TELE-TECH

Formerly ELECTRONIC INDUSTRIES

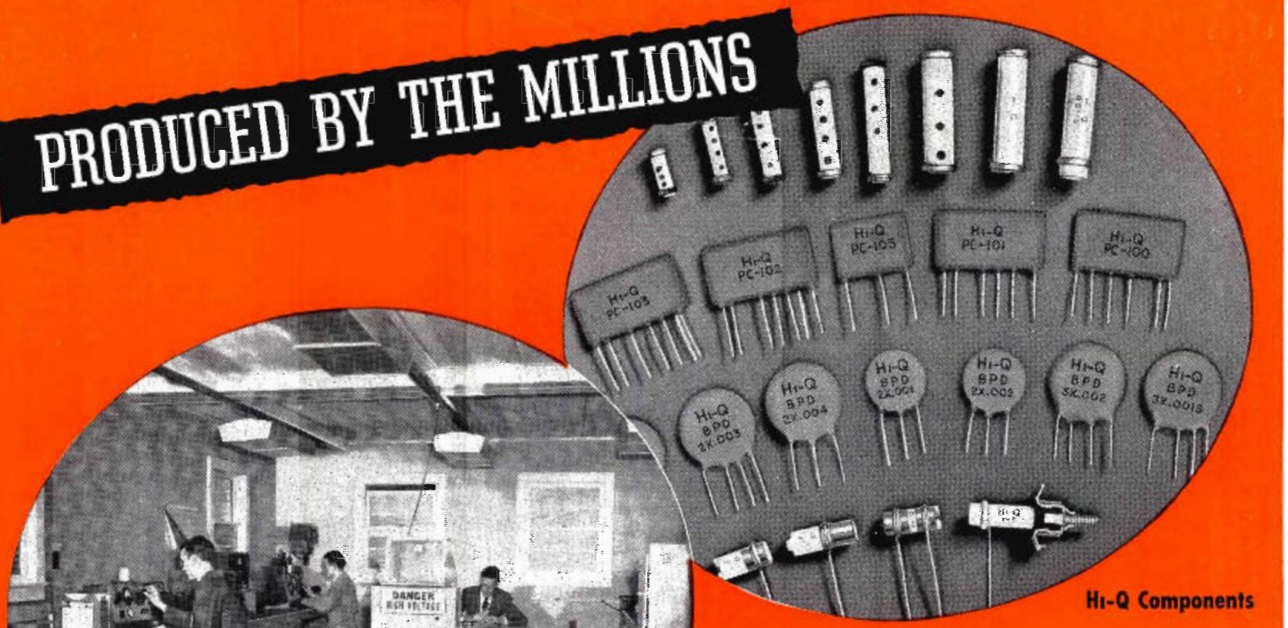
TELEVISION • TELECOMMUNICATIONS • RADIO

FIFTEEN "NO-DRAG" ANTENNAS ON 4-ENGINE TRANSPORT !

See Page 1

May

PRODUCED BY THE MILLIONS



Hi-Q Components

Hi-Q Engineering Laboratory

-Under keenly competent engineering supervision

HI-Q COMPONENTS

Capacitors
Trimmers • Choke Coils
Wire Wound Resistors

BETTER 4 WAYS

- ✓ PRECISION
- ✓ UNIFORMITY
- ✓ DEPENDABILITY
- ✓ MINIATURIZATION

● The engineering laboratory is the alert guardian of **HI-Q** quality. No component can be put into production until it has proven that it meets **HI-Q's** exacting standards to the complete satisfaction of these technicians. It is their further responsibility to see that standards are rigidly maintained during production runs. In addition, **HI-Q** engineers are always available to work with your engineers in the development of components to meet your specific needs. Feel free to call on them whenever and as often as you see fit.

Don't miss the brand new **HI-Q** *Datalog. If you haven't received your copy, write to-day.*

JOBBERS—ADDRESS: 740 Belleville Ave., New Bedford, Mass.

Electrical Reactance Corp.

TELE-TECH

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TELEVISION • TELECOMMUNICATIONS • RADIO

Edited for the 15,000 top influential engineers in the Tele-communications industry 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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LONG & SHORT WAVE RADIO
AUDIO AMPLIFYING EQUIPMENT
SOUND RECORDERS & REPRODUCERS
AUDIO ACCESSORIES
MOBILE • MARINE • COMMERCIAL GOVERNMENT
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CARRIER • RADAR • PULSE
MICROWAVE • CONTROL SYSTEMS

Research, design and production of special types
TUBES, AMPLIFIERS, OSCILLATORS, RECTIFIERS, TIMERS, COUNTERS, ETC. FOR
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Operation

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

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

MAY, 1950

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Publishers also of RADIO & TELEVISION RETAILING

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MY PARTS SHOW

In ROOMS 661A-662A

STEVENS HOTEL, CHICAGO

New PROJECTION UNIT

Now you can have real projection on a special 2′ x 3′ screen at approximately half the lowest previous price. Here's a real advance—a simple, proved *new* method that makes low cost projection a reality.

Get your share of projection profits. See this new unit in rooms 661A – 662A-RMA Show.

3 ROTARY BUILT-IN ANTENNAS

Selective Directivity without Mechanical Rotation

19 leading TV manufacturers made Square Root the greatest producer of built-in antennas in the world. See the newest models and you, too, will profit with the finest in electronic rotation.

QUAD-LOOP
List Price **$27.50**

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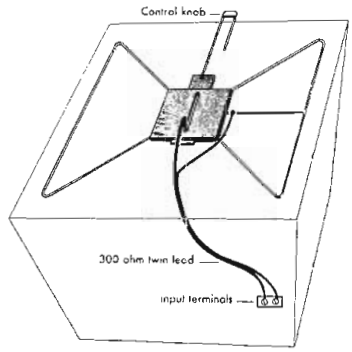
List Price **$12.50**

WIND-O-LOOP
List Price **$8.50**



A complete line of outside antennas at prices that challenge the industry. No other manufacturer offers all the advantages of a mechanically rotated antenna at the low cost of the fixed type. See the Quad-Loop in action in rooms 661A—662A, at the RMA Show.

SQUARE ROOT

ELECTRONIC AND MECHANICAL PRODUCTS

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TELE-TIPS

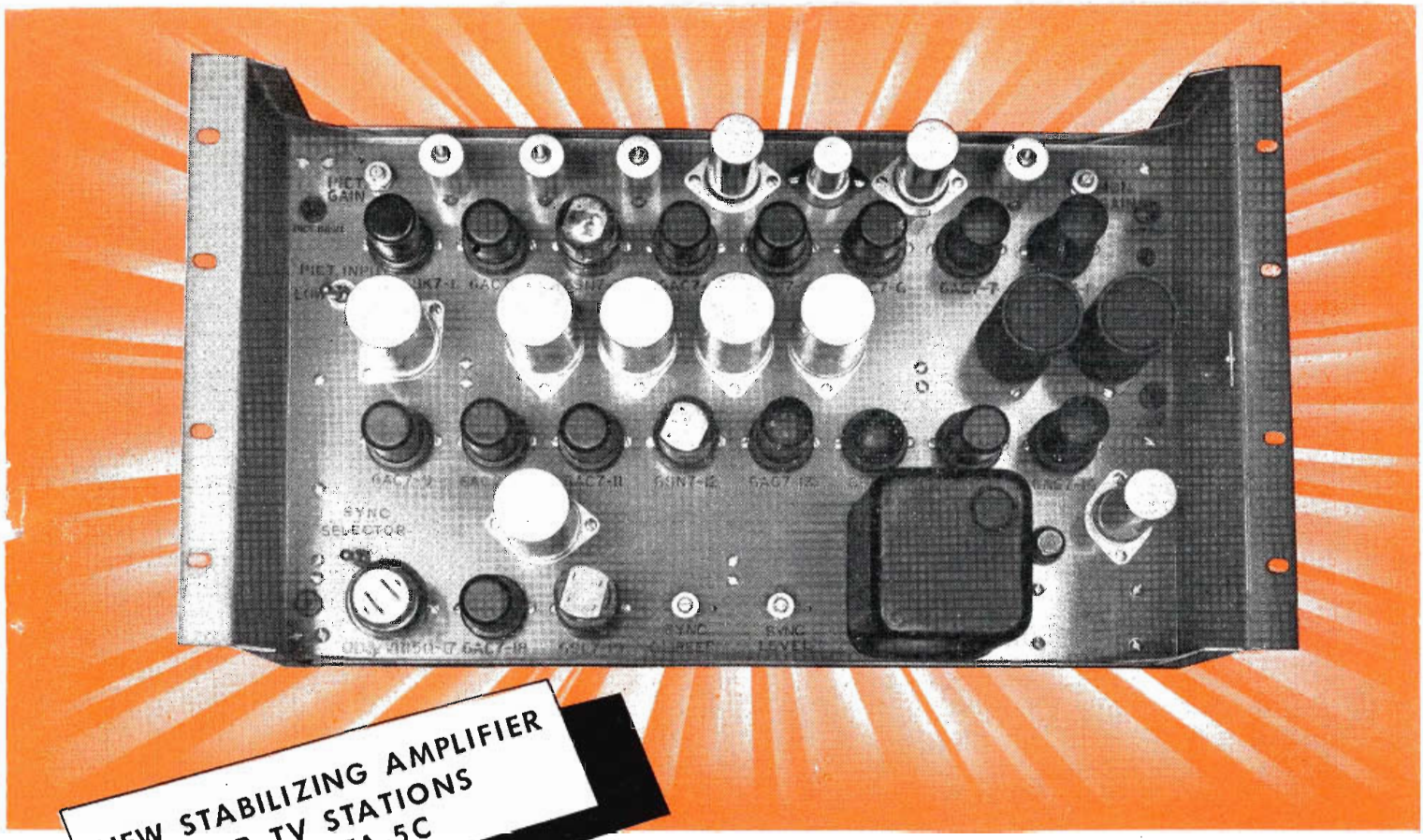
DR. ALFRED N. GOLDSMITH, veteran consulting engineer, is given credit for the initial underlying color-TV suggestion which RCA Laboratory teams developed into the present RCA color tubes. Tribute of acknowledgment was paid to Dr. Goldsmith by his Princeton Lab. associates during one of the early Washington demonstrations.

