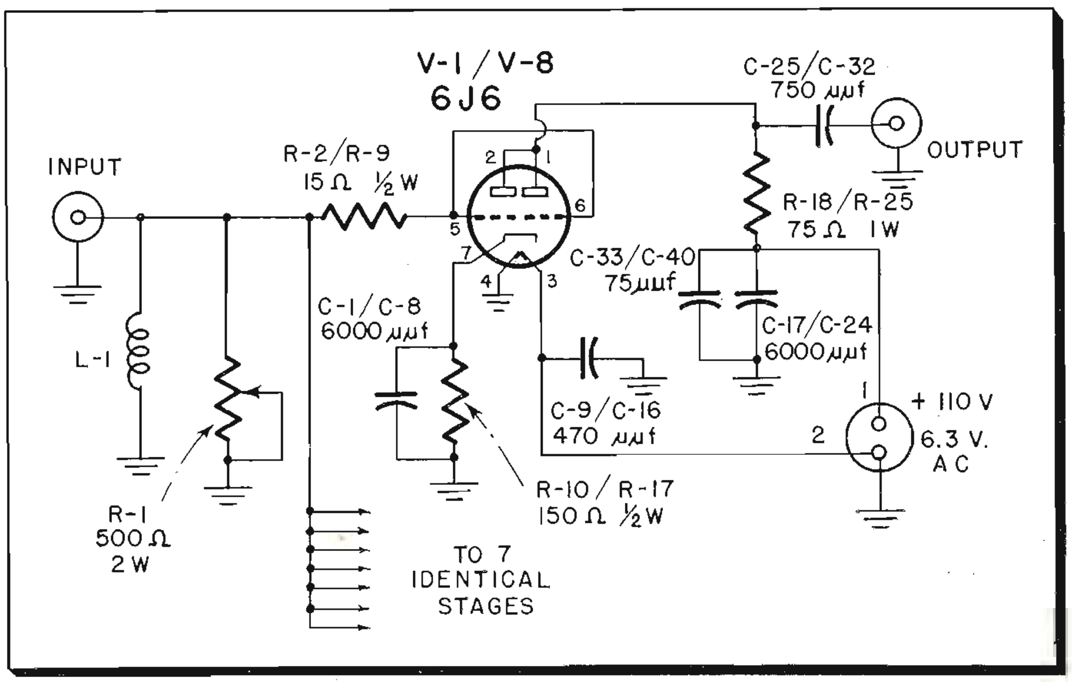


Fig. 4: Distribution amplifier circuit comprises eight plate-coupled, 75-ohm resistor loaded stages



nel 3 video modulated and i-f wobbulated signals. The other, and simpler system, is used for piping the spot frequency and narrowband signals to the test positions.

Fig. 2 shows a diagram of the distribution system used in the operation of Channel 3 signals, composite

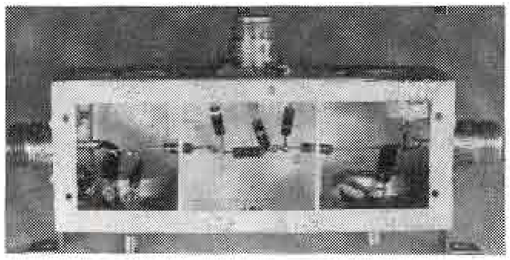


Fig. 5: Bench termination of the tertiary amplifier yields high and low level outputs

video signals, and video i-f signals. The output of the generator (approximately 1 watt) is fed first into an eight-output distribution amplifier. This unit has a gain of approximately 0.6, its major function being to isolate input and output stages to allow for proper line terminations. Located in the Central Signal Room, it is subject to constant monitoring to guard against breakdown.

Seven outputs are fed through RG-12/U coaxial cable to secondary distribution amplifiers located on the test floor. One output is used for monitoring purposes and the rest are transmitted to various parts of the plant.

Extreme care was taken in the installation to insure that each transmission line was terminated in its 75 ohm characteristic impedance at both receiving and sending ends. To avoid ground currents on long runs, the armored outer shield is cut just short of the receiving end connector. This makes an excellent Faraday shield. From each of the two secondary distribution amplifiers, located in the area they are to serve, eight outputs are obtained with a voltage gain of approximately 0.8. These in turn each feed a tertiary distribution amplifier, identical to the secondaries, and each of the eight outputs is cabled to a single test position. With the existing distribution pattern, 128 benches receive signals from one signal source.

The secondary and tertiary distribution amplifier is shown in Fig. 3. Note that each of the eight output circuits is symmetrical with respect to the input circuit. The purpose of this is to minimize any tendency toward differences in waveforms and levels at the test benches. The amplifier is shown schematically in Fig. 4. It consists of eight plate coupled amplifier circuits loaded down into 75 ohm terminating resistors. Plate coupling was preferred over cathode follower because the higher output impedance of the tube at the plate eliminates possible tube loading effects.

Potentiometer Adjustment

R-1 is a single 500 ohm potentiometer adjusted to 75 ohms to terminate the line, and L-1 helps resonate any latent capacitance at the termination. The procedure used to adjust R-1 is as follows:

The sending end of the input line is opened and a wobbulated signal at the approximate line frequency is applied. A rectifier and oscilloscope is then attached to one of the amplifier outputs. If standing waves exist on the line as the frequency is varied, output voltage will vary according to the vswr as the frequency is varied, giving rise to ripples in the oscilloscope trace.

R-1 is then adjusted to reduce this ripple. This method is very rapid, can be set up for production checks, and yields results of the order of 1.02 vswr.

Each output of the tertiary distribution amplifier feeds directly to its individual test bench where it undergoes 20 db attenuation, both to act as further isolation and to prevent the test operator from upsetting the lines as he makes and breaks connections to his receiver under test.

An example of the type of bench terminations used may be seen in Fig. 5. Not only is it necessary to terminate the line properly, but as much isolation between stations as possible must also be assured to remove any possibility of interference from one position to another. It is seen from Fig. 6 that two outputs are obtained. The high output, approximately 2000 µv, is used toward aligning and checking the receiver on a normal high level signal. The low level jack, adjusted to 25 µv, is necessary to fulfill the requirement that all receivers show a good picture at this fringe area signal.

Two requirements are essential here. The first is that the line termination remain fixed at 75 ohms, and the second that there be negligible leakage from input to output, approximately 50 db lower.

The three-stage attenuator between input and output, with shielding between each stage, as shown, achieves the result of proper isolation. To prevent change in load as outputs are connected and discon-

(*Continued on page* 84)

Fig. 6: Bench termination circuit makes 2000 µv and 25 µv signals available at two separate outputs

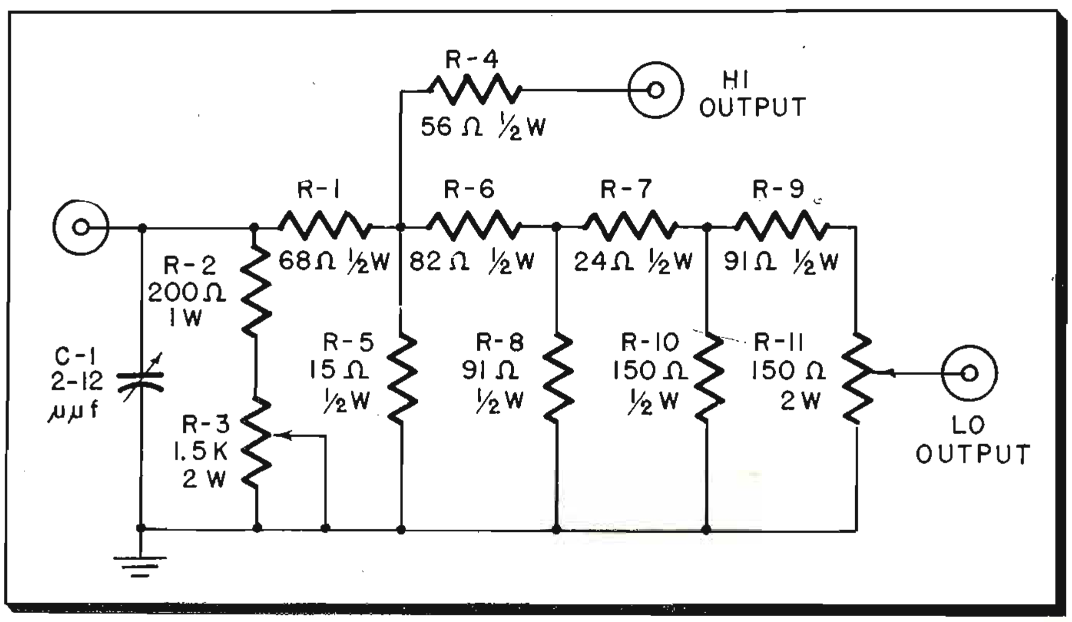
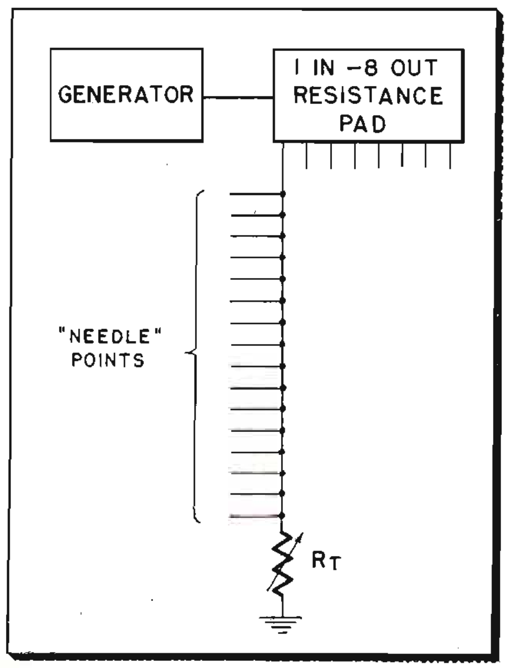


Fig. 7: "Needled line" system for distribution of single frequency and narrowband signals



Automatic Station Break Announcer

Cessation of average program level actuates relay circuit which plays tape recorded announcement. Cam and motor timing device prevent false operation

By PHILIP WHITNEY,
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Winchester, Va.

MOST FM stations are rendering a much needed service, especially to the audience beyond their AM affiliate's night time coverage. It is therefore desirable to afford extended hours of operation, in many cases beyond the capabilities of present FM station staffs, and with limited budgets, adding further staff members is not always the solution.

WRFL is the FM affiliate of AM station WINC in Winchester, Va. The FM station operates with an ERP of a little over 13 KW from a mountain top approximately 2400 ft. above sea level. WINC is a 250 watt local station on 1400 KC. Both are affiliates of NBC. The engineer on duty at the AM transmitter, which is also the AM and FM studio site in the city of Winchester, also controls the FM transmitter on the mountaintop some 23 miles away, through a system described some months ago.[1]

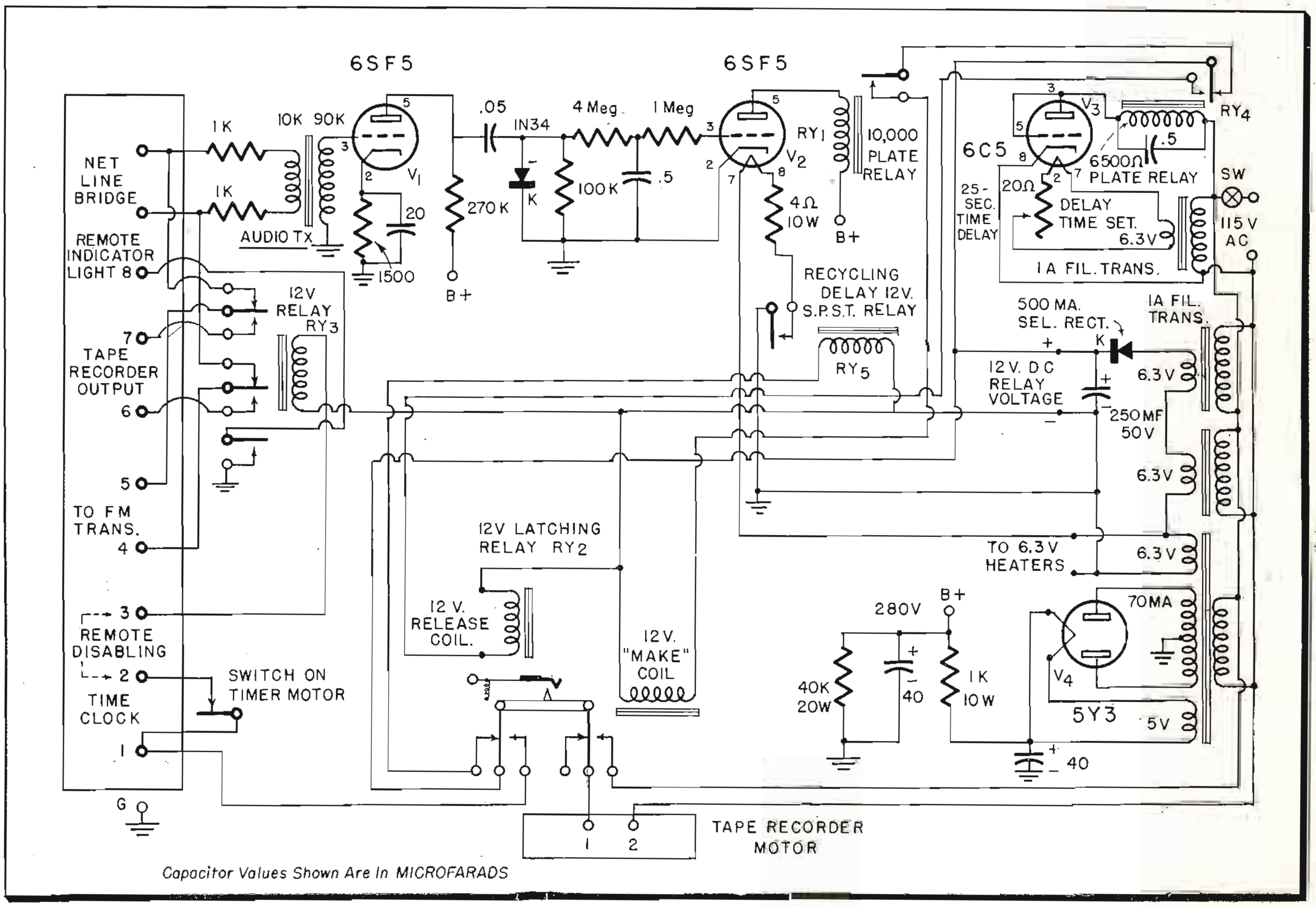
Since the coverage contours place the AM (especially at night) in the local classification, and the FM in a regional class, the programs, in order to cater to these two classes of audience, are, as far as practicable, distinct and separate. The network programs are generally preferable to particularly local programs, in which local advertisers, only, are mentioned.

For regional consumption, the net is fed to the FM station with network breaks sold to regional advertisers for the greater portion of the average broadcast day. (Of course, there are times when both stations carry the same network show; and when net service is not available the local show is fed to both stations.) Therefore, this would mean two separate announcers to read the two different commercials on the station break. This was financially impractical, as the salary which would be paid the extra announcer would outweigh the income from the station-breaks. This expensive cycle was broken by the use of the automatic station break announcer to be described.

It was decided to base the operation of the machine upon the time interval between network shows, with a time clock affording a safety device to prevent operation at any

(Continued on page 80)

Fig. 1: Station break circuit starts operating when program level drop cuts voltage to crystal integrator. Relay system initiates tape playback



Evaluation of Unidirectional

Appraisal of performance of corner reflector, parabolic and suitability of each type for different applications. Economics of

By J. S. BROWN,
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Chicago 19, Ill.

THE 450-460 MC emergency communications band is, in a sense, between VHF and microwaves as far as unidirectional antennas are concerned. Therefore, antennas commonly used for both applications are practical possibilities for this band. It is the purpose of this paper to summarize the characteristics of several types of antennas that might be used for this application.

While there are many types of unidirectional antennas, three stand out as presenting the best possibilities from a practical standpoint. They are the corner reflector, the Yagi or parasitic array, and the parabolic.

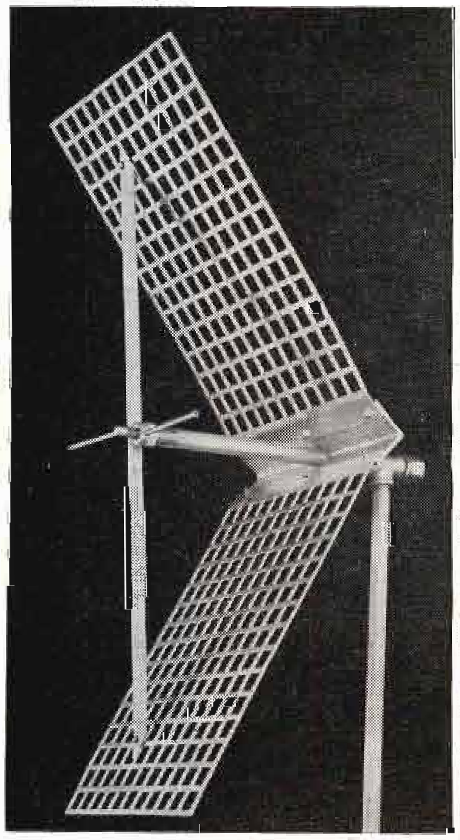
The corner reflector shown in Fig. 1 is a simple, easy-to-design, broadband, non-critical antenna. The reflecting sheets forming the corner are made of perforated metal in this model to reduce wind loading, but solid sheets may be used without encountering excessive wind loads. The gain of a single corner reflector is definitely limited by economic considerations. While theoretical gains up to 15 db are indicated, economics point to 8 db as the optimum choice. (All gains are referred to a half wave dipole). This can be achieved using a 90° corner angle and reflecting sheets approximately ⅝ or ¾ wavelength in size, which is a practical size for this frequency. Higher gains can be provided by reducing the corner angle and increasing the size of the reflecting sheet, but the increase in mechanical complexity and cost does not justify it. For example, 10 db gain can be obtained by using a 45° corner and reflecting sheets four ft. long (dimension perpendicular to the corner).

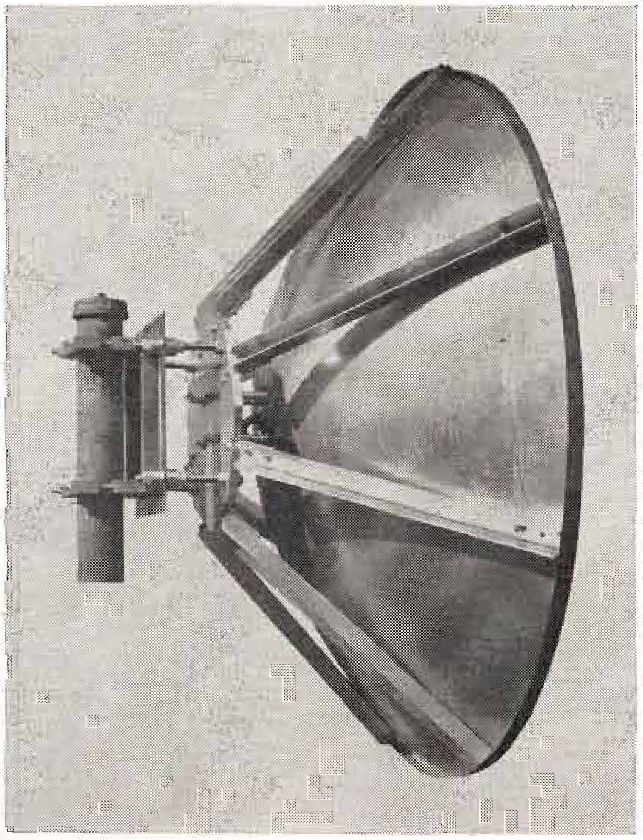
Impedance characteristics of the corner reflector are excellent. The radiation resistance is high, eliminating the possibility of low efficiency due to ohmic losses in the antenna itself. Impedance matching is easily accomplished by varying the length and position of the dipole, both of which may be adjusted over rather broad ranges without affecting the pattern. Bandwidth, both with respect to pattern and impedance, is much greater than is required for this specific application. This implies less effect on antenna performance by ice and sleet than on a more critical array.

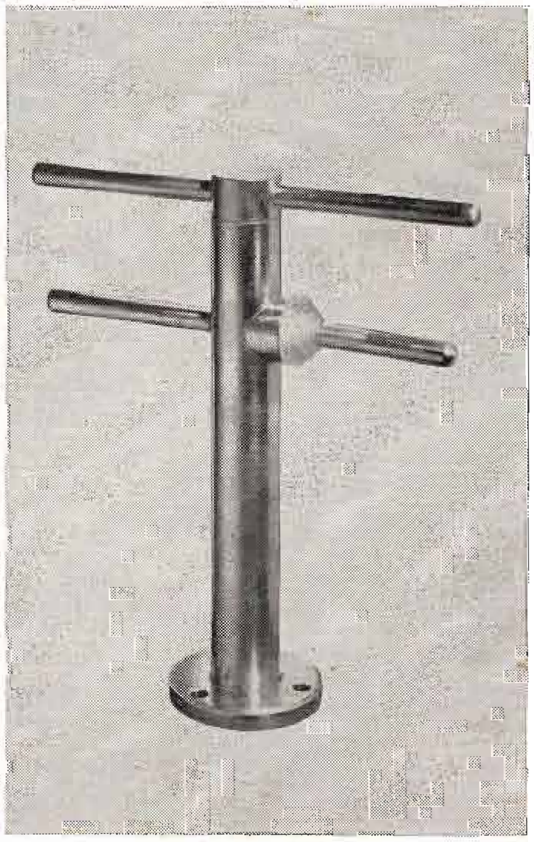
All three of the types under consideration can be fed directly from an unbalanced transmission line, without the use of any balancing means. Additional gain can be obtained by using a stacked array of two corner reflectors, spaced approximately one wavelength and fed in phase. Two 8 db corner reflectors will provide about 12 db when used in such an array.

The Yagi type of array is capable of slightly higher gains than the corner reflector. A single six element array antenna will provide 10 db, while two such arrays properly stacked and fed will provide 12.5 to 13 db. From a design standpoint, the Yagi presents a much more difficult problem than the corner reflector. Both pattern and impedance are quite narrow in bandwidth. The bandwidth is sufficient to cover 450-

Fig. 1: (l) Non-critical broadband corner reflector. Fig. 2: (c) High-gain parabolic antenna. Fig. 3: (r) Simple primary feed for parabolic antenna

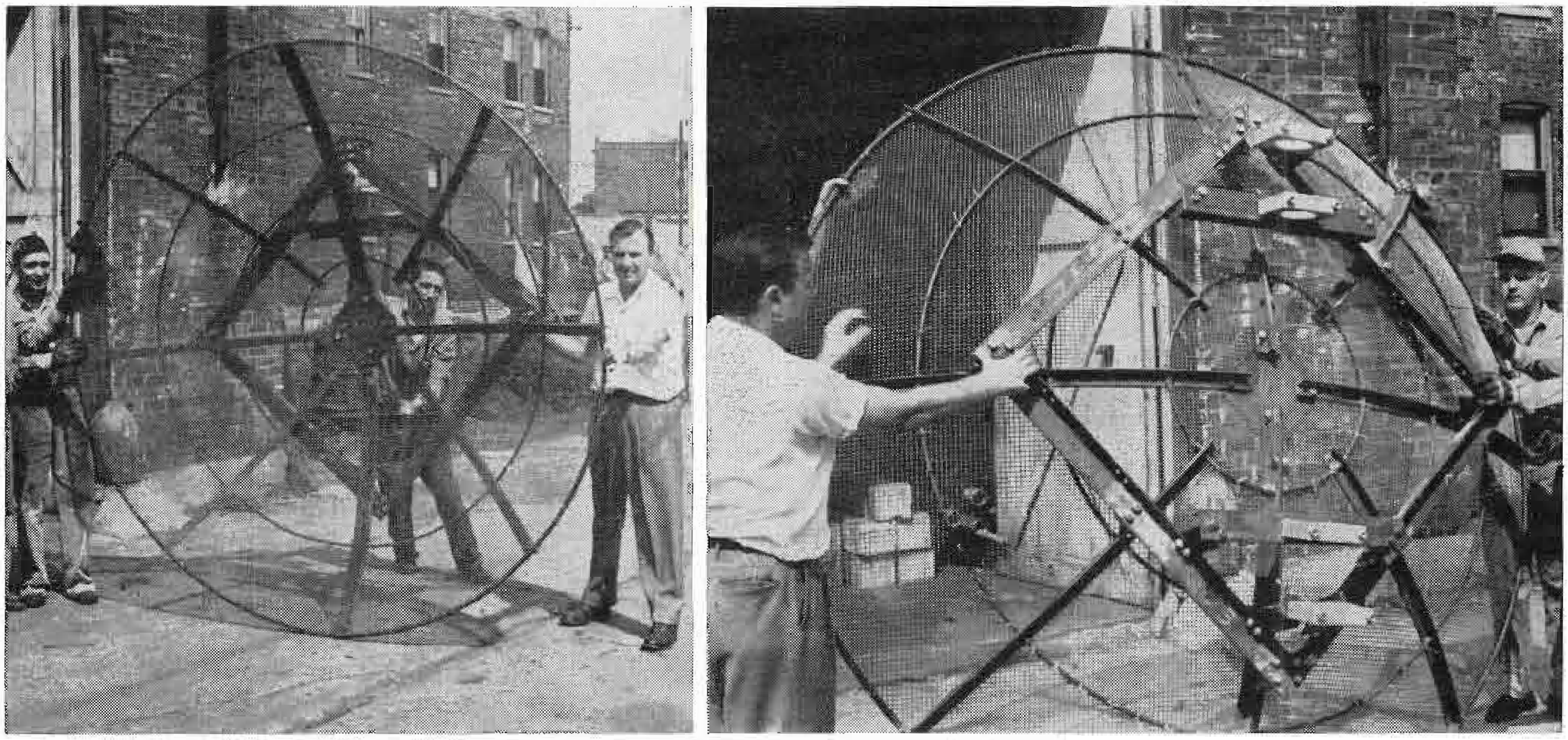






Antennas for 450-460 MC

Yagi antennas for emergency communications band indicates different antennas compared in "$/db gain" and "$/watt erp"



Figs. 4-5: Economical mesh type reflector for reduced wind loading is made of woven steel wire welded to steel frame. Entire assembly is galvanized

460 MC when properly designed, but achieving the design is a tedious task. Obviously, there are many more variables than in the corner reflector. Also, the pattern and impedance are much more closely interrelated. Very low radiation resistance may be encountered in this type of array, and the designer must be careful to avoid such a condition, which might result in low efficiency due to ohmic losses in the antenna. Because of the narrow bandwidth, icing conditions will tend to have a more pronounced effect on the Yagi than on the corner reflector. Mechanically, the Yagi presents less wind loading and is lighter in weight than the corner reflector. A practical problem that must be evaluated in the design of the Yagi type of array concerns the method of mounting and the possibility of the supporting structure affecting the pattern. Experimental evidence indicates that the mounting will not affect the performance of a properly designed array if it is not located in front of the driven element.

A significant point in connection with the Yagi type of antenna is that its most serious practical drawback, namely its narrow bandwidth, is not a factor in this application. The band under consideration is quite narrow percentagewise, and experimental work indicates no difficulty in obtaining satisfactory performance over the band with a single model. This is a very important factor from a practical standpoint. It eliminates not only the necessity of field adjustment, but also the inevitable confusion that results from manufacturing, handling, and stocking several antennas which may be identical in construction but which have small differences in length or spacing of radiating elements.

Parabolic Antenna

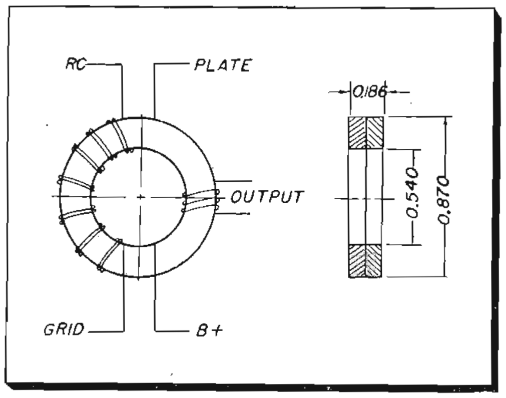
The parabolic antenna, used extensively for many microwave applications, has definite possibilities in the 450-460 MC band. Much higher gains are practical with it than with the previously discussed types. Whereas 15 db is probably the top practical gain limit for stacked arrays of the previous types, a 10 ft. parabolic antenna can easily provide over 21 db. Not only is the gain substantially higher, but it is provided by a single driven radiating element, while the stacked arrays involve several fed elements. The proper field installation and interconnection of a multi-element phased array by inexperienced personnel is sometimes a serious problem. The simplicity of a single feed is a practical point that must not be overlooked.

A photograph of a 6 ft. parabolic antenna appears in Fig. 2. One type of primary feed is shown in Fig. 3. The wind loading of this type of antenna is high, but it can be reduced by the use of a mesh reflector rather than a solid spinning. Two views of an 8 ft. mesh type reflector are shown in Figs. 4 and 5. This reflector is made in two halves, for convenience in handling and shipping. A woven wire steel mesh is attached to a welded steel frame, and the entire assembly is galvanized after welding to provide good electrical contact between the crossover points in the wire mesh and to prevent corrosion. In sizes over 6 ft., this type of construction has a distinct economic advantage over the spun reflector in addition to the convenience of a sectionalized reflector in these sizes.

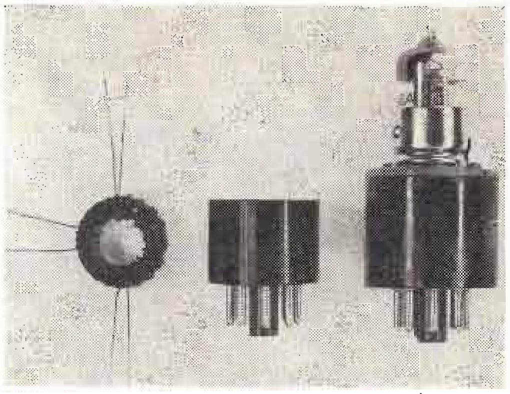
The radiation patterns for antennas of various gains are shown in Fig. 6. Curve A is the pattern of a single corner reflector with 8

(Continued on page 90)

New Developments at National Bureau



Dimensions of ferrite core and windings for rapid rise (90 v. in 0.02 μ sec) transformer



(1) Transformer wound on ferrite toroid. (c) Plug-in transformer. (r) Complete oscillator.

New Pulse Transformer Gives Faster Response

A simple pulse transformer recently devised by Carroll Tschiegg produces an exceptionally fast pulse-rise—from zero to 90 v. in less than 0.02μ sec. in a conventional blocking oscillator. Small size makes the unit suitable for plug-in construction. It consists of a few turns of wire wound around a small ferrite ring.

A blocking oscillator is a transformer-coupled feedback oscillator designed to produce, when "triggered" by an actuating voltage, a single rectangular voltage pulse having a fast rise and fall. The speed with which the oscillator output voltage pulse rises and falls, the duration of the pulse, and the rate at which it can be repeated, are determined largely by the characteristics of the transformer. However, fast response also requires a tube having high transconductance. Optimum pulse transformer design calls for very tight inductive coupling between the windings, and low capactive coupling. Transformers are therefore constructed with a few turns of wire wound on cores having high effective permeability for abrupt changes of current. Steel cores are generally used, thinly laminated to reduce losses. The shortest pulses obtained with such transformers have a duration of about 0.1μsec. and the fastest rise time is about 0.03 or 0.04μ sec.

The new transformer owes its superiority largely to its ferrite core. The various compositions of these non-metallic magnetic materials are now becoming available.

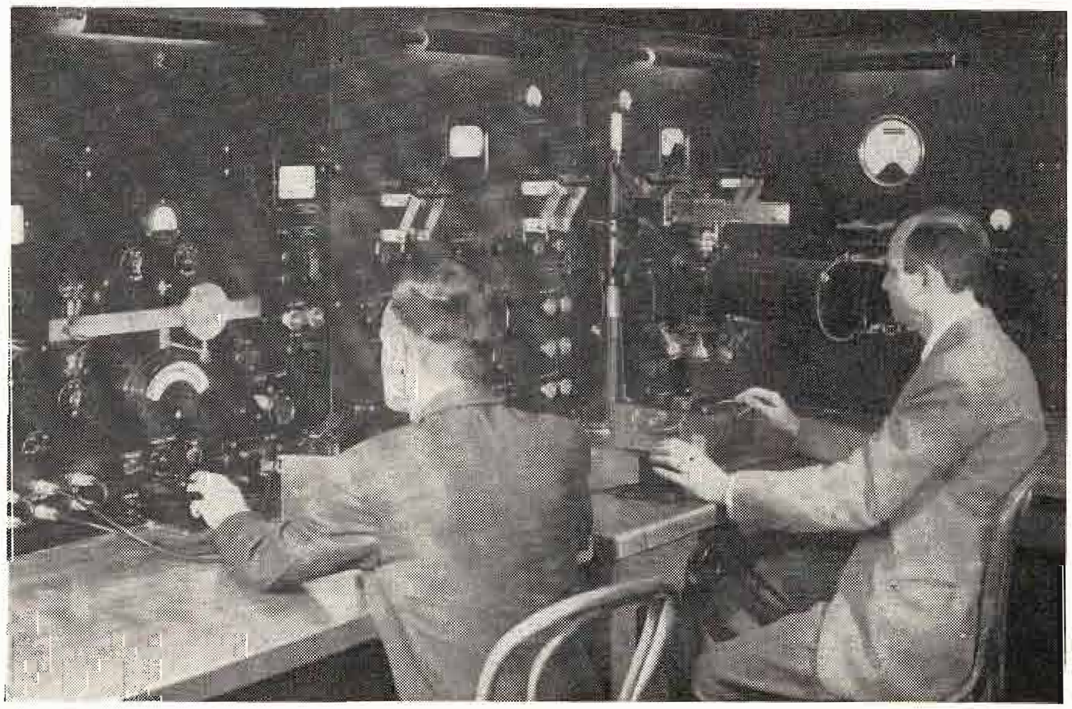
Transfer Standards For Audio-Frequency Tests

DESIGNED primarily for the testing of ammeters and voltmeters, the NBS transfer methods for measurement at audio frequencies make possible accuracies approaching 0.01% over wide ranges of current and voltage. As fundamental electrical units are maintained by dc standards, all ac measurements are actually based on transfer instruments which are standardized on dc and then used on ac.

Electrothermic transfer standards

(Continued on page 95)

Standardization of an ac voltmeter. At left, dc voltage required to give same response in electrothermic transfer standard is being determined. Right, instrument's scale is read on projection device



Noise-Free Instrument Cable

AN instrument cable free of spurious electrical signals due to mechanical shock and vibration has been developed by Dr. T. A. Perls of NBS. In connection with the application of a piezoelectric accelerometer, experiments were set up to compare the performance under dynamic stress of various experimental and commercial coaxial cables consisting of an inner conductor, an insulating dielectric, and a conducting shield. The cables were connected between a small piezoelectric accelerometer and a cathode follower, straining the cable, and recording the output through a dc amplifier.

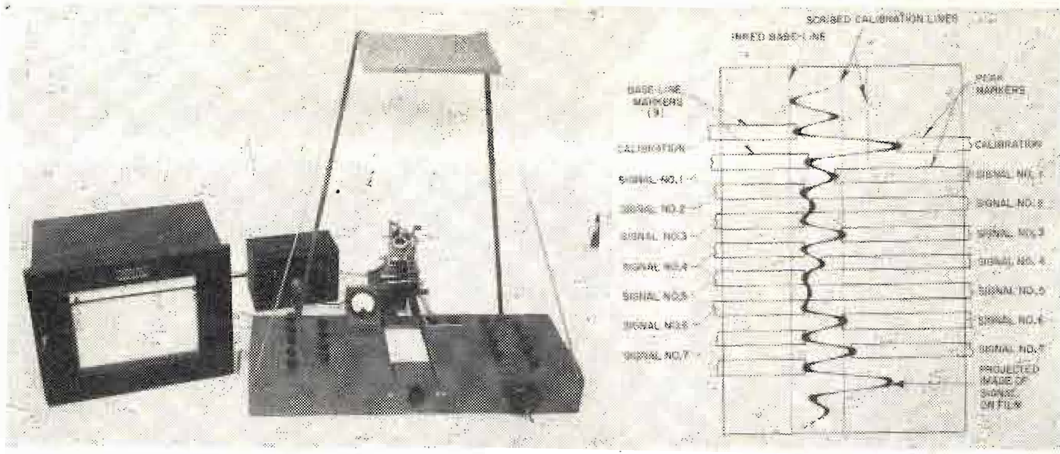
It was found that standard microphone or phonograph pickup cable gave noise signals under these conditions as high as 500 mv peak-to-peak. However, the noise was definitely lowered (to about 60 mv) by tightening the braided shield over the dielectric, thus improving the contact between the dielectric and the shield.

A colloidal suspension of graphite in benzene was applied to the inside of the dielectric, reducing the residual noise to less than 3 mv peak-to-peak. By coating both inside and outside of the dielectric, the noise was almost completely eliminated.

In another series of tests, an experimental cable was made up from an outer braided shield, the same rubber-like dielectric as before, and

(Continued on page 100)

# of Standards



Film readers system (l) utilizes projector and reflector at right to project film images onto a horizontal surface. Marker tips connected to 17 potentiometers on chassis are adjusted to signal-image peaks. Set of seven measurements is transcribed to seven separate channels on recorder chart at left. Rear cabinet houses power unit. Image (r) of single set of seven measurements projected on screen.

Electronic Peak-Reading Kilovoltmeter

AN instrument that rapidly and accurately measures the high voltages associated with medical X-ray equipment has recently been developed by R. E. Brueckmann of NBS. The unit is designed to indicate directly peak voltages between 30 and 125 kv and thus replaces the sphere gap method, which is ordinarily used to measure high voltages in diagnostic X-ray apparatus. The kilovoltmeter is especially useful for measuring voltages during short exposures with provisions to prevent the recording of initial surges.

Diagnostic exposure to the X-rays must necessarily be short to prevent blurring of the radiograph due to motion of the subject. Exposures generally range from 1/60 sec. to 1 or more seconds, necessitating tube currents as high as 500 ma to produce the desired film blackening. At these high currents, the anode of the X-ray tube is heated so severely that it is impossible to make the longer exposures necessary for calibration.

The NBS peak-reading kilovoltmeter overcomes shortcomings of the sphere gap, which include errors from initial surges, excessive gap breakdown time, and arc current overload. It requires no manipulation during the exposure and retains its reading until reset. Peak voltages can be measured during exposures as short as 1/60 second. The unit also includes circuits that can, if desired, prevent the initial surge from being recorded and permits the reading of either the forward or inverse voltage on self-rectified equipment. During normal operation, the meter draws a maximum current of 1.25 ma from the equipment being calibrated.

In principle, the kilovoltmeter operates as follows: A type 2D21 thyratron is used as the HV detector. The critical bias on the tube is about —3 v. at a plate potential of about 150 v. If, for example, the bias voltage is 103 v., the thyratron will fire when the voltage drop across two 50,000-ohm resistors between the bias cell and ground and the cathode and ground reaches 100 v.

(*Continued on page* 107)

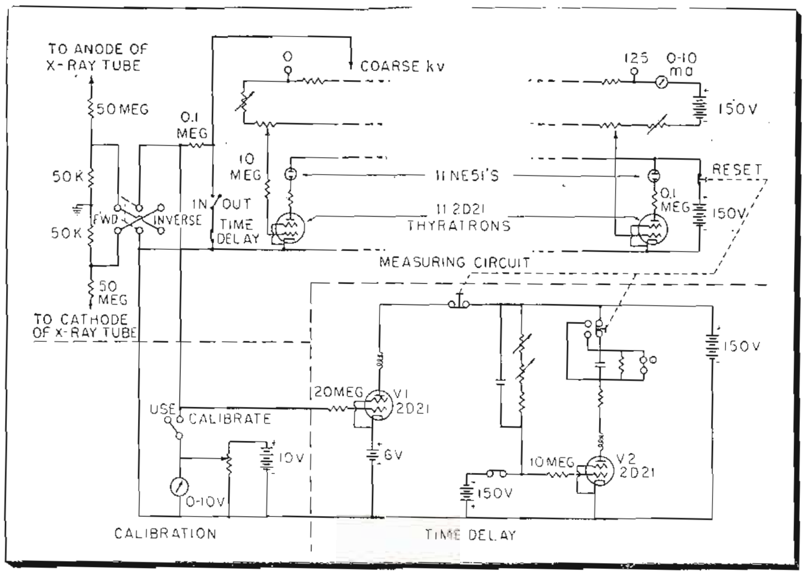
Film Reader For Telemetered Information

A semi-automatic film reader system recently developed by F. H. Bayhi and M. L. Greenough of NBS facilitates the transcription of telemetered data recorded on 16mm film.

The parachute-telemetering system is designed to transmit from a parachute-borne radio transmitter to a ground station. The transmitter is modulated by a calibration signal and up to seven measurement signals, selected in turn by a commutator device. On the ground, a receiver demodulates the transmitted information and feeds it to a CRT. A single spot on the face of the tube moves up and down with the amplitude of the transmitted measurements, and its position is recorded continuously on film moving at constant speed. This gives a series of pulses on the film, with peaks of varying height, the height of each peak corresponding to a single measurement.

The observations are made at the rate of 6000 sets (commutator revolutions) per minute, but are made continuously only during certain critical portions of the parachute's fall. A typical film record of a single parachute drop depicts about 500 sets of measurements, made at successive intervals of time, each set consisting of a single observation of each of eight quantities. To make it useful, the data on the film must be replotted to give seven curves (the calibration signal is omitted) having a common time scale, each showing one of the measured quantities as a function of time. This is the problem that the NBS film-reader system was developed to handle.

Circuit of peak-reading kilovoltmeter contains eleven 2D21 thyratrons and eleven NE51 neon indicating lamps to show which tube is conducting, affording fine kv measurement. Time delay prevents recording of initial and final surges. Unit covers 30 to 125 kv range and requires no sphere gap



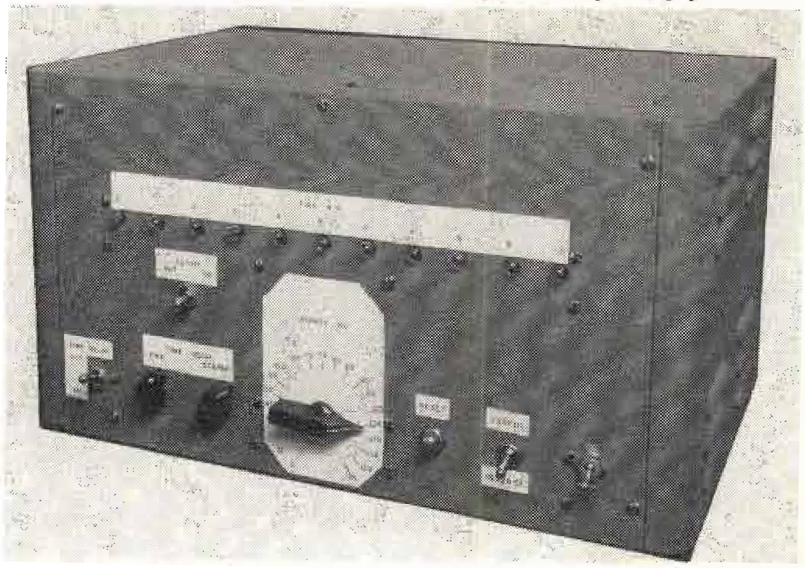


Fig. 1: CBS TV City in Hollywood, Cal., photographed during an intermediate stage of construction

CBS Opens New Hollywood

$12,000,000 project scheduled to begin operations October 1, 1952. and video installation anticipates expansion of present four-studio

By ALBERT J. FORMAN,
Assistant Editor, TELE-TECH

TELEVISION'S rapid growth has made broadcasters aware of the need for long range planning of flexible facilities which will keep abreast of the industry's mushrooming expansion. Answering this call, the Columbia Television Division of CBS is erecting an impressive center —aptly named TV City—at Beverly Blvd. and Fairfax Ave. in Los Angeles, to fulfill some of the broadcasting needs of network program origination on the booming Pacific Coast. Fig. 1 shows the center, located on a 15-acre tract near Gilmore Field and Farmer's Market, during an intermediate stage of construction.