TWO TEAMS of RCA engineers were assigned the problems of developing the one-gun and three-gun color-tubes respectively. These two teams were given every facility, but were completely separated from each other so that each group would be free to work wholly independently and come up with its own ideas.

UHF—At Yale, Amherst, National Bureau of Standards, and elsewhere, superconductivity at microwave frequencies is being studied. The behavior of conductors at low temperatures for these frequencies, it has been found, is intermediate to that for direct current on one hand and infrared radiation on the other. This means that metals loose only a portion of their resistance at low temperatures for microwaves. An interesting field of research for labs having available low-temperature equipment!

CAVEAT EMPTOR!—A manufacturer of Tiffany quality audio transformers expresses concern over the variances in electrical characteristics of comparable transformers made by various competitive manufacturers, both domestic and foreign. It appears that the measured values of some of the very elemental parameters, such as primary inductance, leakage inductance, and frequency response, do not always conform with those listed in the published literature. In some of the units measured, variations of as much as 2 to 1 were found!

MORE EVIDENCE—Further blasting the preposterous claim that "Back in 1930 McGraw-Hill coined the word electronics (See November, 1949 issue of Electronics, Page 63), Dr. E. F. W. Alexanderson, GE's famous pioneer radio and television inventor, and designer of the historic Alexanderson alternators, writes us from Schenectady—"I am sure we used the word electronics much earlier than 1930".



NEW STABILIZING AMPLIFIER FOR TV STATIONS TYPE TA-5C

...best in the business!

HERE'S WHY. Type TA-5C removes 60-cycle hum and other low-frequency disturbances from the video signal —and suppresses switching transients. It reduces high-frequency noise components *substantially*—and cleans up the blanking pulses. It will restore the sync—or reduce it as required. It will maintain constant sync level—or amplify this level to any value up to 50 per cent. It makes it easy to extract a pure video signal from the composite signal—and provides video gains as high as 25 db.

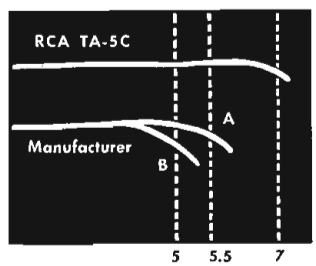
With this stabilizing amplifier you can switch between remote (composite) signal and local video signals. You can adjust video gain control without disturbing the sync. You can control gain, sync level, and sync clipping *remotely*—by means of external controls provided for the purpose. And with the TA-5C, *separate* output monitoring is independent of line characteristics.

For highest fidelity of video signal, cleanest output, and highest sync gain, nothing beats the TA-5C. Call your RCA Broadcast Sales Engineer for details. Or write Dept. 87-E, RCA Engineering Products, Camden, N. J.

Check the performance of the TA-5C . . . and compare!

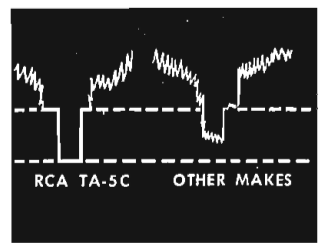
Characteristic	RCA, TA-5C	STAB AMP "A"	STAB AMP "B"
Fidelity Response	Uniform to 7 Mc	Uniform to 5 Mc	Uniform to 5.5 Mc
Signal Gain	25 db; works down to 0.15v input	20 db; works down to 0.2v input	20 db; works down to 0.2v input
Sync Gain	Up to 50%	Up to 40%	Up to 40%
Voltage Output	3v across 37.5 ohms	2.5v across 37.5 ohms	3v across 75 ohms
Separate Sync Output	Yes	No	No
Complete Sync Stripping	Yes	No	No
Clean Output Signal	Yes	No	No
No. of Tubes	19	24	27
No. of Controls	4	7	4

Highest signal fidelity



FREQUENCY RESPONSE (Mc.)

Cleanest output signal



OUTPUT QUALITY AND SYNC GAIN

RCA

TELEVISION BROADCAST EQUIPMENT

RADIO CORPORATION of AMERICA

ENGINEERING PRODUCTS DEPARTMENT, CAMDEN, N.J.

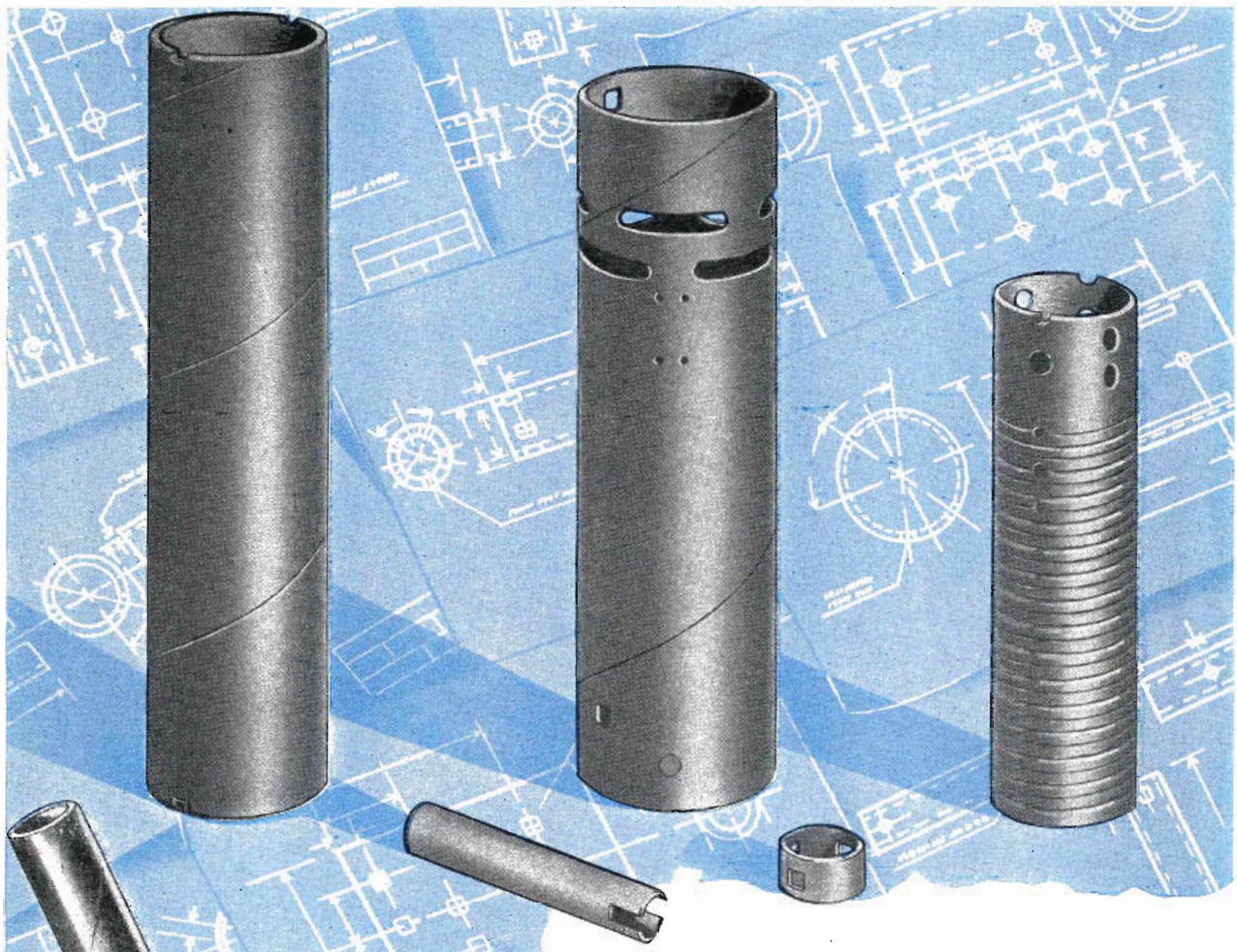
In Canada: RCA VICTOR Company Limited, Montreal

TELE-TIPS (Continued)

TV-SET INCREASE in the 134 most important metropolitan counties (out of 1,800 counties reached by TV) will be progressively indicated by monthly reports of TV-set makers' shipments, now being undertaken. Figures by counties will be made available to local TV stations, as well as to participating manufacturers. Counties selected represent 53% of total U. S. buying power, 80 to 90% of all TV buying power, and 92% of all TV sales in U. S.