Flexibility is the keynote of this $12,000,000 project, which is expected to begin operation on Oct. 1, 1952. Initially, TV City, illustrated in the photograph of the scale model (Fig. 2) will contain two audience studios (located in the rear wing on the right) seating 350 and two non-audience studios, (center foreground) each 12,100 sq. ft. in area. Also, 8,000 sq. ft. of rehearsal halls (extreme right glass wall section), dressing and storage rooms, service shops and production offices (at the left) and the latest audio and video equipment will be provided.

By October, all studio facilities together with concomitant telecine (film transmission) facilities are to be installed. The master control switching installation will take place immediately following the completion of this phase. Initially, the TV City studio outputs will be fed via Telephone Co. circuits to the present CBS-Television master control located at 1313 Vine St., in Hollywood. As soon as facilities installation will permit, the master control operation will be shifted to TV City and the studios at 1313 Vine St. and other locations will then feed into the TV City master control point.

The scope of the audio and video facilities installation is indicated by the fact that over 60 CBS engineers, technicians and draftsmen are involved in the design, construction, installation and pre-operational testing of equipment. The work is directed from the CBS Engineering Dept. in New York with the close cooperation of the KNXT technical staff in Los Angeles.

Future Construction

This conservative, though far from modest, beginning takes into account an anticipated demand for more facilities in the foreseeable future. Construction plans which presently call for four studios, one program control room, telecine projection and control rooms, five announce booths, eight film chains, master control with 24 inputs and six outputs, can be conveniently expanded on an adjacent 25-acre tract with the growth of programming from the West Coast. Plans for the future envision a 13-story administration building; 24 studios, four program control rooms, 28 announce booths, 20 film chains, expansion of master control to have 40 inputs and 12 outputs, and a house monitor selector system with 40 inputs and 80 outputs. The photograph of Fig. 3 shows the construction of (l to r) the production offices at the rear, non-audience studios, rehearsal halls over the service passage, and audience studios. Two additional studios

Fig. 3: Structure shows (l to r) production offices at rear, two 12,100 sq. ft. non-audience studios, 8,000 sq. ft. rehearsal halls over passage, and two 12,100 sq. ft. audience studios seating 350 each

may be added to the facing wall in the foreground, in line with the two wings shown, and a third four-studio wing with intervening passage can be constructed to the left.

Fig. 6 is the ground floor flow pattern layout drawn by the architects, Pereira & Luckman. The central technical area will contain telecine facilities, TV recording, master control, program coordinating control and film cutting. This section can be expanded into the dressing room space if necessary. Across the truck service passageway is the technical maintenance section. The scenery storage area will contain the sets which are mounted on dollies and easily stored for future use.

The master control switching system, tailor-made by RCA, initially will have six outputs which will include feeds to KNXT, CBS TV Network, a second Network group, two lines to TV recording, temporarily located at 6121 Sunset, and one spare. In order to accommodate all the channel controls and monitoring equipment, the master control console (see layout in Fig. 5) is divided in two; one part contains the cue selector, preset switching controls, and two test picture and waveform monitors which may be switched to any program bus; the second part, set in the wall, contains a picture monitor for each of the six output channels. Smooth programming is assured by the provision of double preset switching. Patching and adjustments for audio and video are grouped on the facing rows of racks behind the console operating position.

Fig. 2: Model shows offices (l) and wing (r) containing two audience and two non-audience studios

Television Studios

Flexible design of audio structure to 24 studios

Telecine Facilities

Telecine facilities include eight film chains, each with two audio and video outputs for patching to studios or program control rooms. One camera is used with each of three Eastman 16 mm projectors, three RCA 35 mm projectors, and two Gray Telop projectors. Two Fairchild synchronized tape playback units supplement the projector audio for TV recorded delayed programs.

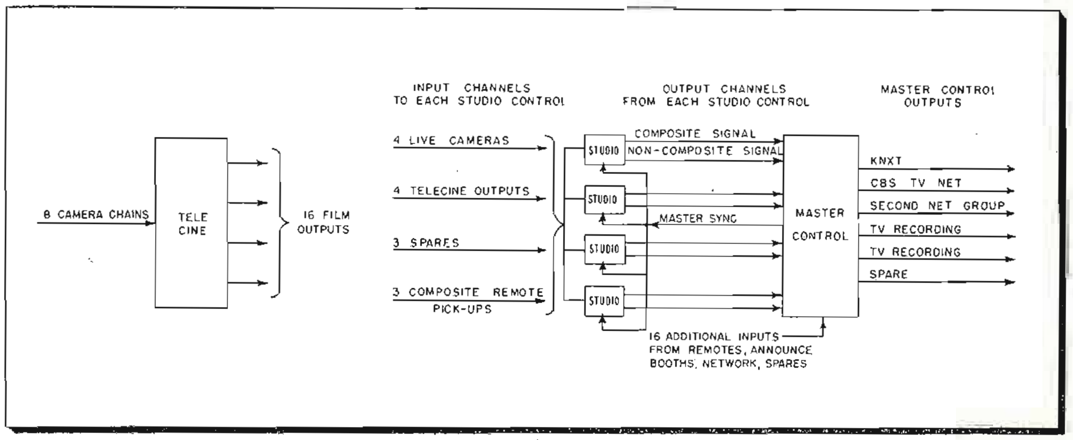
For unimpeded accessibility, all lines are brought to a central terminal frame room adjoining master control. This 50 x 7 ft. room facilitates rapid testing of the maze of wiring involved in the installation.

Each of the four studios shown in Fig. 7 will have four RCA cameras of the latest commercially available design. The video switching system in each studio is of the relay operated type with provisions for three-way superimpositions and for later addition of special effects devices if and as called for by program requirements.

Efficient flow of materials is indicated by the arrows in Fig. 7. Raw materials for set scenery coming in at the receiving area go to the carpentry and paint shops. The completed sets are transported through the set passage to the individual studios, going in and out either end. Incoming furniture goes directly from receiving to the studios.

Fig. 4 shows how studio functions relate to master control and telecine facilities. The guiding principle in designing the system was to make each studio semi-autonomous or decentralized from master control so that modifications with expansion and new technological developments could be made with a minimum of effort. Each studio control has four live camera inputs, four lines from telecine for film signals, and three spares, totaling 11 non-composite inputs. Sync pulses are added to these signals in the studio control room from the sync generator signals being distributed from the centrally located GE sync generators in master control. In an extreme emergency, a portable sync generator can be connected in the studio to replace the master unit. Three additional inputs, generally composite remote signals also feed the studio. One composite and one non-compo-

Fig. 4: Four of 16 film outputs feed each studio with four cameras, three spares, three remotes. One composite and one non-composite (no sync) signal enter master control from each studio



CBS TV STUDIOS (Continued)

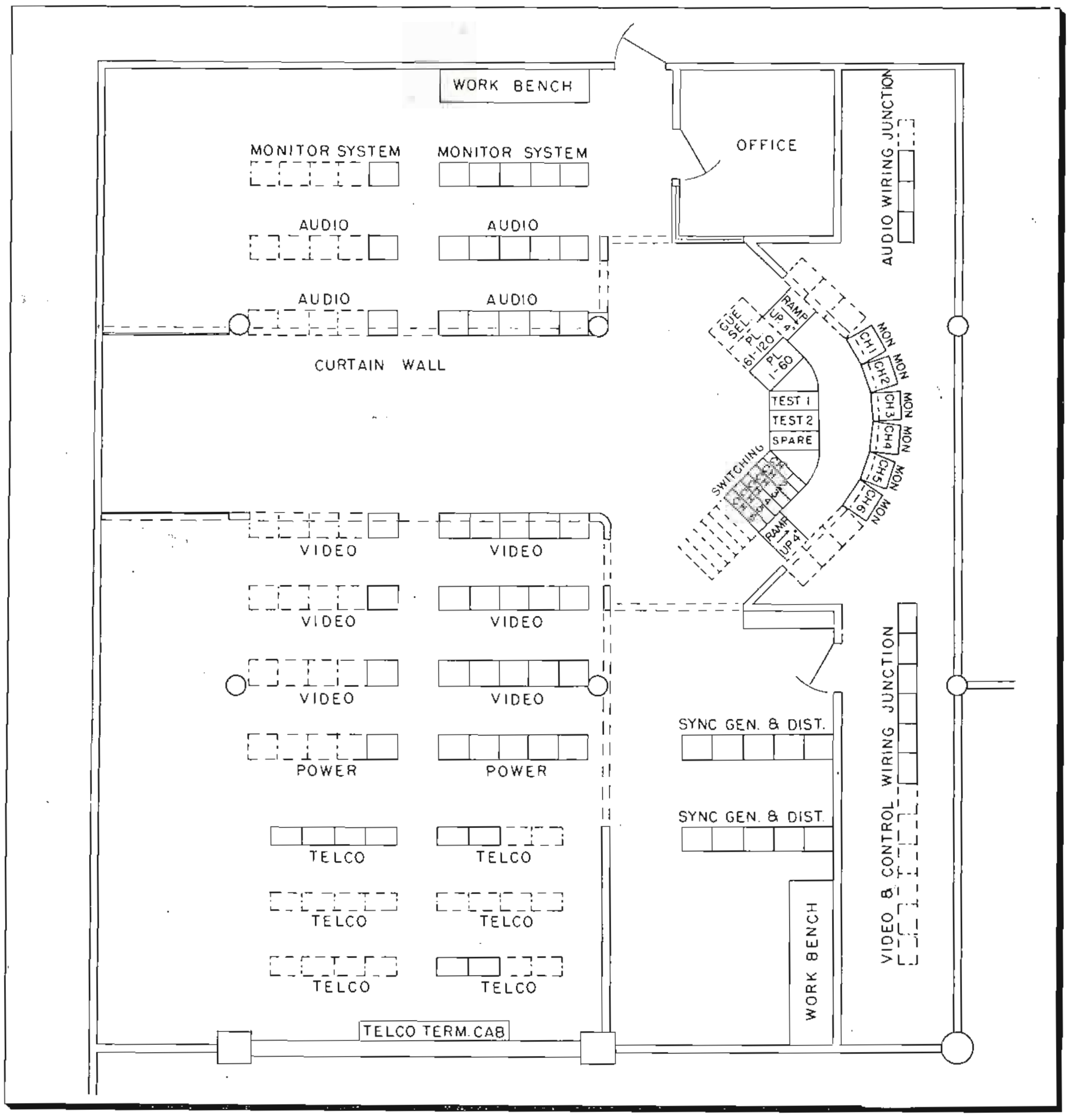


Fig. 5: Master control system uses divided console. Switching is at console proper, monitors in wall

site signal are sent from each studio to the master control, accounting for eight of the master's 24 inputs. The non-composite signal allows master control to combine the outputs of two studios prior to sync addition or to patch the signals through a so-called program control room for such coordination.

An extensive studio monitoring system includes two monitors for lighting, two on mobile floor dollies, one for sound effects, one on each of two Houston camera cranes, and four large audience monitors in each studio. Within the studio control room, a 10 in. monitor is used for each camera and for the outgoing line, while a 17 in. cue monitor and two 17 in. preview units are mounted over the studio window. Similar sets are provided for the audio man and in the announce booths. Three monitor bus circuits are provided in each studio, each of which can be independently switched to on-air cue, studio output line, or to either of the two video switcher preview circuits. Individual monitors can be patched to any of these three busses.

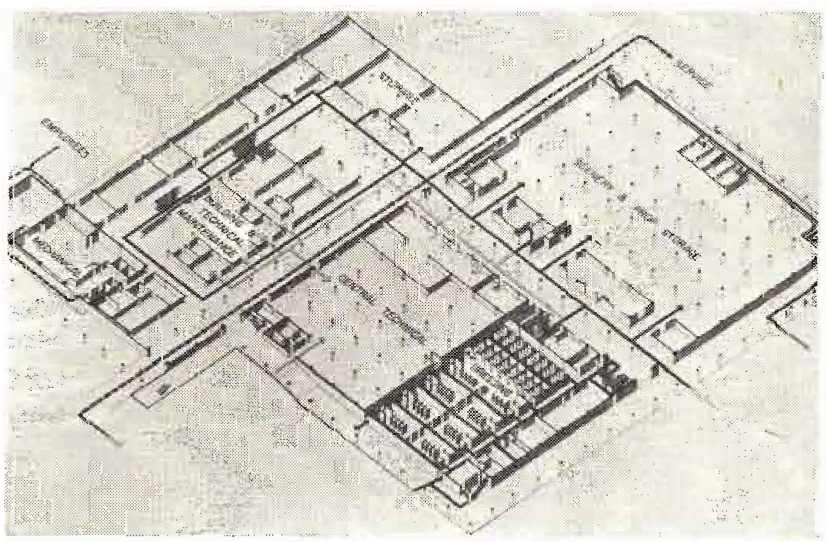
Audio Facilities

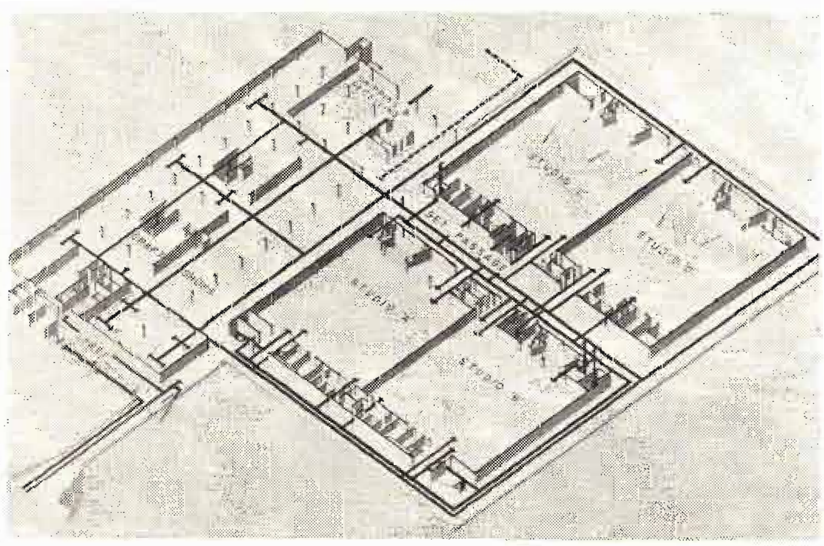
The studio audio facilities are CBS designed and constructed. In each studio control room, an audio console capable of handling 11 simultaneously connected microphones, four of them fed through a self-contained sub-mixer, is located. In addition, input positions are provided for six incoming remote lines or film projectors, and another position for sound effects. There are two outputs from the audio console, a regular and an emergency channel. This console is supplemented by a turntable control unit, which handles two transcription turntables providing cueing, and direct floor loudspeaker feeds, in addition to the audio output to the console. Associated equipment racks which also include Langevin amplifiers contain sound reinforcement amplifiers, audience reaction microphone preamplifiers, intercommunication, talkback and interphone components and the transmitter for the 100 KC audio cue system which is picked up by subminiature receivers worn by the floor director and other production personnel who must move about in the studio.

The light operator who handles the all electronically controlled Century-Izenour Board in each studio has an extra monitor at his command which can be switched to preview any camera or superimposition where critical lighting adjustment is necessary. The lighting control console and preset panel (Fig. 8) are connected by a single cable to

(*Continued on page* 96)

Fig. 6: (l) Basement floor plan shows maintenance, central technical (including master control), prop storage and dressing facilities. Fig. 7: (r) First floor has craft and shipping areas, and four studios. Arrows indicate flow pattern of scenery materials from receiving through shops to studios





Synchronous Detection of AM Signals

Signal-to-noise improvements obtained in receivers using correlation techniques. DSB reception less susceptible to adjacent channel interference than SSB

By JOHN P. COSTAS
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General Electric Co.
Syracuse, N. Y.

RECENT work [1,6,7] in applying correlation theory to problems of signal detection shows large improvements in signal-to-noise ratio obtained by using correlation techniques when detecting periodic signals in noise. When the signals involved are non-periodic, signal-to-noise improvements are limited. In the particular problem of detection of AM signals, it will be shown that the application of correlation methods leads to receiver circuits which have been known in the past as synchronous detection receivers. Although synchronous detection schemes are not new, if properly used they offer many important advantages over conventional envelope detection.

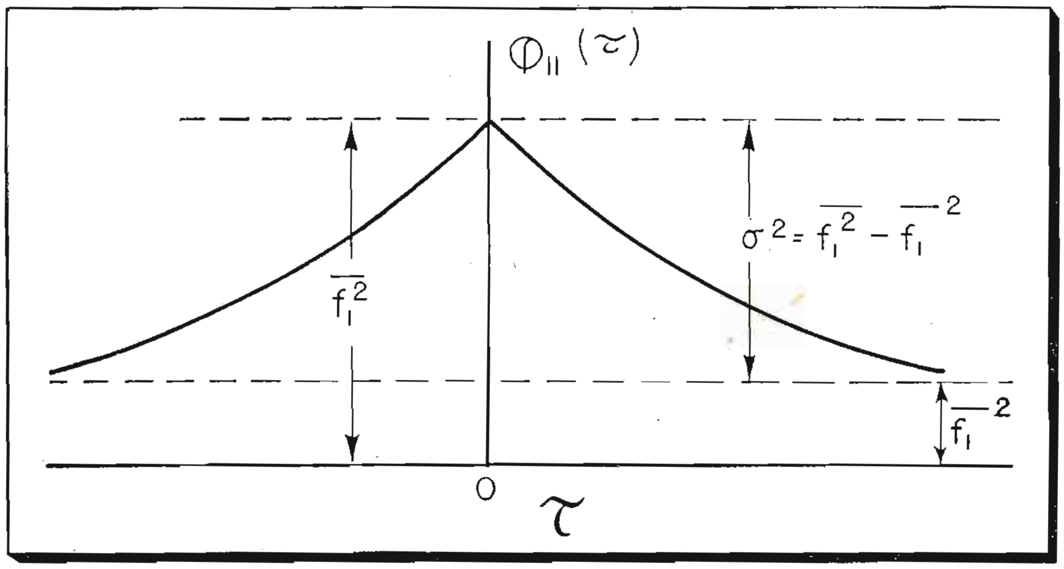


Fig. 1: Autocorrelation function; $\varphi_{11}(\tau)$ is time avg. of original function times itself advanced τ

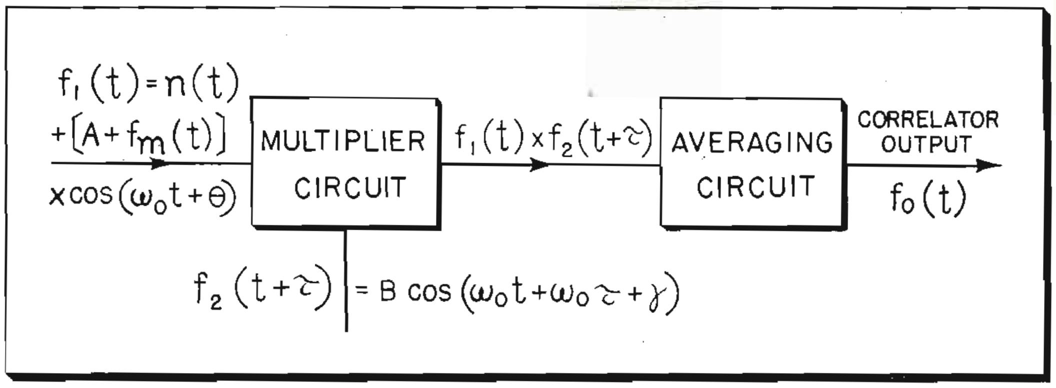


Fig. 2: Block diagram of crosscorrelation detection process. Averaging circuit may be linear filter

Autocorrelation

The autocorrelation function $\phi_{11}(\tau)$ of a random function $f_1(t)$ is defined as

$$\varphi_{11}(\tau) = \lim_{T\to\infty} \frac{1}{2T}\int_{-T}^{T} f_1(t)\, f_1(t+\tau)\, dt \qquad (1)$$

That is, $\varphi_{11}(\tau)$ is the time average of the product of the original function times itself advanced in time by τ. A typical autocorrelation function is shown in Fig. 1. Several items bear special mention. If we imagine that the random function $f_1(t)$ represents a voltage across a 1-ohm load, then $\varphi_{11}(o)$ is in effect the average power of $f_1(t)$. For large τ, the autocorrelation function approaches $\bar{f}_1^{\,2}$ which is the dc power of the random voltage. Although the correlation functions are of great importance in the design of linear filters and predictors[8], no discussion of such use will be given here.

Non-random functions may also possess autocorrelation functions, for example, if

$$f_s(t) = A\cos(\omega_0 t + \theta) \qquad (2)$$

then from (1) we have that

$$\varphi_{ss}(\tau) = \frac{A^2}{2}\cos\omega_0\tau \qquad (3)$$

Of course, when dealing with periodic functions, one needs merely to average over a single period rather than over all time as indicated by (1). Note that the phase angle θ does not appear in (3) and, in general, we may state that for periodic functions phase relationships are lost in the process of autocorrelation.

Considering the problem of detecting the presence of a small periodic signal in random noise, if we take (2), for our periodic signal, we have for the correlator input, $f_i(t)$,

$$f_i(t) = A\cos(\omega_0 t + \theta) + n(t) \qquad (4)$$

where the autocorrelation function of the noise, $\varphi_{nn}(\tau)$, is of the form of Fig. 1. Since the signal and noise voltages of (4) are independent, the autocorrelation of the sum will be equal to the sum of the individual autocorrelation functions.

$$\varphi_{ii}(\tau) = \varphi_{ss}(\tau) + \varphi_{nn}(\tau) \qquad (5)$$

If τ is made quite large, $\varphi_{nn}(\tau)$ will approach $\overline{f_n}^2$, a constant value. Thus

$$\varphi_{ii}(\tau)_{\tau\to\infty} = \frac{A^2}{2}\cos\omega_0\tau + \overline{f_n}^2 \qquad (6)$$

so that regardless of the ratio of signal power to noise level some range of τ may be found for which the signal correlation becomes the dominant variation. It must be kept in mind, however, that the process of autocorrelation involves the operation

$$\lim_{T\to\infty}\frac{1}{2T}\int_{-T}^{T} f_i(t)\, f_i(t+\tau)\, dt \qquad (7)$$

in going from (4) to (5). Certainly an infinite averaging time is not possible, thus we must determine what averaging time is necessary for a given accuracy of $\varphi_{ii}(\tau)$. A more detailed discussion of the question of averaging time follows.

Crosscorrelation

Although a knowledge of the frequency of the signal component of (4) was not needed using autocorrelation detection if ω_0 is known, crosscorrelation detection will give improved performance[1,2]. The cross-correlation function $\varphi_{12}(\tau)$ between $f_1(t)$ and $f_2(t)$ is given by

$$\varphi_{12}(\tau) = \lim_{T\to\infty} \frac{1}{2T}\int_{-T}^{T} f_1(t)\, f_2(t+\tau)\, dt \qquad (8)$$

Now let

$$f_1(t) = f_i(t) = A\cos(\omega_o t+\theta) + n(t) \qquad (9)$$

and

$$f_2(t) = B\cos(\omega_o t+\gamma) \qquad (10)$$

then using (8) we have

$$\varphi_{12}(\tau) = \frac{AB}{2}\cos(\omega_o \tau+\gamma-\theta) \qquad (11)$$

$$+ \lim_{T\to\infty} \frac{1}{2T}\int_{-T}^{T} n(t)\, B\cos(\omega_o t+\omega_o\tau+\gamma)\, dt$$

Since $n(t)$ and $\cos(\omega_o t+\gamma)$ are independent, the second term of (11) is zero since the average of a product is equal to the product of the averages. Thus (11) becomes

$$\varphi_{12}(\tau) = \frac{AB}{2}\cos(\omega_o \tau+\gamma-\theta) \qquad (12)$$

Here again it can be seen that detection is always possible regardless of the signal-to-noise ratio provided that the true time average as indicated by (8) is obtained. Note that operation at large values of τ is not necessary when crosscorrelation detection is used.

The output "noise" of the crosscorrelation detector comes from the second term of (11). The integrand has a zero average value, but if the time of integration is limited some error must be expected in the evaluation of the mean. A detailed discussion of this sort of error or "noise" is given elsewhere[4] but for the purposes of this discussion it is sufficient to realize that the error can be made as small as desired by increasing the integration time. In fact, the only limit to the amount of improvement in S/N ratio for an ideal correlator is the length of integration time, it being understood that the signals involved are periodic.

Crosscorrelation Detection of AM Signals in Noise

If instead of a periodic signal in noise we have an AM wave, (9) must be rewritten as

$$f_1(t) = [A + f_m(t)]\cos(\omega_o t+\theta) + n(t) \qquad (13)$$

The message or modulating function, $f_m(t)$, is assumed to have a zero mean value. If $f_1(t)$ of (13) is crosscorrelated with $f_2(t)$ of (10) using (8) we have

$$\varphi_{12}(\tau) = \frac{AB}{2}\cos(\omega_o \tau+\alpha-\theta) \qquad (14)$$

We have certainly eliminated the noise, but in so doing the message has been eliminated as well. It becomes clear, therefore, that if correlation methods are to be used, the integration time must be kept sufficiently short to follow the changes in the signal due to the message, $f_m(t)$. Reference to the discussion following (11) shows that if the integration time is shortened, the output "noise" of the correlator increases. Thus a compromise must be made in choosing an integration time which gives a low noise output con-

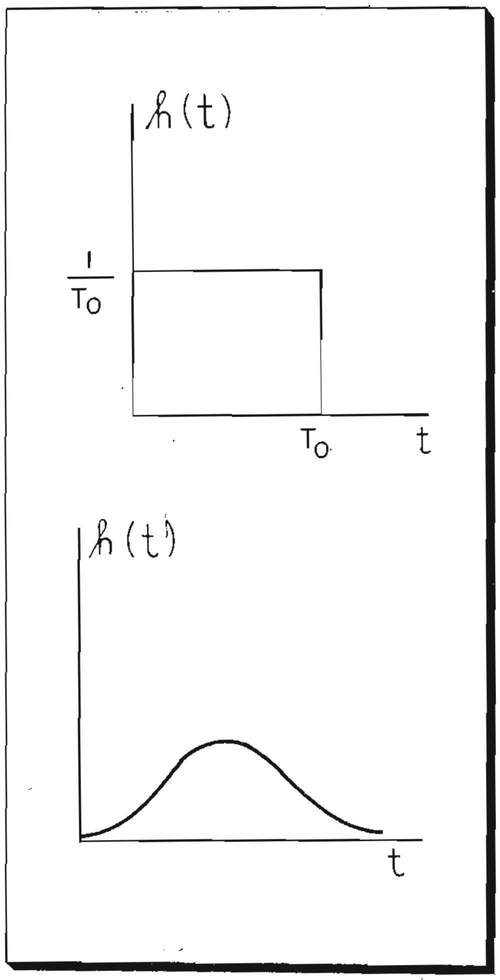


Fig. 3: (a) Filter impulses response for short-time average. (b) Filter for weighted average

Fig. 4: Arrangement for the transmission of a single message, $f_m(t)$, which modulates cosine carrier

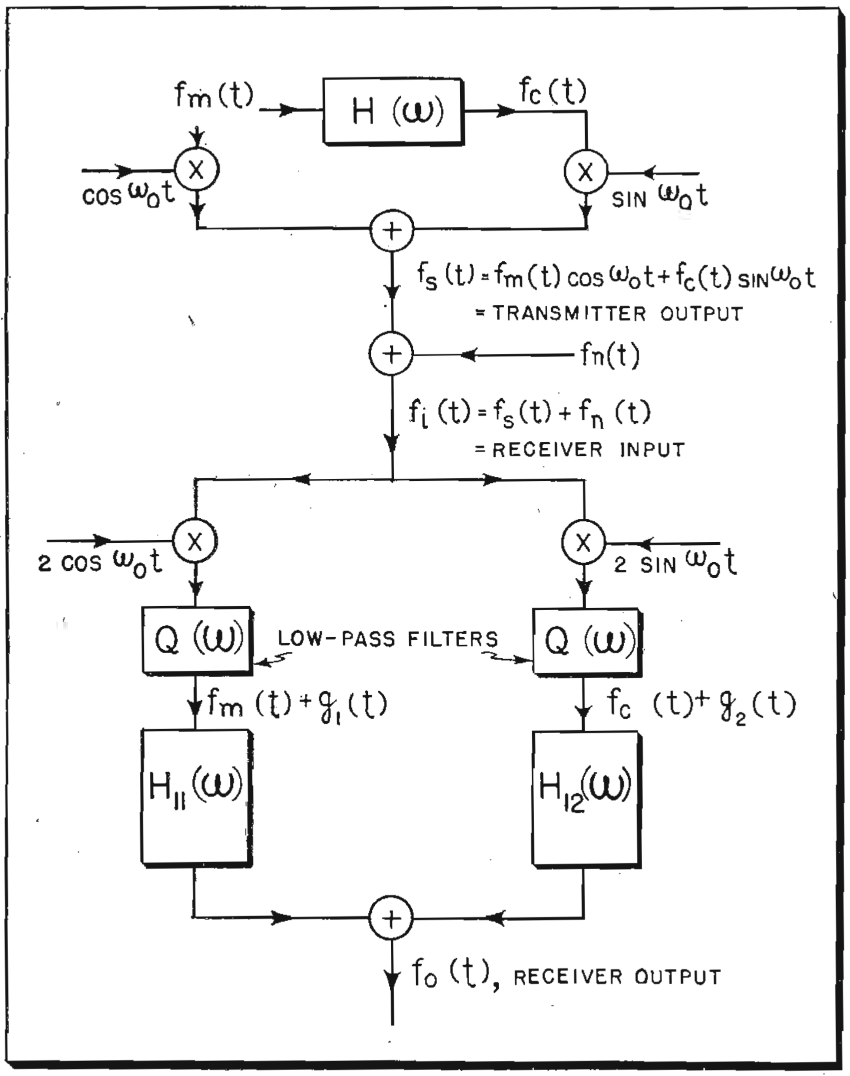
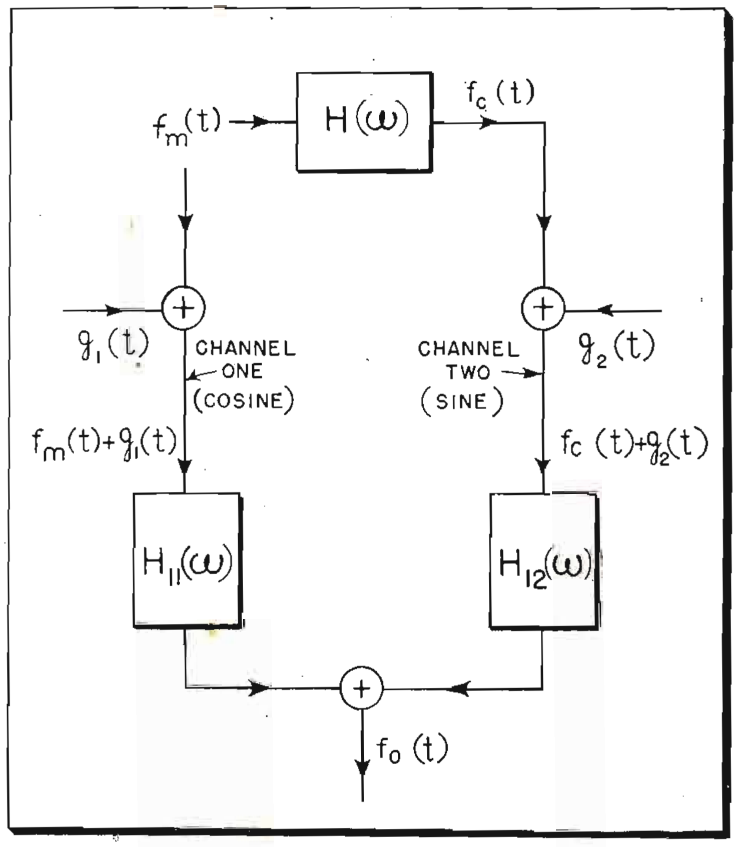


Fig. 5: Equivalent two-channel circuit for system in Fig. 5



sistent with a reasonable amount of smoothing of the message.

The block diagram of this cross-correlation detection process is shown in Fig. 2. Although in practice[5] sampling techniques are generally used to perform the multiplication and averaging, it is useful in this instance to consider a continuous type correlator. Since the integration time must be kept reasonably short to prevent loss of message, the averaging operation of Fig. 2 could be performed by a linear filter having the impulse response shown in Fig. 3a. With such an impulse response the correlator output voltage, $f_0(t)$, will be given by

$$f_0(t) = \frac{1}{T_0}\int_0^{T_0} f_1(t-\sigma)\, f_2(t-\sigma+\tau)\, d\sigma \quad (15)$$

which represents the average value of $f_1(t)f_2(t+\tau)$ from T_0 seconds in the past to the present. The output voltage of (15) represents a uniform or non-weighted average over T_0. One could argue (and correctly so) that a weighted average might produce better results. That is, a filter impulse response such as shown in Fig. 3b might give a better output than that obtainable using the filter of Fig. 3a.

Limitations

Another look at Fig. 2 will show that what we have called a cross-correlation detector is, in fact, the well known synchronous detector. The problem of choosing the proper weighting function for averaging purposes is, in essence, the problem of specifying the filter to be used after the multiplier. The synchronous detector, though it has many advantages over the usual envelope detector, has definite limitations in its ability to extract information bearing signals from noise.

Schemes for the detection of AM signals involving synchronized local oscillators have been discussed recently by Tucker[9] and Norgaard[10]. One advantage of synchronous detection that has attracted much attention is the possibility of "phase duplexing" two messages in a single AM channel[11,12]. This is done by generating two carrier signals in phase quadrature and modulating each with a different signal. Demodulation of each message is performed by generating a sinusoid having the phase of the desired signal carrier and multiplying the composite incoming signal by this sinusoid. In this manner, each message may be recovered without crosstalk from the other.

Transmitting Single Message

If only a single message is to be transmitted in the AM channel, the "two-phase" transmission and detection methods outlined above may still be used to good advantage. A possible arrangement for the transmission of a single message is shown in Fig. 4. The message, $f_m(t)$, modulates a cosine carrier directly while a sine carrier is modulated by $f_c(t)$, the output of linear system $H(\omega)$ whose input is $f_m(t)$. To the transmitted signal, $f_s(t)$, a noise voltage, $f_n(t)$ is introduced additively in the transmission path so that the receiver input, $f_i(t)$, is equal to the sum of $f_s(t)$ and $f_n(t)$. Cosine and sine synchronous detection is then performed at the receiver, the $2\omega_0$ terms being removed by the low-pass filters $Q(\omega)$. Except for the removal of these high radio-frequency terms, networks $Q(\omega)$ serve no other purpose. The actual filtering of the messages from noise is performed by networks $H_{11}(\omega)$ and $H_{12}(\omega)$. Thus, the inputs to networks $H_{11}(\omega)$ and $H_{12}(\omega)$ are $f_m(t) + g_1(t)$ and $f_c(t) + g_2(t)$ respectively where $g_1(t)$ and $g_2(t)$ are disturbance voltages originating due to the channel noise, $f_n(t)$.

Since the processes of modulation and demodulation are in a sense complementary, the actual representation of Fig. 4 may be replaced by the equivalent two-channel circuit of Fig. 5. It should be understood, that voltages $g_1(t)$ and $g_2(t)$ for any given channel noise, $f_n(t)$, must be obtained by reference to Fig. 4. Thus, through the use of synchronous detection, it has been possible to represent one AM channel by two channels which are completely independent with regard to message voltages, but may or may not be independent with respect to disturbance voltages. This statement is generally true since two independent messages could be used to modulate the sine and cosine carriers. The two messages $f_m(t)$ and $f_c(t)$, Figs. 4 and 5, are of course not independent.

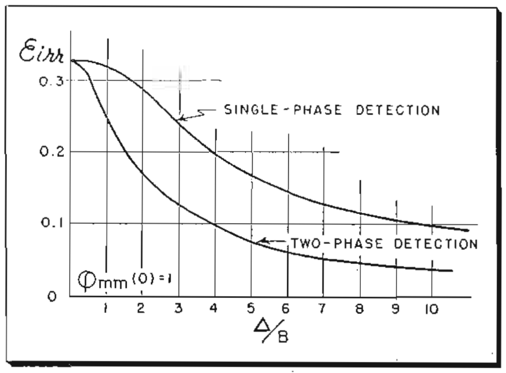


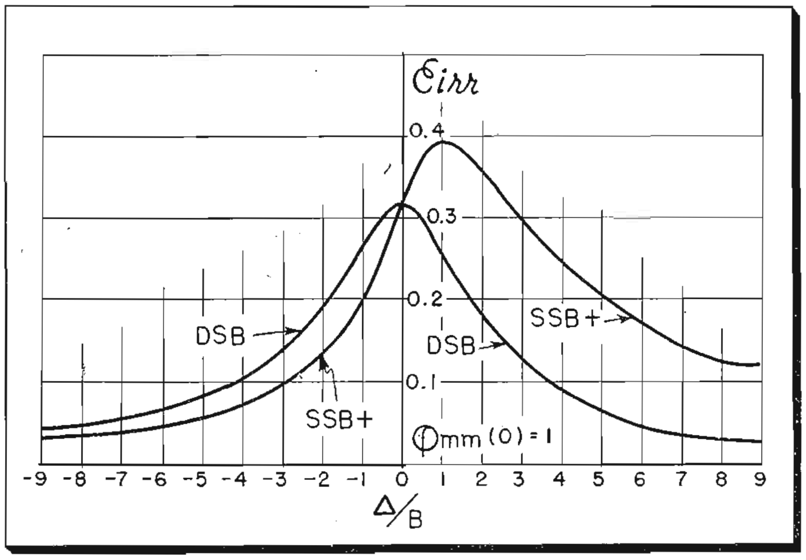
Fig. 6: Adjacent channel interference. Desired and undesired signals are double-sideband

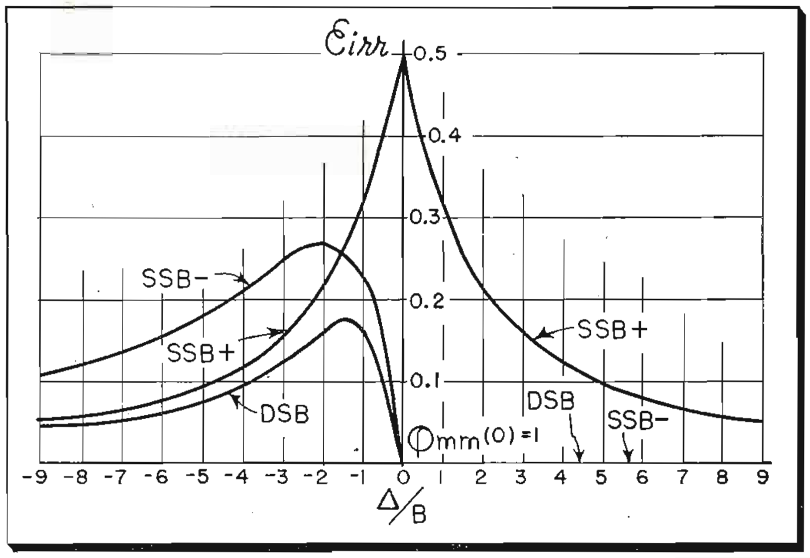
Interference Filtering

The filter design problems posed by Fig. 5 are rather unusual. We have shown two separate channels carrying message voltages $f_m(t)$ and $f_c(t)$ and disturbance voltages $g_1(t)$ and $g_2(t)$ respectively. Since the two channel messages are not independent and since the disturbance voltages $g_1(t)$ and $g_2(t)$ will, in general, be related one to the other, best message recovery will involve a simultaneous treatment of both channel voltages. Networks $H_{11}(\omega)$ and

(*Continued on page* 116)

Fig. 7: (l) Adjacent channel interference, undesired signal is double-sideband. Fig. 8: (r) Performance comparison, undesired signal is SSB+





CUES for BROADCASTERS

Practical ways of improving station operation and efficiency

A Remote Tower Light Indicator

PHILIP WHITNEY, Chief Engineer, WINC, WRFL, Winchester, Va.

AN indicator located at the operating position which will show the number of tower lights burning is a time saver for the busy operator, and a necessity when a transmitter is remotely controlled. The unit to be described was built for a local station maintaining a small tower with only six 100-watt lamps, but the idea may be adapted to stations with blinker beacons, multiple lamp installations or several towers. For the multiple tower array, one of these units should be constructed for each tower. When used at a remotely-controlled transmitter, a load resistor is substituted for the meter shown in the diagram, and the voltage, which is a function of the number of tower lights burning, applied to whatever telemetering system is used.

The device is actually a vacuum tube voltmeter which measures the voltage drop across a resistor in series with the tower lights. The resistance is calculated so that the drop with full load is approximately 5 or 6 v. This voltage heats the filament of the 6J5 tube, resulting in an almost undetectable drop in illumination, but a greatly extended service life of the tower light bulbs. If desired, an audio transformer may be substituted for the plate load resistor and 1000 ohm germanium load resistor. This would allow isolation of the output ground from the power line if it is difficult or impossible to find the ground side of the line. Under these conditions, no connection should be made to the chassis. If a shorter time constant is desired in the circuit response, the 15 µf filter capacitor may be decreased to a much smaller value. However, the 15 µf value chosen is desirable when the circuit is used in remote telemetering applications where hum might be introduced into the system with a smaller filter.

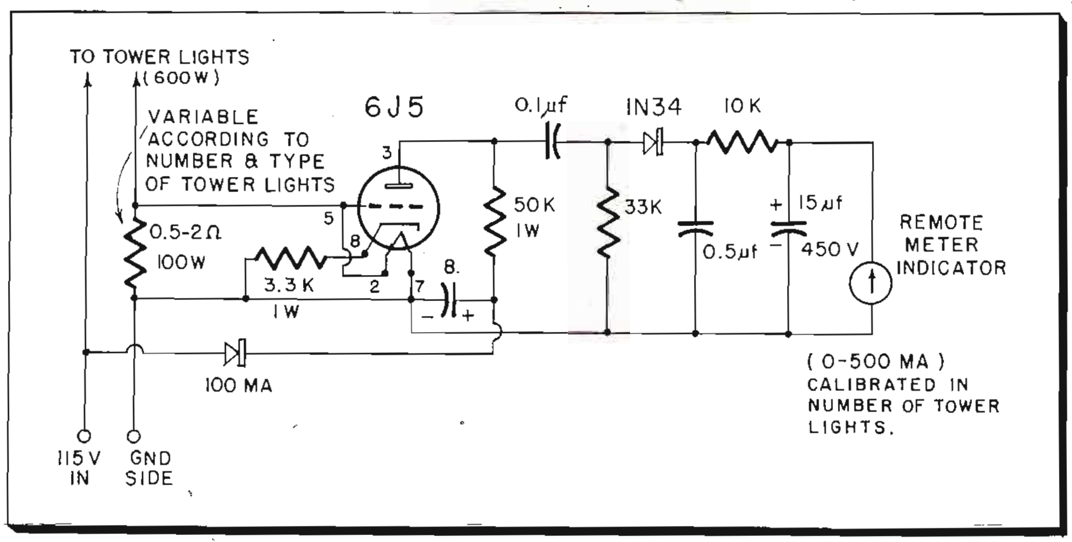
The meter face is calibrated by "tower lights," and the calibration is made by connecting as many tower lights as are used, in parallel, then unscrewing them in the sockets one at a time, placing a mark on the meter face with each change. The meter should be installed with a single wire and ground return to the chassis which is preferably located near the tower light switch or line from the building to the towers. When calibrating the meter face, it is suggested that rather than mark a small point for each tower light number, a dash be made which would extend from low line voltage through normal to high line voltage conditions.

This equipment has been installed at WRFL and has been operating for several months, during which time it has proven very satisfactory. The resistor in series with the tower lights is made of several 12 ohm, 20-watt resistors from a surplus BC-604, but may be made by winding about number 18 iron wire on a porcelain form for the necessary resistance.

$$$ FOR YOUR IDEAS

Readers are invited to contribute their own suggestions which should be short and include photographs or rough sketches. Typewritten, double-spaced text is preferred. Our usual rates will be paid for material used.

Vacuum tube voltmeter indicator circuit for tower lights for remote operation



Cure for Slipping Discs

M. L. SNEDEKER, WERE, Cleveland, Ohio

AMONG the many woes of operating engineers is slipping records on turntables. This problem is aggravated by the new and smaller discs. We corrected the difficulty by using weights fitted over the turntable spindle: not an original solution—but the weights themselves may be of interest to others.

A piece of 1⅝ in. coax was filled by melted lead, and cut into 1 in. lengths, each of which was drilled axially so that it fitted snugly over the spindle of the turntable. One end of each length was then machined out to accommodate the 45 rpm adapter disc. The 1⅝ in. coax fits easily around these discs, placing pressure on the records, thus making the weight suitable for either standard or 45 rpm records.

Announcer's VU Meter Eases Gain Stabilization Problem

JOHN P. ARMSTRONG, WHIZ, Zanesville, Ohio

ONE of the problems of a radio station is stabilizing studio gain when announcers are running their own control boards since the calibrated scale on the VU meter does not seem to mean much to them:

Trace the VU meter scale and size on thin paper. Then make a template on thin cardboard adding two more scales. Draw an arc ¾ in. below the bottom set of scale numbers from −20 to −2. Draw radius line from arc to just below bottom numbers on scale indicating maximum level and label this "voice." Draw second arc as above from −20 to zero VU and label "music." The second arc is ¾ in. below first arc. Cut stencil from template, hold stencil on VU meter scale and ink. At a glance, the announcer can tell if his gain is off without having to study the meter scale.

Master Control Room Talk-Back System

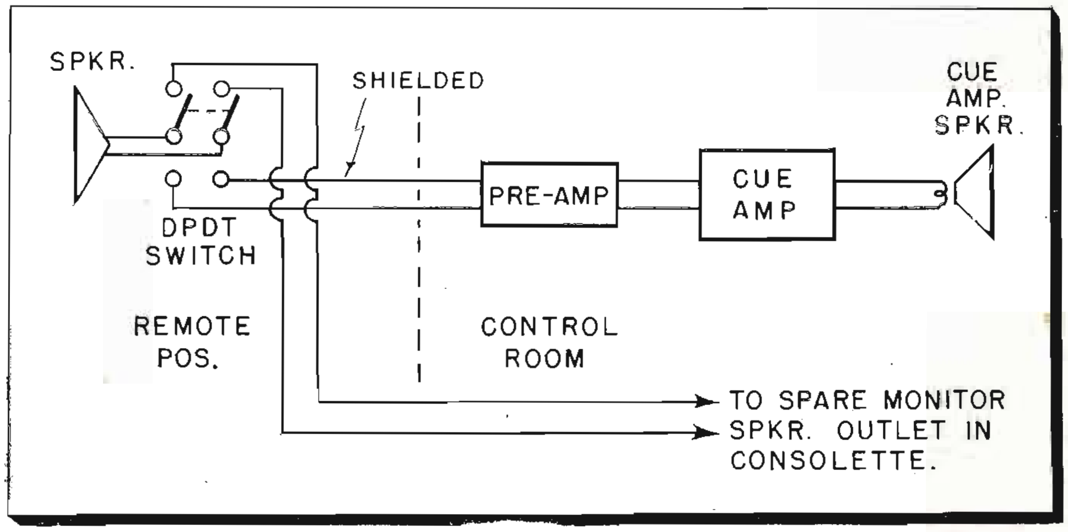
BILL GORDON, Chief Engineer, CJDC, Dawson Creek, British Columbia, Canada

IN many stations a need often arises for a talk-back system from the manager's office, or some other location, to the master control room. Most stations have a separate cueing amplifier which is always on except when the control room microphone is alive.

The remote talk position speaker is used as a microphone and speaker. The output of this speaker is fed into a small preamp using 2 6ST7's. The output of this preamp is fed into the input of the cueing amplifier in the control room. The signal from the remote talk position then goes through the preamp, through the cueing amplifier and comes out cue amp. speaker.

Most consolettes have spare speaker terminals which are not used, and the output of a pair is fed to the speaker at the remote talk position. The operator can then talk to the remote position by simply putting the consolette and control room mike on "audition talking."

A simple throw of the switch at the remote talk position is all that is required to talk to or listen to the operator.



Talk back circuit using spare cueing amplifier for chief engineer's use in master control

Fool-Proof Remote Cue Feed

R. S. HOUSTON, Chief Engineer, KBNZ, La Junta, Colo.

WITH many makes of broadcast consoles, it is often necessary to use two hands in order to bring in a remote. One hand throws the cue switch from cue to broadcast, and the other opens the fader. In the case of announcer-operator stations, this often means leaving the mike open during the operation with attendant noise, or at best, preventing the announcer from hearing the start of the broadcast. Many times, of course, it is possible to use only the switch if the program material is not in progress at the moment of switching. But often fading is necessary. The standard faders with "cue" taps on the last step can be used satisfactorily in a cue feed circuit.

In this usage, the "Q" tap of the fader is connected to a source of cue. As long as the fader is closed, cue is fed back to the line, and testing can also be conducted without fear of unwanted signals on the air. When the line is thrown on the air, the first step cuts the cue, and fading-in is possible from there with one hand. With most consoles this change can be readily incorporated with no circuit changes other than addition of the cue connection to the fader. Cue is still fed to other lines in the usual manner, but cue to the line in question is fed back through the fader, with the key in the "mix" position. Since these faders are of the unbalanced type, it may be desirable to incorporate repeat coils on the input and output of the mixer and also the cue feed system.

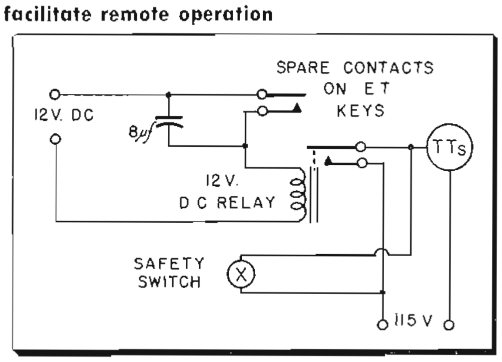
As an adjunct, a key could be put in the cue feed, so that a telephone could be used for talking to the remote operator. Or it could change the "Q" tap from cue to audition, so that the line could be checked without using the audition system in the console. Some variations can be obtained with detents on the last position. These are valuable especially with announcers running the boards as they may more easily determine where the off position is.

Simplification of Turntable Operation

DON VOIGT, Chief Engineer, WLTC, Gastonia, N.C.

TO simplify turning on and off turntables at WLTC, we installed relays controlled by the transcription keys to operate them. The Collins console has a 12 v.dc supply for operation of the other relays, so 12 v. DPST relays with the contacts wired in parallel were used.

Turntables controlled by switcher keys in console facilitate remote operation



Spare contacts on the transcription keys close the 12 v. circuit, and are adjusted so that they close before the contacts to the pre-amplifier. The relays are mounted in the basement directly under the turntables, since they make an audible "click" when they operate. Clicks were eliminated from the dc circuit by 8μf capacitors across the contacts. A safety switch in parallel with the relay contacts is mounted by the turntables in case the relays fail to operate. In almost four years of operation, no trouble has been encountered. This system is very convenient for the combination announcer-operators at WLTC and makes for smoother operation.

Checking Tape Speed

HENRY R. KAISER, Chief Engineer, WWSW, Pittsburgh, Pa.

WITH the ever increasing use of tape as a recording medium in the broadcast industry, it is becoming more important than ever that each tape recorder and playback system be checked regularly to determine if it is operating at the standard tape speed of 7½ and 15 in. per second. Such a practice is a must when programs are recorded on one machine and played back on another.

Although there are a number of systems for detecting minute changes in tape speed, we are of the opinion that a simple method of checking average tape speed, which could be used and evaluated by even non-technical personnel, would be most useful.

With the foregoing in mind, we made a test tape by placing visual marks on a reel of regular production tape, in such a way that they can be observed with the eye under any type of illumination. Incidentally, paper tape was chosen for the particular purpose, since the plastic

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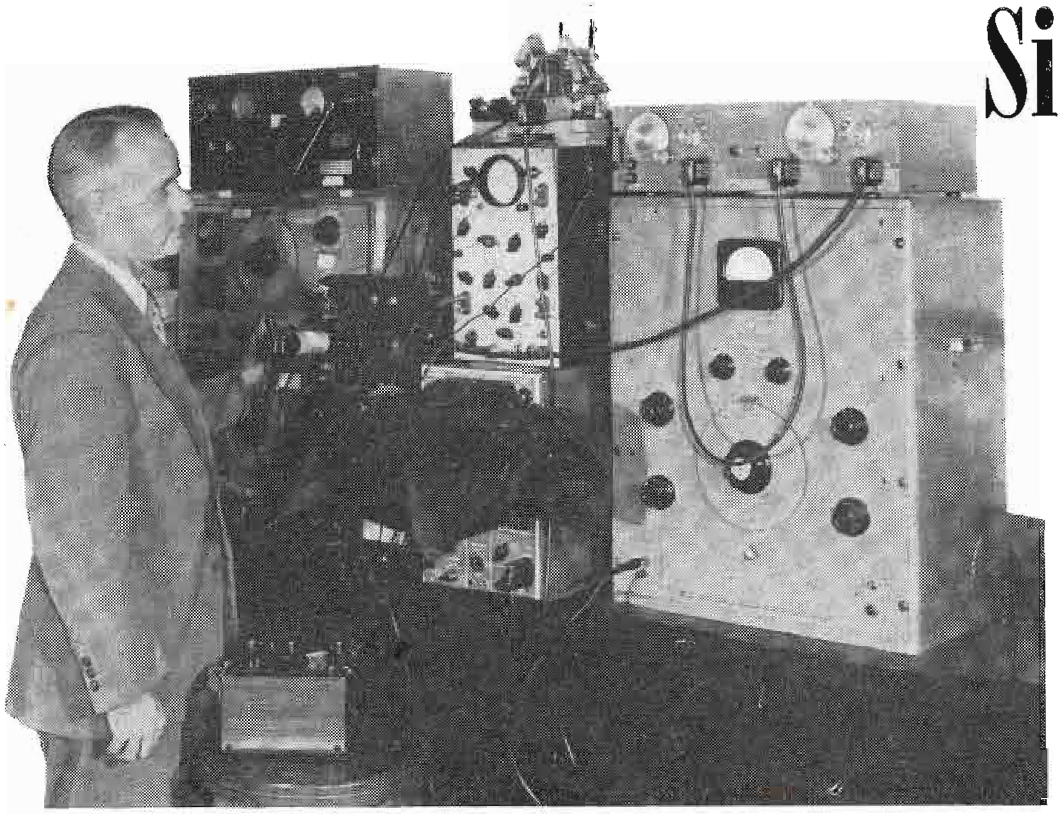


Author Schooley checks equipment for measuring detector noise at Naval Research Laboratory

Signal-to-Noise

Data on linear, are expected to

By ALLEN H. SCHOOLEY and SAMUEL F. GEORGE
Naval Research Laboratory, Washington 25, D. C.

THE detection of CW signals imbedded in noise and having about the same rms value as the noise is important in many applications. In such cases interest is centered around the region of unity signal-to-noise ratio. Since conventional AM detectors tend to decrease the signal-to-noise ratio of the output as compared to that of the input, it is desirable to determine the effects of various detector characteristics.

Rice,[1] Landon[2], Bennett[3], Ragazzini[4], Middleton[5] and others have devised theoretical methods for completely analyzing the performance of linear and square law detectors when subjected to noisy signals. Unfortunately, the inherent complexity of the detection process requires mathematical skill that is not possessed or readily acquired by some engineers. In view of this a simple experimental investigation of several detector characteristics was made to confirm the theoretical predictions and also to determine if the experimental approach yields worthwhile results beyond the reach of present mathematical acuity.

Fig. 1 shows four detector characteristic shapes that were considered. They are all symmetrical with respect to the y axis. In the experiments the operating point was placed at the origin; thus, balanced detection was used. The linear and parabolic (or square law) shapes were chosen because they are widely used and the theory is complete in these cases. The semi-cubical and clipped linear shapes were selected because they represent cases in which detector saturation is present and also because they have not been fully analyzed theoretically.

In the experiments the photoformer of Sunstein[6] is used as the detecting element. As shown in Fig. 2, the desired detector characteristic is cut as a silhouette from opaque material and placed as a mask in front of the screen of a cathode ray tube. The spot on the screen is forced to follow the vertical outline of the mask, for any horizontal position dictated by the x-input, by a feedback circuit consisting of a phototube and a dc amplifier connected to the vertical deflecting plates. The output of the detector characteristic being studied is obtained from the output of the amplifier which automatically applies a voltage to the deflecting plates proportional to the y-dimension of the mask.

Fig. 3 shows a picture of the photoformer used, with the light shield removed. A type 5CP15 tube is mounted in a type 304H DuMont oscilloscope. In front of the oscilloscope is a slide arrangement which permits placing the various detector-characteristic masks directly in front of the crt screen. The linear, parabolic, and semi-cubical detector masks, mounted between standard 3¼ in. by 4 in. slide projector cover glasses, are shown in the slide carriage. The upper left slide is a linear mask (not linear detector) used in measuring the input signal-to-noise ratio. The upper right slide is the clipped linear detector mask. All slides except the center one in the carriage are backed with white paper to increase contrast in the photograph. The center slide in the carriage is in the operating position directly in front of the crt screen. Light from the cathode-ray spot is transmitted through the slide to the type 931A photomultiplier tube mounted about 7 in. in front of the screen. The output of the photomultiplier is fed into a one-stage push-pull direct-coupled amplifier which is connected to the vertical deflecting plates of the crt. The short persistence of the screen, together with the circuits used, allows the spot to follow the masks within approximately 2% of full scale deflection when the x-input has a frequency of 8 KC.

Experimental Set-up

Fig. 4 shows a block diagram of the complete experimental set-up including the photoformer detector. Emphasis has been placed on making the apparatus as simple as possible, and maximum use is made of commercially available equipment. A signal frequency of 7.7 KC is selected because it is well below the top operating frequency of the photoformer detector and also allows measurement of the double-frequency components of the detector output with an available harmonic analyzer having an upper limit of 16 KC. The signal is generated by a Model 205AG Hewlett-Packard audio oscillator. Noise is generated by the input circuit of a Model 450A Hewlett-Packard decade amplifier. The noise is amplified 100 db by three of these amplifiers before being added to the signal. The adder consists of two 6SJ7 tubes with separate grid inputs and a common

Characteristics of Detectors

parabolic and semi-cubical detection of signals embedded in noise have a significant effect on television and radar circuit design

plate-resistor output. The bandpass filter is a two-section inductance-capacitance filter having a 1.2 KC band-pass between the 6 db points down from the 7.7 KC point. The selectivity characteristic of the band-pass filter used is shown in Fig. 4 immediately above the block representing this equipment. The output of the band-pass filter is fed into the input of the photoformer detector. The output of the detector is observed in three different channels. First, the rms value of the low frequency output voltage of the detector, excluding dc is observed on a thermocouple meter. The low frequency filter is a Spencer-Kennedy Model 302 variable electronic filter. Second, the dc component of the detector output is observed by a dc meter. Third, the output is examined by a Hewlett-Packard Model 300A wave analyzer. The characteristics of the variable low pass filter for two different settings that are used in the experiments are also shown in Fig. 4.

The thermocouple meter and dc meter are calibrated to have the same sensitivity. This is done by impressing the 7.7 KC signal frequency, without noise, on the input of the photoformer with the square law mask (c) in place. The variable low pass filter is adjusted to the 20 KC cut-off point, as shown in Fig. 4, to allow the double frequency signal (15.4 KC) to pass through the amplifier to the thermocouple meter. Thus the signal is squared, making it possible for the dc meter to read the mean-square value. The attenuator feeding the thermocouple meter is then set to bring the calibration of both meters into coincidence.

Fig. 5 is a picture of the experimental equipment.

Input Signal-to-Noise Ratio

The input signal-to-noise ratio is measured by inserting the linear mask (a) of Fig. 4 [not linear detector mask (b)] in the photoformer so that no detector action is present. With the variable low frequency filter set at 20 KC and the 7.7 KC signal turned on, the noise is attenuated to zero, and the reading of the thermocouple meter is noted. Next, the signal is turned off and the noise adjusted to give a suitable reading on the thermocouple meter. For example, the noise is adjusted to the same reading as the signal if a signal-to-noise ratio of 1 is desired. Input signal-to-noise values given in this paper are expressed in terms of power ratios. These are obtained by squaring the individual signal and rms noise voltage readings before taking the ratio. This is allowable because the impedance of the photoformer is a constant resistance. Thus we define the input signal-to-noise ratio as

$$r_i = \frac{S^2/2}{V_n^2} \qquad (1)$$

where: S is the peak value of the sinusoidal signal input voltage, and $S^2/2$ is the mean-square of the signal; V_n is the rms noise input voltage and V^2_n is the mean-square input noise.

Fig. 6A shows the voltage amplitude spectrum of the input to the detector for an input signal-to-noise ratio of unity. It consists of the 7.7 KC signal plus the noise in a 1.2 KC band as defined by the bandpass filter characteristic indicated in Fig. 4.

Fig. 1: Four detector characteristic shapes

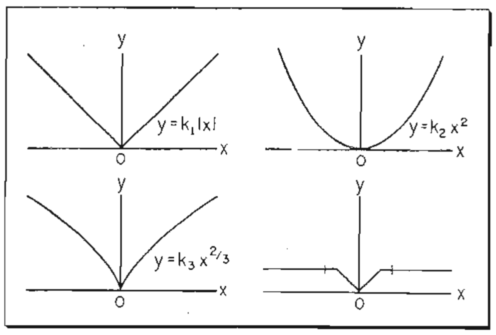
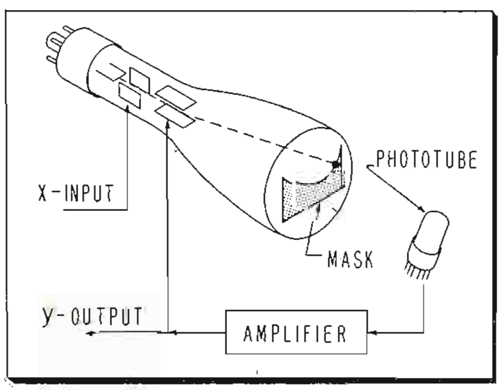


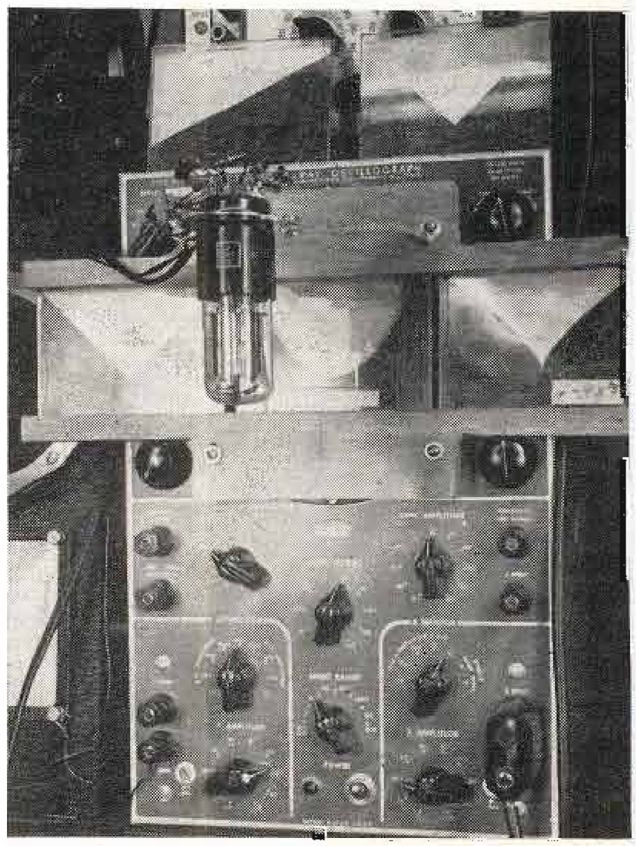
Fig. 2: Desired detector characteristic cut as opaque silhouette mask in photoformer study



Before defining the output signal-to-noise ratio of a detector, it is helpful to examine the output voltage amplitude spectrum of a particular detector. The spectrum shown in Fig. 6B represents the output of a balanced parabolic detector having an input signal-to-noise ratio of unity. With only signal and no noise the output of the detector would consist of a dc value plus a component at twice the signal frequency. When signal and noise are both present, as in the case shown in Fig. 6B, there will be a low frequency band and a band of frequencies centered at double the carrier frequency. The slight bump in the spectrum near 8 KC is due to the fact that the detector was not perfectly balanced.

In most applications one is interested only in the low frequency band because it is within the low frequency band that any modulation of the carrier will reappear at its original frequency. All higher frequencies are usually filtered out. In the case shown, where no modulation is present, the low frequency band contains the low frequencies

Fig. 3: Photoformer with light shield removed



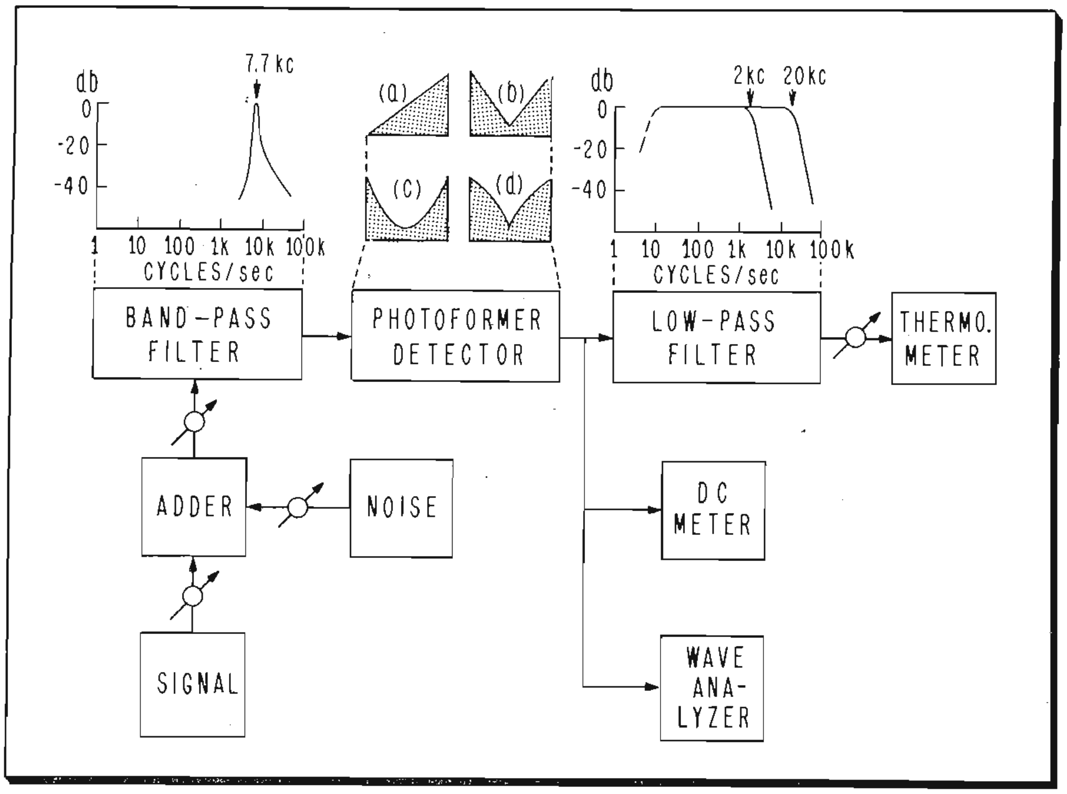


Fig. 4: Overall experimental arrangement utilizes 7.7 KC signal well within photoformer range

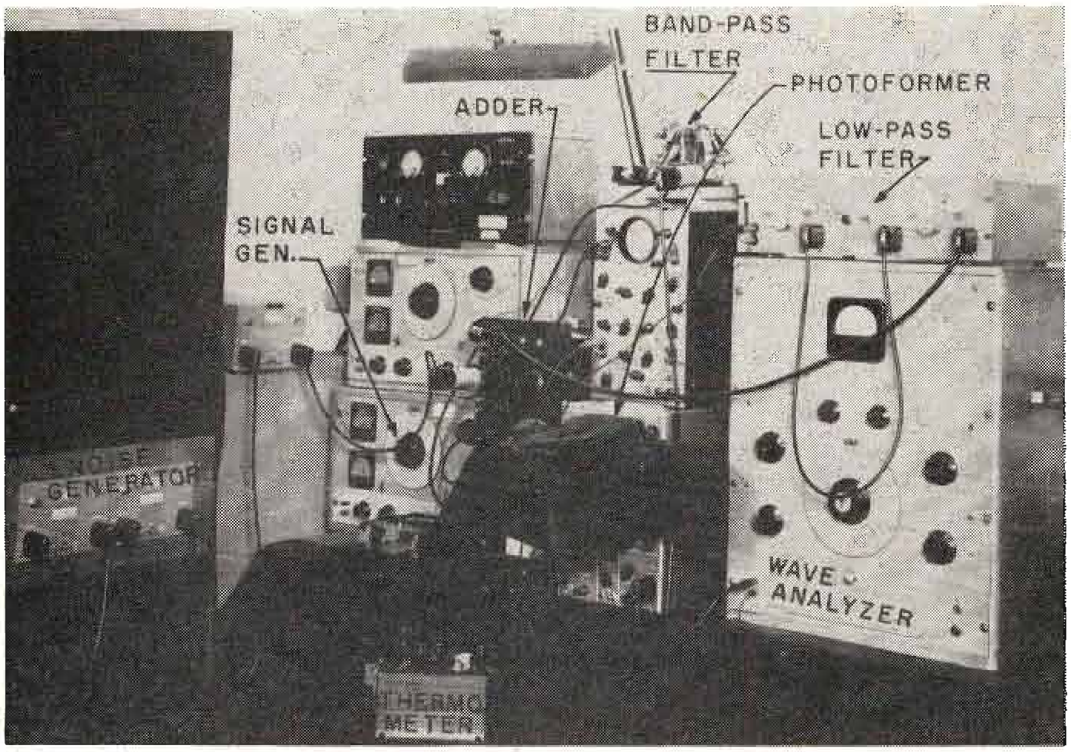


Fig. 5: Equipment for system in Fig. 4 includes noise and signal generators, filters and photoformer

created by the mixing, in the detector, of the unmodulated signal and the noise contained within the 1.2 KC band around the signal frequency. In the work herein described, no signal modulation has been used in order to simplify the experiments, causing the desired output signal to appear as dc. This makes it possible to use a simple dc meter in place of a very narrow-band low frequency filter which would be required to indicate the signal output of the detector if modulation were used. The results are consistent with those obtained for a 100% modulated carrier, provided the input signal-to-noise ratio is defined on the basis of total input signal power, including the carrier.

In this report the output power signal-to-noise ratio of a detector will be defined as the ratio of the change in dc level, due to the addition of a signal, to the mean-square masking disturbance.

$$r_o = \frac{(E_{dc(s+n)} - E_{dc(n)})^2}{E^2_{lf(s+n)}} \qquad (2)$$

where: $E_{dc(s+n)}$ is the dc output voltage when signal and noise are present; $E_{dc(n)}$ is the dc output voltage when noise alone is present; $E^2_{lf(s+n)}$ is the average power in the low frequency spectrum of the output, excluding dc, when both signal and noise are present.

In the experimental measurements the numerator quantities are indicated on the dc meter shown in Fig. 4. The denominator quantity is measured on the thermocouple meter with the lowpass filter set at 2 KC.

Experimental Results

Fig. 7 shows theoretical and experimental input-output signal-to-noise ratio characteristics of linear and parabolic detectors. The experimental points were determined with the equipment and under the conditions that have been discussed previously. The theoretical curves were obtained by means of the theory of Rice[1].

It is evident from Fig. 7 that corresponding theoretical and experimental curves are similar in shape but not in position. The theoretical curves indicate approximately 2.5 db better output signal-to-noise ratio, for a given input signal-to-noise ratio, than do the corresponding experimental curves. This 2.5 db discrepancy can probably be explained by 1) a small amount of residual noise in the photoformer servo loop, 2) a small amount of residual 60-cycle hum in the experimental apparatus.

Each of the experimental points was determined by taking the mean of two to nine observations. In order to give an idea of the spread of the original experimental data the standard deviation of the output signal-to-noise observations around the solid point of Fig. 7 was determined to be slightly less than 0.1. This means that the vertical extensions to the point approximately represents the standard deviation.

The theoretical curves of Fig. 7 indicate that, for an input signal-to-noise ratio of 10, the linear detector is almost 4 db better than the square law detector. For an input signal-to-noise ratio of 1, the linear detector is only approximately 1.5 db better. When the input signal-to-noise ratio is 0.1, there is no appreciable difference in the output signal-to-noise ratio, no matter which of the two detector characteristics is used. The experimental curves confirm these predictions although extrapolation is necessary to reach the 0.1 and 10 input signal-to-noise ratio limits.

The experimental observations are limited to the region shown by the points because of the limited dynamic range of the photoformer. The dynamic range of input signal-to-noise ratios is limited to about 40:1 because of the finite spot size compared to the crt face dimensions. The finite size of the photoformer tube face also limits the minimum input signal-to-noise ratio. Under this condition the rms noise is large compared to the signal and the peaks of the noise are very much larger than the signal peaks. Since a high percentage of the noise peaks must be accommodated by the photoformer, it is necessary to operate the photoformer at a lower average signal level when the signal-to-noise ratio is small than when it is large. For large input signal-to-noise ratios, the noise amplitude finally gets comparable to the crt spot size; hence reliable observations could not be made much beyond an input signal-to-noise ratio of 6.

Middle of Dynamic Range

An input signal-to-noise ratio of about 2 appears to be in the middle of the dynamic range of the experimental apparatus. At this point the theoretically perfect linear detector would cause deterioration of the input signal-to-noise ratio of slightly more than 2 db. The deterioration for the experimental linear detector is nearly 5 db. For an input signal-to-noise ratio of 2, the theoretical square-law detector deterioration is over 4 db, while experimentally it is nearly 7 db.

The fact that the linear detector is a few db better than a square law detector in the region around an input signal-to-noise ratio of 2 leads to the possibility of a reverse curvature detector improving the output signal-to-noise ratio. A semi-cubical parabola was chosen as a simple detector shape that would be suitable for investigating this question experimentally and possibly theoretically. To date the theoretical investigation, which is not included in this paper, has indicated that the output signal-to-noise ratio for a semi-cubical detector is a function of input amplitude which is not the case for the linear and parabolic detectors. This greatly complicates the theory and a complete solution of the problem has been considered but not attempted because of the time involved.

The semi-cubical detector was investigated in the region of input signal-to-noise ratios between 0.5 and 7.0. In the region of 2, it was found that the output signal-to-noise ratio was only about 1 db better than the linear detector as

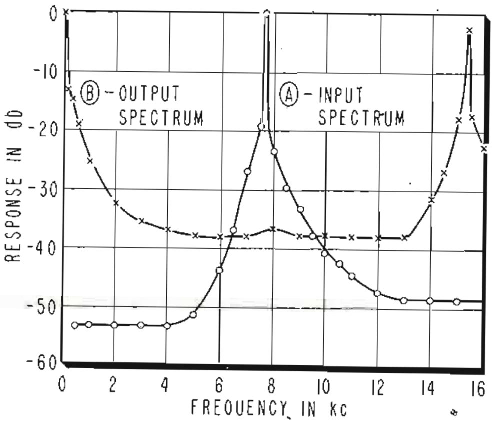


Fig. 6: (A) Input spectrum with unity signal-to-noise ratio. (B) Output spectrum of balanced parabolic detector with unity s/n input.

indicated by the point marked (x) in Fig. 7. The moderate variation in the amplitude of the detector input that was allowable, due to the limited dynamic range of the photoformer, did not show any variation in the output signal-to-noise ratio. Noticeable variation would hardly be expected because the total improvement in output signal-to-noise ratio is only slightly above the resolution of the experimental techniques.

As a check to further determine if amplitude limiting or clipping does in fact improve the output signal-to-noise ratio, a linear detector mask was made which is similar to the lower right-hand characteristic shown in Fig. 1. The two marks on this characteristic indicate the peak swing of the signal without noise. Noise was then added to give an input signal-to-noise ratio of 2. Under these conditions the output signal-to-noise ratio was about 2 db better than the experimental linear detector, as shown by the point marked (□) in Fig. 7. Due to the limited dynamic range of the photoformer detector it was not possible to determine the input amplitude for best output signal-to-noise ratio. There can be little doubt that there must be an optimum amplitude because a small amplitude input will work wholly within the linear detector portion of the characteristics and therefore the output signal-to-noise ratio will be the same as for the linear detector. For very large amplitude input, the clipping will become so severe that it is probable that the output signal-to-noise ratio will deteriorate as the amplitude is further increased.

From the results of the experimental observations it may be expected that the semi-cubical and clipped-linear detector characteristics will give slightly better output signal-to-noise ratios when the input signal-to-noise ratio is in the region of between 1 and 6 and when the input amplitude is near the optimum value. As far as is known, theoretical confirmation of these results has not been accomplished due to the difficult and tedious computations involved, and it appears that such work may not be warranted.

The photoformer is a satisfactory tool for experimentally studying the input-output signal-to-noise characteristics of various detectors. However, its usefulness is limited to

(*Continued on page 75*)

TANK LOUDSPEAKER INVITES ENEMY SURRENDER

Cpl. Joseph Dutkanicz of the 2nd Loudspeaker and Leaflet Co. broadcasts an invitation to a theoretical enemy to surrender during an army maneuver. The Model B-12, 300-watt speaker manufactured by University Loudspeakers, Inc., of White Plains, N. Y. is useful for emergency battle communications and propaganda purposes. Amplifiers employed in system are made by David Bogen Co., N.Y.C.

World-Wide Standard Frequency

Thousands of observations of standard transmissions on 5, 10 and 15 MC show how location, frequency, seasons and time of day affect global coverage

By E. L. HALL,
National Bureau of Standards, Washington, D. C.

REFERRING to the curves for 5 MC, it is seen that WWV comes in before sunset at Los Angeles and reaches a maximum after dark. WWVH comes in about three hours later. It presumably maintains a strong signal throughout the night until an hour after daylight, as it is still night at the station. WWV's signal, however, was zero because of the earlier sunrise at WWV. Los Angeles is beyond the reach of the 5 MC transmissions during most of the daylight hours, being approximately 2300 and 2500 mi. from WWV and WWVH, respectively.

The 10 MC transmissions of WWV are usable in Los Angeles most of the time except for a period of about nine hours starting about an hour after sunrise. WWVH's 10 MC transmission is similar, except that the unusable period starts an hour or so later.

The 15 MC transmissions of WWV have greater intensity than those of WWVH. This is not surprising when one considers that the powers have a ratio of 22:1 and the distances are similar. The curves indicate that WWV's 15 MC transmission is useful during the daylight hours when the 5 and 10 MC transmissions are not received satisfactorily.

The 20 MC transmission was received during daylight hours, but is less dependable than transmissions at the lower frequencies.

Data from South Australia

Observations shown in Fig. 7 were made by an individual for ten months on the reception of stations WWVH and WWV on 5, 10 and 15 MC at Huddleston, South Australia. Examination of the 5 MC curves for WWVH shows no seasonal difference. Reception begins near sunset at Huddleston and drops out about the time of sunrise at the transmitter. The most intense signals from WWV are received during the two hours when the transmission path is in darkness. The transmission path from WWH is in darkness from six to seven hours during which signals from WWVH are heard. The signal intensities on 5 MC are below those on the higher frequencies and the data demonstrate the futility of this frequency for day transmissions over long distances, and its dependence upon darkness over the transmission path for reception at great distances.

The 10 MC curves of Fig. 7 show much higher field intensities than the 5 MC curves and also a seasonal effect. WWVH's intensity increased from zero following sunset at the transmitter and maintained a strong signal during the hours of darkness at Huddleston when observations were made. It was not heard during the morning and early afternoon hours.

WWV's reception shows two periods of increased intensity with periods of nonreception in between. WWV begins to come in a few hours before sunset at Huddleston (night at transmitter), reaches a maximum and slowly falls to zero a few hours after sunrise at the transmitter (night at Huddleston). It is again heard with lesser intensity for a few hours.

Signal More Intense

The 15 MC curves for WWVH show a more intense signal for the Oct. to Feb. period than for the May-Aug. period. WWV reaches maximum intensity soon after sunset at the transmitter (morning at Huddleston), falling to zero in about 5 hours. The intensity built up again and held at a low value as long as the observations were continued (until about midnight). The May-July curve shows greater intensity over a longer period with the peak occurring 17 hours earlier than in the Oct.-Feb. period. The 15 MC curve for Aug., plotted separately because of its radical departure

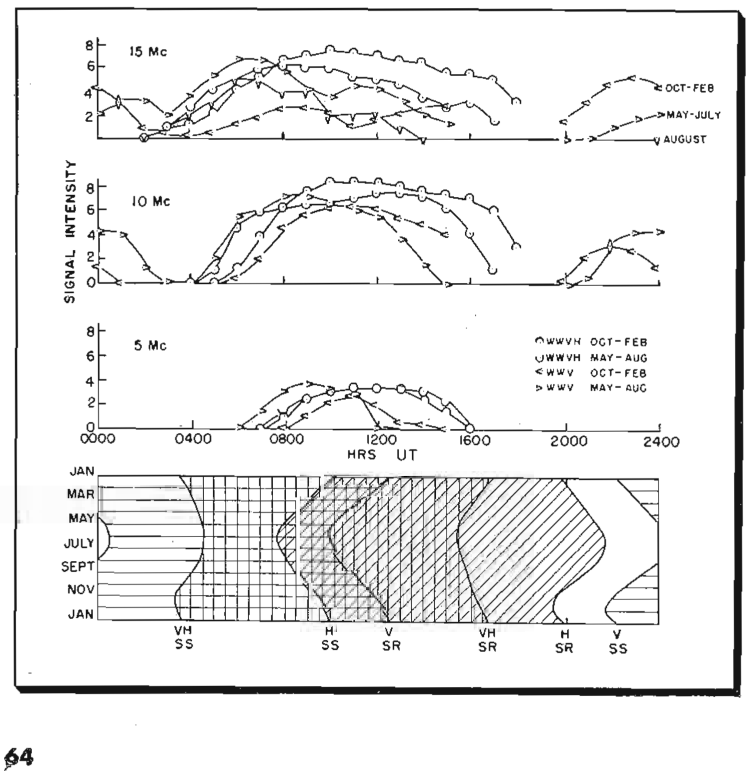
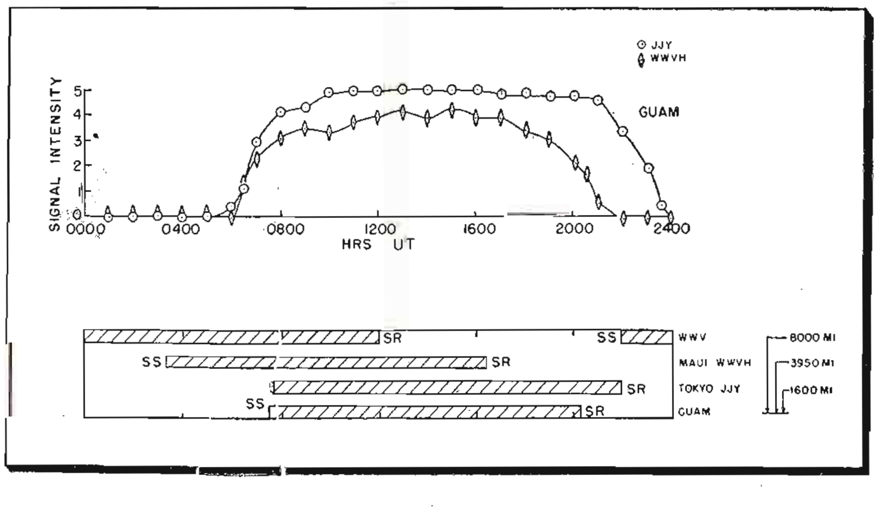


Fig. 7: (l) Reception of WWVH and WWV on 5, 10 and 15 MC at Huddleston, South Australia, October, 1949 to August, 1950. Approximate distance to WWVH is 5600 miles; to WWV, 10,600 miles.

Fig. 8: (r) Reception of WWVH and JJY at Guam, November 26 through December 7, 1949. WWV was too distant to receive 5 MC signals



Broadcast Reception

PART TWO OF TWO PARTS

from the other curves, builds up to S5 for an hour but much of the remaining time has less intensity than in the May-July period.

If an intensity of S4 is taken as a minimum for reception, it is seen that the 5 MC transmissions are not satisfactory. However, the 10 and 15 MC transmissions are useful a considerable part of the day. The advantage in having station WWVH is evident from the curves and Table III.

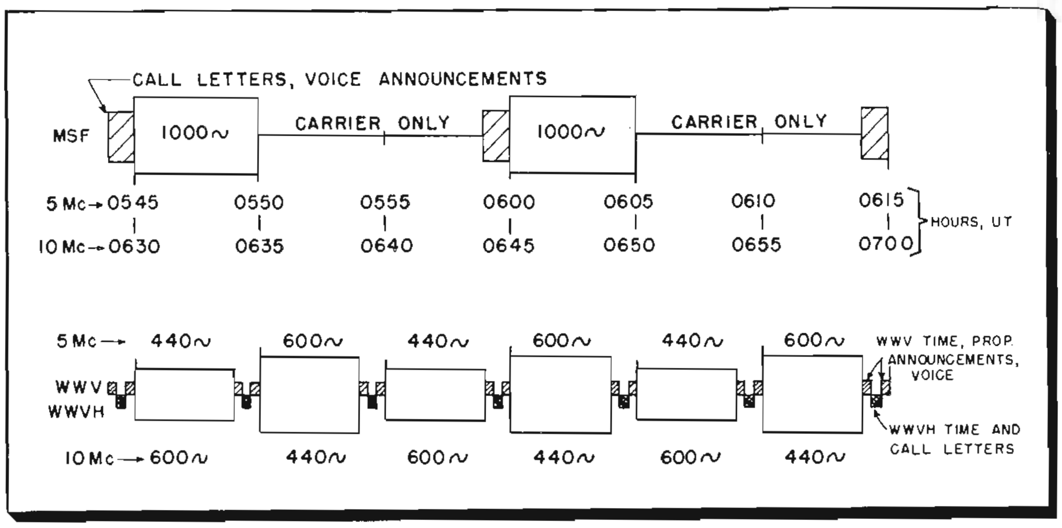


Fig. 9: Standard transmission of MSF, Rugby, England and relation to WWVH, WWV modulations

Data from Kingston

Data were submitted on a QSA (1-5) scale (QSA-5) representing the strongest signal) for reception of WWV and WWVH as observed by an individual at Kingston, Jamaica for the period Feb.-Nov. 1950. Observation times were 7:00 a.m., 1:00 p.m., and 7:00 p.m., EST, which is the same as Jamaica time. The data for each frequency were averaged for each month and are presented in Table III. Kingston is about 1470 mi. from WWV and 5200 mi. from WWVH. Trial observations on 5 MC at 1:00 p.m. were without success, as daylight paths existed for both transmissions.