SONIC SHUT-OFF circuit for terminating annoying radio advertising commercials is described by I. Clyder Cornog in February American Journal of Physics, page 62. At a handclap or other sharp sound, a gas triode triggers a time-delay circuit which cuts off the loudspeaker for a pre-set interval!

METAL RECTANGULARS—According to a report from the development laboratories of a major TV tube manufacturer, mass production of rectangular metal-funneled TV tubes is now practical. Initial announcements are expected in the next 90 days.



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COSMALITE* AND CLEVELITE* SPIRALLY LAMINATED PAPER BASE PHENOLIC TUBES

Cosmalite is known for its many years of high quality performance. Clevelite is the new improved tubing designed to meet more exacting specifications.

"Cleveland" has an enviable record of service and dependability. Your orders receive prompt attention. Deliveries are made in time for your production schedules.

For the best . . . "Call Cleveland."

Samples on request.

*Trade Marks

Of Proven Performance in the Radio and Television fields.

Excellent for Motors, Relays, Transmitters, Fans, Controls, Switches, Bobbins, and many others.

The CLEVELAND CONTAINER Co.

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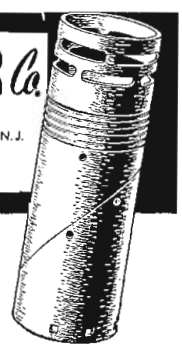
PLANTS AND SALES OFFICES at Plymouth, Wisc., Chicago, Detroit, Ogdensburg, N.Y., Jamesburg, N.J.
ABRASIVE DIVISION at Cleveland, Ohio
CANADIAN PLANT: The Cleveland Container, Canada, Ltd., Prescott, Ontario

REPRESENTATIVES

CANADA	WM. T. BARRON, EIGHTH LINE, RR #1, OAKVILLE, ONTARIO
METROPOLITAN NEW YORK	R. T. MURRAY, 614 CENTRAL AVE., EAST ORANGE, N.J.
NEW ENGLAND	E. P. PACK AND ASSOCIATES, 968 FARMINGTON AVE. WEST HARTFORD, CONN.



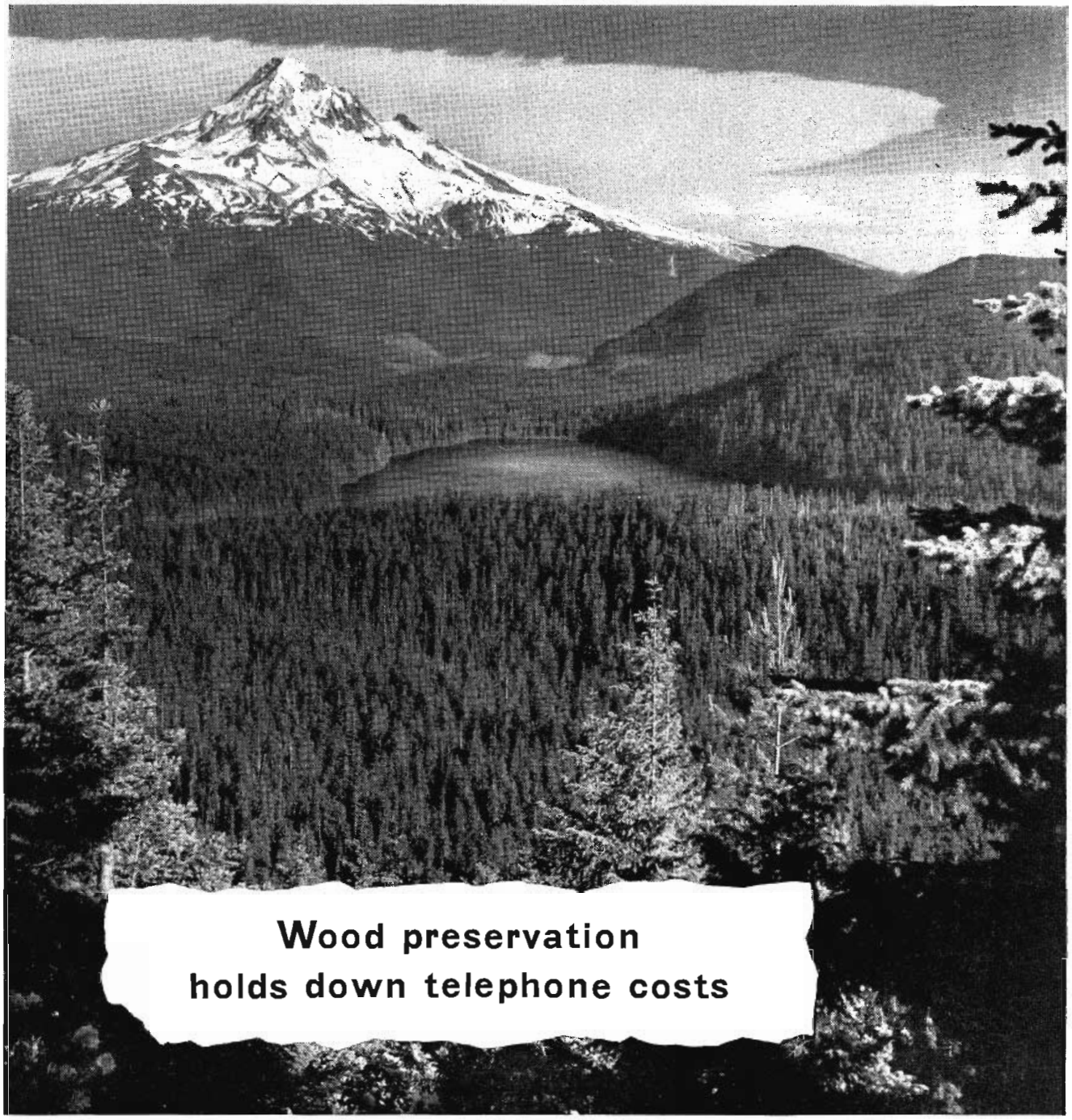
Teamwork pays off!

...And THOMAS Has An Engineering Team

that cooperates to the fullest with television receiver manufacturers to produce a unit that will more than meet the increased competition. Buyers discriminate more and more and only the best tube on the market will sell. Write or phone for full information now. For the finest picture, use the finest tube — THOMAS!

THOMAS ELECTRONICS, Inc.

118 Ninth Street Passaic, New Jersey



Poles are a substantial part of the plant that serves your telephone; making them last longer keeps down repairs and renewals that are part of telephone costs. So Bell Laboratories have long been active in the attack on wood-destroying fungi, the worst enemies of telephone poles.

Better, cleaner creosotes and other preservatives have been developed in co-operation with the wood-preserving industry. Research is now being carried out on greensalt—a new, clean, odorless preservative. Even the products of atomic energy research have been pressed into service—radioactive isotopes are used to measure penetration of fluids into wood.

Treated poles last from three to five times as long as untreated poles. This has saved enough timber during the last quarter century to equal a forest of 25,000,000 trees. More than that, wood preservation has enabled the use of cheaper, quickly growing timber instead of the scarcer varieties.