The 5 MC transmission from WWV at 7:00 p.m. showed a maximum intensity when sunset had occurred at WWV and Kingston an hour or more before the measurements. The 5 MC transmission from WWVH was received with low intensity at 7:00 a.m. when it was daylight in Kingston but night at WWVH. The signal intensity averaged about QSA-1.

The data indicate that the 10 MC transmissions were stronger than the 15 MC transmissions for both WWV and WWVH, but WWV was stronger than WWVH, as would be expected.

Reception of Other Stations

About 1000 observations were received from the U. S. Navy's Communication Station at Guam on the 5 MC standard frequency transmissions from radio station JJY, Tokyo, Japan, and WWVH, Maui, Hawaii, covering the period Nov. 26 through Dec. 7, 1949.

Station JJY was operated with a power of 1 kw on 5 MC for the period from 0058 UT Nov. 18 to 0700 UT Dec. 8, 1949. Each hour of the 24 was made up of the following emissions and silent periods: 0-10, 20-30, 40-50 minutes, 1000-cycle modulation; 10-18, 30-38, 50-58 minutes, off the air; 18-20, 38-40, 58-60 minutes, voice announcements, call letters, in Japanese and English.

WWVH was operated with a power of 0.4 kw on 5 MC almost continuously during the period of test except for the following regular interruptions: each hour, 0-4, 30-34 minutes, off the air; each day, 0700-0734 and 1900-1934 UT, off the air. Station WWV, Beltsville, Maryland, operated continuously, but as it is 8000 mi. from Guam, its 5 MC transmissions were probably received there with low intensity.

The time schedule used by JJY was excellent to enable observers to monitor JJY and WWVH together and separately. The data consisted of from 80 to 90 observations per day for 12 days, reported on the signal intensity using the QSA (1-5) scale. Station JJY was approximately 1600 mi. from Guam, while WWVH was about 4000 miles eastward. The records stated that on some days JJY's 1000-cps tone "blocked out WWVH completely."

The average received signal intensities for JJY and WWVH were plotted versus time in Fig. 8. Hours of darkness (sunset to sunrise) were also shown for Guam and the two radio stations. The distance from Guam to WWV is about 8000 mi., which is too great for reception of 5 MC.

Monitoring JJY

Many other observers in the United States spent time endeavoring to monitor JJY, but without much success. This was partly because of erroneous announcements of transmission schedule. However, examination of the chart of darkness hours for JJY and WWV indicate that the most likely time to have heard JJY on the west coast was from about 1200 to 1500 UT.

(*Continued on page* 120)

Table III

Freq. Mc.	Station	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.
					1200 UT (7:00 a.m. EST)						
5	WWV	1.2	2.7	2.0	1.6	1.8	1.4	1.4	1.5	1.5	2.2
5	WWVH			0.8	1.1	1.2	1.1	1.0	1.1		
10	WWV	4.2	4.8	4.6	4.7	4.9	4.8	4.7	4.6	4.2	5.0
10	WWVH	2.2	3.2	3.6	3.4	3.7	3.9	3.8	3.3	3.3	1.7
15	WWV	3.9	3.9	3.8	3.3	3.6	3.2	3.0	3.1	2.9	3.8
15	WWVH	1.7	1.8	2.1	2.2	2.4	2.2	2.0	1.3	1.4	0.6
					1800 UT (1:00 p.m. EST)						
10	WWV		3.6	3.6	2.5	2.8	3.7	3.5	3.1	2.8	3.8
15	WWV		4.4	3.8	3.4	4.0	3.3	3.3	3.3	3.8	4.3
					0000 UT (7:00 p.m. EST)						
5	WWV	2.9	3.5	2.3	1.7	1.9	1.7	2.2	2.9	3.4	3.6
10	WWV	4.7	4.9	4.6	4.9	4.9	4.7	4.7	4.6	4.5	4.5
10	WWVH	3.1	2.4	2.4	2.0	1.5	1.0	0.9	1.4	1.5	1.4
15	WWV	4.5	4.2	4.0	3.8	3.6	3.2	2.7	2.2	1.4	1.7
15	WWVH	2.6	2.0	1.8	1.8	1.8	1.3	1.1	1.0	0	0

SUBSCRIPTION TV--Pro & Con!

Glimpses of several of the "subscriber-pay" systems now offered for commercial tests. And comments for and against present sponsored TV

The Case Against Subscription-TV

Editors, TELE-TECH:

When I was in your editorial offices this week, you discussed with me the points made in your editorial "Let's Take a Careful Look at Subscription-TV." And while I found the editorial fairly stating both sides,—at your request I am giving you my personal views critical of the proposed subscriber method of financing TV programs. I hope that others in the broadcasting and television field will similarly express their frank opinions.

Subscription-TV is a very controversial subject. I find most people in the TV business are ready to *fight* for their beliefs! Except for those who have something to sell, most TV men are against the subcription proposal. Although I try to be neutral, I too, confess a disbelief or rather skepticism as to the final application of the idea to American TV broadcasting.

Programs Will Improve

Of the arguments presented in your editorial, the strong one, it seems to me, relates to the question of *who* will continue to foot the staggering bills for TV shows. The objectionable, worthless TV program material that plagues us at present will fade away as soon as the broadcasters have enough letters or concerted action from their audiences to realize that the majority are serious about deletion of such programs. At present I suspect the majority of the TV audience really *want* the type of entertainment they are getting. (I wish I knew some way to keep my own children from looking at so many Western and crime pictures.)

We, in USA, are so used to free radio and TV that subscription-TV would be thought un-American. The quality of present top-notch TV programs is so high that subscription-TV could offer better fare only by showing one of Hollywood's better features, and there are only a very limited number of these each year, not nearly enough. By the use of a patented system on a national scale there would be a feeling of monopoly by the company forcing others to pay indirect royalty for something restricting the use of the ether, which is considered belonging to everyone (the present administration is always on a monopoly hunt). The general restrictiveness, both as to extra gadgets or wire connections to the TV set and financial limitation, coming after we have had years of pleasurable reception without such restrictions, would meet strong opposition.

To be acceptable, some think the "cash customers" should be given, not only better programs but some definite improvement in performance, such as, color, higher definition, etc. To start subscription-TV would raise the question of installing adapters, etc. and increasing the complication of the receiver and probably lowering its reliability and increasing the need for more repairs and service. It is very doubtful if the FCC would assign channels to private companies for this type of service. The "pig's-squeal" FM service was never approved by FCC but on a somewhat different basis.

Counterfeiting. There will be some of this, as long as radio men retain this Yankee inqenuity. But experience with pay-telephones and slot machines shows a rather small percentage use of "slugs"; the money lost would not warrant any policing.

Alternatives

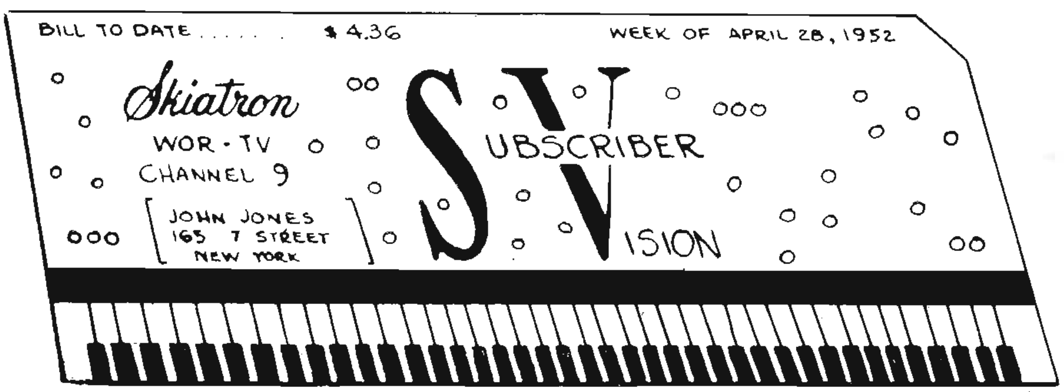
Looking ahead, possibly too hopefully, I can see: Elimination of a large part of the objectionable programs; an increase in the worthwhile programs of an instructive nature (not high-cost because of absence of expensive actors); a reduction in extravagant feature programs; more syndicating of good New York shows when 2,000 TV stations are operating thus spreading the production costs. We all hate Government control, but *outside* the framework of the Government there is a possibility that a small charge for program costs, say $10 a year could be levied on set users. For the first year this might be payable at the time the set was purchased.

Freedom from commercials would be welcomed, but in this connection it is interesting to note that there is now some discussion of introducing limited advertising into the BBC TV programs!

In closing, let me say I think your editorial states fairly both sides of the subscription-TV argument, and I hope there will be letters from others expressing their candid comments, pro or con.

New York, N. Y. — OLD-TIMER

"PRINTED-CIRCUIT" CARD FOR SUBSCRIBER-TV SYSTEM



In the several systems of subscription-TV so far offered, garbled pictures and sound are transmitted. These can be "cleared" for good reception by (1) keying impulse over telephone wires [Phonevision]; (2) inserting punched or printed card into decoder receptacle on set, or (3) depositing coin in slot on set [Telemeter]. In the card method (2) pictured, the subscriber who has paid for a given week, day or single program, would be mailed such a card bearing concealed printed-circuit connections which clear reception for the period designated. Some 3000 different combinations are claimed for the card shown.

Letter for Special Delivery

To the Video and Radio Industries,
Gents:

Why all the indignation and surprise over a Congressional inquiry into what's being pumped into the American home over the airwaves, especially in blueprints for criminal routines? You asked for it. By making it clear that your own loudly proclaimed code was just a gag and your professed concern for the kiddies all in fun, you boys practically insisted on outside interference. "Never give the battlers against juvenile delinquency an even break!" has seemed to be your operating slogan, especially on television. The American living rooms are knee deep in sawed-off shotguns, switch-blade knives, ropes, bludgeons, daggers, clutching hands, screams, police whistles, death agonies and the facial contortions of killer and victim. There ain't a code in a carload, bub.

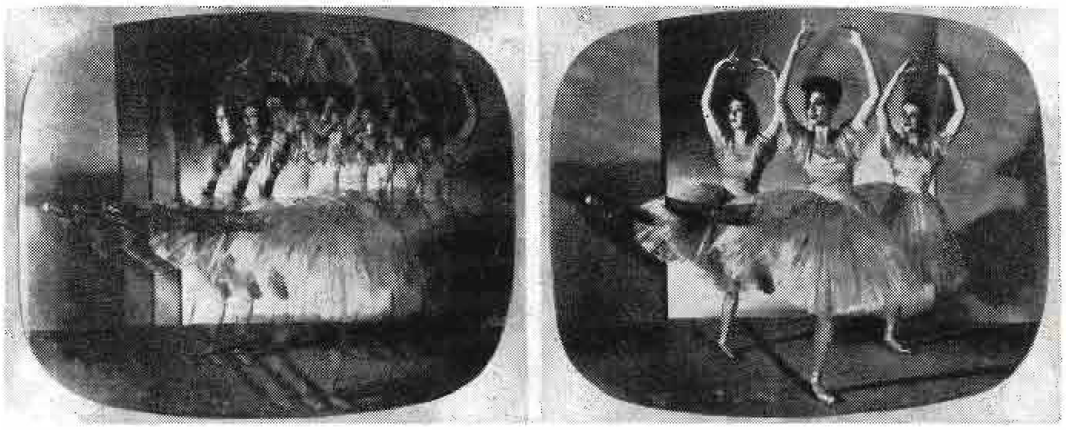
A bad influence on the kids! Why, brother, they have reached a point where they are a bad influence on the grownups. Popper thinks nothing of chasing mommer with a hammer if his eggs are burnt; mommer hurls an ax at him if he won't help with the dishes. The other night we found grandma toying with a switch blade because the weather had been unpleasant. Aunt Agatha just wound up a tour of the 11 channels by asking where she could get some arsenic pills and a poison arrow to put a little zip into life.

Radio and video are wonderful. They bring happiness to millions. Nobody wants the politicians taking over. But they have only themselves to blame if they get probed to a fare-thee-well. Dirty jokes, double-entendre gags and the big leer are on the rise on the living-room screens. But it is the crime programs that have outraged the country. And it is the hypocrisy of video and radio executives in their annual issuance of codes that makes the fathers and mothers sore and a little sympathetic to Congressional probes.

The crime programs have doubled since your first code. The blueprinting of criminal routines is indefensible. As for my home the joint is jumping with garroters, mugging experts, slashers, gunmen, poison plotters and other scum of the earth all giving home and fireside a play-by-play of Murder Inc. Even public officials and retired district attorneys are getting into the act for a fast buck. Haven't you noticed it? Take a look, and maybe you'll understand why trouble is threatened. Pardon my pointing. I just happen to be a guy who thinks the character of a child is worth protecting from the airwave biggies hell-bent for higher profits, and from the smug sponsors (most of them leading industrialists and family men of repute) who put a new sales record for a fruitcake, jelly, cigaret or a cold cream ahead of the small fry.

New York World-Telegram & Sun — ELMER (per H. I. Phillips)

ZENITH'S "PHONEVISION"—SCRAMBLED and CLEARED PICTURES



The only subscription-TV system so far to have an actual test under FCC authority, is Phonevision, developed by Zenith Radio, Chicago. Both video and sound can be garbled, but when the householder phones in to order a given feature, a corrective signal is sent over his telephone wire which clears up the scrambled image as illustrated. The local telephone company would be relied upon to keep a record of the feature programs ordered by each customer, and add amount due to his monthly telephone bill

LETTERS on Other Topics

Transistor Requires "One Flea Power"

Editors, Tele-Tech:

R. L. Wallace, Jr., of our technical staff, who has directed much of the circuit research in transitor electronics, has naturally been quite impressed by the incredibly small amounts of power needed to supply the junction transistor. As a result, he has suggested that we think of the transitor as requiring "one lazy flea power."

This is the way he reaches this very intriguing suggestion. First, consider a flea weighing one milligram and capable of jumping 50 centimeters high. Every time the flea jumps he gives himself 50 ergs of potential energy. Remember, please, that this is a lazy flea and as he jumps only once per minute, this amounts to about an erg per second, or one-tenth of a microwatt. Thus "one lazy flea power" equals one-tenth of one microwatt. Or, if you want another equivalent, it is equal to about one ten-billionth of a horsepower.

Bell Telephone Laboratories
463 West St., New York 14, N. Y.

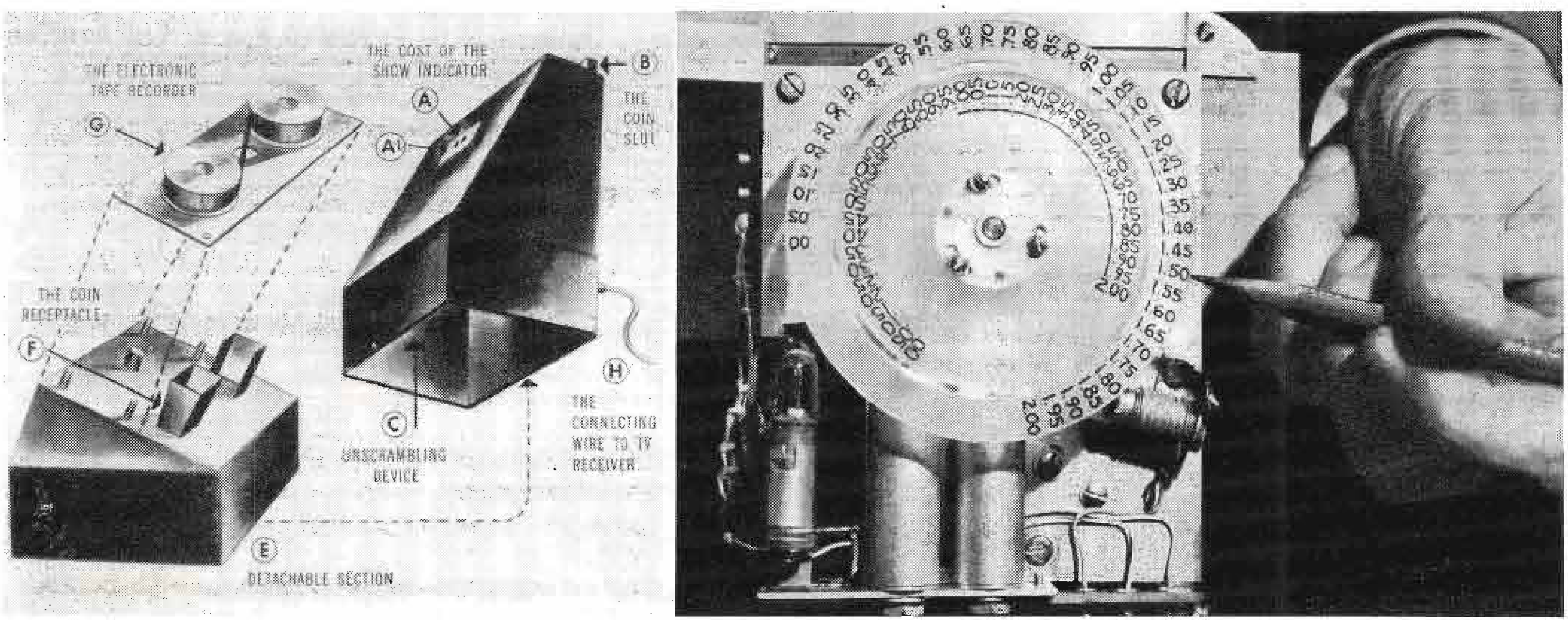
Binaural Listening via AM-FM

Editors, Tele-Tech:

In late April I phoned you seeking some information on the acceptance of FM radio broadcasts and why FM receivers were slow sellers.

(Continued on page 114)

COIN-BOX, INDICATOR, and PROGRAM RECORDER of "TELEMETER"

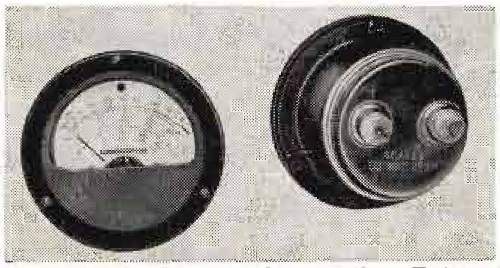


Telemeter, a form of subscription television wherein the viewer drops coins in a slot to unscramble the incoming picture, was demonstrated at New York, June 3, by International Telemeter Corp., Los Angeles 25, Cal. The coin-box attached to receiver operates as follows: The user looks in window (A) to find the cost of the show, then inserts in coin slot (B) the required amount . . . this sets in motion the unscrambling device (C). Window (A-1) adds the coins as they are inserted. The detachable section (E) consists of two parts, the coin receptacle and the electronic tape (G) that records different shows that have been received and paid for. Picture at right shows interior mechanism for ratcheting price dials

New Equipment and Components

Ruggedized Instruments

Series R-210 2½ in. and R-310 3½ in. ruggedized instruments are suspended by internal live rubber ring mounts for maximum



shock displacement and protection. External live rubber grommet for shock mounting with interlocking part of front bezel eliminates glass breakage and bezel distortion. Watertight seal to panel is provided by rubber grommet. Glass-to-metal seal facilitates perfect hermetic sealing. Drawn steel case with heavy cadmium plate gives high degree of magnetic shielding. High grade fusion seals for terminals and window glass withstand thermal shock of extreme temperature changes. Rugged glass-to-metal seal terminals can withstand a 3000 v. breakdown test under extreme humidity conditions. Entire mechanism has complete ruggedized construction for high shock and vibration resistance. Ranges are from 250 μa to 8 ma in 2½ in. size now available.—**Industrial Sales Div., DeJur Amsco Corp., 45-0-1 Northern Blvd., Long Island City, N. Y.**—TELE TECH.

Ground Plane Antennas

SPPA-94 ground plane antenna for 144-152 MC; SPPC-94 covering many of the aircraft frequencies, operating between 108-120 MC; and SPPD-94 covering 120-132 MC are now available. Together with other ground plane antennas, these models present a line covering all frequencies between 108 and 174 MC.—**Ward Products Corp., 1523 E. 45 St., Cleveland 3, Ohio.**—TELE-TECH.

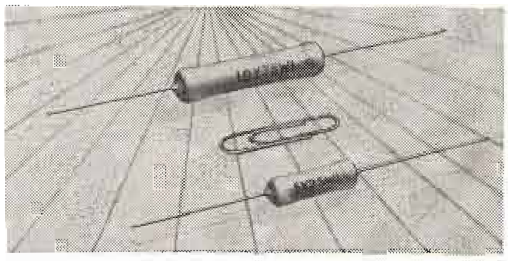
Voltmeter

Model 314 electronic voltmeter measures ac voltages from 100 μv to 1000 v. in the 15 CPS to 6 MC frequency range. Its accuracy

of 3% up to 3 MC and 5% above is the same at all points on the single logarithmic voltage scale. With its probe, the input impedance is 6 μμf shunted by 11 megohms and the voltage range is 1 mv to 1000 v. in 6 decade ranges. Without its probe it may be used to measure down to 100 mv but the input impedance is reduced to 25μμf shunted by 1.1 megohms. Stabilization is accomplished by the generous use of negative feedback. One of its features is the unique probe which has a self-holding connector tip and also a group clamp especially designed to insure a low impedance ground return. It may also be used as a wide band amplifier with maximum gain of 60 db variable in 20 db steps and flat within ½ db from 100 CPS to 3 MC and within 1 db from 50 CPS to 6 MC.—**Ballantine Laboratories, Inc., Boonton, N. J.**—TELE-TECH.

Resistors

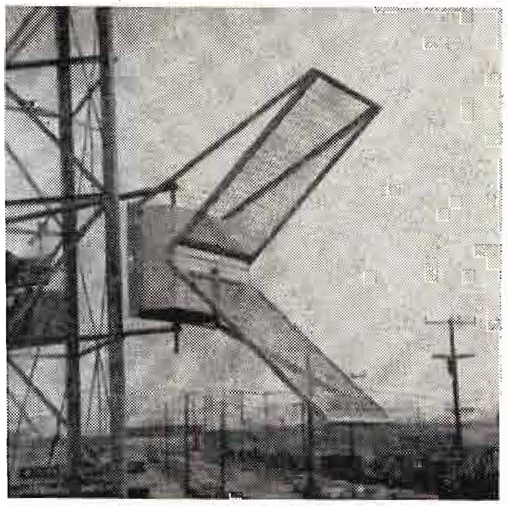
New miniature power type resistors (Axiohm) with axial leads can be used in equipment where space saving and minimum assembly costs are essential. These resistors are made with special alloy resistance wire of low temperature coefficient of resistivity wound on tough miniature ceramic cores. Sturdy No. 20 B.&S. tinned axial leads are mechanically anchored and silver brazed to end caps. Entire assembly is encased in Vitrohm enamel forming a hard, crazeless, heat-conducting hermetic seal. They are available in conservatively rated 5 and 10 watt sizes. A wide range of resistance values is available from stock.



Standard resistance tolerance is ±5%. Closer tolerances on special order.—**Ward Leonard Electric Co., Mount Vernon, N. Y.**—TELE-TECH.

Corner Reflector

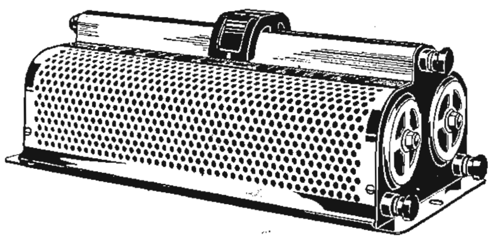
A new cavity-fed corner reflector for 360-420, 890-960, and 1850-1990 MC provides a substantial gain over conventional corner



reflectors and has a front-to-back ratio of better than 20 db. The 400 MC corner reflector wings are mesh constructed to reduce wind loading. These completely weatherproof antennas may be oriented for either vertical or horizontal polarization and the wings, factory preset for optimum operating conditions, may be varied to obtain other desired characteristics. Antenna terminates in an UG-21/U equivalent fitting.—**Product Development Co., Inc., Kearny, N. J.**—TELE-TECH.

Double Rheostats

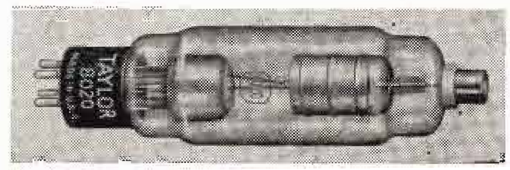
A group of Double Rheostats are now available for 1120, 1560 and 2000 watt capacity. Two tubes of the same length are



mounted between sturdy mounting brackets, while only one slider moves a double contact arm with double copper-graphite contact brushes. These models have the advantage of two ranges connecting both tubes in series or in parallel.—**Rex Rheostat Co., 3 Foxhurst Rd., Baldwin, N. Y.**—TELE-TECH.

High-Voltage Rectifier

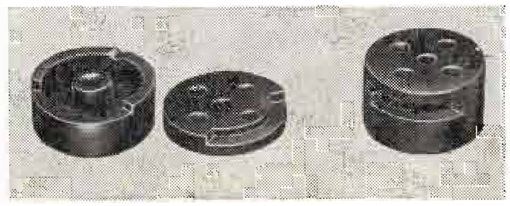
High-voltage rectifier type 8020 is rated at 40 kvp inverse or forward in air, 60 kvp in oil, an average current of 100 ma, and in-



stantaneous peak current capacity of 2 amp. Tube construction of nonex glass with standard four-prong base uses special oil-resisting silicone basing compound to eliminate loose bases caused by oil immersed operation. A treated tantalum anode for stability and long life and a thoriated tungsten type filament operating at 5 v. and 6 amps are featured. Life expectancy is over 5000 hours and maximum dimensions are 8 in. length, 2-5/6 in. diameter.—**Taylor Tubes, Inc., 2312-18 W. Wabansia Ave., Chicago 47, Ill.**—TELE-TECH.

Adjustable Cup Cores

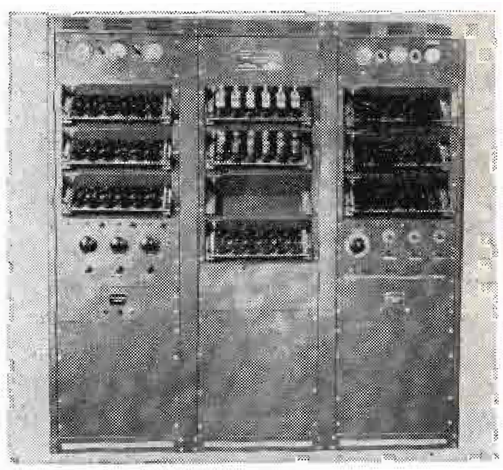
A new line of adjustable airgap cup cores made of high-efficiency Ferramic materials suitable for frequencies from low audio up



to 150 MC with Q values to 300 is now available. Both core and cover are notched on the outside circumference. Angular displacement of one piece with respect to the other will change the effective permeability and therefore the inductance of the coil through a range of 20%. Sizes of these cores range from 0.5 to 1.5 in. with 11 variations available. Maximum inductance obtainable with large size approximately 20 henries.—**General Ceramics and Steatite Corp., Keasbey, N. J.**—TELE-TECH.

Vacuum Tube Life Test Set

Model TS-3 was designed for the life testing of vacuum tubes, including miniature and subminiature types, with either directly

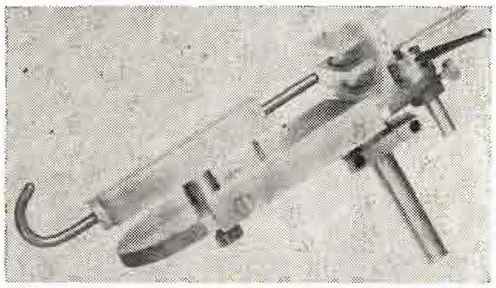


heated or indirectly heated filaments. All supply voltages are contained in the unit, are completely adjustable from 0 to rated maximum, and voltage regulated where required. Up to 120 tubes of 10 different types may be tested simultaneously. Additional features include: 13 self-contained continuously variable power supplies; adjustable on-off recycling of power supplies, as required; front-panel switch for reversing polarity of H-K supply; direct, continuous meter readings of all operating voltages; elapsed time meter for determination of total running time; simple, universal connections provided for all tube types; and interchangeable, plug-in type tube test panels with handles.—**General Electrosonics, Inc., 32 W. 22 St., New York 10, N. Y.**—TELE-TECH.

for Designers and Manufacturers

Crystal Orientation Table

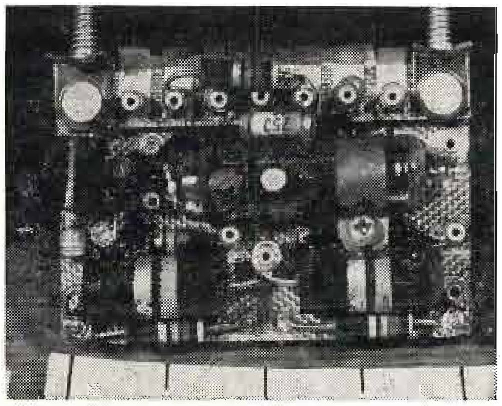
Quartz crystal orientation table (type 52190) uses a head with multiple X-ray slots to measure pieces of quartz of vary-



ing heights, and bar and section holder having matching height adjustment. Reference guide at either side checks angles in mother quartz, sections, bars, wafers, blanks, and test cuts. Unmounted pieces of quartz are measured by placing them against the head and fixing them in place with the bar and section holder. All axes may be accurately determined and various cuts located and measured on the goniometer scale. Similarly, test cuts may be placed against the head for measuring deviation in the same manner. —**Research & Control Instr. Div., North American Philips Co., Inc., 750 S. Fulton Ave., Mt. Vernon, N. Y.**—TELE-TECH.

Plug-in Circuits

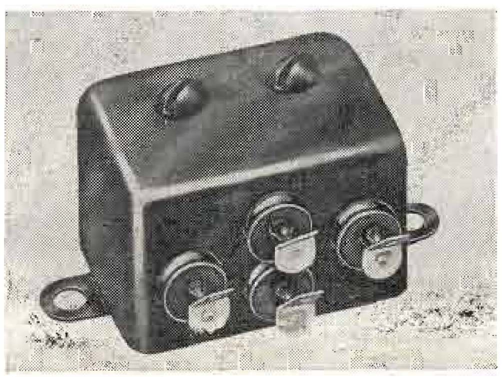
Basic plug-in circuits permit rapid design and assembly of computers, high speed counting devices and electronic controls on



assembly board in 'building block" fashion. New units include bi-stable multivibrators (flip-flops), astable and monostable multivibrators, delay lines, pulse amplifiers, cathode followers and gates. Small size (1-7/16 x 5/8 x 2 1/8 in.) and light weight (heaviest complete circuit weighs 1.5 oz.) are made possible by using subminiature tubes, hand-wound coils and special transformers. Variety of pulse transformers are also available.—**Jacobs Instrument Co., 4718 Bethesda Ave., Bethesda 14, Md.**—TELE-TECH.

Hermetically Sealed Rectifier Cells

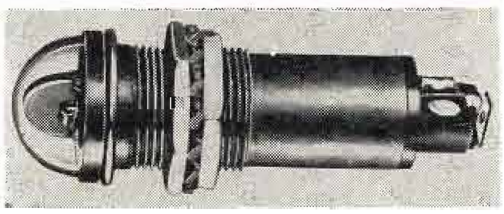
Hermetically-sealed units have been added to a line of magnesium copper sulfide rectifier stacks in order to meet the increasing demand for metallic rectifier stacks capable of operating under all types of



environmental conditions, including high temperatures. Although individual Mg-CuS rectifier cells had been known to operate with little or no chemical changes in temperatures up to at least 225°C (427°F), operation of rectifier stacks in these high temperatures in the past had always been prevented by the inability of protective coatings to hold up at temperatures above 130° or 140°C (265° to 284°F.) the introduction of hermetic sealing now makes possible efficient high temperature operation. Four single-phase, full-wave bridge rectifier stacks are offered for operation over a range of ambient temperatures from –70°C to 200°C (–94°F to 392°F.) The black coating on the container will withstand salt spray for at least 500 hours. In applications where dc voltages or currents higher than that provided by one stack are required, two or more stacks can be connected in series, series-parallel or parallel.—**P. R. Mallory & Co., Inc., 3029 E. Washington St., Indianapolis 6, Ind.**

Power Failure Indicator

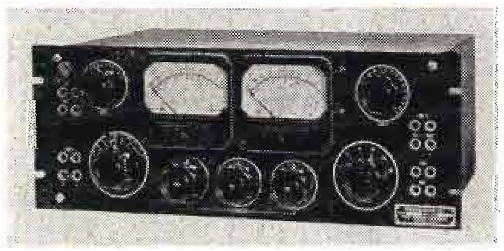
A new device for indicating power or signal failure in aircraft is interchangeable with lamp assembly AC42B3593 and consists of a solenoid actuated butterfly which glows with



reflected or radio-active light when voltage is present. The absence of signal allows the butterfly vanes to close, thus showing black under all conditions. The indicator reflecting members are available in red, amber, green or white and are equally effective in total darkness or bright sunlight. No incandescent lamp is required. The "Signalette" is designed for extreme ruggedness and complete dependability. Life tests show normal performance after 450,000 cycles of operation. Voltage surges often encountered in aircraft systems do not affect the unit. There are no delicate parts to break from shock and because of its permanently closed circuit it cannot ignite explosive gases. Power consumption is 2.5 watts. Standard types are designed for 48, 28, 12 and 6 v. dc operation. Special types for 400 v. ac 3-phase or single phase for other alternating current requirements are provided upon request.—**Lytle Engineering & Mfg. Co., 4721 N. Kedzie Ave., Chicago 25, Ill.**—TELE-TECH.

Transmission Measuring Set

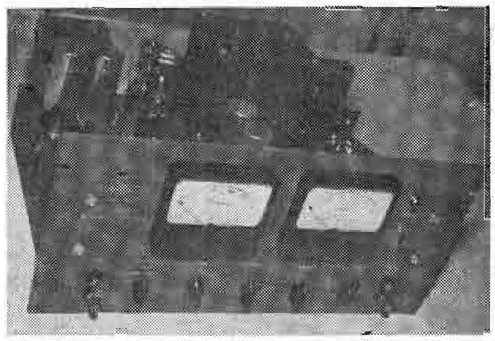
Transmission Measuring Set, Type 10B, has a frequency range of 50 to 15,000 CPS with ± 0.1 db accuracy. It is a direct reading in-



strument that eliminates intricate calculations and complex "set-ups." The circuit consists of a combination of resistive loss and impedance matching networks and shielded isolation coils, so that the meters and their associated range controls can be independently used as VU meters in program monitoring or other applications. No external power or electronic tubes are used. A stable external source of audio signal is required. Suggested measurement applications are: audio gain; audio loss; matching and bridging; frequency response; and volume level. An additional feature is the provision for feeding noise-distortion meters over a frequency range of 50 to 45,000 CPS.—**Daven Co., Dept. G, 191 Central Ave., Newark 4, N. J.**—TELE-TECH.

Wow-Meter

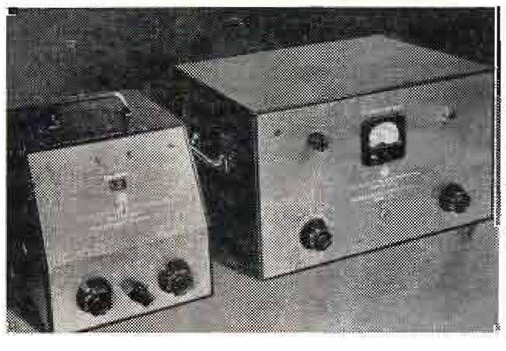
Type 152A wow-meter is a direct indicating instrument measuring both the frequency variations and the center frequency of an audio signal. It is designed to measure



wow in the center frequency range 800 to 1250 CPS. The built-in frequency meter is calibrated in the 600 to 1500 CPS range. Other corresponding ranges may be obtained on order to frequencies as high as 10,000 CPS with appropriately higher wow ranges. A static frequency-to-voltage translating unit produces an output voltage directly proportional to the input frequency and is independent of the signal amplitude. The frequency-metering section responds directly to the translator dc output voltage. The wow-metering section consists of an ac coupled peak-to-peak reading voltmeter with suitable filters and range switching to allow selection of the appropriate sensitivity and wow spectrum measured. The available full-scale wow sensitivities are 0.3, 1.3, and 3.0%. Three wow spectrums are available: ½ to 10, ½ to 120, and 10 to 120, with appropriate damping for each range, and a meter reset switch for use on the more highly damped ranges. Oututs are provided for independent monitoring of frequency and wow, allowing connections to recording equipment to record the center frequency and the wow continuously, and the attachment of a spectrum analyzer or oscilloscope to examine the waveform of the frequency variation (wow). An internal, stable, wow-free 1000 CPS oscillator is provided as an aid to rapid measurements of recording systems.—**The Minnesota Electronics Corp., 47 Water St., St. Paul, Minn.**—TELE-TECH.

Magnetometer

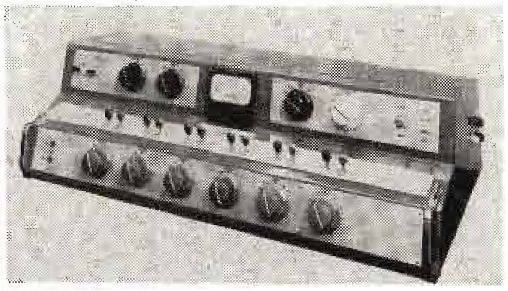
Model 101 Magnetometer measures magnetic field strength by using the principle of nuclear resonance. An oscillatory magnetic field is provided by means of a coil surrounding a sample which permits measurement of proton resonance and the nuclear resonance of lithium (Li^7). The coil is part of an oscillator whose oscillation level drops with an increase in circuit losses as introduced by nuclear resonance in the sample material. Means have been provided to make this reasonance easily viewed on an oscilloscope. Field strength range is 300 to 25 000 gauss, covered by proton and lithium resonances in a frequency spectrum of 1.18 to 34 MC. Means are provided for varying the width of modulation sweep from 1.6 to 16 gauss. The equipment's use is limited to



fields whose homogeneity is at least one part in 500 for proton resonance and one part in 5000 for lithium resonance.—**Laboratory for Electronics, Inc., 75 Pitts St., Boston 14, Mass.**—TELE-TECH.

Audio Console

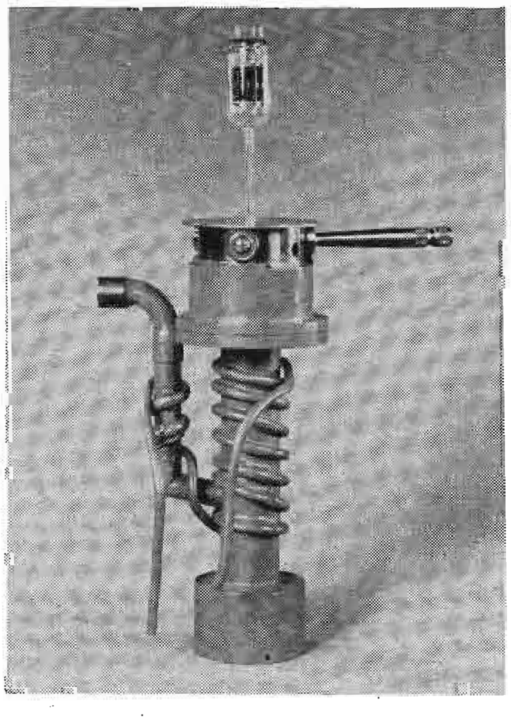
The 230B console is designed for two-studio use and is equally suited for use in elaborate public address and recording installations. It is an entirely self-contained, operated unit, carefully engineered to do the



largest job in the least space. There are 4 separate preamplifiers, two booster amplifiers, a line amplifier and a monitor amplier, all mounted on one chassis. Miniature plug-in power supplies for plate and filament supply, and for relay and signal lights operation, are easily removed for complete servicing or instant replacement. The console is equipped with six mixing potentiometers, four of which are connected through switching keys to eight low level microphone or turntable inputs. The other two are connected with four line inputs, providing a total of twelve inputs, any six of which may be mixed simultaneously. The output channel can be switched to either of two output lines automatically connecting the control room telephone to the unused line. An emergency amplifier switch permits instant replacement of the line amplifier with the monitor amplifier. All controls are color coded, logically grouped and properly spaced for ease of operation. All parts and wiring are easily accessible by lifting hinged front panel. Available input impedances are 50, 150, 300 or 600 ohms and the output impedance is 600 ohms. The system gain is 100 db (including a 6 db isolation pad). Frequency response is ± 1 db, 20-20,000 CPS and the signal-to-noise ratio is 74 db. Dimensions: 9⅝ in. high; 36¾ in. long; and 17 in. deep. Distributed by the Graybar Electric Company, Inc.—**Altec Lansing Corp. 9356 Santa Monica Blvd. Beverly Hills, Calif.**—TELE-TECH.

Pump, Valve and Port Assembly

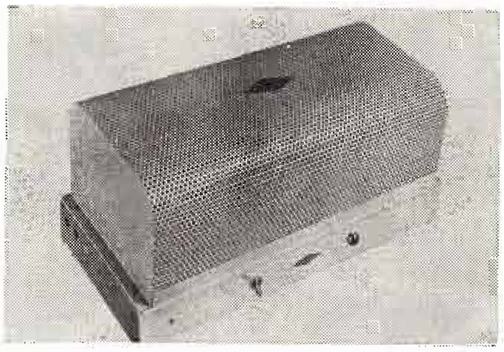
A compact high-vacuum conversion pumping unit (MB-10), designed to evacuate standard electron tubes, can also be used to pump other relatively small volume containers such as hermetically sealed relays, vials, instrument control elements, and vacuum capacitors. For evacuating larger volume vessels or when back-filling operations are desired, a modification of the new unit will permit small solenoid valves to be incorporated. This permits the inclusion of a "roughing" stage in the cycle, practically eliminates pump oil deterioration and loss, and provides a simple means for introducing measured amounts of gases into the evacuated vessel. Since the MB-10 pump, valve and port assembly has a high forepressure tolerance of 400 microns, the need for major conversion changes in installations of this



new equipment is eliminated. The pump will operate through most standard sweep and sliding valve combinations. The pump operates at a pumping speed of 10 liters/sec. between 0.1 and 10.0 microns HG. It also offers ultimate vacuum of 5 x 10-5 MM HG. —**Distillation Products Industries, Division of Eastman Kodak Co., Rochester 3, N. Y.**—TELE-TECH.

Direct Drive Amplifier

Model 500D direct drive amplifier and matching 500 ohm voice coil speaker eliminate output transformer. Frequency re-



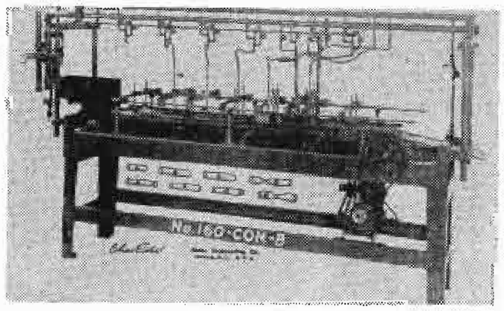
sponse 20-70,000 CPS ±0.25 db; hum and noise 90 db below full 20-watt output; distortion less than 0.5% at 20 watts; and 47 db voltage gain. Power supply requires 117 v. at 50-60 CPS. Input to 20-lb. amplifier is 0.1 meg with one side grounded. Circuit utilizes four 2A3 tubes in parallel output connected to voice coil through 80 µf capacitor. Dimensions are 7.75 x 15.25 x 7 in. Line of speakers to operate with 500 ohm voice coil are available.—**Stephens Mfg. Corp., 8538 Warner Dr., Culver City, Calif.**—TELE-TECH.