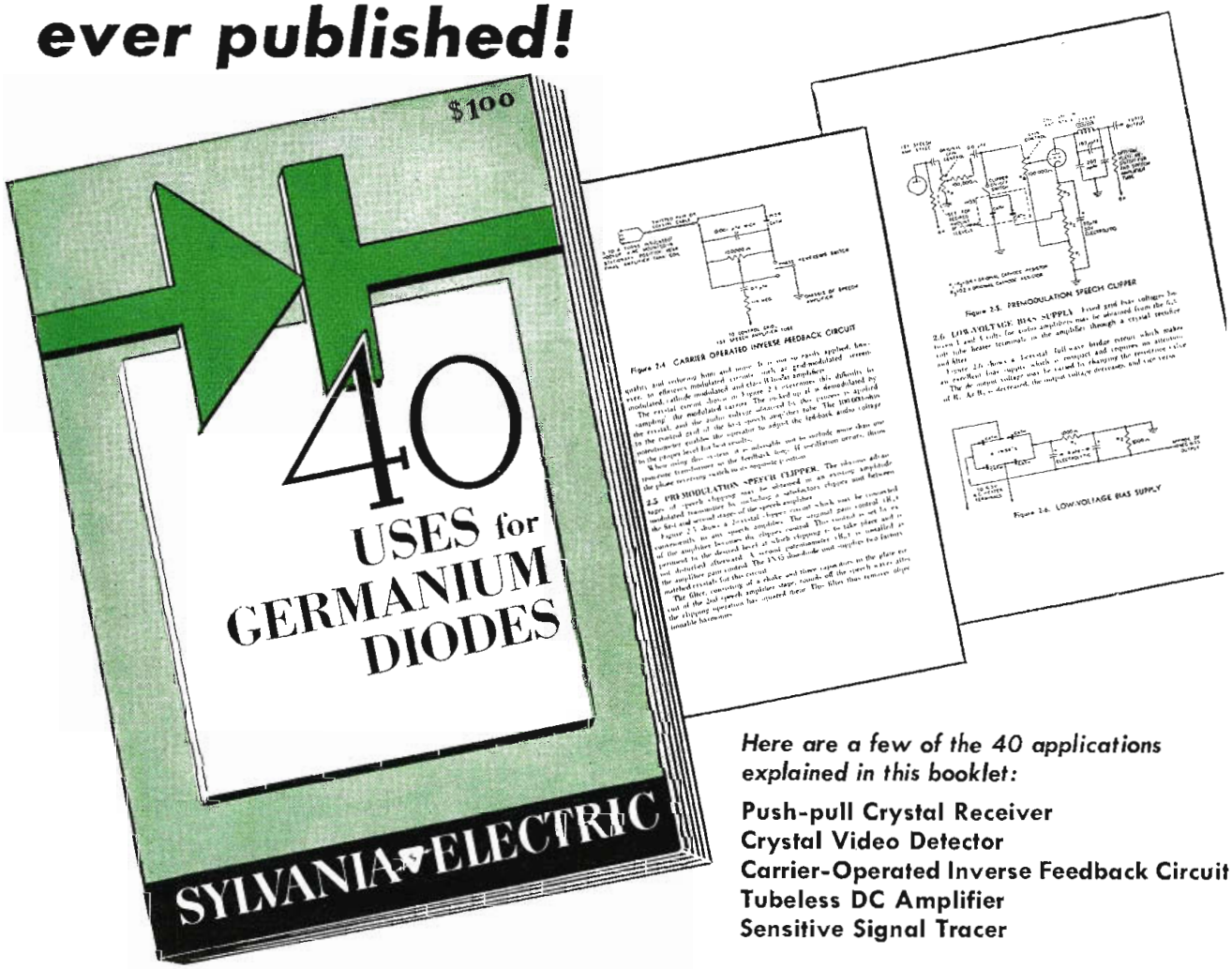
This and other savings in pole-line costs, such as stronger wires which need fewer poles, are some of the reasons why America's high-quality telephone service can be given at so reasonable a cost. It is one of today's best bargains.

BELL TELEPHONE LABORATORIES

Exploring and Inventing, Devising and Perfecting, for Continued Improvements and Economies in Telephone Service.

ENGINEERS, TECHNICIANS, HOBBYISTS—

Here's the most complete collection of Germanium Diode Applications ever published!



Here are a few of the 40 applications explained in this booklet:

Push-pull Crystal Receiver
Crystal Video Detector
Carrier-Operated Inverse Feedback Circuit
Tubeless DC Amplifier
Sensitive Signal Tracer

Sylvania's new handy-sized book, "40 Uses for Germanium Diodes," presents for the first time all the most important applications of germanium diodes. In it, the engineer and technician will find time-saving devices and simplified circuits. Hams, hobbyists and experimenters will find plans for a host of interesting instruments and gadgets, from crystal receivers to voltage and frequency multipliers. Simple, clear explanations, plus more than 40 separate diagrams, describe germanium diode applications in receiver and transmitter circuits, instrument construction and electronic "gadgets."

This book is full of new circuit ideas. It will save you time and money. It costs only $1. Mail the coupon today with your dollar and your copy will be sent you at once.

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

SYLVANIA ELECTRIC

Sylvania Electric Products Inc.
Advertising Dept. E-1205
Emporium, Pa.

Please send me "40 Uses for Germanium Diodes." Enclosed is $1.00.

*Name*_____

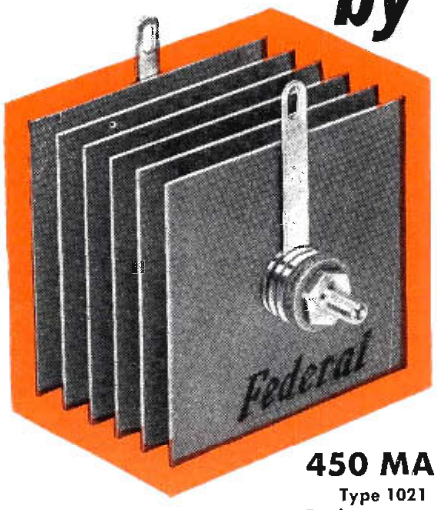
*Address*_____

*City*_____ *Zone*____ *State*_____

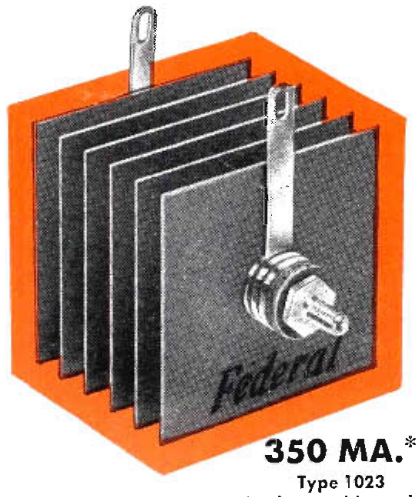
To TV manufacturers!

Here's Another Milestone in RECTIFIER PROGRESS by *Federal*

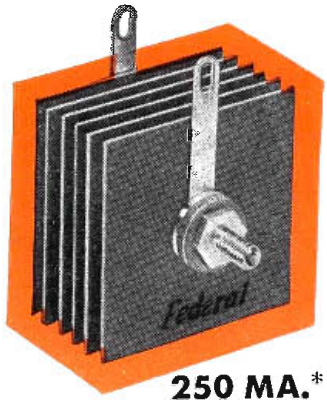
Who Pioneered the Selenium Rectifier for TV Design



450 MA.*
Type 1021
For large consoles



350 MA.*
Type 1023
For large table models and small consoles



250 MA.*
Type 1010
For small table models

FEDERAL *Announces*

its "Blocks of Power"... Three New Selenium Rectifiers in Ratings to Cover the Full Range of TV Power Requirements with these New Features—

1 ALL ALUMINUM
Plates, washers, mounting studs—all aluminum! Same coefficient of expansion under all operating conditions.

2 SIMPLIFIED MOUNTING
No need to stock a variety of mounting hardware. Single-end stud with simple nut and washer permits mounting anywhere in any position.

3 RUGGED CONSTRUCTION
Improved mechanical design, using a one-piece mounting stud, provides a sturdy mechanical assembly that will withstand stress and shock.

4 COOLER OPERATION
Resulting from improved design and production techniques—and even greater quality control of materials.

Federal opened the way to smaller, lighter weight TV receivers. Now Federal goes further ... provides still further weight saving for receivers of *all* sizes ... meets all major TV power requirements ... with new stacks to operate with the higher rated capacitors used in latest TV design. Write today for full information. Address Dept. F-766 *Ratings shown are typical

America's Oldest and Largest Manufacturer of Selenium Rectifiers

Federal Telephone and Radio Corporation

FEDERAL TELECOMMUNICATION LABORATORIES, Nutley, N.J. . . . a unit of I T & T's world-wide research and engineering organization.

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In Canada: **Federal Electric Manufacturing Company, Ltd., Montreal, P. Q.**
Export Distributors: **International Standard Electric Corp., 67 Broad St., N.Y.**

FEDERAL TELEPHONE & RADIO — FTR — An IT&T Associate

RMC DISCAPS

Exceed Guaranteed Minimum Capacity at 85°c

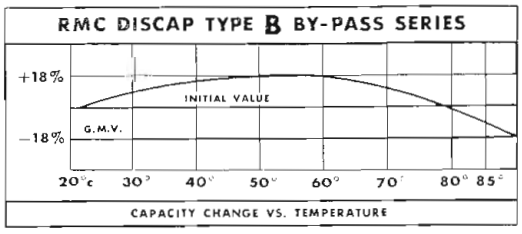
Capacity change between room temperature and 65°c, +18% −0%

More than eight years of intensive engineering research and three years of successful commercial production are behind this outstanding RMC achievement.

Type B Series DISCAPS were developed to maintain capacity much nearer initial values than heretofore possible. This accomplishment, in small size condensers that have real practicability, results in a decidedly more effective by-pass at the higher frequencies encountered in TV and FM applications. Because RMC produces the complete condenser, even to the processing of the dielectric element itself, it is possible to exercise the finest quality control through every phase of manufacturing.

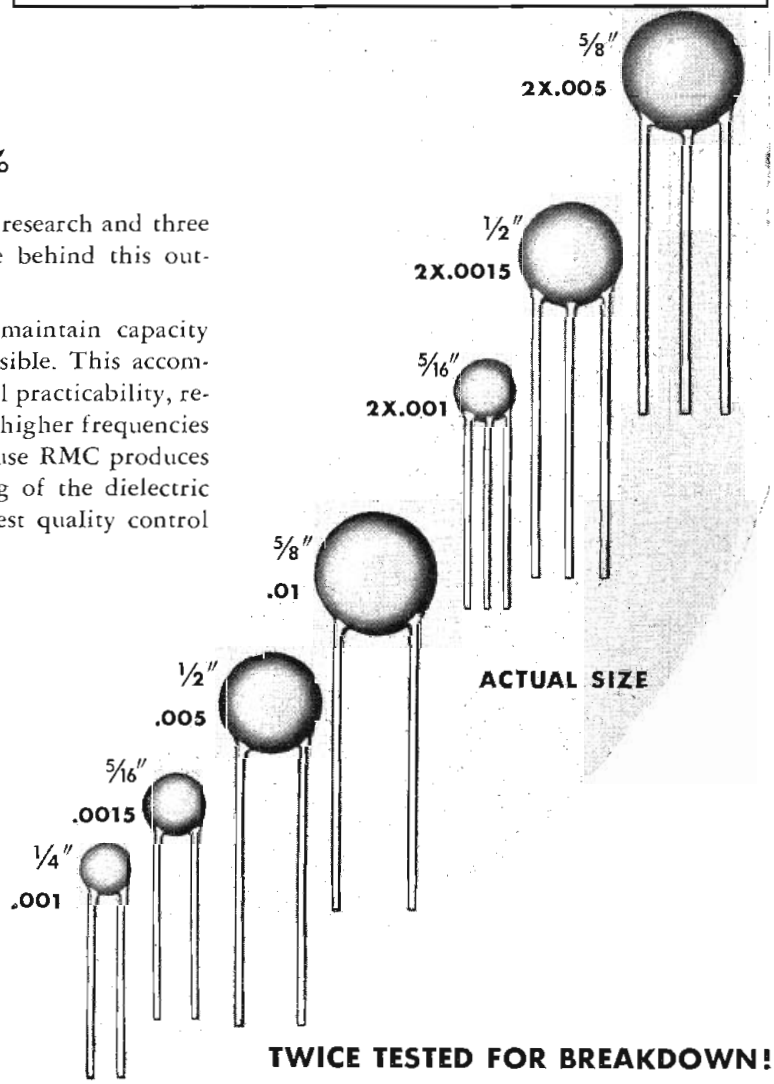
The Newest Development in Ceramic By-Pass Condensers

Improved processes of dielectric element impregnation and outer casing insulation are exclusive with DISCAPS. They are available in all standard capacities from .001 MFD to .01 MFD and in dual capacities from 2 x .001 to 2 x .01 MFD. Their small size, low self inductance, low power factor and moisture impervious characteristics place them in a class alone.



2 PLANTS TO SERVE YOU!

Now there are two fully equipped RMC manufacturing plants — one in Chicago, the other in Attica, Indiana — both devoted exclusively to the production of ceramic condensers. With requirements for DISCAPS increasing daily, RMC is expanding with this demand to guarantee your production schedule. Approval by leading makers of TV set and tuners, as well as by manufacturers of specialized high frequency equipment, is proof of DISCAP superiority.



TWICE TESTED FOR BREAKDOWN!

Every DISCAP Condenser is 100% tested for capacity, leakage resistance and breakdown. Tests for breakdown are made at 1000 V.A.C. as well as at 1200 V.D.C. RMC production checks eliminate costly service failures. Yes, DISCAPS are definitely better.

SEND FOR SAMPLES AND TECHNICAL DATA

CERAMIC CONDENSERS IS OUR BUSINESS

DISCAP CERAMIC CONDENSERS

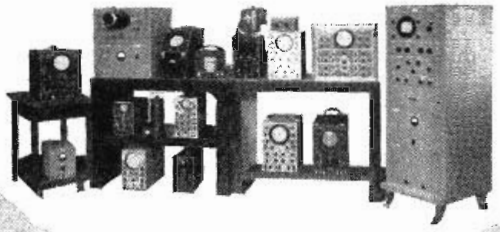
RMC

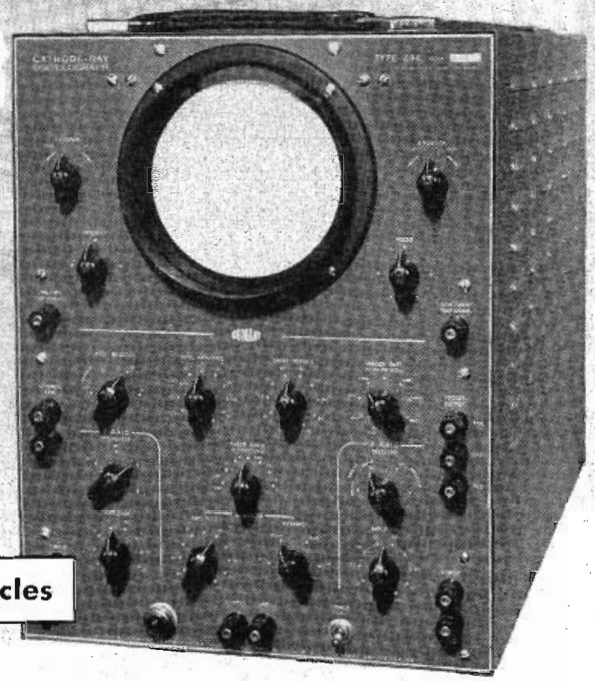
RADIO MATERIALS CORPORATION

GENERAL OFFICE: 1708 Belmont Ave., Chicago 13, Ill.

FACTORIES AT CHICAGO, ILL., AND ATTICA, IND.

DUMONT *Oscillography..*





. . . the outstanding heritage of another great performer

DEFINING THE OSCILLOGRAPHIC SPECTRUM **from 10 cps. to 15 megacycles**

THE NEW DU MONT TYPE 294 CATHODE-RAY OSCILLOGRAPH

The Type 294 is an extremely versatile cathode-ray oscillograph combining high-voltage operation with precise high-frequency circuit design, extending its general-purpose utility to meet the specialized needs of high-speed transient study.

Stable operation of the high-gain, wide-band amplifier of the Y axis over the entire frequency range from 10 cps. to 15 megacycles includes the performance of a signal-delay line built into the Y-axis circuit to insure full display of short-duration pulses. An input pulse rise time of 0.01 μs. will be reproduced with a rise time not exceeding 0.03 μs.

Available undistorted deflection of both symmetrical signals and unidirectional pulses of either positive or negative polarity exceeds the usable vertical scan of the cathode-ray tube. A built-in high-voltage unit supplies 12 kv. accelerating potential to the Du Mont Type 5XP- cathode-ray tube; rear-panel selection of a lower potential may be made for increased sensitivity and deflection.

A flexible sweep circuit provides continuously variable driven and recurrent sweeps with sweep calibration being provided by internal timing markers applied through the Z-axis amplifier.

• • •

Permanent records of phenomena studied with the Type 294 may be made with either the Du Mont Type 271-A or 314-A Oscillograph-record Camera.

GENERAL SPECIFICATIONS

Cathode-ray Tube . . . . . Du Mont Type 5XP-
Accelerating potential . . . . . 12,000 volts
. . . . . 7,000 volts

Y-axis Amplifier
Frequency response
10 cps. to 15 megacycles
Sensitivity . . . . . 0.15 rms volt/in. at 7 kv.
. . . . 0.20 rms volt/in. at 12 kv.
Rise time . . . . 0.03 μs. from 10% to 90%

Signal Delay . . . . . 0.25 μs.