Analog Computer

The LINEAC analog computer for the solution of linear simultaneous algebraic equations, both scalar and complex, uses no amplifiers and obtains solutions immediately without any iterative process. It may be used in reverse for the simulation of linear functions. Device consists essentially of multi-coil tapped transformers and a voltage divider, and operates on 60 CPS voltage. For well-conditioned matrices of the order of ten, the error is a fraction of 1% and can be extended by the use of simple compensating adjustments. Basic components are non-precision transformers and rheostats. The non-iterative feature permits one-shot operation, and eliminates failure due to non-convergence of the solution.—**American Hydromath Corp., 145 W. 57 St., New York, N. Y.**—TELE-TECH.

Tube Bottoming Machine

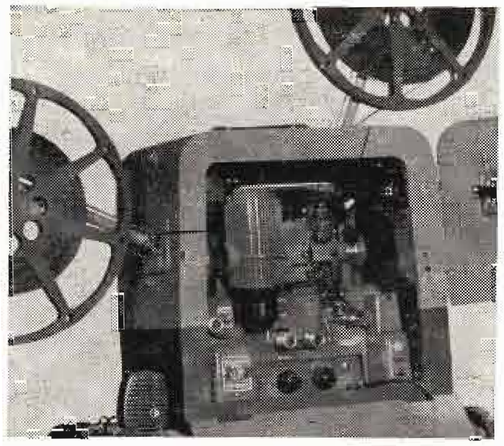
A high-speed automatic tube bottoming machine can be adapted to handle all kinds



of glass tubing, soft glass or pyrex glass, from ⅛ in. to ¾ in diameter, and the length of the finished product can be adjusted from 1 in. to 6 in. The production output ranges from 8,000 to 16,000 per hour, depending on the tube diameter, wall thickness, and the nature of the glass tube products. The sturdily constructed framework with fabricated table and legs corries the driving mechanism, which is powered by a ½ HP motor and speed reducer. A series of rotating shafts with glass roller moves continuously, while taking the blank tubing off the automatic hopper feed. The glass tubing is carried in a horizontal position under a row of ribbon burners. These ribbon burners are placed on the bottom and on the top of the glass, and the finished product is discharged on the opposite end of the machine.—**Eisler Engineering Co., Inc., 750 S. 13th St., Newark 3, N. J.**—TELE-TECH.

Magnetic Sound

Bell & Howell 202 magnetic recording-projector and Soundstrips coated film permits a sound track to be recorded or erased



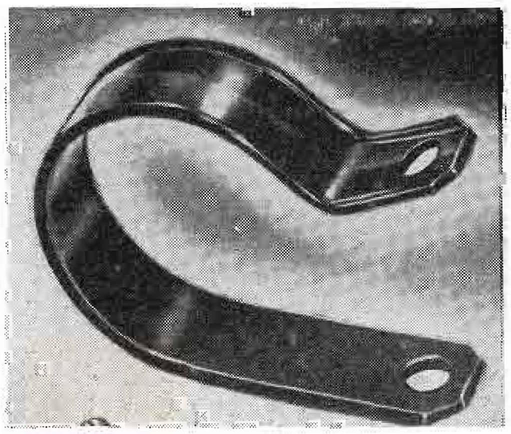
as the motion picture is being projected. Unit uses 16mm single-perforated film at 16 or 24 frames per second. The iron oxide magnetic stripe applied to one edge of the film costs $0.035/ft., while the projector is priced at $699.00. Projector capacity is 2,000 ft. of film, and it will project conventional sound and silent pictures. If a permanent optical sound print (variable area or density) is desired in addition to the magnetic track, a half-track magnetic coating may be made, retaining the optical recording. Functional features include instantaneous reverse projection for sound editing; clutch and manual drive knob for single frame projection; safety interlock to prevent accidental erasure; and a compact magnetic reproducing unit which combines the erase and playback heads on a single mounting quill.—**Bell & Howell Co., 7100 McCormick Rd., Chicago 45, Ill.**—TELE-TECH.

Capacitors

Two high voltage "Ceramicon" TV bypass capacitors will provide high voltage power supply filtering for television receivers. Style 412 is rated at 20 KV and Style 414 at 10 KV. The case insulation is made of low-loss, molded thermosetting plastic, which is said to provide an excellent moisture seal. Ring convolutions are molded into the surface of the 20 KV capacitor, to prevent surface leakages that are caused by ordinary handling and a consequent deposit of conductive materials. According to the manufacturer, the convoluted design increases the effective surface creepage path by more than 14%.—**Erie Resistor Corp, Erie, Pa.**—TELE—TECH.

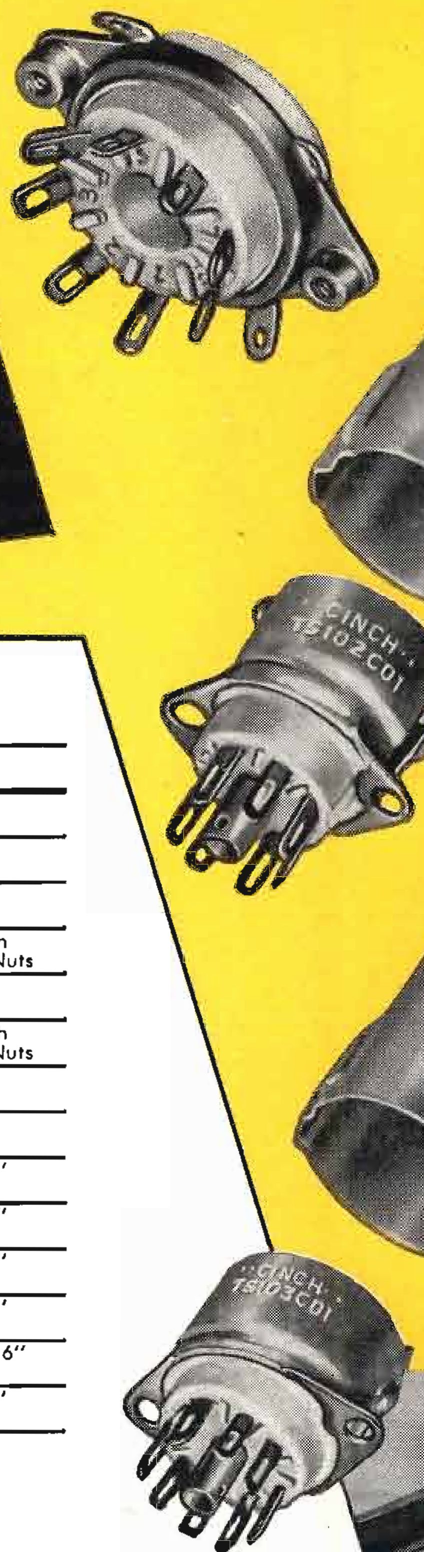
Wiring Support

A new loop type wiring support known as the NyLoc Cable Clip has all the advantages of Nylon: high tensile strength over a wide



range of temperature both hot and cold; not affected by oils; dilute acids and alkalies. It can be used under sustained temperature of 250°F and higher non sustained temperature. It will even withstand steam sterilization and is inert to fungus. The specially designed cross section of the tape of which these clips are made has rounded edges for gripping the cable without chafing and to provide maximum strength. These cable clips are made in two types. Type 6 is made in sizes to hold wiring from ⅛ in. to 1¼ in. diameter and type 3 is a lighter and more economical type for smaller wiring from ⅛ in. to ½ in. diameter.—**Weckesser Co., 5261 N. Avondale Ave., Chicago 30, Ill.**—TELE-TECH.

CONSULT CINCH FOR THE PRODUCTION OF *ANY* COMPONENT ASSEMBLY FOR COMMERCIAL OR MILITARY USE THAT FALLS WITHIN THE GENERAL CATEGORY OF ELECTRONICS PARTS MANUFACTURE



Cinch sockets and shields to JAN specifications:

DESCRIPTION	MAT.	JAN S-28	JAN S-28-A	JAN S-28-A AMEND 1	
7 Pin Miniature	Mica	SO-10-M (T9365-1)	TSE7T101 (9356)	TS102P01 (9356)	
7 Pin Miniature	Ceramic	SO-10-C (T9316-1)	TSE7T102 (9355)	TS102C01 (9355)	
8 Pin Octal	Mica	See Note #1	TSB8T101 (51B16203)	TS101P01 (51B16203)	
8 Pin Octal	Mica	See Note #1	See Note #1	TS101P02 (51B16758)	With Mtg. Nuts
8 Pin Octal	Ceramic	See Note #1	TSB8T102 (51B16220)	TS101C01 (51B16220)	
8 Pin Octal	Ceramic	See Note #1	See Note #1	TS101C02 (51B16759)	With Mtg. Nuts
9 Pin Noval	Mica	See Note #1 (53F12875)	TSE9T101 (53F13373)	TS103P01 (53F13373)	
9 Pin Noval	Ceramic	See Note #1 (53F12776)	TSE9T102 (53F13381)	TS103C01 (53F13381)	
7 Pin Shield	*	SOS-3 (8660-1)	TSF0T101 (8690-1)	TS102U01 (8690-1)	1⅜"
7 Pin Shield	*	SOS-6 (8661-1)	TSF0T102 (8691-1)	TS102U02 (8691-1)	1¾"
7 Pin Shield	*	See Note #1 (16G12564)	TSF0T103 (8698-1)	TS102U03 (8698-1)	2¼"
9 Pin Shield	*	See Note #1 (16G12626)	TSF0T104 (16G13375)	TS103U01 (16G13375)	1½"
9 Pin Shield	*	See Note #1 (16G12627)	TSF0T105 (16G13376)	TS103U02 (16G13376)	1-15/16"
9 Pin Shield	*	See Note #1 (16G12628)	TSF0T106 (16G13377)	TS103U03 (16G13377)	2⅜"

*JAN S-28 Shields—Steel—Cadmium Plated
JAN S-28-A Shields } Brass—Nickel Plated
JAN S-28-A Amend 1 } Brass—Nickel Plated
Note #1. Not Included in Jan. Spec.
Numbers Shown in Parentheses ( ) Indicate Cinch Part Numbers

Cinch is producing many variations of standard electronic components for military use. An organization that is flexible, readily adapted to *any* requirement . . . in military or commercial emergency. Ample physical properties . . . space and production facilities.

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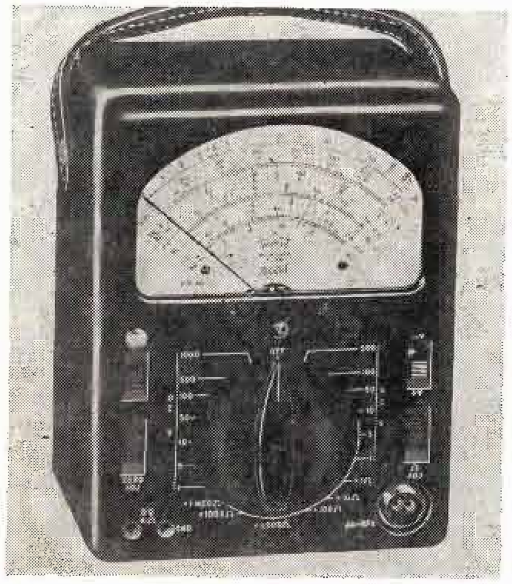
Cinch components are available at leading electronic jobbers — everywhere

Voltmeter

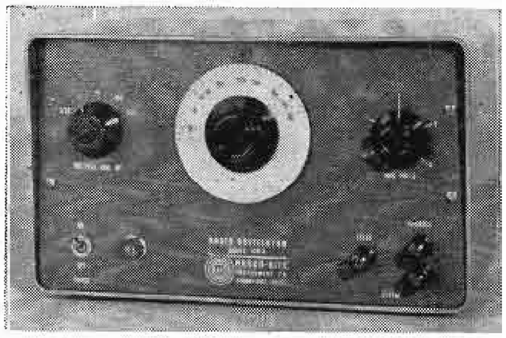
When using the Model 650 vacuum tube voltmeter, peak-to-peak ac v. and r-f measurements are made with one probe. This



eliminates troublesome change of probe when changing from ac v. and r-f measurement. Complete frequency coverage is from 20 CPS to well over 100-MC with one probe. One main selector switch controls all ranges. The tester has one volt full scale reading on both ac and dc. An especially designed, insulated, shielded r-f probe with short leads provides for high frequency measurements and the tester has zero center mark for FM discriminator alignment plus any other galvanometer measurements. High input impedance 11 megohms on dc allows for accurate measurements without loading the circuit under test. There are special means for making adjustments for ac v. zero shift with line voltage variation. High precision composition resistors are used throughout. Separate 1 ac v. and 5 ac v. scales guarantee greater accuracy.—**Triplett Electrical Instrument Co., Bluffton, Ohio.**—TELE-TECH

Audio Oscillator

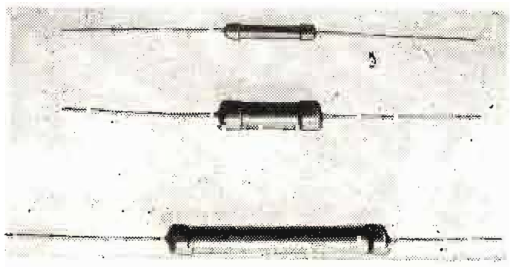
Model 430-A audio oscillator covers the 4.5 to 520 KC frequency range in five overlapping bands. A single scale logarithmic dial



is used. Calibration is held within ±2% accuracy. Two output terminals are provided. The voltage on one of them is controlled by a calibrated output level control; the other provides a fixed sine wave signal for scope synchronization. Other features include low distortion and hum at any setting of the output level control and excellent amplitude constancy over the entire frequency range. Price: $145.00.—**Krohn-Hite Instrument Co., 580 Massachusetts Ave., Cambridge,, Mass.**—TELE-TECH.

Resistors

Three resistance ranges (50 ohms to 5 megohms, 50 ohms to 10 megohms and 100 ohms to 50 megohms) are offered in a new line of deposited carbon resistors. Temperature coefficients vary only slightly (140 to 500 parts per million C°) depending upon



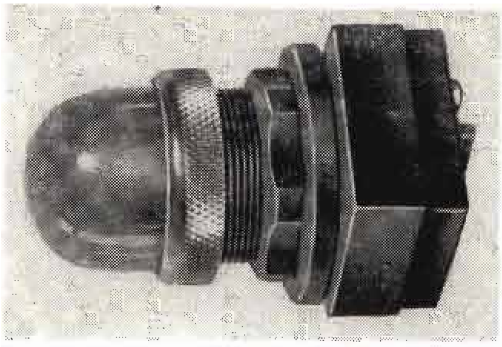
resistance. Voltage coefficient is less than 0.002% per v. with the average coefficient about 0.0012%. Resistors are supplied with 1% tolerance and are calibrated at 25°c. If such precision is not required, resistors can be supplied with tolerances of 2% and 5%. Humidity characteristics are negligible. Special coatings can be supplied that will reduce to a minimum any changes due to extremely humid conditions.—**Dale Products, Inc., Columbus, Neb.**—TELE-TECH

Watertight Binding Posts

A new binding post for use in sealed equipment requiring external connections will meet government and commercial requirements for rugged portable and vehicular equipment. They provide heavy spring pressure for good contact on small soft wire or heavy steel and copper conductors. Contact jaws are of stainless steel; insulators are of teflon; washers of rubber. Rubber caps are available in red or black if desired.—**Hugh H. Eby, Inc., 4700 Stenton Ave., Philadelphia, Pa.**—TELE-TECH

Switchboard Indicator Lights

A new line of switchboard indicator lights has been designed to operate on 115 v. ac (60 or 400 CPS) and 450 v. ac (60 or 400



CPS). These lights are supplied with globe assembly or lens in red, blue, green, amber, translucent white and clear. Type B-27C (illustrated) operates an 2.5 v. ac and is supplied with globe assembly, target cap assembly or dim-out cap assembly.—**Kinetix Instrument Co., Inc., 902 Broadway, New York 10, N. Y.**—TELE-TECH

Voltmeter

The indicating dial on the MU-12A ac voltmeter has been designed to satisfy both linear and logarithmic scale requirements.

Previously, users of vacuum tube voltmeters had to decide whether they preferred a logarithmic voltage scale combined with a linear db scale or a linear voltage scale combined with a logarithmic db scale. In either case, readings are difficult and reading errors unavoidable through crowding of the scale divisions at one end of the logarithmic part of the scale. The new dial used in the MV-12A strikes a compromise by zero suppression of its linear voltage scale. This spreads the logarithmic db divisions sufficiently to avoid congestion beyond a point where accurate reading would be difficult. Another feature of the new meter is its high sensitivity and wide voltage range (0.7μv to 1000 v.) Its frequency range is 20 CPS to 250 KC.—**Millivac Instrument Corp., 444 Second St., Schenectady 6, N. Y.**—TELE-TECH.

Pulse Transformer

The PT-1 is a versatile pulse transformer for the microsecond and fractional microsecond ranges, and is also useful in blocking

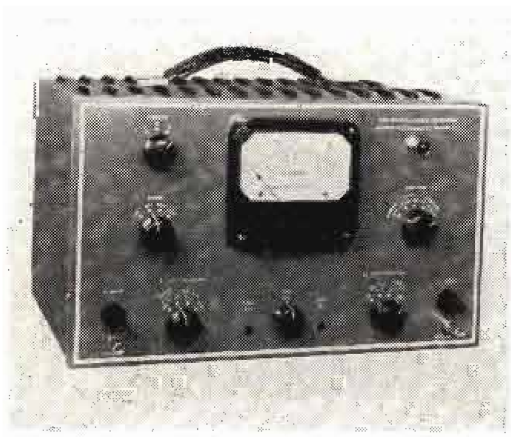
oscillators and other pulse circuits. It is compact and convenient to use, being built in an octal tube base. Its windings comprise six sections, of which two pairs are connected in series; the other two are individually connected to base pins. Windings are made with #36 wire with 50 turns each section. Overall dimensions are: diameter, 1.372 in. max.; height 1.107 in. max.; overall height, 1.657 in. max. Price: $8.95—**Berkshire Laboratories, 518 Beaver Pond Road, Lincoln, Mass.**—TELE-TECH

Toroidal Windings

Improved winding techniques characterize the manufacture of a new line of toroidal coils. High Q inductor requirements of miniaturized apparatus may be met readily when these coils are used. Both powdered-iron and continuous strip-wound core material are utilized, depending upon the particular application.—**D & R Ltd., 402 E. Gutierrez St., Santa Barbara, Calif. (affiliated with G. M. Giannini & Co., Pasadena, Calif.)**—TELE-TECH

Phase Meter

Type 404 phase meter gives direct, accurate reading in degrees between two alternating voltages of any waveform, symmetri-

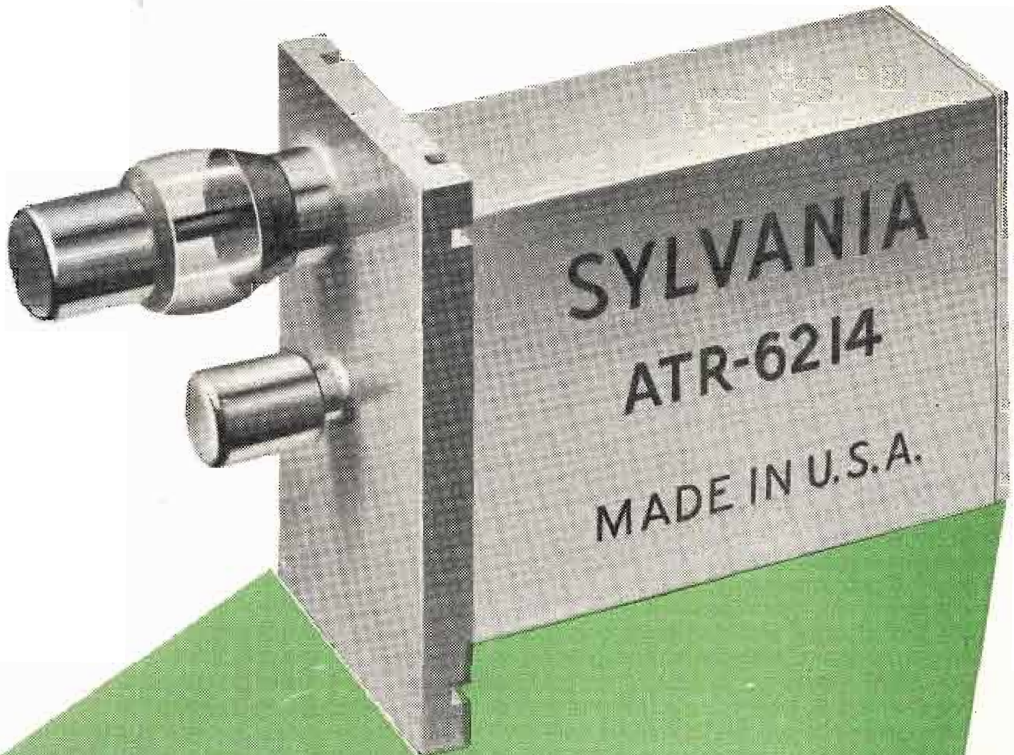


cal or unsymmetrical, from 100 KC down to zero CPS. A new circuit known as "Advancetron," permits the comparison of phase difference between two alternating voltages at the exact instant when their waveforms intersect with the x-axis. As a result, the input voltages can be rectangular, exponential sawtooth, sinusoidal, or any symmetrical or unsymmetrical waveform. Because only direct comparison between voltages takes place in the instrument, there is no limitation on the low end of the operating frequency—**Advance Electronics Co., P.O. Box No. 394, Passaic, N. J.**—TELE-TECH

SYLVANIA CHALKS UP

Another First

Now an Instant-Firing ATR TUBE



Sylvania proudly announces a new Instant-Firing ATR Tube, Type 6214.

This tube now makes possible for the first time, the operation of a Beacon Radar from a single antenna. Previously, reliable Beacon operation required use of two separate antennae—one for receiving and one for sending.

The New Sylvania Tube permits a Beacon to "clear its throat" immediately and answer a received signal instantly by transmitting a reply signal—OVER THE SAME ANTENNA. It opens the way to new and more compact designs resulting in worthwhile savings in equipment manufacture.

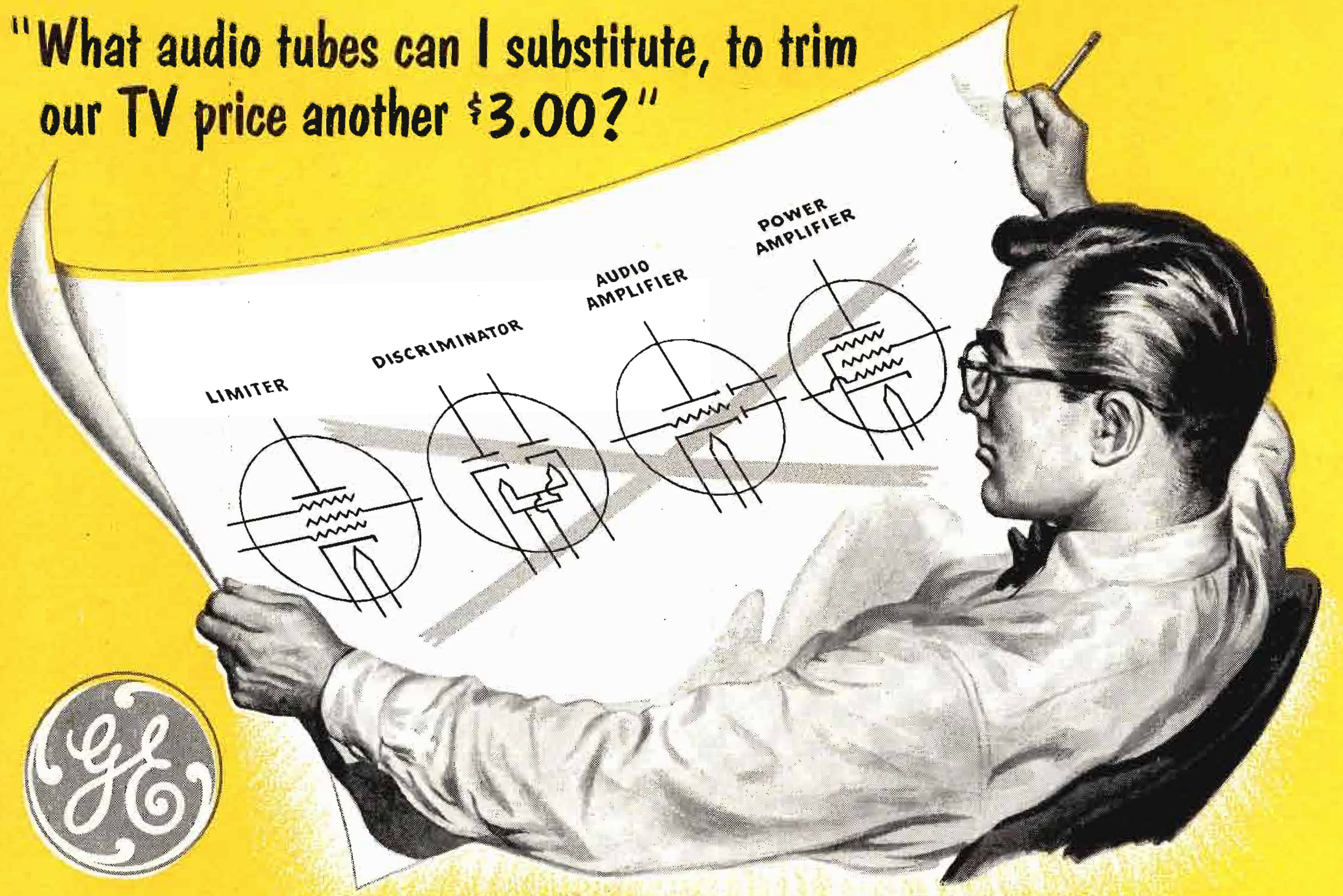
This new component is just one more example of the constant research and engineering skill which has established Sylvania's leadership in electronic development.

For data concerning the ATR-6214 or any other Sylvania Microwave Tube, write today to: Sylvania Electric Products Inc., Dept. E-3507, 1740 Broadway, New York, N. Y.

SYLVANIA

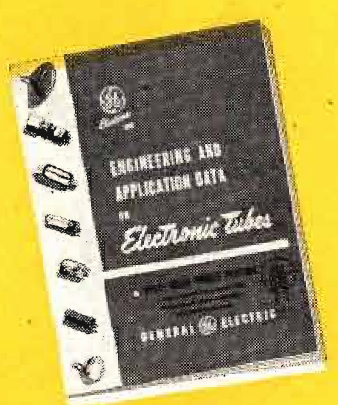
ELECTRONIC DEVICES; RADIO TUBES; TELEVISION PICTURE TUBES; ELECTRONIC TEST EQUIPMENT; FLUORESCENT TUBES, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; PHOTOLAMPS; TELEVISION SETS

"What audio tubes can I substitute, to trim our TV price another $3.00?"



6BN6
Combined limiter, discriminator, and audio amplifier

6BK5
High-sensitivity power tube, designed for use with 6BN6



New G-E pair does work of 4 tubes!

SAVES TV COST, MAINTAINS QUALITY PERFORMANCE!

The 6BN6-6BK5 audio pair helps solve your chief problem, Mr. Designer—how to bring prices *down*, keep performance *up*, in a TV market that's strongly competitive.

Fine reception: you retain it because General Electric custom-designed the new 6BK5 power pentode to team up with its companion, the 6BN6. High sensitivity . . . plenty of clear audio output . . . are 6BK5 features. The new pentode will produce up to 3½ watts of audio, yet is so sensitive that only 5 volts peak is needed to drive the tube into distortion.

Cost saving—both in tubes and components—is a product of the 6BN6's versatility. This gated-beam tube is a real "triple-threat" performer, serving simultaneously as limiter, discriminator, and audio amplifier.

More TV sets sold, better-satisfied customers . . . that's how the 6BN6 and 6BK5 pay off for you! Booklet ET-B35 describes the tubes fully. Phone, wire, or write for it! *General Electric Company, Tube Department, Schenectady 5, New York.*

GENERAL ELECTRIC

162-1A4

Signal-to-Noise

(*Continued from page 63*)

a decade or two in the region of unity input signal-to-noise ratio.

For an input signal-to-noise ratio of around 2, the output signal-to-noise ratio for a linear detector is about 2.5 db better than the parabolic detector. In the same region and for certain input amplitudes, the semicubical detector is about 1 db better than a linear detector. For a particular input amplitude a clipped square-law detector was about 2 db better than a linear detector.

For input signal-to-noise ratios of 0.1 or less there is no appreciable

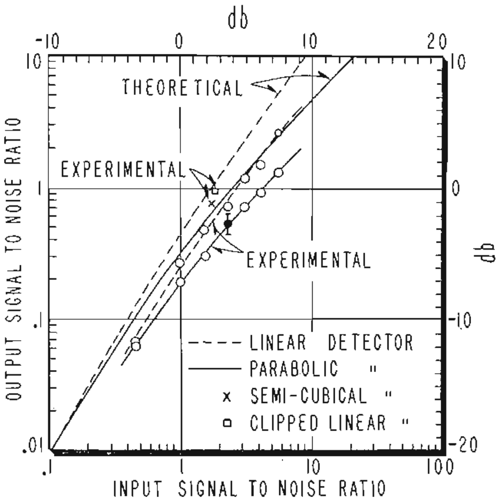


Fig. 7: Theoretical and experimental input-output characteristics of linear and parabolic detectors. An experimental point for a semi-cubical and one for a linear detector shown

difference in the output signal-to-noise ratios of linear and parabolic detectors. Experimental results indicate that this is probably true for semi-cubical detectors.

Theoretical analysis of semi-cubical and clipped linear detectors is so complicated and tedious that it is probably not profitable to pursue. This is particularly true since the experimental results indicate that output signal-to-noise ratio improvement, over a linear detector, is probably only a matter of 1 or 2 db for an input signal-to-noise ratio of about 2. Furthermore, the output signal-to-noise ratio of semi-cubical and clipped linear detectors depends on input amplitude, not desirable in practical applications.

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[1] S. O. Rice, "Mathematical Analysis of Random Noise," **The Bell System Technical Journal**, vol. 23, pp. 282-332, July 1944; vol. 24, pp. 46-156, Jan., 1945.
[2] Vernon D. Landon, "The Distribution of Amplitude with Time in Fluctuation Noise," **Proc. I.R.E.**, vol. 29, pp. 50-55, Feb. 1941.
[3] W. R. Bennett, "Response of a Linear Rectifier to Signal and Noise," **Jour. Acous. Soc. Amer.**, vol. 15, pp. 164-170, Jan. 1944.
[4] J. R. Ragazzini, "Effect of Fluctuation Voltages on the Linear Detector," **Proc. I.R.E.**, vol. 30, pp. 277-288, June 1942.
[5] David Middleton, "Rectification of a Sinusoidally Modulated Carrier in the Presence of Noise," **Proc. I.R.E.**, vol. 36, pp. 1467-1477, Dec. 1948.
[6] David E. Sunstein, "Photoelectric Waveform Generator," **Electronics**, vol. 22, pp. 100-103, Feb. 1949.

This paper was first presented before the National Electronics Conference in Chicago, Ill., Oct. 22-24, 1951.

TELE-TECH's NEWSCAST

Low Priced Computer in Production

Computer Research Corp., 3348 W. El Segundo Blvd., Hawthorne, Cal., has recently announced increased production facilities for the manufacture of a new low priced general purpose computer, the CADAC 102A. Seven month delivery from the date of receipt of order is expected. Price of the CRC 102, including Flexo-Writer and control panel is $52,000, exclusive of taxes, FOB Hawthorne. An auxiliary magnetic memory tape unit sells for $12,000. Three financial arrangements are offered: 1) Outright Purchase; 2) Finance plan at standard interest rates; and 3) Lease with option to purchase, including service guarantee.

Cedar Rapids IRE Conference, Sept. 19-20

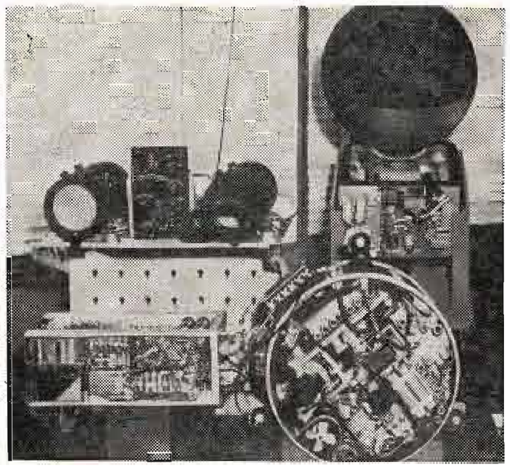
The Cedar Rapids Section Institute of Radio Engineers will hold a Conference on Communications in Cedar Rapids, Iowa, September 19-20. This will be a two-day meeting and the officers anticipate having a registered attendance of about 400. Activities will include plant tours, exhibits, luncheon, banquet, and technical papers. Following the keynote address by Arthur A. Collins, President Collins Radio Company, the following will present papers:

Dr. I. S. Coggeshall, General Traffic Mgr., Western Union Telegraph Co., "The Transmission of Intelligence in Typescript"; Murray G. Crosby, President, Crosby Laboratories, "Long-Range Communication Trends"; Dr. R. M. Page, Associate Director of Research for Electronics Naval Research Laboratory "Comparative Study of Modulation Methods"; L. Morgan Craft Vice-President, Collins Radio Company, "Design Trends in Communication Equipment"; George Q. Herrick, Chief, Division of Radio Facilities, Plans and Development, Broadcast Service, U. S. Dept. of State, "The Voice of America in the Electronic War"; Al Graf, Chicago Patent Attorney, Director of Region 5, "Comments on Region 5 Activities."

Radar Set for Aircraft Navigation in Production

Production of the new An/APS-42 collision radar system has been announced by RCA. Presently being produced solely for the military, it should prove highly suitable for commerical applications. At the pilot's selection, the signal from the antenna can be transmitted within a 200-mile range either in the form of a pencil beam for obstacle detection and general search, or in the form of a vertical fan for terrain mapping and navigation. As a weather indicator, this radar shows the position of thunderheads and other cloud formations.

Weight of the device is 173 lbs. before installation and 250 lbs. installed. It is pressurized to operate at altitudes up to 50,000 ft. The antenna is mounted on a gyroscope-controlled platform, permitting the reception of radar reflections to be unaffected by plane pitch and roll.



AN/APS-42 radar equipment comprises four groups: (t-l) indicator scopes and control box; (t-r) antenna reflector and stabilizing platform; (b-l) synchronizer; (b-r) transmitter and receiver. Total installed weight, 250 lbs.

CUFFLINKS AND CANDLESTICKS MARK SILVER ANNIVERSARY

A presentation of silver cufflinks to top officials of Littelfuse, Inc., Chicago, Ill., marks the 25th year of the company's activity in the industry. Silver candlesticks symbolized the silver anniversary celebration. Shown above are (l to r) Jack Hughes, vice-president; Tom Blake, executive vice president and treasurer; Bob Abbott, ad manager; Ed Sundt, president; and Herb Cornelius, sales manager

Coming Events

August 19-22—1952 APCO Conference, Hotel Whitcomb, San Francisco, Calif.

August 26—September 6—British National Radio Show, Earls Court, London, England.

August 27-29—Western Electronic Show & Convention, WCEMA and IRE, Long Beach, Calif.

September 8-12—ISA, 7th National Instrument Conference and exhibition, Cleveland Auditorium, Cleveland, Ohio.

September 19-20—IRE Conference, Cedar Rapids Section, Cedar Rapids, Iowa.

September 22-25—NEDA, 3rd National Convention, Ambassador Hotel, Atlantic City, N. J.

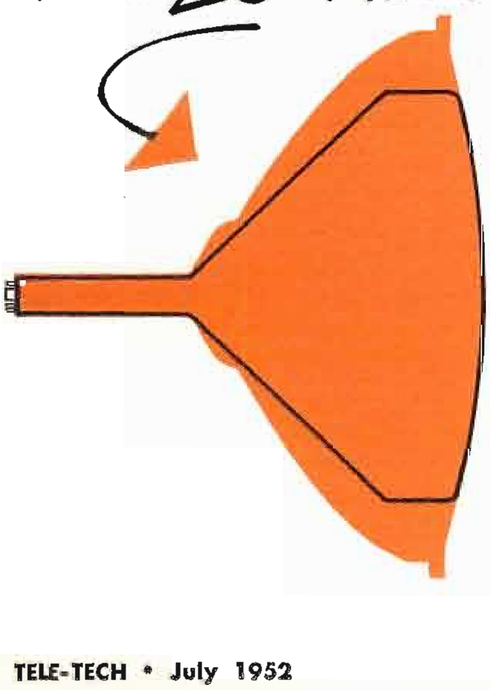
September 29-October 1—Eighth National Electronics Conference and Exhibition, Sherman Hotel, Chicago, Ill.

October 5-10—SMPTE, 72nd Convention, Hotel Statler, Washington, D. C.

October 21-23—1952 RTMA-IRE Fall Meeting, Syracuse, N. Y.

APCO: Associated Police Communication Officers
IRE: Institute of Radio Engineers
ISA: Instrument Society of America
NEDA: Nat'l. Electronic Distr. Assoc.
RTMA: Radio-Television Mfrs. Assn.
SMPTE: Soc. of Motion Picture and TV Engineers
WCEMA: West Coast Electronic Mfrs. Assn.

Actually shorter than 20" tube!



On March 3, Rauland unveiled the first "giant-screen" tube that makes attractive cabinetry possible.

This new 27" tube, with 390 square inch picture area, minimizes cabinet problems in two ways. First, it has the compactness of rectangular rather than round cone and face. Second, by means of 90° deflection, depth has actually been held slightly shorter than present 20" tubes!

The tube employs Rauland's usual "reflection-proof" filter glass face plate with maximum reflection of only 2½% of incident light. It uses the Rauland tilted offset gun with indicator ion trap. It is offered with either magnetic or low-focus-voltage electrostatic focus. Weight is held at minimum by use of a metal cone.

If you want a picture of really spectacular size that can be housed in acceptable furniture, here is your answer.

A picture actually more than 70 sq. in. larger than the center spread of a tabloid newspaper. Rectangular for minimum cabinet height and width. And actually permitting a small reduction in depth from today's 20" cabinets!

THE RAULAND CORPORATION

Perfection Through Research

4245 N. Knox Avenue, Chicago 41, Illinois

MODE INTERACTIONS

(*Continued from page 41*)

using the expression $i = av - bv^3$ to relate current and voltage in the active portion of the circuit. There is no reason to believe that current, either in a triode or in a magnetron equivalent circuit is proportional to $-v^3$ for large values of v. Therefore, a solution was carried out in which it was assumed that i approached a maximum value as v became large,

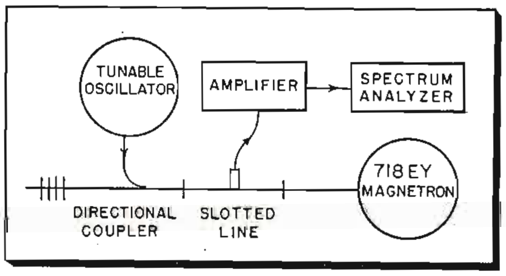


Fig. 5: Mode interaction experimental circuit

while at the same time it was directly proportional to v when v was small. A convenient function with these characteristics is $i = a \tanh bv$.

Results which arise from the use of the function are of the form shown in Fig. 4. The shape of the contours is altered but the kind of results is not.

The most important result which comes from applying this kind of nonlinear circuit theory to magnetrons is that large amplitude oscillation in one mode has a strong tendency toward discouraging oscillation in other modes. It is particularly significant that the effect of the amplitude in one mode has more effect upon the rate of build-up of another mode than upon its own rate of build-up. This is demonstrated clearly by Eq. (1) and (2); for example σ_1 is affected even more by the value of V_2 than by V_1. This condition is one which Rieke assumed in describing mode competition during build-up. It is a necessary one if stable oscillation in two modes simultaneously is not to be possible. Simultaneous stable oscillation in two modes has rarely, if ever, been observed.

Mode Interaction Experiments

In order to measure the effect of large amplitude oscillations in one mode upon resonances in another mode, an experiment was set up to measure the loaded Q of one mode of oscillation by small signal cold test methods during operation in another mode. The r-f circuit used in such an experiment is shown in Fig. 5. The small amplitude signal, synchronized to be injected into the system only during the steady state portion of the magnetron output, is injected through a directional coupler. The swr measurements were made with the aid of a klystron amplifier and a spectrum analyzer; these two sharply tuned amplifiers were sufficient to suppress the large amplitude signal generated by the magnetron.

The magnetron oscillated in the π mode ($n = 4$) at 10.9 cm.; the resonance measured by small-signal methods corresponds to $n = 3$.

The results of these swr measurements are shown in Fig. 6. The curve (1) is for normal cold resonance; curve (2) is made with 1.1 amp. peak current and with no coherent oscillation; curves (3) and (4) are with π mode oscillation present, and with 7 and 10 amp., respectively. Loaded Q's corresponding to curves (1), (2), (3) and (4) are respectively 285, 95, 86, and 40. Similar results for another specimen of the same type were extended to a condition in which there was a large anode current, but no coherent oscillation. The resonance curve and the calculated loaded Q were comparable with the second curve in the slide, which represents another nonoscillating state.

Presence of Space Charge

These results show that the presence of space charge loads the resonance in question; they also show that the presence of oscillation in another mode loads it much more. In other words, the results support the nonlinear theory discussed here, in that large amplitude oscillation in one mode tends to suppress oscillation in any other mode.

The theory under discussion has been supported indirectly by observations of mode change performance in several magnetrons. In one of these tests, a sawtooth voltage pulse was applied to the anode of an 18-vane rising sun magnetron. Three modes of oscillation were observed. It was possible selectively to load any one of these modes by a resonant circuit without affecting any other. In each of these transitions, with either rising or falling voltage, it was observed that the conditions for mode change depended primarily on the failure of the first mode in the transition, and not upon the second building up and suppressing the first. Thus, the first mode suppresses the second one until the first one fails for causes apart from interference by the second mode.

The second example is a transition from a low voltage mode to the π mode in a commercial 10 cm magnetron. In this case it was observed that the conditions for mode change from the weakly oscillating low voltage mode to the π mode were influenced by conditions in the π mode. This is different from the results obtained in the magnetron mentioned before. However, in that magnetron, each of the three modes oscillated with comparable intensity; in the latter magnetron, the π mode was much stronger than the initial mode. However, it was quite clear that the starting of oscillation in the π mode was delayed substantially by the presence of oscillation in the low voltage mode.

Third Magnetron Type

In a third magnetron type, attempts to observe mode transitions were unsuccessful. As current input was increased further and further, voltage at which π mode oscillation was still stable became higher and higher, finally exceeding the theoretical threshold voltage of a higher voltage mode without any sign of oscillation in the latter mode. Oscillation in the π mode was stopped only by dc cutoff. Here is another example of possible oscillation in one mode being suppressed by large amplitude oscillations in another mode.

The principal idea which has come from this research is that large amplitude oscillation in one mode

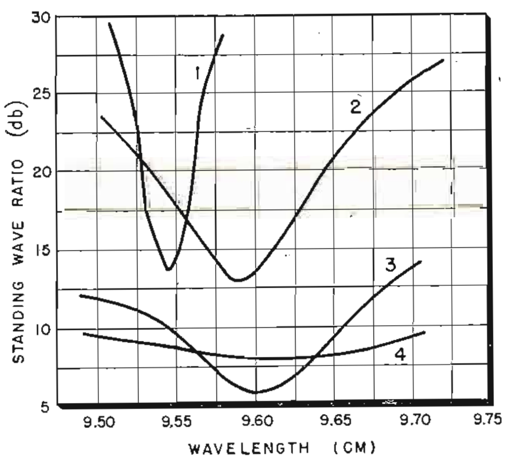


Fig. 6: SWR measurements of 718EY magnetron in n=3 mode. (1) No anode power (2) Peak anode current=1.1 amp., no oscillation. (3) Peak anode current=6.8 amp., π mode oscillation. (4) Peak anode current=9.9 amp., π mode oscillation. Magnetic field 1220 gauss each case

tends quite strongly to suppress oscillation in other modes. This supports the mode competition theory by Rieke. On the other hand, it contradicts all mode stability and mode change criteria based primarily on the effects of other modes upon a

(*Continued on page 88*)

As old as

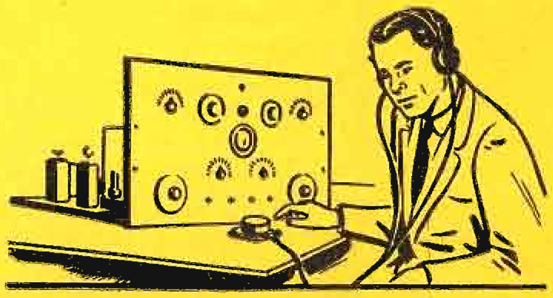
RADIO

yet as young as

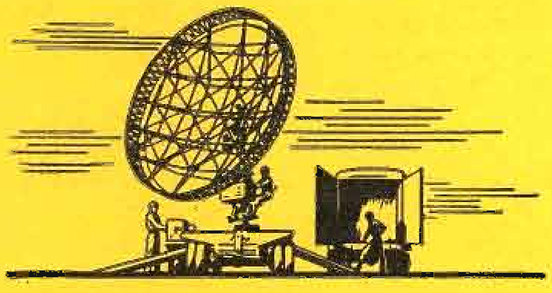
ELECTRONICS...

AEROVOX

CAPACITORS

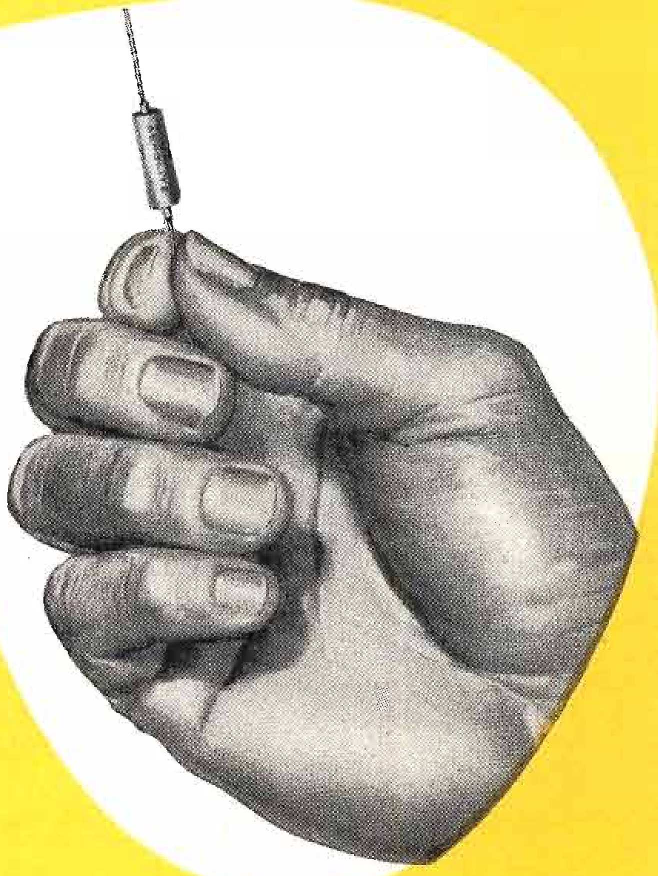


1922 At the very dawn of radio—30 years ago, Aerovox came into being to meet capacitor needs. Pioneer radiophone transmitters and earliest radio receivers specified Aerovox capacitors. Such collaboration has continued down through the first three decades of radio-electronic progress.



1952 Today, giant atom-smashing betatrons . . . radar gear spotting unseen targets . . . transoceanic radio-guided rocket bombs . . . world-wide radio communications . . . electronic computers reducing thousands of calculation man-hours to mere seconds . . . the modern miracle of television—for all facets of the Electronic Age, Aerovox capacitors are still engineered to customer specifications.

Indeed, from tiny precision "ceramics" and metallized-paper "space-savers," to giant power-handling "oils" and "micas," Aerovox remains the time-proven source for ALL capacitor needs.



Sub-miniature vitrified ceramic terminal end-seal Type P123ZN Aerolene-impregnated metallized-paper tubular capacitor.

AEROVOX CORPORATION

NEW BEDFORD, MASS.

Hi-Q® DIVISION OLEAN, NEW YORK **WILKOR** DIVISION CLEVELAND, OHIO

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STATION BREAK ANNOUNCER

(*Continued from page 47*)

time but the half hour break times.

Experiments were begun some months ago to develop a relay circuit, the operation of which depended upon the cessation of an average program level, but with a time constant long enough to prevent operation on the average pause in a program. The circuit shown may be constructed to operate at any initial time delay desired, and to hold the circuit for any period up to thirty seconds which is the length of the network station break maximum time.

Circuit Operation

The circuit operates in the following manner: Upon the conclusion of a program, the IN34 crystal ceases to supply voltage to the integrator circuit, which at the end of from 5 to 10 seconds has discharged the 0.5 µf condenser, allowing the relay tube to draw current, closing relay #1. This closes the latching relay #2, providing that relay #4 is open. The latching relay applies power to the tape playback motor, starting it with practically no inertia.

The playback amplifier is left on, eliminating warm up time. The latching relay also closes relay #3, which removes the regular program line from the FM transmitter and applies the output of the tape playback. This relay also has a set of contacts which operate a remote indicating light for operator's supervision in another part of the building. A pair of connections for a remote disabling switch is also supplied, so that the operator may eliminate a station break announcement if for any reason it becomes necessary.

When the tape recorder motor is started, the 25 second time delay circuit is put into operation. This depends upon the slow heating of an undervolted triode heater. The heater voltage and thus the delay time is adjusted by a rheostat in its heater circuit. The delay time may be set anywhere from 3 to 30 seconds. When this tube conducts, it pulls in plate relay #4, which applies power to the "unlatch" coil of the latching relay. This in turn returns the regular program circuit to the FM transmitter, and cuts off the Ampex tape playback motor. Relay #5, in conjunction with the resistor in the heater circuit of V2 (6SF5), offers a delay to the re-operation of the complete circuit until the timer motor safety device has disabled the relay circuit or the program is resumed on the network.

It is wise to have the mechanism rejoin the network about 5 seconds before the program on the net line is resumed, in case there should be any time lag which could possibly become cumulative over a long time, causing the equipment to join the net late.

The relays used in the unit, with the exception of the latching relay were all inexpensive stock parts. It was necessary to construct a 12 volt dc supply. This was done with an ordinary 500 ma. selenium rectifier and two 1-amp. 6.3 v. filament transformers, which when added to the 6,3 v. winding on the power transformer, give the necessary 19 volts ac. Of course, a single transformer could be used for this application, but they are rather hard to find and probably would be more expensive than the two small units.

The bridging transformer used is

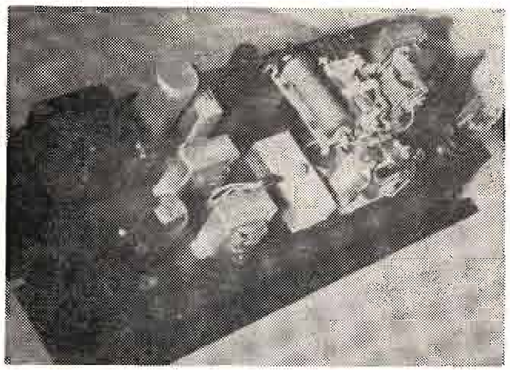


Fig. 3: Photograph of the automatic announcer

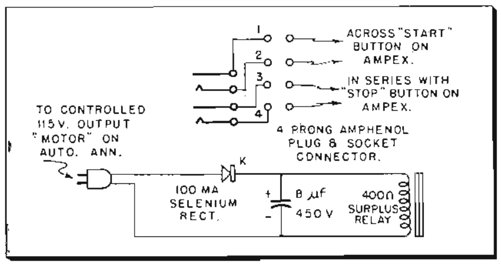


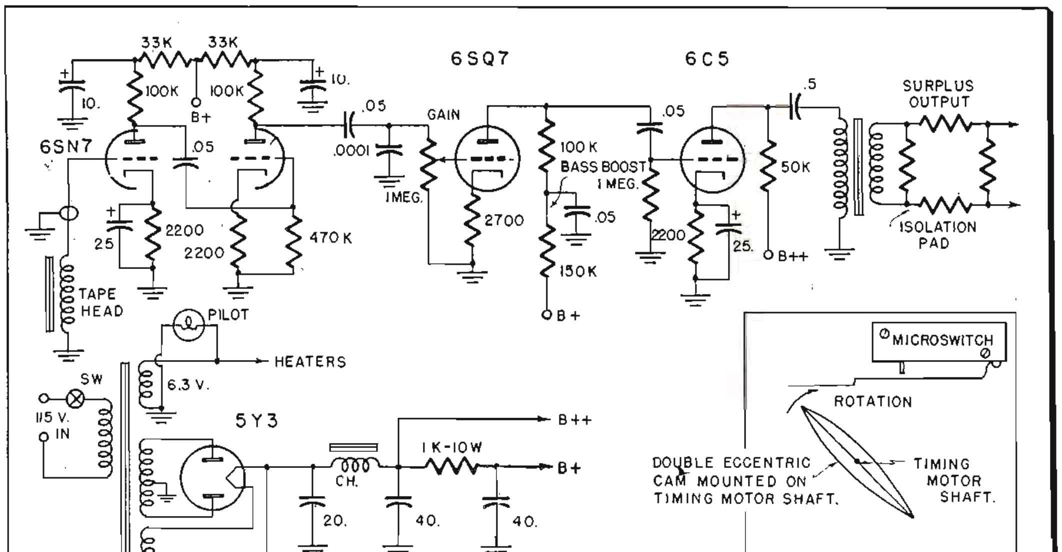
Fig. 4: Stop-start device adapts Ampex Model 401A for use with the station break announcer

an interstage audio transformer with a primary impedance of 10,000 ohms and a secondary of 90,000 ohms. It is wise to keep it as far away as possible from any 60 cycle components as the hum pickup might become troublesome.

Safety Devices

The time clock safety device consists of a timing motor, with a double eccentric cam, (actually an ellipse) which actuates a sensitive switch twice each hour for a period of about a minute and a half. The motor shaft makes one revolution per hour. This allows the automatic device to operate only during a minute and a half on the half hour. The long time period was chosen to prevent any trouble which might be caused by a low or higher power line frequency causing the timing motor to actuate either a little early or late. Even synchronous radio clocks sometimes run as much as a half minute slow or fast because of this slight frequency deviation in the power lines.

Fig. 2: Tape playback amplifier and time device which permits announcement only at half-hour breaks



[1]"Remcte Control System for FM Broadcast Stations," Part I, TELE-TECH, Aug. '51, p. 32
"Remote Control System for FM Broadcast Stations," Part II, TELE-TECH, Sept. '51, p. 44

New Company Division

Hoffman Radio Corp. has announced the establishment of Hoffman Laboratories, Inc., a wholly-owned subsidiary, at 3761 S. Hill St. and 3716 S. Grand Ave. in Los Angeles, and 335 S. Pasadena Ave. in Pasadena. The Laboratories are presently fulfilling military contracts, including the "acorn" transmitter for field communications, and the URC-4 transmitter-receiver for air-sea rescue work.

WASHINGTON
News Letter

Latest Radio and Communications News Developments Summarized by TELE-TECH's Washington Bureau

BIGGEST TASK—Undoubtedly the biggest task in the history of the FCC since its creation in July, 1934,—the processing of the approximately 1,000 applications for new television stations—will be launched July 1, almost on its eighteenth anniversary. The granting by Congress of an additional $600,000 appropriation for the enlargement of its staff of hearing examiners, attorneys, engineers and clerical personnel for the sole purpose of handling the hearings and processing the TV applications, should expedite the FCC's determinations of the new video stations throughout the nation. But while this increases the "teams" for TV hearings from seven up to fifteen, it will take a long period of time for final authorizations by the Commission.

OUTLOOK FOR GRANTS—At the best the Commissioners and the FCC staff will be fortunate to complete the 1,000 or so present application cases by the end of the next fiscal year on June 30, 1953. One important pledge has been made by the FCC Commissioners, particularly by Chairman Paul A. Walker and Vice Chairman Rosel Hyde, that no discrimination will be made against any TV station applicant because of affiliation with newspapers or with existing AM broadcast stations, and that educational organizations will have to fulfill the same rules of the FCC as commercial telecasters of starting the construction of stations in two months after a grant and completion within eight months.

DISCRIMINATORY PROPOSAL—What would be a financial burden on the fast-growing television industry is the proposal of the Senate Appropriations Committee that the FCC investigate "the requirements for the initiation of fair and equitable fees and charges in connection with the licensing of television stations." Since no other communications services nor broadcasting was mentioned by the Senate Committee, the discriminatory aspects of the proposal were felt sufficient to defeat the idea. But it did show the trend of thinking in Congress which last year ordered the FCC and all other federal regulatory agencies to study the possibility of charging fees for their services to the regulated companies under their jurisdiction.

MOBILE RADIO IMPORTANCE—The importance of the safety and special radio services to the national defense, to the safety of the public and to vital industries, was stressed before Congressional committees recently by FCC Chairman Walker and Commissioners E. M. Webster and George Sterling because of the paucity of funds for this function of the Commission. Serious backlogs and delays in the processing of the mobile radio stations, which are growing at an enormous rate are most apparent. The FCC leadership is fearful that the great value and development of these services will be seriously injured.

RELAY RULES HEARINGS—One of the most important hearings in FCC, although completely neglected by the press, was that on the formulation of new Commission rules governing the licensing of mobile relay stations in the industrial and land transportation radio services. Conducted by Commissioner Robert T. Bartley as his first case, a major issue was whether control stations in mobile relay systems should be permitted to operate on mobile service frequencies. Dr. Daniel E. Noble, Motorola Communications-Electronics Vice President, was principal spokesman at proceedings on practical needs of the mobile systems.

COMPONENTS DEMAND FROM MILITARY—The demand by the armed services for electronic components is expected to increase steadily until early 1953 and then level off and continue at a constant rate through 1955, it has been authoritatively forecast by the Defense Department. It is expected there will be a substantial increase in armed services' procurement orders for components in the third and fourth quarter of this year.

MISCELLANY—FCC, faced with crushing load of new television station applications' processing, has now set controversial theater television hearing for Jan. 12, 1953, which should give time for possible "meeting of minds" between telecasters and motion picture industry . . . Most comprehensive and undoubtedly most accurate technically, study on the conservation of the radio spectrum is to be issued for distribution in mid-July by the Joint Technical Advisory Committee. The report, drafted by twenty-five leading authorities on radio and electronics after more than a year's intensive work, contains an ideal frequency allocation plan to be used as a guide and reference source in planning future frequency allocations.

National Press Building
Washington, D. C.

ROLAND C. DAVIES
Washington Editor

PRODUCTION TEST

(*Continued from page 46*)

nected, part of the high level attenuation is done with the use of R-4 in series with the 75 ohm receiver input impedance. Since this is shunted by 15 ohms, opening or closing the receiver termination has no effect on the circuit with change in load. R-11 is used to adjust signal level for "fringe area" tests to prescribed levels. Since lines from here to the sets are very short, there is no necessity for careful output terminations.

This same type of signal distribution is used for a 100 KC square wave signal used in checking video amplifier response, and a Channel 3 square wave modulated signal used for DuMont's exclusive "Pulse" alignment of the i-f chain. Another system is used for signals of smaller frequency spread.

Narrowband Distribution System

On all single frequency signals, and on the sound wobbulated signal, having an overall signal spectrum of less than 1 MC, it was realized that the lines need not have as precise a termination over wide frequency ranges. For these signals, a much less costly method of distribution known as "Needling" the lines was used.

It may be pointed out at the outset that on a purely theoretical basis, this system leaves much to be desired. The system was arrived at through a process of evolution and failures and does the job very well in practice. Fig. 7 shows a schematic of the system for distributing single frequency and narrowband signals.

In this system, the output of the generator is fed into a one-in-eight-out resistive distribution pad. The minimum loss pad serves to distribute the output of one incoming transmission line among eight outgoing lines with a corresponding drop in signal level. In designing the pad, it is necessary to terminate all lines into their surge impedance.

The distribution pad is shown schematically in Fig. 8. It consists of nine equal resistors, each in series with the center conductor of its incoming cable, and all connected together at the other end. Outer conductors of all cables are grounded together.

The value of each resistor is obtained from the general relationship $R = (1 - 2/N)\ R_0$ where R = resistance in ohms, N = no. of cables connected to box, and R_0 = surge impedance of line.

For 72 ohm cable, R-1 is 56 ohms in a one-in-eight-out box.

Each output of the pad is connected via RG-12/U coax cable to the area it is to service. The cable is run alongside the benches and taps are run to each bench from the main cable. With this system, as many as 20 outputs have been obtained from each line. The tap-off point is a fixture shown in Fig. 9 and schematically in Fig. 10. A hole is opened in the cable large enough to expose the inner conductor. An ordinary phonograph needle is driven into the inner conductor to make good contact. The other end of the phonograph needle is soldered to resistor R-2 and, in turn, is connected to the center connector of an RG-12/U feeder line. Ground is obtained by fastening the "needle housing," Fig. 9, to the main outer conductor, and this is connected to the feeder line outer conductor. The other end of the feeder line is terminated in 75 ohms at the test bench it is to service with the circuit shown in Fig. 11. The load output jack is used to feed signal to the test operator.

The value of resistance R-2 in Fig. 10 depends upon the number of taps to be made in the line. If N = no. of taps, R_0 = surge impedance of line, then $R\text{-}2 = R_0\ (N + 1)$.

The "1" factor is used to include the resistance of the final termination. Looking at the line, it is seen that if there were no standing waves in the main line after the "needling," the effective load impedance at the first tap-off point would equal the surge impedance. Up to this point along the line, there would be no reflections. At each succeeding tap, the mismatch would become larger and at the last tap, the swr should be very high. In practice, the final terminating resistor is adjusted to minimize this swr in the manner previously described, and it has been found, if the taps are not too closely spaced (about 8 ft. apart minimum), the result is quite tolerable.

Fig. 8: Resistive distribution pad attenuates and terminates lines in their surge impedances

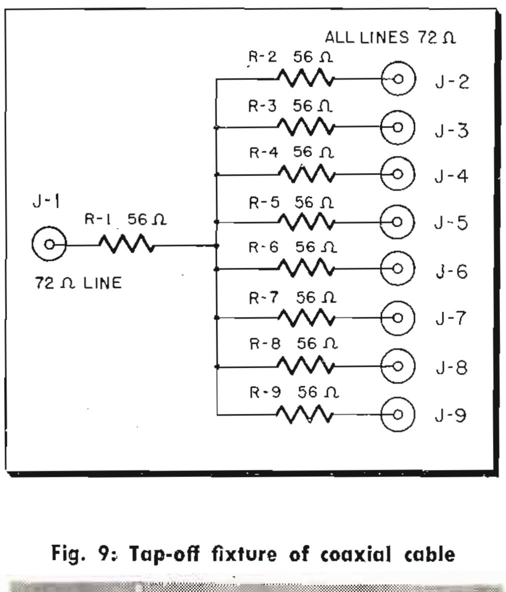
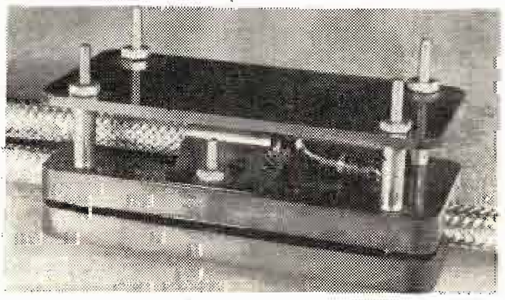


Fig. 9: Tap-off fixture of coaxial cable



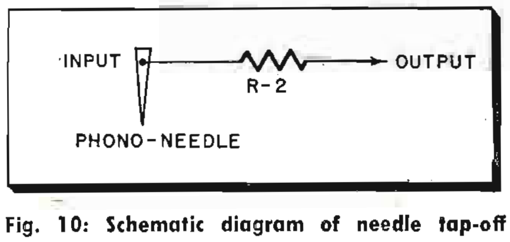


Fig. 10: Schematic diagram of needle tap-off

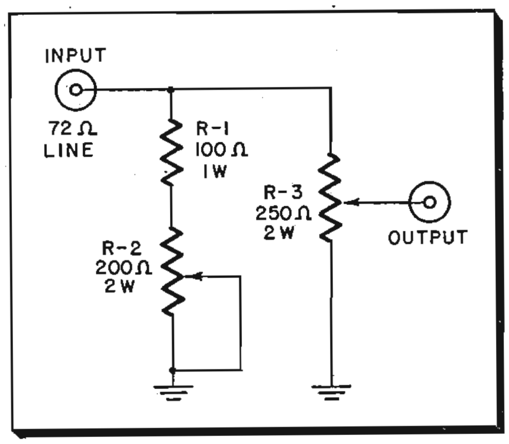


Fig. 11: Narrowband bench termination circuit

Series of Experiments

A series of experiments preceded this final arrangement of line tap-offs. Originally, Tee connectors were used for this purpose. However, they were found to be incapable of adjustment to low swr. The original thought was that they introduced non-constant impedance into the line. To overcome this, a complicated procedure was undertaken to cut the main cable, introduce another piece with special care to interrupt the cable contours as little as possible. This involved splicing two cables together after carefully shaping the ends to have them meet perfectly. Then all conductors were soldered at all points, and the final splice carefully taped. Despite all efforts, this difficult process fared no better than had its predecessor.

While investigating a simple method of sampling line voltages, the final method was discovered. It has been used successfully ever since. It must be pointed out that some

(*Continued on page 95*)

READIN'-'RITIN'-'RITHMETIC

KNOW YOUR THREE Rs when it comes to Tubes for Industrial, Military and Transportation service

RAYTHEON RELIABLE RUGGEDIZED

Look at the chart. Keep it for reference. It tells you better than a thousand words why RAYTHEON may be regarded as the No. 1 source of Reliable and Rugged Tubes *of all kinds.*

Type	Description	Controlled Characteristics: Shock	Fatigue vibration	Vibration output	Stabilization	Centrifugal acceleration	5,000 hour life	Heater cycle life	High temperature life	Median control	60,000 foot altitude	Proto-type	Heater Volts	Heater Ma.	Plate Volts	Plate Ma.	Grid Volts	Screen Volts	Screen Ma.	Amp. Fac-tor	Mut. Cond.
Reliable Miniatures																					
CK5654	RF Amplifier Pentode	√	√	√	√			√		√		6AK5	6.3	175	120	7.5	—2.0	120	2.5	—	5000
CK5670	Medium Mu Dual Triode	√	√	√	√			√		√		2C51	6.3	350	150	8.2	R_k = 240 ohms	—	—	35	5500
CK5686	AF-RF Output Pentode	√	√	√	√			√				—	6.3	350	250	27.0	—12.5	250	5.0	—	3100*
CK5725	RF Mixer Pentode	√	√	√	√			√		√		6AS6	6.3	175	120	5.2	—2.0	120	3 5	—	3200
CK5726	Dual Diode	√	√		√			√		√		6AL5	6.3	300	Max. Peak Inv. 330 volts. I_0 = 9 ma. dc per plate						
CK5749	RF Amplifier Pentode	√	√	√	√			√		√		6BA6	6.3	300	250	11.0	R_k = 68 ohms	100	4.2	—	4400
CK5751	High Mu Dual Triode	√	√	√	√			√		√		12AX7	6.3/12.6	350/175	250	1.1	—3.0	—	—	70	1200
CK5814	Low Mu Dual Triode	√	√	√	√			√		√		12AU7	6.3/12.6	350/175	250	10.5	—8.5	—	—	17	2200
Reliable Subminiatures																					
†CK5702WA (6148)	RF Amplifier Pentode	√	√	√	√	√	√	√	√		√	5702	6.3	200	120	7.5	R_k = 200 ohms	120	2.5	—	5000
†CK5703WA (6149)	High Frequency Triode	√	√	√	√	√	√	√	√		√	5703	6.3	200	120	9.0	R_k = 200 ohms	—	—	25	5000
†CK5744WA (6151)	High Mu Triode	√	√	√	√	√	√	√	√		√	5744	6.3	200	250	4.0	R_k = 500 ohms	—	—	70	4000
†CK5784WA (6150)	RF Mixer Pentode	√	√	√	√	√	√	√	√		√	5784	6.3	200	120	5.2	—2.0	120	3.5	—	3200
CK6021	Medium Mu Dual Triode	√	√	√	√	√	√	√	√		√	—	6.3	300	100	6.5	R_k = 150 ohms	—	—	35	5400
CK6110	Dual Diode	√	√	√	√	√	√	√	√		√	—	6.3	150	Max. Peak Inverse 420 volts. I_0 = 4.4 ma. per plate						
CK6111	Low Mu Dual Triode	√	√	√	√	√	√	√	√		√	—	6.3	300	100	8.5	R_k = 220 ohms	—	—	20	4750
CK6112	High Mu Dual Triode	√	√	√	√	√	√	√	√		√	—	6.3	300	100	0.8	R_k = 1500 ohms	—	—	70	1800
CK6152	Low Mu Triode	√	√	√	√	√	√	√	√		√	5975	6.3	200	200	12.5	R_k = 680 ohms	—	—	15.8	4000
Rugged Miniatures																					
6AK5W	RF Amplifier Pentode	√	√	√				√				6AK5	6.3	175	120	7.5	—2.0	120	2.5	—	5000
6AL5W	Dual Diode	√	√					√				6AL5	6.3	300	Max. Peak Inv. 420 volts. I_0 = 9 ma. dc per plate						
6AS6W	RF Mixer Pentode	√	√	√				√				6AS6	6.3	175	120	5.2	—2.0	120	3.5	—	3200
6C4W	RF Power Triode	√	√	√				√				6C4	6.3	150	250	10.5	—8.5	—	—	17	2200
6J6W	Dual AF-RF Triode	√	√	√	√							6J6	6.3	450	100	8.5	R_k = 50 ohms	—	—	38	5300
6X4W	Full Wave Rectifier	√	√					√				6X4	6.3	600	Max. Peak Inv. 1250 volts. I_0 = 70 ma. dc.						
Rugged GT Types																					
6J5WGT	General Purpose Triode	√	√	√								6J5GT	6.3	300	250	9	—8.0	—	—	20	2600
12J5WGT	General Purpose Triode	√	√	√								12J5GT	12.6	150	250	9	—8.0	—	—	20	2600
6SN7WGT	Dual Triode	√	√	√								6SN7GT	6.3	600	250	9	—8.0	—	—	20	2600
6X5WGT	Full Wave Rectifier	√	√									6X5GT	6.3	600	Max. Peak Inv. 1250 volts. I_0 = 70 ma. dc.						

The above listing of Controlled Characteristics is based on the requirements and test limits of the applicable JAN-1A test specification.
Note: All dual section tube ratings are for each section. *2.7 watts Class A output. 10 watts Class C input power to 160 mc.
†For simplicity of identification with the prototypes, the type numbers with a "WA" suffix were established at the request of the Armed Services to replace the type numbers in parenthesis previously announced for these types.

Over 300 Raytheon distributors are at your service on these tubes. Application information is readily available at Newton, Chicago, Los Angeles.

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RAYTHEON MANUFACTURING COMPANY
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CUES for BROADCASTERS

(Continued from page 59)

base tape currently used by the industry is subject to dimensional variations due to changes in relative humidity and temperature.

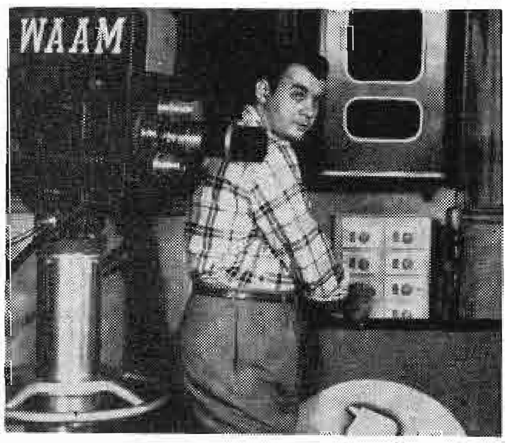
Since the standard tape speeds of 7½ in. and 15 in. per second represent 37½ ft. and 75 ft. per minute respectively, we unreeled portions of a spool of tape on the floor and with the aid of a steel rule, placed marks on the non-coated side of the tape at adjacent intervals of 37½ ft. The marks to indicate the start of a measured section of tape were made with red fingernail polish. The next mark, which was made with black india ink, indicated 37½ ft. which corresponds to one minute of playing time at the standard 7½ in. speed. The end of the next 37½ ft. interval was marked with red fingernail polish. The distance between these two red marks (with the black mark in the middle), therefore represents a playing time of one minute with the tape traveling at the standard speed of 15 in. per sec.

To make use of the test tape on a recorder or play-back mechanism, one merely needs an accurate timepiece with a sweep second hand. The tape is run through the machine and at a reference point on the machine passage of the marks is observed and the elapsed time between marks is checked with a clock or watch. If the elapsed time between marks is over a minute, the tape is slow and conversely if the elapsed time is less than a minute, the tape is running fast.

In making the test tape, sections of it were marked as described previously, near the beginning of the spool, near the middle, and also near the end, in order to provide a means of detecting changes in tape speed due to improperly adjusted supply reel and/or take-up reel clutches. Of course, a continuous series of marks throughout the length of a reel of tape would be more desirable. However, unwinding a 1200 or 2400 foot spool of tape and marking it is quite monotonous.

We hope that when a new base material with stable dimensional characteristics becomes available for general use, the tape manufacturers will consider printing standard timing marks on all tape during manufacture. Then every reel of tape will have a built-in means of checking tape speed.

REMOTE CONTROL LIGHTING



TV station WAAM, Baltimore, Md., has installed General Electric remote-control wiring to handle all of its studio lighting. The installation provides quick, silent control of 72 lighting and power circuits which are controlled by the switches shown in the small panel. The individual wires are cabled together into a long, flexible, portable cord so that the panel of remote-control switches is portable and can be transported to other sections of the stage

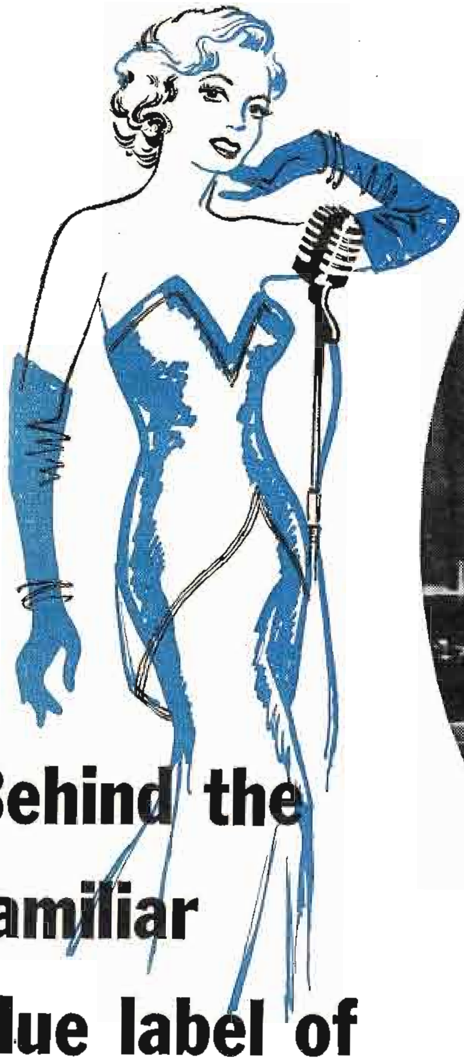
Telephone Beep Eliminator

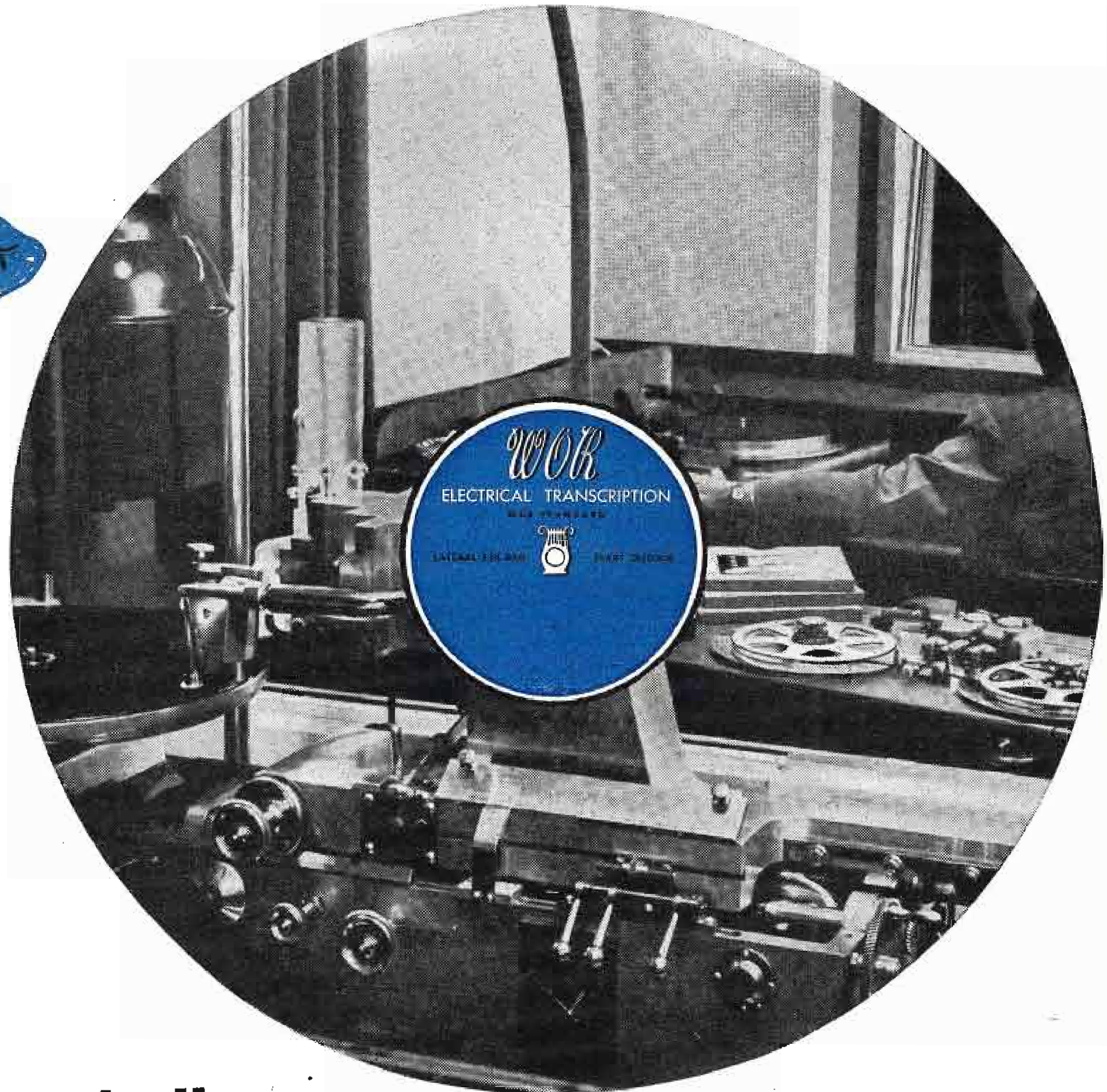
Lt. Col. W. H. MEINERS, Chief Engineer, KRIO, McAllen, Texas

BROADCASTING of the "beep" is usually an annoyance. In fact, it sometimes becomes a technical problem because some "recorder connectors" have a beep that is louder than a normal telephone conversation and if it were not for limiter action it would probably kick the transmitter off the air.

Recent FCC hearings revealed that the only purpose of the signal is to acknowledge that the conversation is being recorded and a tape may be edited to eliminate the beep before broadcasting.

The recorder schematic shows that the beep is mixed with the phone line and everything is then fed through a tube and 500 ohm matching transformer. Therefore, all parties will hear the beep regardless of what is done with it after it goes through the tube and transformer. Editing a tape for the purpose of eliminating beeps would be time wasted. Therefore, we have installed a filter for attenuating the beep. For practical purposes, one can use a parallel tuned circuit in one leg of a 500 ohm line and cut down the beep about 15 db. We had a 0.75h (high Q) coil on hand and experimented with various size condensers across it and found that tuning to the fundamental (1400 CPS) resulted in attenuation of only 3 or 4 db. As we increased the frequency of the tuned circuit attenuation increased. We finally used a .0002 µf capacity.





Behind the familiar blue label of WOR recording studios . . .

the finest in modern sound recording methods and equipment

Radio stations from coast to coast recognize this label as the mark of a top quality transcription. One that can be depended on to meet or exceed the extremely high broadcast standards of sound quality.

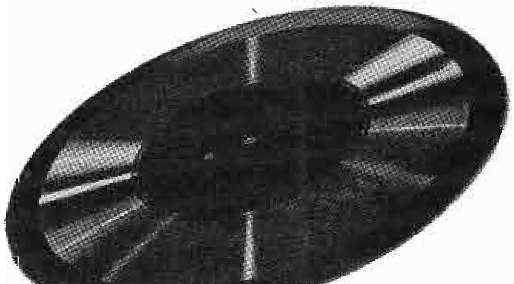
To maintain this reputation, WOR Recording Studios, one of the largest in the world, use the finest and most costly tape and disc recording equipment obtainable. And—what's equally important—their engineers have found that Audiotape and Audiodiscs are an ideal combination for meeting the exacting requirements of broadcast transcription and commercial recording work. This same record-making combination is also being used with outstanding success by America's leading producers of fine phonograph records.

With Audiotape and Audiodiscs, you can achieve this same sound perfection in *your* recording work, too. Their consistent, uniform quality is the result of more than 12 years of specialized experience by the only company in America devoted solely to the manufacture of fine recording media, both tape and discs.

. . . *including*

audiotape*

and **audiodiscs***



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Mode Interactions

(Continued from page 78)

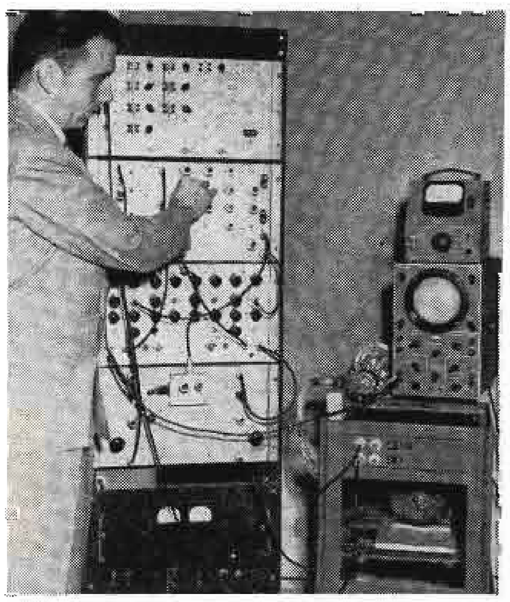
strongly oscillating mode. For example, it is not necessarily true that when the starting voltage for the next higher voltage mode is reached, the originally oscillating mode will give way to the mode with the higher starting voltage; on the contrary, if first mode is one which oscillates strongly, it is much more likely that the first one will persist, and the second will arise only after conditions are such that the first mode will collapse, primarily independent of conditions in the second mode.

It is therefore true that no fundamental limitation upon high power in magnetrons exists as a result of the possible presence of unwanted modes, provided oscillation in the desired mode can be firmly established. No fundamental limitation on high power in magnetrons could be found which is associated with mode instability, except when dc cut-off was reached; whether another limit exists or not is still open to question.

The essential requirement both for quick starting, in order to avoid misfiring, and for stability, with or without the presence of other modes, is to establish and maintain effective electron bunching in the desired mode.

The magnetron designer can control r-f feedback and therefore electron bunching, in both desired and undesired modes, through the geometry of the interaction space and through the coupling to the external load.

IMPROVED STRAIN MEASUREMENTS



Daine C. Maxwell of the Armour Research Foundation of Illinois Institute of Technology inspects the new aircraft propeller strain measuring equipment, which is three times as sensitive as previous instruments. The device just left of the oscilloscope acts as a propeller mock-up, sending out strain pulsations

ANOTHER CBS-HYTRON FIRST YOU'LL BE BUYING SOON

CBS-HYTRON 1AX2

NEW HEAVY-DUTY TV HIGH-VOLTAGE RECTIFIER CAN TAKE IT!

TV high-voltage rectifiers take a beating: Terrific variations occur in applied filament voltage . . . 0.8 to 2.4 volts! Sudden arcs in the rectifying system place destructive electromechanical stresses on the filament. And the increasingly larger TV picture tubes demand peak emission and peak inverse voltage simultaneously. The new CBS-Hytron 1AX2 was especially designed to take such rough treatment and come up smiling.

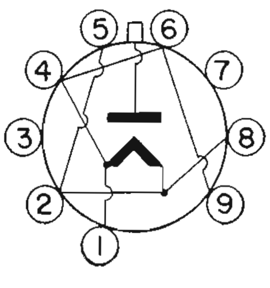
1AX2 DATA

The CBS-Hytron 1AX2 is a compact, 9-pin miniature TV pulse rectifier. Plate is brought out to top cap and filament is oxide-coated. Absolute maximum ratings are: peak inverse plate voltage, 25,000 volts; d-c load current, 1.0 ma.; and steady-state peak plate current, 11.0 ma.

Typical Operation — TV Pulse Rectifier

Filament voltage	1.4 v ± 10%
Filament current	650 ma
Positive-pulse plate voltage	20,000 v
Negative-pulse plate voltage	5,000 v
Peak inverse plate voltage	25,000 v
D-c output voltage	20,000 v
D-c load current	300 μa

BOTTOM VIEW OF SOCKET



ADVANTAGES OF NEW CBS-HYTRON 1AX2

1. Rugged, high-wattage filament of CBS-Hytron 1AX2 has adequate peak emission for the new, larger TV picture tubes. 1AX2 may be run simultaneously at both its peak inverse voltage and maximum d-c current.
2. Higher load of 1AX2 filament on transformer tends to regulate filament voltage. Eliminates need for limiting resistor. Yet lower plate-to-filament capacitance (0.7 μμf) of 1AX2 prevents loss of high voltage.
3. Insulated tension bar (patent applied for) through center of 1AX2 coiled filament limits destructive movement of filament by electromechanical stresses.
4. Filament of 1AX2 is located in base and shielded to eliminate bombardment of cool ends of filament by gas molecules.
5. An overloaded 1X2A may be replaced with its big brother, the CBS-Hytron 1AX2, by simply removing the limiting resistor. In rare cases, it may be necessary to add another turn to the secondary of the filament transformer to obtain the required 1.4 volts for the 1AX2.

MANUFACTURERS OF RECEIVING TUBES SINCE 1921
HYTRON
RADIO AND ELECTRONICS CO.
A DIVISION OF COLUMBIA BROADCASTING SYSTEM, INC.