X-axis Amplifier
Frequency response . . . . . 2 cps. to 700 kc.
Sensitivity . . . . . 0.4 rms volt/in. at 7 kv.
. . . . . 0.5 rms volt/in. at 12 kv.
Rise time . . . . . 0.5 μs. from 10% to 90%

Driven Sweep Range . . . . . 0.1 sec. to 2 μs.

Recurrent Sweep Range . . 10 cps. to 150 kc.

Z-axis Amplifier
Polarity selection—3 volts peak to blank trace of normal intensity.

Timing-Marker Intervals
100 μs., 10 μs., 1 μs.

Trigger Generator
Repetition rate . . . . . 200 to 3600 p.p.s.
Output amplitude . . . . . 50 volts peak
Output polarity . . . . positive or negative

Physical Specifications
Indicator Unit
24½" d.—15¾" h.—12¾" w.—62 lbs.
Power Supply
19¾" d.—15¾" h.—12¾" w.—100 lbs.

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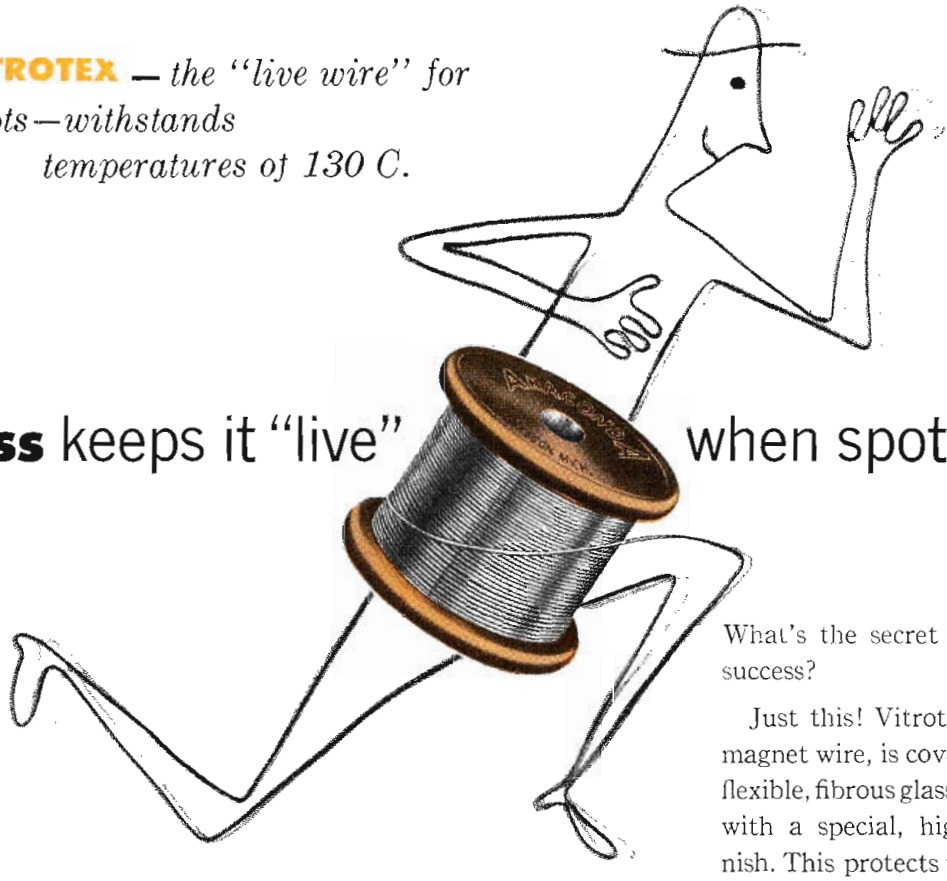

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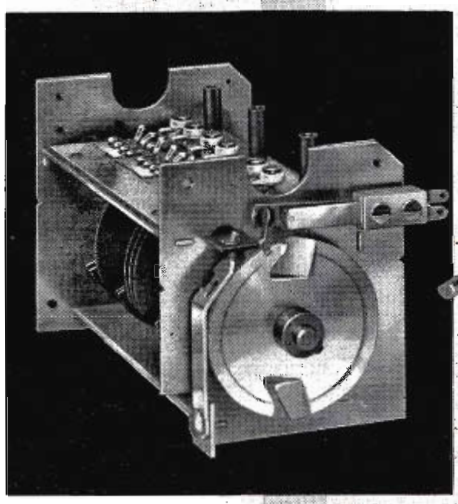

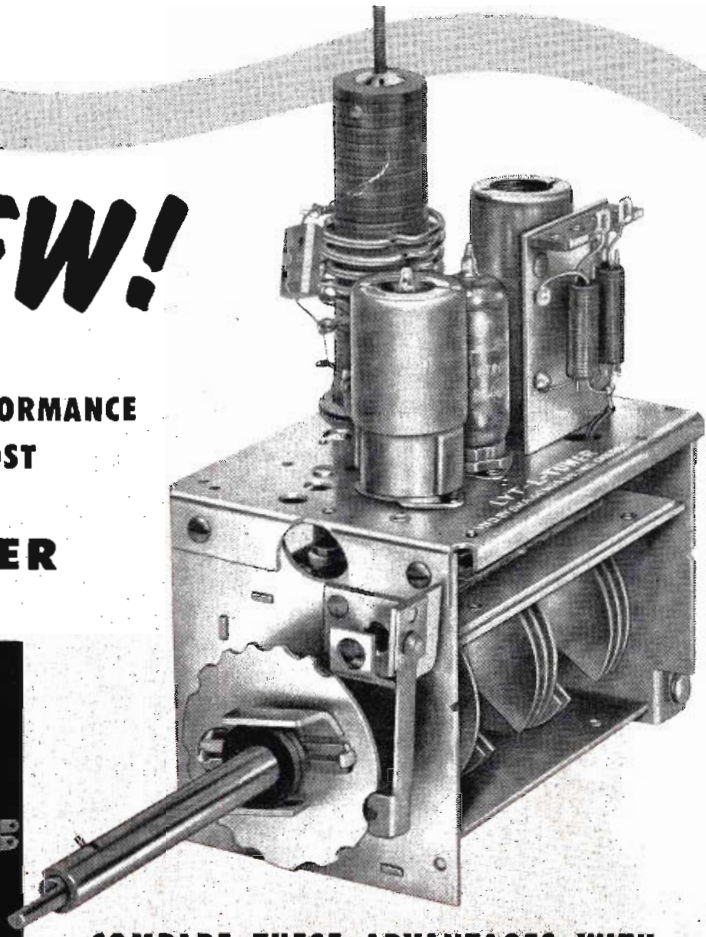

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TELE-TECH

TELEVISION • TELECOMMUNICATIONS • RADIO

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

DEPENDABLE INDUSTRY STATISTICS NEEDED

Manufacturers' Two-Billion-Dollar Annual Business Is 95% TV and Tele-Communications!

Right now there is urgent need for accurate production and marketing statistics of our industry. Anyone today looking for basic figures on which to do future planning, will find wide discrepancies in the estimates of supposed industry authorities.

For example, McGraw-Hill's "Electronics" for March (page 68) solemnly predicts 1950 television-set production at only 3,700,000 sets! Yet during that very month, TV output had already reached a rate of over 5,200,000 sets per year, and was week-by-week increasing! Based on current production, many industry leaders believe 1950 TV output may well exceed 6,000,000 sets. This means a 1950 factory value of $900,000,000 for TV receivers alone—actually double the $450,000,000 figure given at another point in our contemporary's above-mentioned chart of "statistics for 1950."

Other Factors in Radio-TV's $2,000,000,000

The 12,000,000 radio sets (AM and FM) certain to be produced in 1950, we estimate, will have a factory selling value of $260,000,000. Broadcast-station, recording, studio, and associated equipment will add another $200,000,000. And mobile, airplane, police and taxi radio will reach $100,000,000.

From Washington we get definite budget figures of $350,000,000 to be spent for radio in 1950 by the Government's armed forces and other agencies.

Add to all the above, the huge miscellaneous totals for replacement tubes, and parts, accessories and test equipment, estimated at $190,000,000, and we reach at manufacturers' selling prices—

A 1950 total of **two billion dollars for radio, television and government alone!**

This two-billion dollar figure, please note, is again just *twice* the corresponding industry total which our contemporary shows in the article mentioned. Such a wide, two-to-one disparity in basic totals further emphasizes the need for sound dependable industry statistics on which to do any intelligent market planning.

Industrial Electronics Only 2½ to 5% of TV-Radio

Going now to "industrial electronics" (non-communication uses) which for 1950 we estimate at $50,000,000—or 2½% of the industry's total production—our contemporary's March article indicates a value of $100,000,000. Even at the latter more liberal figure, industrial electronics would account for less than 5% of the radio-TV total. Stated another way, the present size of industrial electronics compares, relatively, about with that of Rhode Island in the U. S. picture.