CBS HYTRON RADIO TUBES

MAIN OFFICE: SALEM, MASSACHUSETTS

450 MC Antenna

(*Continued from page 49*)

db gain. Curve B shows the 6 element Yagi pattern, which provides 10 db gain. For these two antennas both the E and H plane patterns are almost identical. When two antennas are stacked, the radiation pattern is compressed in the plane in which stacking is done, while the other plane pattern is not affected noticeably. For a 12 element Yagi, consisting of two vertically polarized 6 element arrays spaced one wavelength horizontally, curve C shows

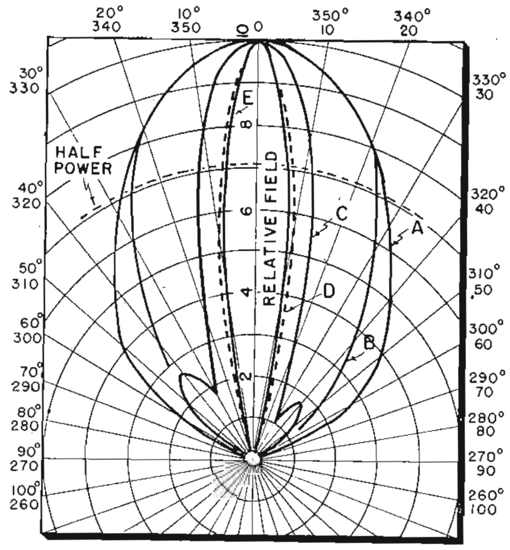


Fig. 6: Radiation patterns for various antennas: A, single corner reflector; B, 6-element Yagi; C, 12-element Yagi; D, 6-ft. parabolic; E, 10-ft. parabolic. Minor lobes not included

the H, or horizontal plane pattern, while curve B is the E, or vertical plane pattern. This array provides a gain of about 12.4 db. Curve D shows the pattern of a 6 ft. parabolic antenna with 17 db gain, while curve E is the 21.4 db gain pattern of a 10 ft. parabolic antenna. Minor lobes have not been plotted for purposes of clarity. For higher gain antennas these lobes are quite important, and unless they are held to a minimum

(*Continued on page 92*)

TABLE I

Antenna	Gain, db Over $\lambda/2$ Dipole	Cost ($)	$/db
1 corner reflector	8.0	50	6.25
2 corner reflectors	12.0	110	9.15
6 element Yagi	10.0	45	4.50
12 element Yagi	12.4	100	8.05
4 ft. parabolic	13.4	250	18.80
6 ft. parabolic	17.0	375	22.00
8 ft. parabolic	19.4	550	28.30
10 ft. parabolic	21.4	1100	51.50

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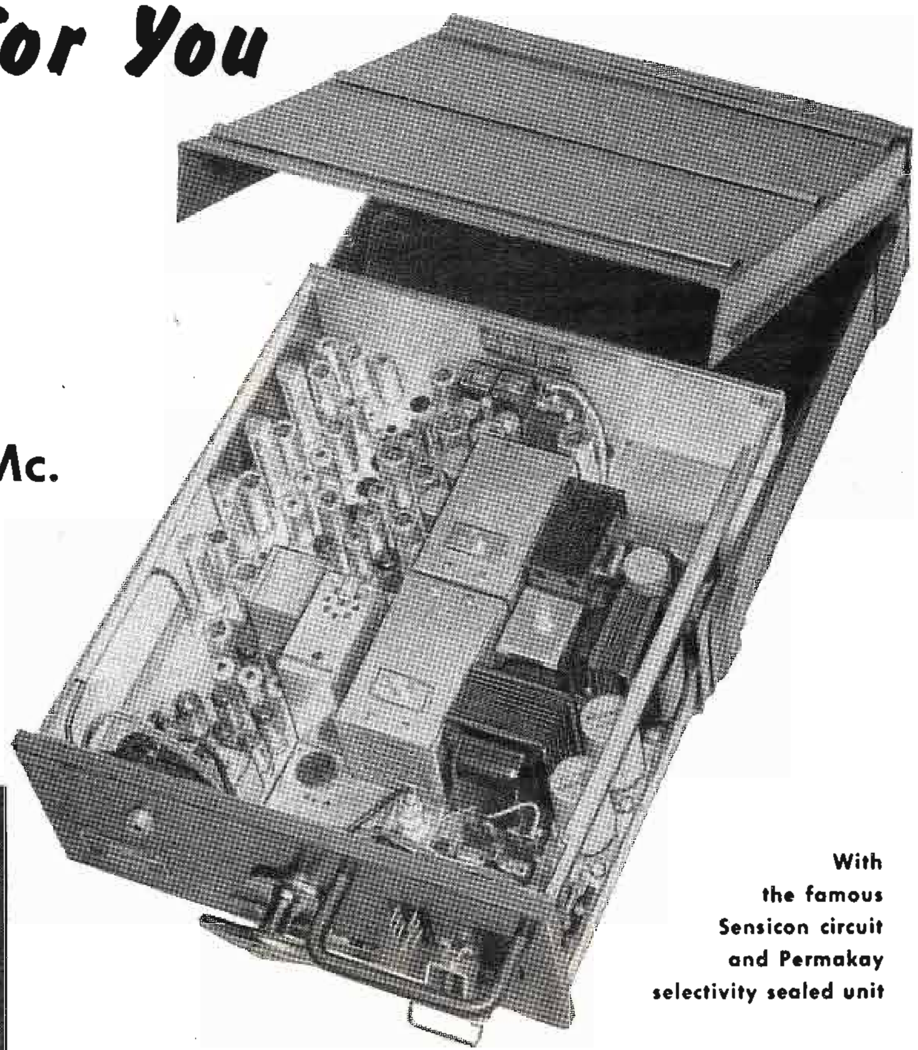

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the gain may be substantially reduced, even though the shape of the main beam is as narrow as it should be.

Cost Analysis

An attempt has been made to analyze the economics of several types of antennas, and the results are shown in Tables I and II. Table I tabulates gain in db, approximate cost, and "dollars per db" for the several antennas discussed above. The costs of the various antennas are approximate, and in some cases are based on very tentative production designs. Such variables as type of mounting and adapters for various kinds of coaxial cable can make appreciable changes in the values shown. However, they do point to some general conclusions.

TABLE II

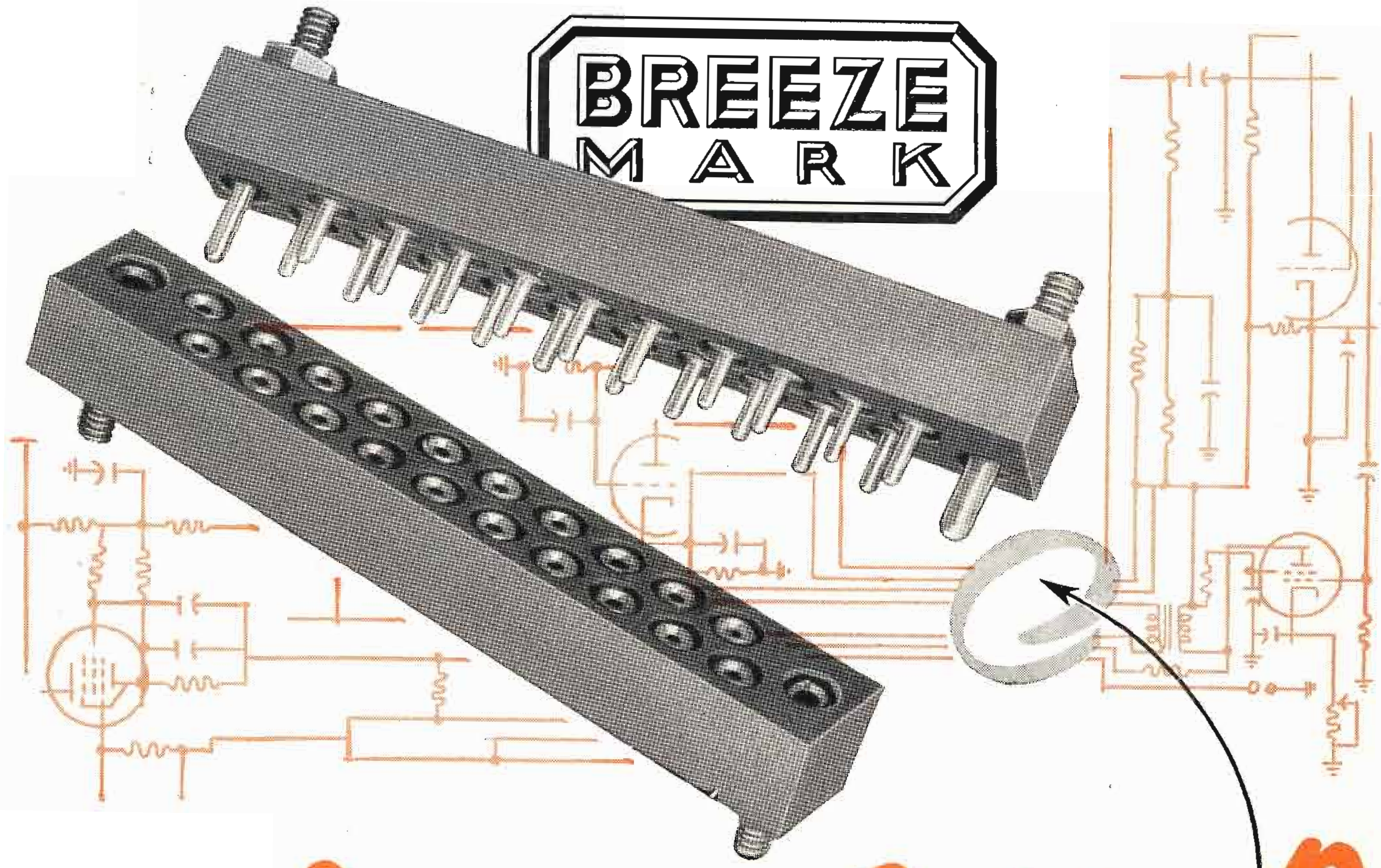
Antenna	Power Gain Over $\lambda/2$ Dipole	\$/Watt for 1 Watt Xmtr. Output
1 corner reflector	6.3	7.94
2 corner reflectors	15.8	6.95
6 element Yagi	10	4.50
12 element Yagi	17.4	5.75
4 ft. parabolic	21.9	11.40
6 ft. parabolic	50	7.50
8 ft. parabolic	87	6.32
10 ft. parabolic	138	7.96

It is apparent that the Yagi type of antenna has a small advantage over the corner reflector, both in unit price and on the "dollars per db" basis. The cost per db increases considerably for gains in the parabolic antenna class.

Another Basis of Comparison

To provide another basis of comparison, Table II shows cost per watt of effective radiated power in the direction of maximum radiation, assuming one watt of r-f transmitter output and neglecting transmission line losses. On this basis, the parabolic antennas compare much more favorably with the lower gain antennas. Again, the Yagi provides the lowest cost on a unit gain basis.

Cost, of course, is not necessarily the only consideration in choosing an antenna. Both the mechanical and electrical characteristics must be considered along with the economic aspects.



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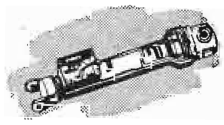
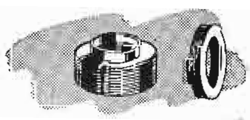
...We'll take it from HERE

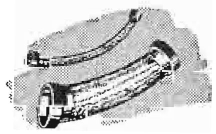
Good ideas for electronic circuitry sometimes run afoul of connector problems. Maybe existing connector units won't hold air pressure gradients, won't stand the heat, aren't rugged enough for the job. Or maybe it's a question of altitude, or under-water application. But if you can sketch the circuit, we'll take it from there. We've engineered so many special connectors, solved so many "impossible" problems, that whatever the requirements are, we can usually provide the answer.



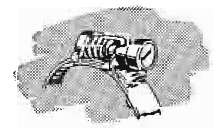
Lightweight actuators for any requirement.



Job engineered, welded-diaphragm bellows.



Flexible conduit and ignition assemblies.



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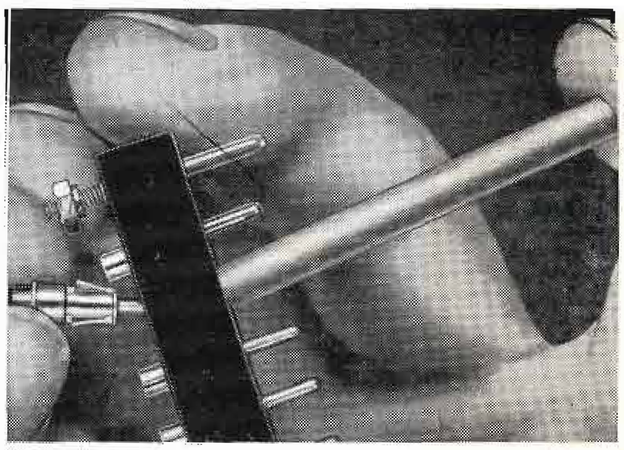

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Caldwell-Clements' Annual Statistics on Radio

ANNUAL BILL OF U.S. FOR RADIO-TV

Sale of Time by broadcasters 1951	$ 565,000,000
Talent Costs	150,000,000
Electricity, batteries, etc. to operate 119,000,000 radio and TV receivers	400,000,000
13,500,000 radio receivers, at retail value	675,000,000

RADIO AND TV SETS IN U.S.; WORLD

United States homes with radio
Secondary sets in above homes
Sets in business places, institutions, etc.
Automobile radios
TV sets

Time - Talent Total
$715,000,000

Caldwell-Clements staff-prepared TV-Radio-Electronic Statistics are "the best in the business"

Official FCC release dated April, 1952 confirming accuracy of Caldwell-Clements data

FEDERAL COMMUNICATIONS COMMISSION
Washington 25, D. C.

PUBLIC NOTICE
74918
April 17, 1952

1951 AM AND FM FINANCIAL DATA

Total revenues of the combined AM, FM and TV broadcast services attained a record high of almost $700 million in 1951 as indicated by preliminary estimates filed by networks and stations with the Federal Communications Commission. Total revenues consist of revenues derived from the sale of time, talent and program material to advertisers.

Time - Talent Total
$700,000,000

Statistical data and information on the radio-TV-electronic industries, as published in RADIO & TELEVISION RETAILING and TELE-TECH, are regularly reprinted by such standard reference sources as the Encyclopedia Britannica, World Almanac, Information Please Almanac and many others.

Caldwell-Clements, Inc.

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TELE-TECH

RADIO & TELEVISION RETAILING

PRODUCTION TEST

(*Continued from page 84*)

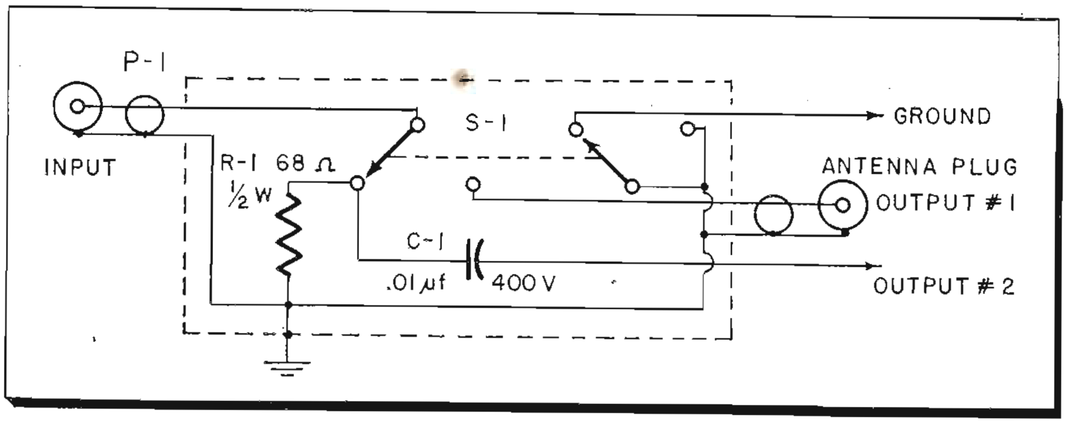

Fig. 12: Antenna and RC probe combines two circuits with coaxial switch for signal injection

standing waves do exist along the spliced line. These are comparatively small and are easily accounted for by adjusting the setting of potentiometer R-3 in Fig. 7.

The test benches themselves have many novel features peculiar to a mass production organization. In many benches there are more than eight separate signals. Originally, each separate signal termination box was equipped with its own cable extension and probe. This was found to be uneconomical, both with regard to time lost in test and with regard to breakage and maintenance. A coaxial switch was inserted in the test bench with one single output probe. The probe, shown in Fig. 12, was made universal to accommodate all signals. This system has proven itself to be quite economical, both in time and standardization for maintenance. It is a combination of the two circuits necessary for overall signal injection.

Receiver Termination

Signals that are fed into the receiver through the antenna jack are terminated in the receiver and require merely a feed-through circuit. Signals that are injected into the receiver proper must be terminated in 75 ohms. With the time-saving combination probe, flicking the switch will transform the probe to conditions that will satisfy both requirements. The 0.01 µf capacitor is inserted to allow signal injection to points of high dc potential.

Other devices on the test bench which have been found to be expedient include:

(a) A special CRT rigidly mounted to observe received test pattern;

(b) A wideband amplifier to observe waveshape of a 100 KC square wave on DuMont 304H oscilloscopes;

(c) Special scope probes and wiring to allow for a minimum of effort on the part of the operator in testing receivers.

It must be pointed out that the ultimate intention of the entire system is to simplify and speed up the test operation without in any way introducing any effects which might decrease the intensity of test. By eliminating or reducing to a simple routine any operations which are not direct test operations, the efficiency of test is improved. By so doing also, a less technically qualified person may be trained to perform tests which would otherwise demand the services of a good technician.

It is obvious that this system is not very flexible. Once such an expensive installation has been completed, there can be no major deviations. However, its advantages with regard to mass production and uniformity of product have been proven time and again in practice. Moreover, this is by no means the ultimate in signal distribution. Improved methods are constantly being adopted, evolution on a gradual scale continues, all with the ultimate goal of a "GO-NO-GO" test operation.

TRANSFER STANDARD

(*Continued from page 50*)

are thermal converters, often called thermocouples or thermoelements. Each thermal converter consists of a conductor, heated by the ac to be measured, and a thermocouple, one junction of which is thermally connected to the heater. They provide the basis for a simple instrument which responds equally well to dc and ac at audio frequencies as well as r-f. Investigations have shown that certain selected and tested commercially available thermal converters can be used for transfer work to an accuracy of 0.01% at currents from 1 ma to 50 amperes over the range of 20 to 20,000 CPS. Based on studies by F. L. Hermach of NBS, two forms of multirange voltmeter elements with ranges from 0.2 to 750 v., consisting of commercially obtainable resistors in series with the heater of a selected thermoelement, have been constructed.

In standardizing electrical instruments, these transfer standards are used for two distinct types of tests: one for instruments which respond to dc as well as ac; the other for those which cannot be used with accuracy on dc. Instruments of the first type are generally given a transfer test which directly determines their ac-dc differences. The instrument under test and the standard are connected to "see" the same electrical quantity successively on ac and dc. In each case the current is adjusted to produce the same deflection in the test instrument, and the response of the standard is observed. From these observations the ac-dc differences of the test instrument are computed. These differences are relatively permanent, and their measurement need not ordinarily be repeated. Thus, when combined with a dc test, this procedure gives more information than would an ac test alone.

Instruments Connected

In the ac test, the standard and test instruments are connected together on alternating current, and the current is adjusted for the required response of the test instrument. The response of the standard is observed, and the standard is then switched to direct current, which is adjusted to give the same response. The value of the direct current or voltage required to give this response is then measured with a potentiometer and accessory apparatus.

The results obtained at NBS show that, when properly used, certain thermal converters are capable of a transfer accuracy approaching that of the best electrodynamic and electrostatic instruments and are useful over wide frequency, current, and voltage ranges. For laboratories that may wish to set up similar equipment, the sets of tested thermal converters at NBS make possible direct determination of the transfer performance of other converters to high accuracy. At present, comparison with the Bureau's converters is recommended if accuracies better than about 0.1% are desired.

CBS TV Studios

(*Continued from page 54*)

the tube bank which contains a switching and dimming unit for each circuit. The versatile preset panel permits the operator to set up control 10 light cues ahead of the performance. Proportional light intensity dimming, no minimum capacity loading, automatic variable speed fader, and 62,500 possible circuit combinations are the prime features of the $500,000 lighting system. The capacity of the C-I system is 450 kw in non-audience studios and 300 kw in audience studio.

Power Services

Three electrical power services are planned for TV City. First, there is the studio lighting service; second technical equipment and general lights; and third, a power company emergency supply. Also, an automatic starting and switching system, including a 100 kw diesel driven generator, picks up certain portion of the load to keep the station on the air if the other sources should fail. An interesting feature of the power system is the fact that the high voltage line (4800 v. 3-phase) is brought directly into and distributed through the building to reduce the high copper losses which heavy load, low voltage operation would incur. One 750 kva power transformer distributes the low voltage for each studio, and these units are housed in vaults in pairs. The initially connected load capacity is 5,500 kw. The breakdown on power distribution is 4,000 kw for stage lighting and air conditioning, 500 kw for technical facilities,

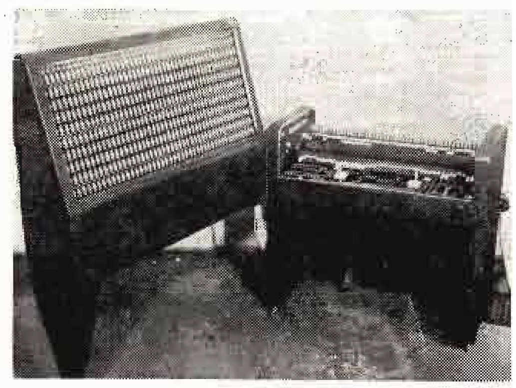

Fig. 8: Lighting control console and preset panel handles 450 kw in non-audience studios

and 1,000 kw for utilities and general services.

The second floor of the area between studios contains rehearsal halls and the second and third floors of the service building house offices, conference rooms and smaller shops.

(*Continued on page 98*)

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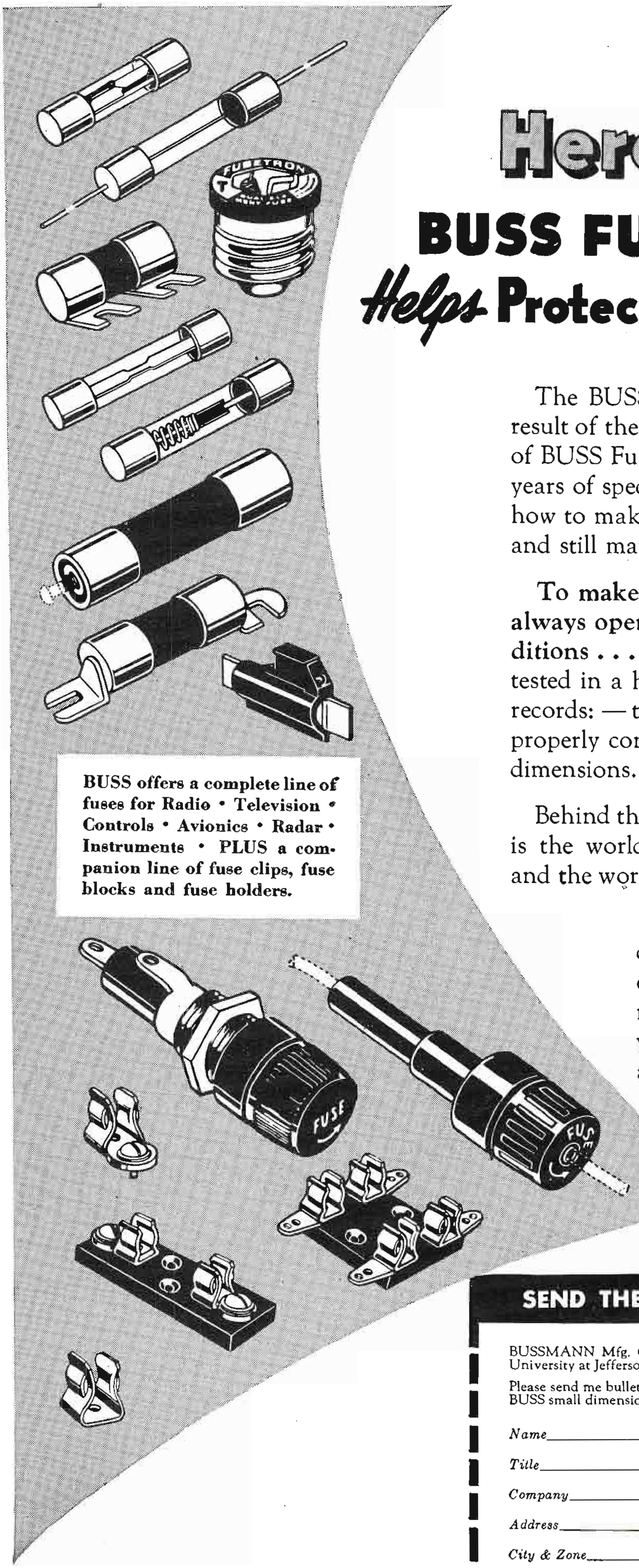

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On the fourth floor level, a microwave installation (Fig. 9) enables reception of remote originations relayed from the KNXT site on Mt. Wilson for integration with studio material in the TV City plant. For originations taking place near TV City, rotatable microwave receivers can be installed on top of the fourth floor enclosure shown in Fig. 2 at the upper left. Transmission of signals from master control to the Mt. Wilson transmitter, as in the case of other feeds off premises, will normally utilize Telephone Co. facilities. However, in an emergency, the microwave enclosure can be used to house a link to Mt. Wilson on either 2000 or 7000 MC channels.

Atop Mt. Wilson is the KNXT channel 2 antenna which radiates 25 kw video erp from its perch 2838 ft. above average terrain. Two 5-kw air cooled transmitters are used alternately. This VHF system, including three and two-bay antenna, is similar to the Empire State installation in New York City.

Future Installations

The experience garnered in the design and construction of the West Coast TV center may serve as an excellent guide for planning the large TV installation CBS intends to make in their recently acquired structure at 10th Ave. and 56th St. in New York City. Formerly occupied by Sheffield Farms Co., this depot and office building contains 405,000 sq. ft. of floor space and is considered highly adaptable to TV.

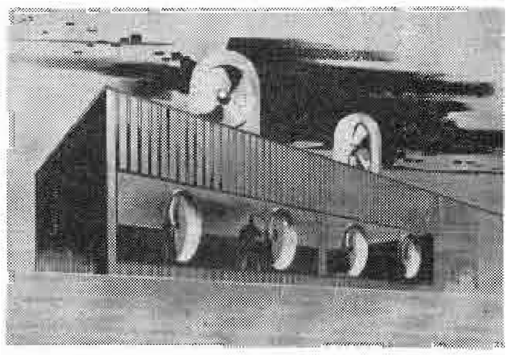

Fig. 9: Microwave system used for nearby remote pickups and emergency relay to transmitter

CBS-TV City is a forward step in the long-range planning of well organized TV studio facilities—an ordered planning that has not always been attainable during the phenomenally rapid rise of TV broadcasting. It is anticipated that this carefully integrated plant will make possible a major advance in TV program production efficiency and that it will serve as a nucleus for straightforward expansion to meet changing requirements.

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Unit-Type
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When the 1 Mc output is used to standardize the oscillator against WWV, it is only necessary to hang 8 to 12 inches of wire on the oscillator output terminal. Zero-beat with WWV will be readily secured by receiver within 10 feet of the oscillator.

The GR Type 1213-A Unit Crystal Oscillator

For amateur and low-budget laboratory use, the new G-R Type 1213-A Unit Crystal Oscillator fills a long-felt need. It supplies accurate 10 kc, 100 kc and 1 Mc signals and their harmonics. Frequencies as high as 1,000 Mc are available with stability of .0001%. The crystal frequency can be adjusted at any time to agree with WWV's standard-frequency transmissions.

Type 1213-A Unit Crystal Oscillator (without Power Supply) $130

An extensive line of unit fixed and variable power supplies, amplifiers, oscillators and other low-cost precision amateur and laboratory measuring instruments are available. They are easily inter-connected through plug-in terminals mounted on the unit cabinets.

- ★ *Crystal oscillator and good communications receiver permit frequency measurements to an accuracy of .0002% or better up to 15 Mc. Limiting factor is precision of receiver calibration*
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Noise-Free Cable

(*Continued from page* 50)

an insulated central conductor. This cable was found to be quite noisy and was not materially improved by applying the graphite suspension.

Analysis of these results, in combination with other reported data on cable noise, led to the formulation of a theory which describes completely the mechanism of noise generation in instrument cables. According to this theory, the noise signals are due to currents set up in the cable when static charges are separated at the surfaces of the dielectric. Whenever a metal makes intermittent contact with a solid dielectric, a separation of electrical charges takes place. A portion of this charge is redistributed by flowing through the terminal impedance of the cable, so that it ultimately appears on the central conductor. To free the cable of these unwanted signals, it is only necessary that the inside and outside surfaces of the dielectric be entirely covered by a well bonded conductive coating.

One method for making "noise-free" cable which appears to have commercial possibilities consists in extruding concentric layers of conductive rubber, nonconductive dielectric, and more conductive rubber over each metallic conductor, preferably stranded for flexibility.

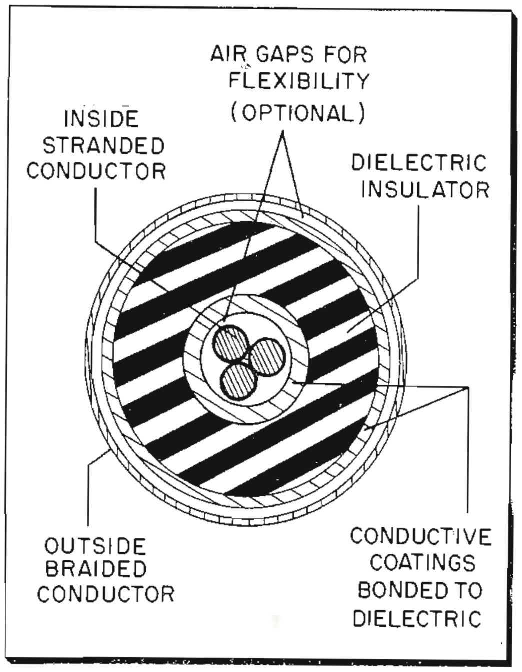
Short Lengths Made

Until noise-free cable becomes commercially available, short lengths—up to six feet—can be made by laboratory workers by combining parts of three different kinds of cable that are easily obtained. Lamp cord composed of stranded copper conductors between 0.006 and 0.007 in. diameter can be used to make the central conductor. The shield can be obtained from microphone or phonograph pick-up cable about 0.07 in. outer diameter, and for the dielectric, "push-back," hook-up wire with an AWG No. 20 conductor can be used. This wire should have a thin, rubber-like or impermeable plastic insulation and a solid conductor.

The hook-up wire is first stretched slightly, the outer surface of the insulation of the wire, except for about 1 in. on each end, coated with a conductive paint, and allowed to dry. Meanwhile, the shield is stripped from the microphone pick-up cable in such a way as to increase the inside diameter of the shield. This may be accomplished by pushing the shield toward the center of the cable and slipping it off after it has been compressed in length and correspondingly expanded. This shield may be slipped loosely over the hook-up wire. Five or six of the strands should be pulled out of the lamp cord and tightly twisted.

To make use of the insulation from the hookup wire, the central conductor must first be removed. After about ½ in. of the dielectric has been stripped from each end of the painted length of hook-up wire, the bare wire is held with the vise and pliers, stretched about 10% of its length without stretching the insulation, and then pulled out of the insulation.

The next step is to apply the conductive paint to the inner surface of the insulation. First, a piece of transparent plastic tubing is taped to the outside of the dielectric tube about ¼ in. from one end. The plastic tubing is connected to a vacuum line, and the other end of the insulation dipped in the conductive paint. When the paint appears in the plastic tube, the hollow dielectric is blown out enough to leave an opening for the inside conductor. After the painted conductor has dried, the stranded lamp-cord wire is pushed through the painted insulation, and the shielding is stretched over the entire length of the cable.



Cross-section of noise-free coaxial cable

For the conductive paint, conductive suspensions in a vehicle designed to bond firmly to the cable dielectric have been found most suitable. If commercial paint is not sufficiently flexible, a mixture of three parts by weight of finely divided (18 to 25 millimicrons) carbon black, 10 parts of flexible adhesive, and 60 parts of methyl ethyl ketone solvent may be used.

Transistors

(*Continued from page 38*)

input resistance may be negative in this Region II. When the internal node voltage has fallen to a value near that of the collector terminal the "valley point" has been reached. At this point, the emitted hole current has reduced the collector impedance to a minimum value beyond which a is essentially zero; the transistor is said to be saturated. From this point on the input impedance again becomes positive and is determined almost entirely by the base and emitter impedances. By terminating the emitter-ground terminals in various ways with resistor-capacitor-bias combinations, such a network can be made to perform monostable, astable or bistable

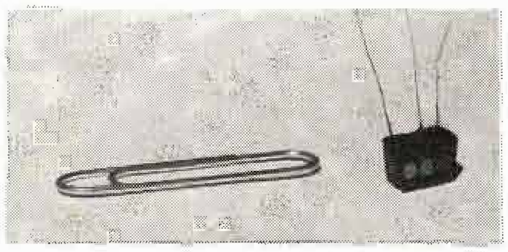


Fig. 6: M1752 developmental junction type unit

functions. Under such conditions, the emitter current and correspondingly the collector current switch back and forth between cutoff and saturation values.

Table II gives the characteristic specifications which must be met by the M1689 bead transistor now under development for computing and switching applications. Interchangeability in various pulse circuits is good, overall behavior being reproducible within about 2 db.

Reliability

Assuming an exponential survival law, 4000-hour tests on Type A units indicated a 10,000-hour half-life (3 db drop in Class A gain) in Sept. 1949. With improved materials and processes, present Type A transistors indicate a half-life in excess of 70,000 hours.

Like other semiconductor devices, transistors are intrinsically more sensitive to temperature variations than vacuum tubes. Strongly affecting linearity, the collector impedance for Type A, r_c, had an equivalent temperature coefficient of -1%/°C in 1949. Today it is one-quarter of that amount. With similar advancements for other point-contact types, reliable operation is expected up to 70°C in most applications, and perhaps as high as 80°C in others. Preliminary findings for junction transistors indicate smaller variations in the small signal parameters such as r_c and alpha, but greater changes in dc. In particular, the collector current at zero emitter current may vary 10%/°C. Although significant improvements have been made, considerable study of temperature dependence is in order before this limitation can be overcome.

Mechanical ruggedness in current point-contact types is illustrated by 20,000 g shock tests which did not change the electrical characteristics. Vibration tests of point-contact and junction transistors over the range 20 to 5000 CPS at 100 g also had no effect.

Miniaturization

The space advantages of transistors become immediately apparent when compared with tubes. For example, the following volumes, in cu. in., show the space needed for various devices; miniature tube, 1; subminiature tube, ⅛; Type A cartridge, 1/50; M1752 junction bead, 1/500 or smaller; M1689 point-contact bead, 1/2,000. For further substantial size reductions in equipment, the next move must comprise the passive components. Lower voltages, reduced power drain and corresponding operating temperatures should make this possible.

During the past two years, point-contact collector voltages have been

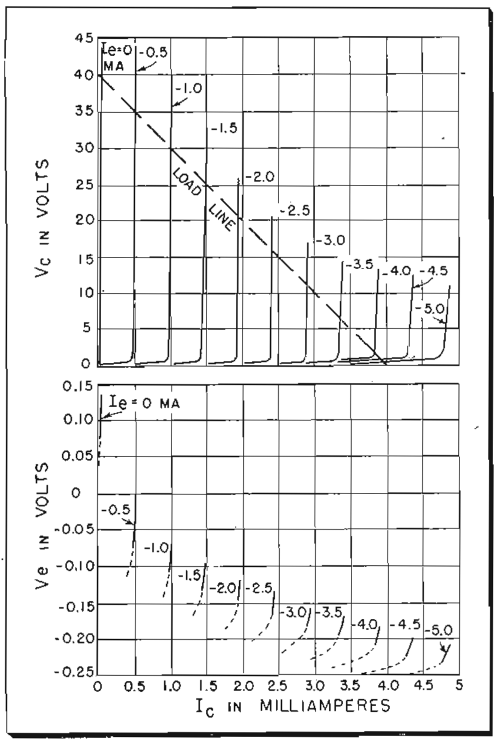


Fig. 7: M1752 family of static characteristics

reduced from 30 v. for Type A to 2-6 v. for the M1768 and M1734. The junction M1752 provides useful gains for collector voltages as low as

(*Continued on page* 104)

0.2 v. Under these same conditions, minimum collector power may be 2 mw for point-contact and 10 μw for junction types. Efficiencies for Class A operation for point-contact and junction have been raised to 35% and 49% (out of a possible 50%), respectively. Class B and C efficiencies are correspondingly close to their theoretical limiting values.

Performance

Exact performance specifications depend on the intended applications. However, by comparing in Table III the salient characteristics of several recent types with the Type A as of Sept. 1949, the progress in performance improvement may be appreciated. The noise figures, greatly improved since 1949, are specified at 1000 CPS. It should be remembered that these figures vary inversely with frequency at the rate of about 11 db per decade change in frequency.

The M1734 point-contact unit showed a gain of 18-24 db/stage and bandwidth of several MC in a 24 MC i-f amplifier constructed in the laboratory. However, more work must be done to reduce its feedback resistance. As a pulse generator and amplifier, the M1734 requires only 6-8 v. and 12-20 mw for the collector to handle 0.5μsec. pulses of 5 v. amplitude and 0.01μsec. rise time.

New junction phototransistors represent a marked advance over the earlier point-contact types, even though their quantum efficiencies are lower than the point-contact units. Their light/dark current ratios have been raised 10-100 times, making possible much greater output voltages for the same light flux.

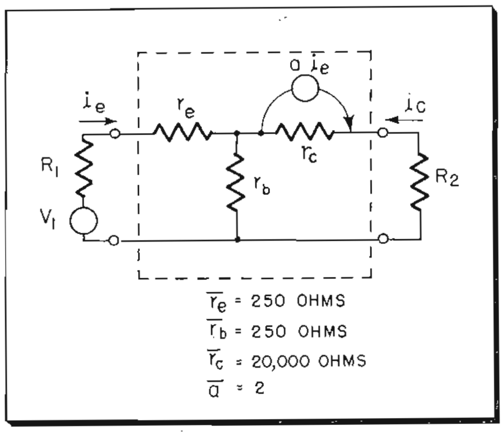


Fig. 8: Equivalent circuit of Type A unit and average element values affecting linearity

Fig. 10 shows a group of circuit packages produced for the Signal Corps for pulse code data transmission systems. Although shown embedded in clear plastic, the final packages will probably be loaded with silica to increase the plastic's strength and thermal conductivity.

To the left in the photograph on the cover is shown a small transistor audio oscillator having a single M1752 transistor, a transformer and one capacitor. It was found that stable oscillations could be maintained down to collector supply voltages as low as 55 mv and collector current as low as 1.5 μa for a total drain of 0.09 μw.

With respect to reproducibility and interchangeability, transistors

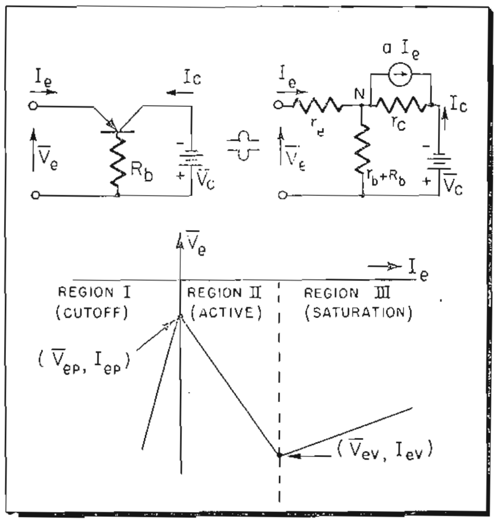


Fig. 9: Emitter-ground negative resistance circuit and characteristic with base resistance

now under development appear to be the equal of commercial vacuum tubes.

With regard to reliability, transistors apparently have longer life and greater mechanical ruggedness to withstand shock and vibration than most vacuum tubes. With regard to temperature effects, transistors are inferior to tubes and present upper limits of operation are 70-80°C for most applications. This restriction is often reduced in importance by the low power consumption which results in low equipment self-heating. This, however, is the outstanding reliability defect of transistors.

Power Supply Requirements

With regard to miniaturization of space and power supply requirements, the comparison figures are so great as to speak for themselves. Operation with a few milliwatts is always feasible and in some cases operation at a few microwatts is also possible.

With regard to performance range, it is believed that the above results imply the following tentative conclusions:

In pulse systems (up to 1-2

(*Continued on page* 106)

MC repetition rates) transistors should be considered seriously in comparison to tubes, since they provide essentially equal functional performance and have marked superiority in miniature space and power.

In transmission at low frequencies (<1 MC) essentially the same conclusions are indicated, primarily because of junction transistors. In the range from 1-100 MC tubes are currently superior in every functional performance figure, except perhaps noise and bandwidth.

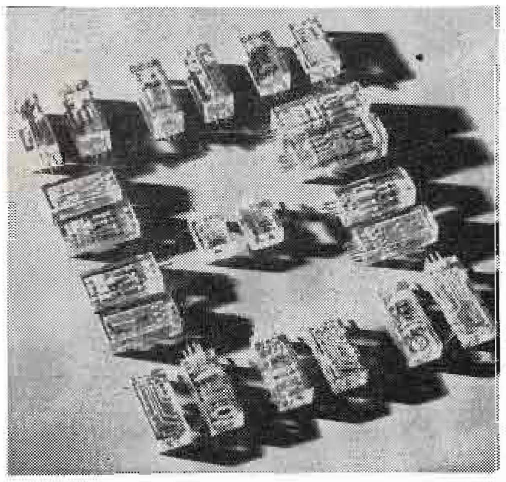


Fig. 10: Miniature circuit packages in plastic

Thus, it might be assumed that, even though there are many outstanding development problems of a circuit and device nature to be solved, it is appropriate for circuit engineers to explore seriously the application possibilities of transistors not only in the hope of building better systems, but also to influence transistor development towards those most important systems for which their intrinsic potentialities best fit. It should be borne in mind that although almost phenomenal strides of progress have been made, several important limitations have not yet been overcome. On the other hand, the full range of performance possibilities is still to be explored and new vistas opened.

For a detailed basic explanation of transistor operation, the reader is referred to the article, "Recent Developments in Transistors and Related Devices," in the Dec., 1951 issue of TELE TECH.

New Nat'l. Electric Div.

National Electric Products Corp., Pittsburgh, Pa., has announced the formation of an Electronics Division, with radar department at Ambridge, Pa., and radio & TV department at Elizabeth, N.J. The new division will manufacture Nepco-Yagi TV antennas, masts, wire, and distribution equipment.

Kilovoltmeter

(*Continued from page* 51)

These two resistors form part of a two-section voltage dividing network across the X-ray tube. Because the ratio between the sections of the voltage divider is very nearly 1000:1, the metering circuit will respond when the peak voltage across the X-ray tube reaches 100 kv. Hence, any desired kilovoltage may be measured by suitably adjusting the bias voltage.

Thyratrons in Circuit

The actual circuit of the NBS kilovoltmeter consists of eleven 2D21 thyratrons each having an indicating neon light in its plate circuit. The grids of the thyratrons are biased in approximately one volt increments by potentiometers inserted into each grid circuit. Twenty series-connected resistors are connected to a 22-position selector switch so that a voltage adjustable from 30 to 125 v. in 5-volt steps may be added to the bias on each tube. These resistors and the grid potentiometers constitute a voltage dividing network across which 150 v. dc is applied. It is thus possible to preset the instrument to read the kilovoltage within any desired 10 kv range, the reading being the sum of the setting on the coarse kv selector switch between the voltage divider and the kv selector switch permits measurement of either the positive or negative peaks of the voltage applied to the potential divider.

A calibrating circuit is included in the instrument for setting the bias voltages of the 11 thyratrons. The time delay circuit, incorporated to prevent recording of the starting surge, includes two thyratrons and two relays.

RADAR FOR FIGHTER PLANES

Compact automatic radar units, developed by General Electric for the Navy, are rolling off the company's assembly line at the Auburn, N. Y., plant. The device feeds information into a computing gunsight, assuring a hit on enemy aircraft as long as the crosshairs of the sight are kept on target. Reported the first radar of its type to be produced on an assembly line basis, it is being adopted by all air arms

News of MANUFACTURERS' REPS

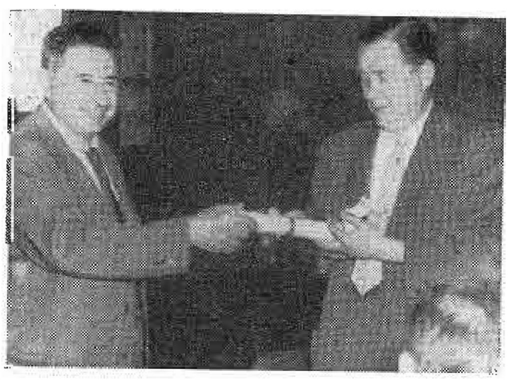
Helpot Corp., South Pasadena, Calif. announces the following additions to its extensive list of representatives covering the principal manufacturing areas of the United States and Canada: Howard N. Heasley, 1940 East Sixth St. Cleveland, Ohio. representative in Western Pennsylvania and all of Ohio except Toledo; The S. Sterling Co. 13331 Linwood Avenue, Detroit 6, Michigan, representative for the State of Michigan and for Toledo.

Vacuum-Electronic Engineering Co., Brooklyn, N. Y., manufacturers of all types of valves, vacuum systems and leak detectors announced the appointment of Harry Bliven, Newton Center 59, Mass., as their representative in the Boston area. Mr. Bliven was formerly purchasing agent for the Raytheon Manufacturing Co.

Ram Electronics Sales Co., S. Buckhout St., Irvington-on-Hudson, N. Y., has announced the appointment of the following Representatives for the Ram line of test-pattern tested flybacks, yokes, width and linearity controls: L. F. Waelterman, 8543 McKenzie Rd., St. Louis, Mo., in the Missouri, Nebraska, Kansas territory; Joe Clancy, Wilder Rd., Angola, Indiana, in the Ohio, Indiana, Kentucky territory.

Henry Lavin Associates of Meriden, Connecticut, electronic manufacturers' representatives, have announced the appointment of Ronald C. Stimpson to their sales staff as sales engineer. He was formerly connected with Graybar Electric.

TWO-WAY HONORS



When Victor Mucher (right), president of Clarostat Mfg. Co., Dover, N. H., was notified that he would present a gold watch and scroll to advertising counsel Austin Lescarboura for 25 years of service to the company, accidentally-on-purpose he wasn't told that a similar timepiece and scroll would be given to him. As the comedy-drama unfolded, it became apparent that Lescarboura, who operates his own agency at Croton-on-Hudson, N. Y., had not been informed that his presentation to Mucher would be reciprocated in kind. A pleasant mutual surprise to mark a quarter-century of association with Clarostat.

BOOKS

Materials Technology for Electron Tubes

By Walter H. Kohl. Published 1951 by Reinhold Publishing Corp., 330 West 42 Street, N.Y., 493 pages. Price $10.00.

Here is a valuable reference volume for tube and development engineers, experimental physicists, and materials engineers, in that it presents up-to-date information on the materials used in the construction of electron tubes. The treatment of materials such as glass, ceramic, mica, tungsten, molybdenum, tantalum, copper, nickel and graphite is one feature of the book. Each chapter dealing with these metals contains an extensive tabulation of the physical characteristics and chemical reactions taking place with various reagents. The description of the processes used for the application of these materials is another feature. Extensive references are listed at the end of each chapter and the index of authors and subjects permits the reader to extend his studies. The book is essentially non-mathematical although there are a few pages where equations do occur.—BFO

Amplifiers

By G. A. Briggs and H. H. Garner. Published 1952 by Wharfedale Wireless Works, Idle, Bradford, England. U.S. agent, British Industries Corp., 164 Duane St., New York 13, N.Y. 215 pages. Price $2.95.

Aptly subtitled **The Why and How of Good Amplification,** this book effectively covers the basic theory, circuitry, associated equipment and measurement of amplifiers on an intermediate technical level. The accent is definitely on audio considerations, particularly phase splitters, push-pull, negative feedback, tone compensation, input circuits and cathode followers. Written in an informal and flowing style, the book employs only the simplest of mathematical calculations. The 174 illustrations include a large number of practical circuits. Of notable interest are the original techniques developed by one of the authors for making oscillograms, and a description of the performance and design of an extremely high quality amplifier system.—AJF

Compilation of Analog Transducers

Compiled by Mark T. Nadir. Published 1952 by Allen B. Du Mont Laboratories, Inc., Instrument Div., 1500 Main Ave., Clifton, N.J. Price $0.50. Over 500 types of analog transducers are arranged alphabetically according to their functions in this new easy-to-use reference catalog. For each transducer, the following pertinent information is given as available from the manufacturer: Function; Principle of Operation; Accessories Required; Transfer Characteristics; Power Required; Amplitude Range; Sensitivity; Output Characteristics; Bandwidth; Resonant Frequency; Resolution or Precision; Linearity; Weight; Range; Sturdiness; Temperature Limitations; Mounting; Size; Remarks; and Model Designation.

Electronic Light Amplifier

(Continued from page 41)

sion from the photo-sensitive lamina. Of course, an amplification factor of 125 is only illustrative and may be significantly increased by employing more amplifying stages and higher secondary emission ratios.

The intensified electron beam then passes through the final conductive layer and strikes the electron-sensitive, photo-emissive lamina which transforms the beam into a high intensity light beam, duplicating the initial light image on the TV picture tube.

One problem encountered in the design of the light amplifier is the tendency for some individual electron rays to spread laterally; that is, perpendicular to the path of the main light and electron beams. This effect, which would reduce resolution, is discouraged in part by the very thin construction of the amplifying cell. However, it is prevented primarily by a magnetic field set up by a helical coil, the axis of which is parallel to the desired path. The electromagnetic field therefore confines the electrons to paths normal to the various laminae.

In TV and similar applications, instead of charging the conductive laminae to progressively higher potentials from a dc source, a high frequency rectified current may be employed. The frequency of such rectified positive pulses should be higher than the maximum video fre-

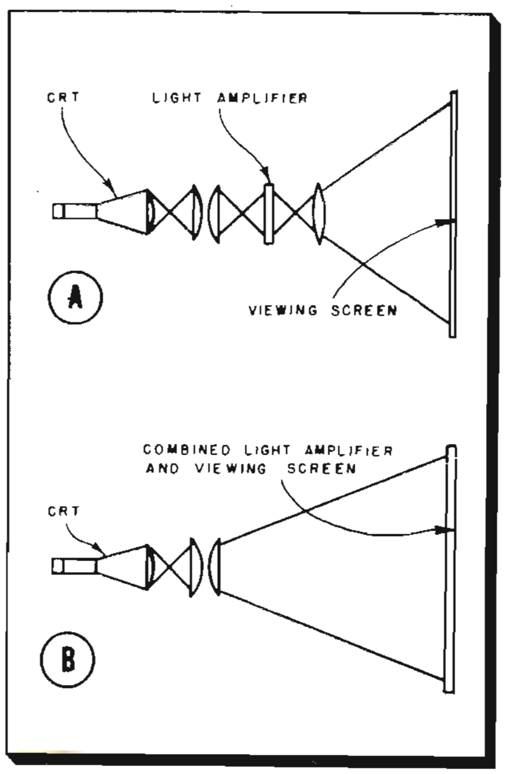
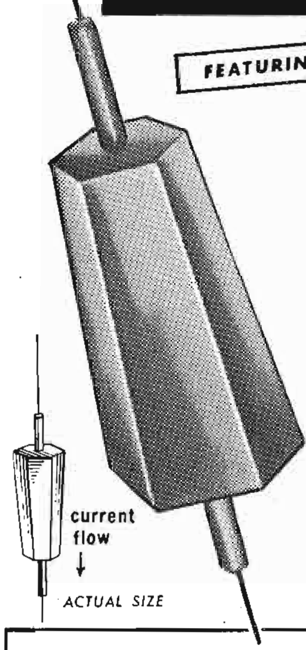


Fig. 3: Two representative applications of the light amplifier to a TV projection system

(Continued on page 112)

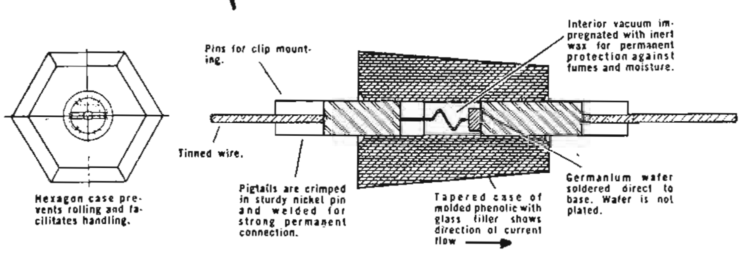
Announcing Radio Receptor's new range of Germanium Diodes

FEATURING POLARITY AT A GLANCE!



Keynoting sound design features and simplicity in construction, the new Radio Receptor Germanium Diodes will give a maximum of trouble-free operation even under the most adverse conditions.

Normally in diodes such as these, one side of the germanium wafer is plated so that it may be soldered to the base...but Radio Receptor's improved production methods make it possible to *omit* plating, thus eliminating possible flaking and improving quality.



CODE NO.	MINIMUM CURRENT AT 1 VOLT FORWARD MA	MAXIMUM CURRENT AT 10 VOLTS REVERSE MA	MAXIMUM CURRENT AT 50 VOLTS REVERSE MA	AVERAGE‡ RECTIFIED CURRENT MA	MINIMUM INVERSE PEAK VOLTS	MAX. CONT. OPERATING INV. VOLTS
1N48	4.0	—	0.833	50	85	70
1N51	2.5	—	1.667	25	50	40
1N52	4.0	—	0.150	50	85	70
1N63	4.0	—	0.050	50	125	100
1N64	Minimum DC current in 44 MC test circuit is 100 μa				20	16
1N65	2.5	—	0.200	50	85	70
†1N69	5.0	0.050	0.850	40	75	60
*1N70	3.0	0.025	0.300	30	125	100
1N75	2.0	—	0.050	50	125	100
†1N81	3.0	0.010	—	30	50	40

*JAN approval pending. †JAN approved.

‡Average half wave rectified current at 60 CPS and 25° C. Consult us for ratings at other conditions. All ratings at 25° C.

The distinctive tapered shape of the glass-filled phenolic cartridge body indicates the direction of current flow, while the hexagon form assures ease of handling — prevents rolling, especially when the leads are cut off to permit mounting the diode in clips.

Submit your germanium diode application problems to us.... We'll be glad to make recommendations without obligation!

Germanium Transistors are coming!

... WATCH FOR OUR ANNOUNCEMENT SOON

RADIO RECEPTOR COMPANY, Inc.

SELETRON & GERMANIUM DIVISION

Since 1922 in Radio and Electronics

Sales Department: 251 West 19th St. • New York 11

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instead of **FACTS**
... **LABEL IT**

with **Kum-Kleen** *labels*

WHY LABEL WITH *Kum-Kleens* — Wherever there's an unanswered question, a guess instead of a know, or a hesitation on identification or procedure, that's the place for Kum-Kleen labels. One electronic manufacturer records assembly and testing steps on Kum-Kleen labels, which are easily peeled off and filed for future reference.

***Kum-Kleens* are EASILY APPLIED** — Avery Kum-Kleen, pressure-sensitive labels are just *laid-on* with a finger-touch. They're self-adhesive — easy to apply — stick to any clean, smooth surface... require no moistening, soaking, heating.

***Kum-Kleens* CUT LABELING COSTS** — The patented Avery Dispensers—manual or electric—feed die-cut labels off roller tape, ready for quick, clean labeling. Many users report labeling speeds *5 times faster* than conventional methods.

***Kum-Kleens* are MORE PRACTICAL** — Kum-Kleens *stay stuck* even in extremes of temperature and humidity with no pop, peel or curl. No excess glue or moisture to clean up! THEY SAVE TIME, LABOR AND COSTLY MISTAKES!

WHAT TO LABEL WITH *Kum-Kleens*: Nameplates—Trademarks — Guarantees — Instructions — Approval Seals — Diagrams — Inspection — Caution — Repairs — Prices — Masking — Routing — How to use Copy... and many others.

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Offices in other principal cities.

☐ Please send case histories, free samples and prices
☐ Have the Avery label man call

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Title __________
Company __________
Address __________

quencies to avoid pulsation effects in the amplified image.

A modified version of the amplifying cell is illustrated in Fig. 2. It is identical in construction to the device shown in Fig. 1, except in the formation of the conductive and secondary-emissive laminae. Instead of using a metal foil conductive layer, a very fine woven wire screen is utilized. The screen is made of 0.0001 to 0.001 in. diameter wire with about 100,000 spaces/sq. in. The secondary emissive lamina is formed by filling the interstices or spaces of the screen with the emissive material, producing thin diaphragms suspended by the screen wires. Alternatively, the secondary emissive lamina may be somewhat thicker so that the screen is in effect embedded therein. The modified light amplifier will operate in substantially the same manner as the unit of Fig. 1.

Fig. 3a illustrates an application of the invention to a TV projection system. The small picture tube projects an image on the light amplifier through a lens system. The light intensity is amplified and projected on the viewing screen by a second lens system. For illustrative purposes, if a light amplification of 125 is assumed, the area of the viewing screen may be 125 times larger than the picture tube without any dimunition of brightness. One advantage of this arrangement is that a relatively small CRT may be employed while maintaining a viewing screen of large size.

A variation of the above projection arrangement is presented in Fig. 3b. The image from the picture is projected directly on an enlarged light amplifier cell. The cell itself acts as the viewing screen, the light amplification compensating for the increased area of light coverage.

Although this invention is particularly desirable for obtaining larger and brighter TV pictures, it is not limited to video alone. Applications are seen in motion pictures, fluoroscopy and other related fields.

Tape-Resistor Publication

Circular 530, *An Adhesive Tape-Resistor System,* by B. L. Davis of the National Bureau of Standards, is available from the Government Printing Office, Washington 25, D.C. for 30 cents. The circular describes the equipment and materials needed to produce and test the carbon-film resistor in the form of an adhesive tape. Capable of operation up to 200°C in the range of 10 ohms to 10 megohms, the tape is presently applicable to glass or ceramic base materials.

PERSONAL

G. I. Jones has been appointed national manager of electronics sales of the Graybar Electric Co., New York. He was formerly in charge of electronic sales for Graybar's Philadelphia district.

John H. Ganzenhuber has been appointed manager of the government contracts department of the Hoffman Laboratories, Inc., Los Angeles, Calif. He resigned recently as vice president of Standard Electronics Corp.

Dr. Wm. G. Tuller, former director of engineering of Melpar, Inc., Alexandria, Va., has been promoted to vice president in charge of engineering. He is a member of the Standards Committee; member of the Institute of Radio Engineers; Chairman of the Technical Committee on information theory and modulation systems; chairman of the sub-panel on Packaged Subassemblies of the Research and Development Board. Charles B. Raybuck, formerly assistant chief engineer, succeeds Arthur C. Weid as chief engineer.

Victor J. Pollock has joined the staff of Consolidated Engineering Corp., Pasadena, Calif., as assistant to Mr. Hugh Colvin, treasurer of the company.

Homer M. Hill, Jr., formerly in charge of the engineering department of Ansley Radio Corp., and more recently with the Applied Science Corp. of Princeton, N. J., has been appointed General Manager of Arthur Ansley Mfg. Co. of Doylestown, Pa.

J. T. Cataldo has been appointed assistant general manager of International Rectifier Corp., El Segundo, Calif. An employee with the Government since 1939, Mr. Cataldo served as Assistant Chief of the Instrument Section at the Material Laboratory, N. Y. Naval Shipyard until 1948. He then joined the Signal Corps Engineering Laboratories, Ft. Monmouth, N. J., as a research and development engineer.

Eugene J. Flesch has been named assistant to the general sales manager of Standard Transformer Corporation, Chicago. He will assist Gilbert C. Knoblock, general sales manager, in all phases of sales and distribution.

J. Warren Gillon has been appointed works manager of Dalmo Victor Company, San Carlos, Calif. In the newly-created post, he will supervise all production, quality control and machine shop operations.

Radio Club Proceedings

The Radio Club of America, 11 W. 42 St., New York, N. Y., has made its highly informative Proceedings for 1951 (vol. 28, no. 2) available for $1.50. The publication contains the 65-page article by E. S. Winlund of Westinghouse, "Survey of Radio-Frequency Transmission Lines and Wave Guides," which comprehensively covers the subject material.

Stereophonic Sound

(*Continued from page 67*)

I raised the question of binaural principles playing an important role in all sound reproduction, and suggested that monaural high-fidelity had reached practical limits for the appreciation of realism in sound reproduction by radio and records. Also, that sound reproduced binaurally even with cut-off at 5000 to 7500 cps, would be more realistic than monaural radio or records with full frequency range to 15,000 cps.

You invited me to write you a letter for publication in *Tele-Tech* re-iterating these thoughts to arouse discussion in your journal.

On June 2nd in your office, when I mentioned binaural sound I was not surprised that you had noted the May 22nd experimental broadcasts over WGN-AM and WGNB-FM during the Chicago Audio Fair.

Today I have accepted an invitation to arrange a suitable program for demonstration and entertainment during the Audio Engineering Society's banquet in New York City this fall.

I am very glad that our discussion of binaural vs monaural sound reproduction via radio has prompted you to publish your own views and resumé of the great future good that binaural can bring to all radio listeners through this wider use of audio.

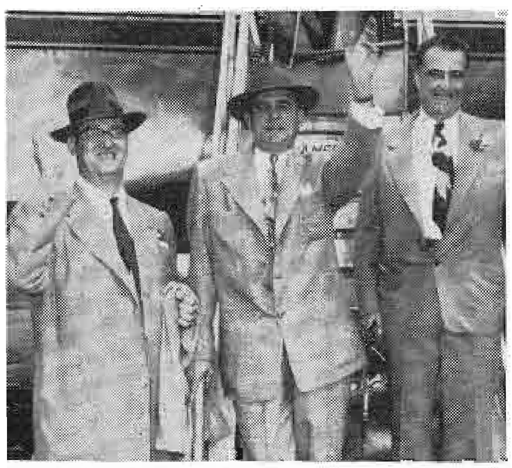
Here at last is a practical way to provide binaural reproduction via radio. And it is to be hoped that it will be done commercially, so that advertisers can sponsor fine new musical broadcasts designed for the best auditory perspective.

When circumstances permit a broad practice of two-channel binaural broadcasting, more live talent will be employed. It goes without saying that the FM radio channels will take on a new, unsuspected value.

HAROLD T. SHERMAN
1208 Carnegie Hall
New York 19, N. Y.

Editors' Note: Mr. Sherman is an audio-radio engineer and inventor, with original patents on microphones and other devices. He was for many years associated with the late Dr. E. E. Free, consulting engineer, and with the Dictaphone Corporation.

EUROPEAN TRADE VISITORS



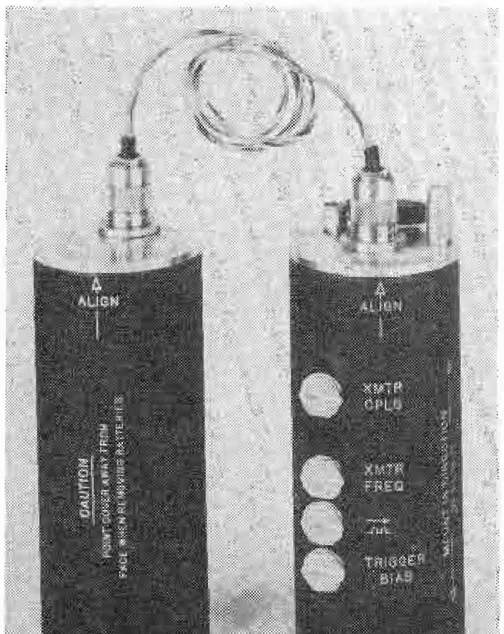
Bound for their 30-day tour of European trade shows are trio of Chicago firm presidents: (l to r) Tempel Smith (Temple Mfg. Co.), Paul Ziegler (Midwest Coil & Transformer Co.), and James A. Boyajian (Triumph Mfg. & Eng. Corp.)

Raytheon Broadens German Licensing

Atlas-Werke A. G. of Bremen, Germany, has broadened the licensing agreements with Raytheon which permit the latter's products to be manufactured in Germany. The more than 30-year-old contracts, which were renewed last fall, now include the production of non-military equipments such as commercial radar and depth sounding apparatus. The agreements were originally made years ago when the Submarine Signal Co. and the European firm decided to exchange manufacturing rights and technical information.

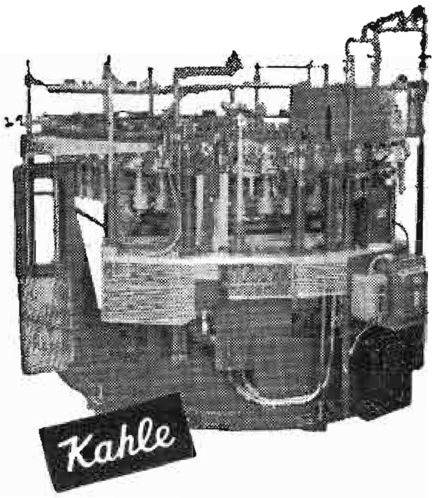
Tiny Radar Beacon Tracks High Altitude Rockets

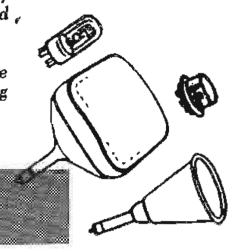
The reduced weight of electronic equipment carried in high altitude rockets sent aloft from White Sands Proving Grounds, N.M., enable the missiles to travel 35,000 ft. higher, reaching the 300,000-ft. mark. The miniature radar beacon AN/DPN-19 (XE-1), developed at the Signal Corps Research Labs., Ft. Monmouth, N.J., has been reduced by two-thirds in weight and by more than six times in volume. It relays signals from and to radar sets on the ground to indicate the rocket's position.

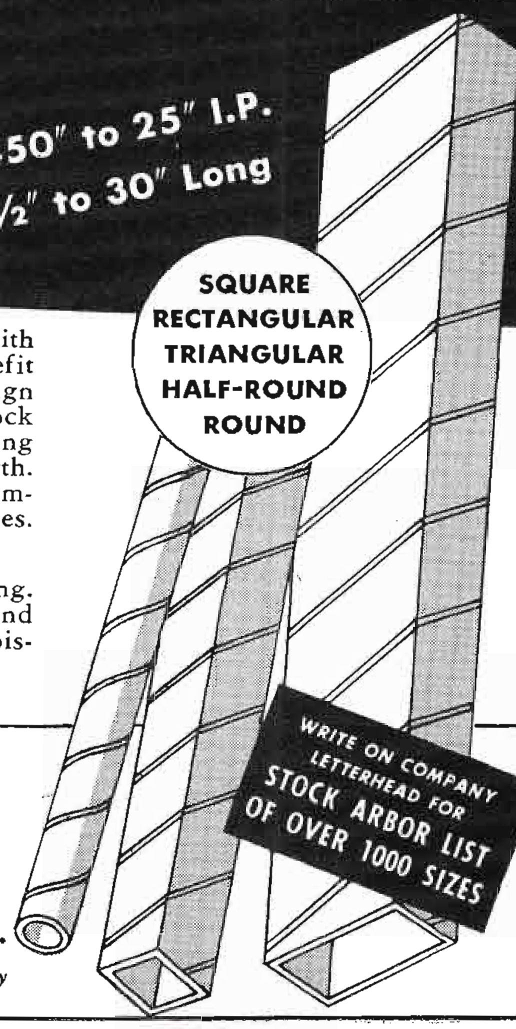


Miniature radar beacon AN/DPN-19(XE-1) for tracking high altitude rockets. Missile-borne units are (l) power supply PP-709(XE-1)/DPN-19, (r) receiver-transmitter RT-229(XC-1)/DPN-19

A special tracking antenna, flush-mounted in the rocket's skin, insures a continuous flow of signals to the ground radar during the downward journey, irrespective of the amount of tumbling in space. Also included in the missile's equipage is a miniaturized fuel cut-off receiver which automatically goes into action if the rocket veers from its predetermined course.







Synchronous Detection

(*Continued from page 57*)

$H_{12}(\omega)$ of Fig. 5 must be designed so that their outputs when added give a reinforced message, $f_m(t)$, while at the same time the network outputs due to the disturbance voltages $g_1(t)$ and $g_2(t)$ tend to cancel when added. This noise cancellation effect has given rise to the term "interference filtering." The simultaneous filtering of two or more signal channels is treated in some detail by Wiener[8] and this writer[3] and a very brief discussion of these references will be given in what follows.

Before any network design can be done some performance criterion must be decided upon. The mean-square error criterion results in a design which is not impossibly difficult mathematically while at the same time is a reasonable measure of system performance from a physical point of view. The mean-square error, ε, between the receiver output and the message may be written as

$$\varepsilon = \lim_{T\to\infty} \frac{1}{2T}\int_{-T}^{T} [f_m(t-\alpha) - f_o(t)]^2\, dt \qquad (16)$$

Thus, networks $H_{11}(\omega)$ and $H_{12}(\omega)$ of Fig. 5 must be designed to minimize the mean-square difference between the actual output, $f_0(t)$, and the message delayed by α seconds, $f_m(t-\alpha)$. In a sense (16) is a measure of the distortion suffered by the message in passing through the communications system. The distortion due to the filtering networks is weighted equally with that due to disturbance signals.

For a specified system delay, α network pair may be found which will minimize ε of (16). This minimum error which results when optimum filtering networks are used, may be shown to decrease continuously as the allowable system delay, α, is increased. The smallest possible mean-square error results when optimum networks designed for an infinite system delay are used.

Irremovable Error

This "minimum-minimum" error has been called the *irremovable error*, ε_{irr}. The irremovable error is important in that it indicates the ing in a given message and noise situation. Although the irremovable error will be achieved only for an infinite delay, it will be found that practically useful delay times will usually yield a mean-square filtering error very nearly equal to ε_{irr}. A discussion of the effect of delay time on minimum filtering error may be found in a recent report by C. A. Stutt[13].

We are now in a position to study two well known AM systems with respect to their performance under conditions of adjacent channel interference. The first system, double-sideband AM, will result when $H(\omega)$ of Figs. 4 and 5 is made zero. In Fig. 4, this corresponds to modulation of the cosine carrier only. However, in the receiver a sine detection should be made even though no message signal will be produced thereby. The disturbance voltage, $g_2(t)$, resulting from this sine detection may be used to advantage for noise cancellation by the methods of the previous section.

Second System

The second system, single-sideband, will result if $H(\omega)$ of Fig. 4 has a 90° phase shift and unity gain for all frequencies of $f_m(t)$. Cosine and sine detections are made in the receiver to recover $f_m(t) + g_1(t)$ and $f_c(t) + g_2(t)$ respectively which are combined by networks H_{11} and H_{12} to give the receiver output, $f_o(t)$. A comparison of double and single-sideband systems may be made with the aid of Fig. 5. When using single-sideband, both channels one and two are used for message transmission; half of the transmitted power going down each channel. Thus at the receiver, networks H_{11} and H_{12} receive an equal amount of message power in the form of $f_m(t)$ and $f_c(t)$ in addition to disturbance voltages $g_1(t)$ and $g_2(t)$. This situation presents a rather difficult filter design problem. Network H_{12} must operate on $f_c(t)$ for proper message reinforcement while at the same time converting $g_2(t)$ for best noise cancellation. In general, these two requirements result in conflicting network designs so that a compromise design must be used.

Double-Sideband Signals

The use of double-sideband signals results in a more pleasant filtering problem. In Fig. 5, all the message power is being transmitted on channel one in the form of $f_m(t)$ while channel two remains unused except for noise monitoring. The input to network H_{12} is just $g_2(t)$, thus the only function of H_{12} is the treatment of $g_2(t)$ for best noise cancellation.

The ability of a receiver to obtain a message-free disturbance component by means of quadrature detection is a very important property of double-sideband AM. Any system of reception (such as conventional

(*Continued on page* 118)

envelope AM detection) which does not make use of this property is not realizing the fullest possibilities of double-sideband.

The results of a study of adjacent channel interference are shown in Figs. 6, 7, and 8. Although the mathematical details involved in obtaining these curves[3] cannot be given here, the method used will be described.

Desired Signal

The desired signal can be made either double or single-sideband by proper choice of $H(\omega)$ of Fig. 4. The undesired adjacent channel signal, $f_u(t)$, is produced in a similar manner except that the carrier frequency is $\omega_o + \Delta$ instead of ω_o. It is assumed that the modulating voltages for both signals have the same power density spectra. In particular, the message power density spectrum, $\Phi_{mm}(\omega)$, was chosen as

$$\Phi_{mm}(\omega) = \frac{\beta/\pi}{\omega^2 + \beta^2} \qquad (17)$$

The average powers of the desired and undesired signals are adjusted to be equal. For each interference situation, the optimum long-delay network solutions for $H_{11}(\omega)$ and $H_{12}(\omega)$ of Fig. 4 are found and the resulting irremovable error, ε_{irr}, is computed. This error is then plotted as a function of Δ/β, where Δ is the radian frequency difference between the desired signal carriers (taken as positive if the desired signal is lower in frequency) and β is the half-power frequency of the message spectra as given by (17).

Fig. 6 compares single-phase (cosine detection only) and two-phase (cosine and sine detection) reception when both desired and undesired signals are double-sideband (DSB). Note that for an ε_{irr} of 0.1 the center-frequency separation, Δ, must be about 9β if single-phase detection is used but only about 4β is needed in the case of two-phase detection.

Performance Comparison

Fig. 7 compares the performance of a double-sideband signal and a single sideband signal transmitting the upper sideband (SSB+) when the undesired signal is double-sideband. Note that for negative values of Δ/β SSB+ shows some advantage over DSB, while for positive Δ/β DSB is considerably superior. If the interfering signal is equally likely to be above or below the desired signal in frequency then double-sideband would clearly give the best average results.

Fig. 8 compares DSB, SSB+, and SSB— (single-sideband, lower sideband transmitted) when the interfering signal is SSB+. The behavior shown by the SSB+ and SSB— desired signals is more or less expected. However, the DSB performance shows some interesting features. Note that the irremovable error is zero for all positive Δ/β. In general, it can be shown that any interference spectrum which lies entirely on one side of the DSB carrier can be removed entirely from the receiver output without at the same time eliminating the contribution of either sideband of the desired DSB signal. In the situation of Fig. 8, DSB shows a clear advantage over both SSB+ and SSB—.

Conclusion

The use of synchronous detection offers many practical and theoretical advantages in the reception of AM signals. It has been shown that the conventional non-synchronous envelope detection type receiver cannot possibly make the fullest use of the capabilities of double-sideband signals. The adjacent channel interference studies verify this last statement somewhat since, contrary to past experience, the double-sideband signals are shown to be less susceptible to interference than single-sideband transmissions.

This paper was first presented before the National Electronics Conference in Chicago, Ill., Oct. 22-24, 1951.

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Standard Frequency

(*Continued from page 65*)

A large number of observations were made at many localities in Japan during these special transmissions. The results were made available through the Department of the Army. A high noise level prevails in Japan so that reception of WWV is unreliable and WWVH is heard consistently only a few hours of the night. The efforts in Japan were therefore largely directed to measurements of signal intensity, noise and interference at the various observation points. When WWVH was observed its intensity was far below that of JJY, inasmuch as WWVH was from 3900 to 4600 mi. from the Japanese observation points. The greatest distance of the Japanese points from JJY was about 600 mi. Conclusions were drawn in the report that JJY's 5 MC transmission was adequate for a 125 mi. radius.

These conclusions seem somewhat restricted in terms of data which have been obtained with station WWV and other results reported for WWVH. The prevailing noise level and other interference at a given location or in a given region are the chief limiting factors in reception at this frequency and hence extremely limited coverage may result. Others of the well-known factors affecting reception, such as antenna directivity, receiver sensitivity, and site location may also play a part, so that any estimates or predictions of results to be expected at a given locality are subject to change in accordance with experimental results at that location. From hitherto unpublished results on certain special transmissions of WWV in 1935-6, during the day, 50% intelligibility of disconnected words was obtained up to 230 mi. in June, Aug., and Sept., and up to 560 mi. in Dec., using 1 kw. WWVH is heard several thousand miles at night.

Natural Interference Barrier

It appears that the Japanese area is plagued with a natural interference barrage in addition to the interference from many stations which do not adhere sufficiently to international frequency assignments. One recording of WWVH and JJY on 5 MC in Japan showed a beat frequency between the two stations at times. Agreement between the stations was better than a part in 10^7 for a period of seven hours. In the following two hours WWVH's frequency was indicated different by as much as 9 parts in 10^7, but in a random manner.

The sunrise or sunset period at a control point in the radio propagation path should be avoided if highest accuracy of frequency measurement is desired. As the ionosphere layers begin to change in height with the coming of daylight or darkness the transmission path is altered. This causes fluctuations in the received frequency known as the Doppler effect. Small beat frequencies may be introduced in spite of very precisely maintained synchronism between two stations.

The frequency of the audio modulation also changes by small amounts. Sudden phase shifts are quite noticeable when monitored against a steady local source and when the Doppler effect is in evidence it would be desirable to use a directional antenna.

Standard Frequency Transmissions

The FCC submitted reports from 12 of their field offices scattered throughout the U.S. and one office in Hawaii covering reception of the standard frequency station MSF, Rugby, England, operating approximately ½ hour each day on 5 and 10 MC with a power of 10 kw. The time and duration of these transmissions were such as to afford a minimum of interference with WWV and WWVH transmissions and are shown in Fig. 9. The detrimental effect (if any) of three standard frequency stations operating simultaneously on the same frequency was accordingly more difficult, if not impossible, to evaluate.

The MSF 5 MC transmission was as follows:[5]

0544 UT	1 minute, call letters, voice announcement
0545	5 minutes, 1000 cps modulation
0550	9 minutes, carrier only
0559	1 minute, call letters, voice announcement
0600	5 minutes, 1000 cps modulation
0605	9 minutes, carrier only
0614	1 minute, call letters, voice announcement

The MSF 10 MC transmission was divided in a similar manner, with the first announcement beginning at 0629 UT and the last one at 0659 UT. The call letters and voice announcements came at the same time as the announcements of WWV and WWVH. The 1000 cps modulation was on at the same time as the 440 cps or 600 cps modulations of WWV and WWVH and could be distinguished along with the modulation from WWV. The distance range involved for continental United States

(*Continued on page* 123)

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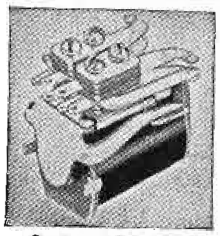

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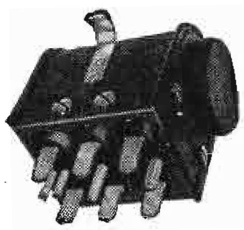

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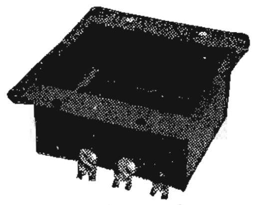

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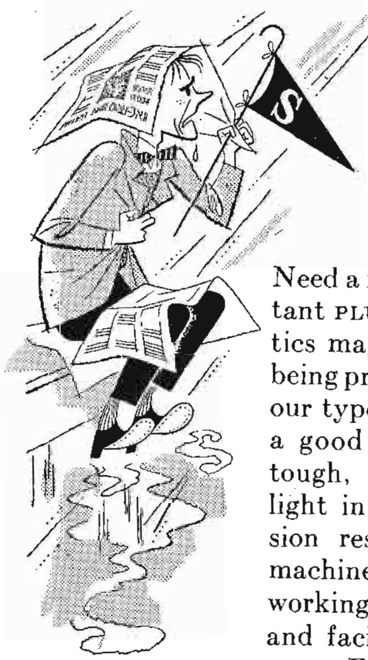

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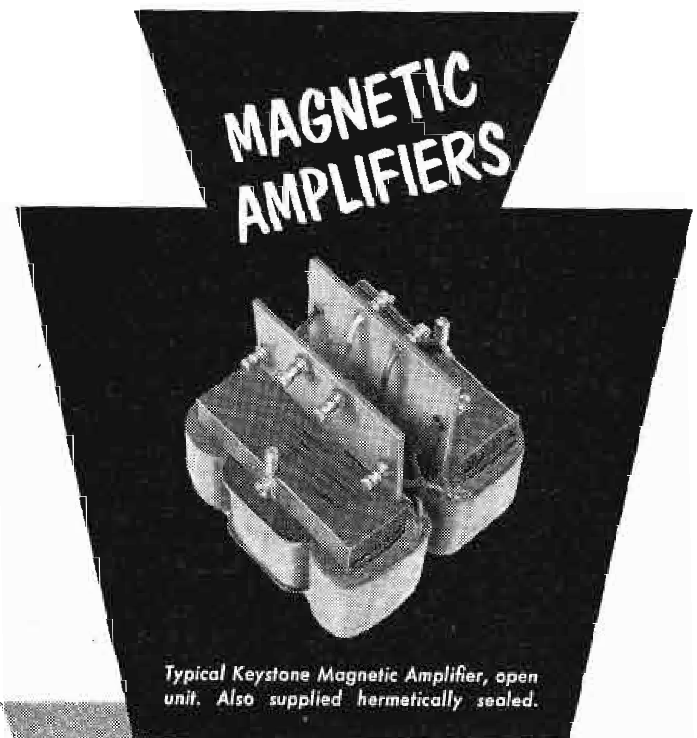

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was from approximately 3300 to 5500 mi.

The 5 MC transmissions were heard faintly in Mass., Ga., Mich., Texas and Idaho. An observer in South Australia has heard MSF on 10 MC a number of times during May, July and Aug.

In view of the above reports there seems to be little use in making further observations in the U.S. on MSF under its present limited time schedule. It would appear that the 5 MC transmissions should have been received more strongly than reported, as they had an all-darkness transmission path to the U.S.

Conclusions drawn from these tests at this time are that MSF does not interfere with stations WWV or WWVH as used in the U.S. What the conclusions may be for observations in the British Isles, Europe and Africa are unknown, but in any event, it would appear that the times of transmission are too short to evaluate in terms of a world-wide standard frequency service.

Discussion

Most of the reports of reception of WWVH and WWV indicated no measurable beat between the carrier frequencies or audio frequencies as broadcast, so that no detrimental effects were noted which were attributable to operation on identical frequencies. However, it is probable that few of the observers, except government agencies such as the FCC, had facilities for the determination of a small frequency difference if such existed.

Some of the reports from a few of the FCC field stations at times indicated beat frequencies from a fraction of a cycle to 2.5 cps for some periods, on 10 and 15 MC. Later the beat was not present. The beat was particularly noticeable on occasions when WWV and WWVH were received with equal intensity. Fading also produced a beat effect at times so that it was difficult to distinguish between the fading and a frequency difference between the stations.

Under suitable receiving conditions it is possible to receive the seconds pulses on one or two of the carrier frequencies both ways around the earth. These pulses as received seldom coincide even though the pulses transmitted from WWV and WWVH are sent at nearly identical times.

Theoretically the beat effects described above may be expected but their absence was surprising. Generally speaking, beat frequencies and phase shifts may be expected

(*Continued on page* 125)

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when receiving two widely spaced stations operating on identical frequencies. Shifting to other standard frequencies or the use of directional antennas may largely overcome undesired effects.

Conclusions

The data presented verify past experience of propagation characteristics acquired on standard frequency transmissions. These may be briefly summarized as follows: The 5 MC transmissions are generally useful for shorter distances during daylight and for a few thousand miles at night. The 10 MC transmissions are useful for longer distances and show no pronounced attenuation or absorption with daylight such as is manifested on 5 MC. Directional antennas may be a necessity at some locations if satisfactory results are to be obtained. The 15 MC transmissions are useful for distances from a few hundred to 10,000 mi., day or night. Seasonal effects, changes in sunspot numbers, ionosphere disturbances and local conditions of atmospheric and man-made electrical noise affect reception ranges. The data are to be interpreted in terms of a drastic change in solar activity, as shown by the 12-month running average Zurich sunspot number, which was 137 for June 1949, and 68 (estimated) for Nov. 1950. The months from June 1949, through July 1950, may be roughly considered as part of a period of high solar activity. The months beginning with Aug. 1950, represent medium solar activity. There was a sharp decline in the monthly average Zurich numbers beginning with Sept. 1950. The effect of decreased solar activity is in the direction of a lowering of critical frequencies and, almost without exception, of a lowering of optimum traffic frequencies for a given transmission path. Results to be expected at a given location on the several standard frequencies may be estimated from the information given herewith. The best frequency or frequencies can be determined by trial.

Experimental Operation

WWVH has been in operation on an experimental basis at low power, for a period of two years. It has been found to supplement the standard frequency and time service coverage of WWV, particularly in the Pacific and Alaskan areas, without introducing undesirable interference. It is likely that increased power at WWVH would further extend the

(*Continued on page 126*)

coverage and also give more definite data on the seriousness of beat frequencies sometimes observed.

Operation on 5 MC

The operation of station JJY on 5 MC for a limited period was insufficient to get the desired experimental results. However, operation of the station would undoubtedly increase the standard frequency coverage for the Far East.

MSF operates on 5 and 10 MC at such a time of day and for such a short period that its effect upon WWV transmissions is of no consequence in the U.S. The effect in Europe has not been published. If the station should operate for longer periods, such as for 24 hours one or two days per week, considerable information of an interesting nature could be obtained in the U.S.

Acknowledgments

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RETUNABLE UHF TRANSLATOR

General Electric has announced a UHF translator for installation in its TV receivers without removal of the chassis from the cabinet. The unit may be tuned to receive any three stations in the 470-890 MC band, and may be retuned to different channels if the owner should move. In GE sets made after the spring of 1949, it is controlled by a selector knob mounted behind the VHF tuning knob. Price has not yet been set, but is expected to be not more than $50

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Test results on three types and five different thicknesses of thin electrical steel are described in a new bulletin by the Armco Steel Corp., Middletown, Ohio. This information has been compiled from data secured over a wide range of inductions and frequencies. By using the curves presented in this bulletin, the design engineer can determine the magnetic properties of each thicknss of Armco thin electrical steel.

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Clipper Diode

A new tube data sheet released by Lewis and Kaufman, Inc., 52 El Rancho Ave., Los Gatos, Calif., describes the Los Gatos brand Type 719A clipper diode. It illustrates the tube, gives outline data with dimensions, and lists the general electrical characteristics.

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The Hammarlund Mfg., 460 West 34 St., New York 1, N. Y., has announced the publication of a new 1952 Capacitor Catalog which is now available to electronic manufacturers, the military services and research and design engineers. This 12-page brochure includes complete drawings and electrical and mechanical specifications covering a broad selection of standard variable air capacitors.

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Volume 7 of the Proceedings of the NEC, covering the 1951 conference has been published by the National Electronics Conference, 852 E. 83rd St., Chicago 19, Ill. Electronic research, development and application in audio systems, components, computers high frequency measurement, information theory, magnetic amplifiers, medical and industrial applications microwave and propagation, signal detection, television and tubes are some of the topics which are covered in the book's 79 papers. Copies are available from conference headquarters at $5.00 each.

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