It is because the publishers of this magazine three years ago saw this huge radio-TV market thus crystallizing, that in 1947 they put the minority "electronic" theme to one side and decided to focus on the main stream—the 95 to 97½% volume of tele-communications and TV, on which TELE-TECH concentrates.

And with our industry now doing over 95% of its business in the clearly defined fields of radio, television and government, the time seems past to go on calling the whole two-billion-dollar industry by the name of its 2½-to-5% industrial component. No longer should the small $50-million electronic tail wag the big $2-billion television-radio dog!

We need better industry statistics to evaluate our markets truly and accurately.

In fairness, too, we should call our industry and our markets by their right names. For this is, after all, **the radio-television industry**, and nothing else!

The present move of RMA to adopt the new name of "The Radio & Television Manufacturers Association" bears this out, one more step in the right direction.

The RADARSCOPE

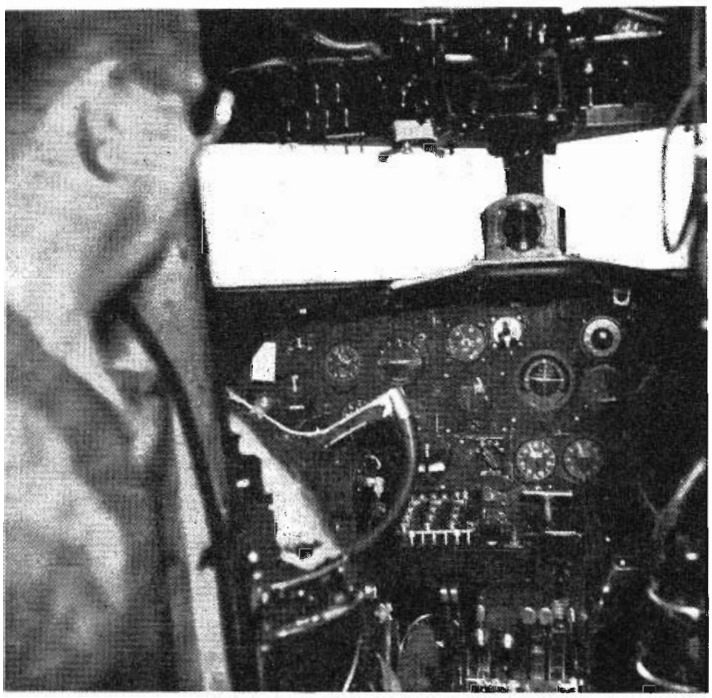
Revealing at a Glance,

FCC & CPB

COMMUNICATIONS POLICY BOARD will also have a hand in the future of TV, it now appears. For important policies respecting the future television-frequency space in the spectrum are felt to be certain to be formulated and recommended to President Truman by the new national Communications Policy Board outranking the FCC. While the television-frequency pattern probably will not be forthcoming from the Board until Fall, the television-frequency space agenda would include such questions as the "upstairs" move to UHF as the eventual video home; the subject of paring down government frequency assignments to permit television, mobile radio etc. to have more space; the tussle between television and mobile radio services for frequency space; etc.

COLOR TV

TECHNICAL PROBLEM SOLVED—With the newly-demonstrated RCA color-tube, indications are that within twelve months color TV receivers could—and possibly will—be available in limited quantities which will increase as more tubes become available. This would be in spite of the admitted past efforts of RMA to slow down public acceptance of color. It appears to be pretty well established in everyone's mind that nothing can stop the ultimate adoption of color now that the Princeton laboratories have made their epic contribution of the tri-color tube. Some sources estimate that these tubes can be commercially produced for as little as twice the cost of present black-and-white tubes. General Sarnoff predicts color receivers incorporating this tube can be made for about 25% to 50% more than existing black-white sets. It is probable that some fifty tri-color tubes will be hand produced in the next few months and be made available to other manufacturers for development. Since RCA says that it is easier and cheaper to produce large tubes than small ones, the move towards larger pictures should be strengthened, and viewers can look forward to larger pictures—in color, FCC willing—in the next twelve to eighteen months. (See color-TV article on following pages).



Rigid self-control is the order of the day for this CAA developmental pilot as he stands out of his seat and watches a little black box land his plane! Taken during an approach, this cockpit photograph shows a DC3 landing entirely by radio control at the CAA Technical Development and Evaluation Center, Indianapolis.

BROADCASTING

TELEVISION IS EXPENSIVE—And network television is even more expensive. The American Broadcasting Company, Inc., has reported a loss of over $500,000 for 1949. In 1948 the net income was over $400,000, but that was partly BTV (before TV). In 1949 between $7,000,000 and $8,000,000 was invested in TV properties in New York, Chicago, Detroit, San Francisco and Los Angeles. The latter includes of course the fabulous Warner lot as well as the studios and plant for KECA-TV. Both in New York and Los Angeles the web has the largest TV studios in the country, the New York, Studio 1 being the envy of the networks. In spite of the 1949 loss, and the recent plans for a $2,500,000 loan, ABC stock recently reached a new high, climbing to over $12 a share. This has revived rumours that one of the large movie companies, possibly Twentieth-Century-Fox, is still in the market for the company.

AVIATION

DISTRESS WATCH RULING—The importance of the radio training given aerial navigators today is emphasized by a recent CAB ruling which deletes the necessity for overwater-flight aircraft to carry radio-telegraphy operators. Although the standard 500-KC "distress" frequency uses code, all other *routine* transmissions are by means of long-distance radio telephone. One reason for the CAB's ruling is the increased skill required of navigators in operating equipment such as Loran, Radar, Consol, etc., has made them virtual communications specialists who should have no difficulty in mastering a little code transmission in the event of trouble, and for keeping the normal "distress watch".

MOBILE RADIO

COOPERATION IS THE KEYWORD—Efficient radio operation is dependent on voluntary or enforced observance of frequency tolerances and allocations. Both the utility and the police communication organizations have set up geographical preferred-frequency plans. In the case of the former, the National Committee for Utilities Radio devised an assignment table which would prevent adjacent and co-channel interference on the important utilities frequencies. In the latter case the National Police Radio Committee established an assignment plan for the vital 30 to 50 MC band used by the police. In each instance the laborious spadework was done by enthusiatic members of the committees who gave freely of their time and energies. These are just two examples of the spirit of self help which radio seems to bring to the fore in everyone who works with it. Perhaps the United Nations would prosper if all the delegates were radio men!

AUDIO

DISC RECORDING WITH HEAT—A new development which promises to become a significant forward step in the technic of disc recording is being used by the Fairchild Recording Equipment Corp., Whitestone, L. I., N. Y. By mounting a miniature heating element near the sapphire tip of the recording stylus, the desired audio intelligence is melted rather than cut into the acetate or wax blank. The resultant groove is highly polished and on playback yields an increase in signal-to-noise ratio of about 20 db. Expressed differently,—with this new method of recording the disc noise-level becomes comparable with that obtained in better quality magnetic tapes.

INTERNATIONAL

VOYEZ-VOUS-FRANCAIS?—In Paris, TV is being transmitted daily on 42 MC for sound, and 46 MC for vision, using 440 lines over a band width of 3.5 MC. Tuesdays through Fridays additional high-definition signals using 819 lines are transmitted on 174.1 MC and 185.25 MC for sound and vision respectively. Reception of the sound transmission has already been reported in the U. S.—we wager that the early days of TV when all the neighbors came in to see the World Series will be nothing to what will happen when some venturesome viewer manages to catch the Folies Bergeres on 185.25 MC!

MATERIALS

GOLD AS SOLDER shows certain advantages in some critical jobs—such as fine instruments, and in special vacuum-tube element fabrication. Its surface tension is high in liquid form so that it flows into

The feasibility of color-TV in the home, on receivers of normal size and shape, is demonstrated by E. W. Herold, one of the RCA research men who helped develop the new tri-color television tube.

restricted crevices, and being chemically relatively inert it does not form oxides or sulphides as does commoner brazing or silvering solders.

Since the vacuum tube's inception, tube designers have usually followed the practices of the lamp makers—using small tabs, wires and plates welded together, with special anchors imbedded in glass. These technics have undergone many improvements of late, and the practices of the glass blower have been superceded by those of the machine shop. Even glass sheet itself is now being punched out in intricate shapes by the hot punching method. These principles have been worked up so that vacuum tube insulating forms are made with a high degree of accuracy.

FILMS

NEW USES IN TV—The trend towards increasing film usage in TV continues. The latest application is to set up a movie camera with properly masked taking and viewfinding lens apertures, in the various places where the TV cameras could be located. Using lenses with the same focal length as those in the TV camera it is possible to make a record of the shots for later study, and thus select the sites which offer the best shooting angles. This operation costs only a fraction as much as a survey using field TV cameras and is considerably more exact than surveys made with the naked eye since the proper 4:3 frame ratio is main-maintained.

RCA

Unique success color TV tubes.

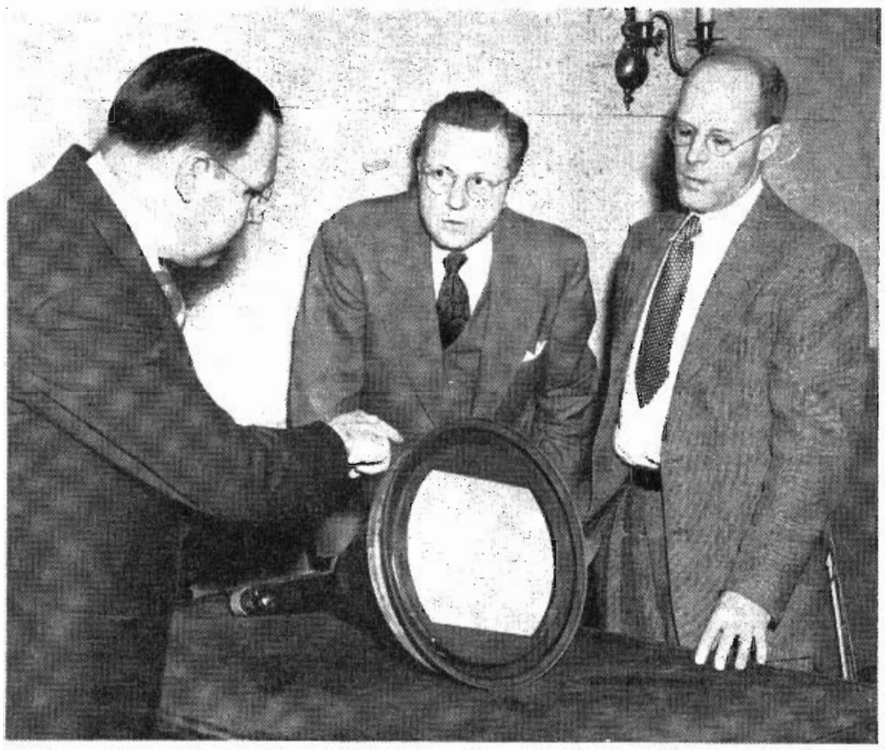


Fig. 1. The missing link, single gun tri-color kinescope, being discussed by Harold B. Law, E. W. Herold and Russell Law (l to r) RCA scientists who participated in the tube's development and experimental hand production

AT the first showing in Washington the culmination of many months of research, experimentation and development was seen in the form of color pictures on the first RCA tri-color picture tube. In previous demonstrations of the dot interlace color system, RCA had used receivers containing three individual cathode ray tubes having screens emitting red, green and blue light respectively. The three images were combined and superimposed by means of dichroic mirrors to secure a picture in color. Such a bulky lay-out, with its inherent registration problems, has been rendered obsolete by the new tricolor tube.

For years the need of such a tube for a simplified color TV receiver has been evident. At least three TV tube laboratories other than RCA have been working on this difficult problem. Credit for this RCA development goes to the scientists comprising the teams cooperating in the work at Lancaster and Princeton under the leadership of Dr. Engstrom.

Before an audience of about 100 engineers, assembled in one of the unused studios of station WRC, were placed: a monochrome table model TV receiver, a single-gun tricolor tube set and a three-gun tricolor tube receiver. A color program staged and broadcast from WNBW about two miles away was received on these sets on Channel 4. The crisp black-white picture showed that the RCA color system was 100% compatible and that black-white receivers in the hands of the public would continue to give good pictures with no alteration, when this system of color is being broadcast.

Picture Quality

The picture in color on the receiver having the single-gun tube was very good, better than previous RCA color pictures which have been seen in the several demonstrations that have punctuated the FCC Color Hearing. The colors were judged true to life, there was no flicker, color breakup, or fringing. Although close viewing was not possible, from a distance of 25 feet the detail appeared adequate.

In the case of the receiver with the three-gun tube the picture had all the attributes just described except it was noticeably brighter (18 KV as against 10 KV on the second anode of the tube) and color contamination was absent.

In terms of illumination a loss of about 40% occurs in the red filter required by the present low efficiency red phosphor available. Thus the light measured is about 7 foot lamberts for the 3-gun, and 4 foot lamberts for the 1-gun tube. Standard black and white sets have a brilliancy of around 30 foot lamberts.

The direct-view color screen is composed of an orderly array of small, closely spaced, aluminized phosphor dots arranged in triangular groups, each group comprising a green-emitting dot, a red-emitting dot and a blue-emitting dot. In the laboratory sample tubes used in the demonstrations there are 351,000 such dots, 117,000 of each color. The screen is viewed in the same manner as for a conventional black-and-white kinescope.

The manner in which the color screen produces a color picture is best understood by considering first the operation of the three-gun tricolor kinescope. An apertured mask is interposed between the three guns and the dot-phosphor screen in such a manner that the electrons from any one gun can strike only a single color phosphor no matter which part of the raster is being scanned. The mask consists of a sheet of metal spaced from the phosphor screen and containing 117,000 holes, or one hole for each of the tri-color-dot groups. This hole is so registered with its associated dot group that the difference in the approach angle of the three beams determines the color. Thus, three color signals applied to the three guns produce independent pictures in the three primary colors, the pictures appearing to be superimposed because of the close spacing of the phosphor dots.

In so far as the color aspects are concerned, this three-gun tri-color kinescope may be utilized in a receiver in much the same manner as three single-color kinescopes, except, of course, that no optical superposing or registration means need be provided and deflection power need be provided for only one deflection yoke.

3-Gun Tri-Color Kinescope

One of the research-type receivers demonstrated employs the three-gun tri-color kinescope and high-level sampling. This receiver utilizes 46 tubes and consists essentially of

Color Kinescope Demonstrated

achieved by RCA scientists in developing and operating single and multi-gun
Only minor refinements now required to render tube commercially available

a 27 tube black-and-white receiver to which have been added 19 tubes for color synchronization, sampling, and additional power supplies.

A block diagram of the principles of the circuit arrangement employed in the receiver utilizing the three-gun tri-color kinescope is shown in Fig. 2. Video signal from a conventional black-and-white receiver is applied simultaneously to the three, internally-connected, control grids of the three-gun kinescope. Another signal, derived from the video amplifier is used to actuate an automatic color phasing and sampling synchronization circuit which produces a local 3.58 MC sampling wave. This is applied through an amplifier and appropriate delay lines to three gating tubes which supply three sampling pulses, differing in phase by 120 degrees at 3.58 MC, to the three cathodes of the kinescope. Thus, each gun is turned on in time sequence corresponding to the original sampling process at the transmitter and the beam current from each gun excites only one of the three phosphor colors.

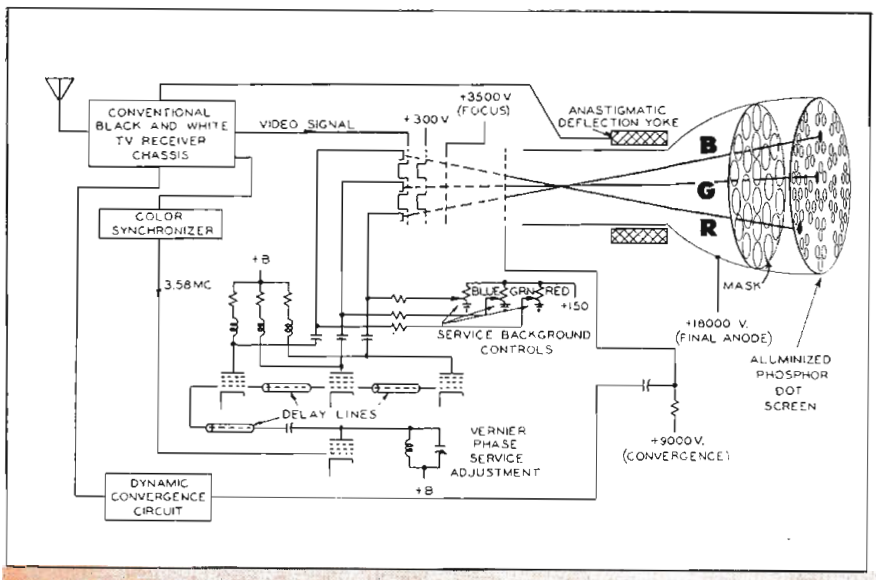


Fig. 2: Diagram and general schematic of control circuits of three-gun color tube showing artist's conception of the beam pattern and interior construction based on available data

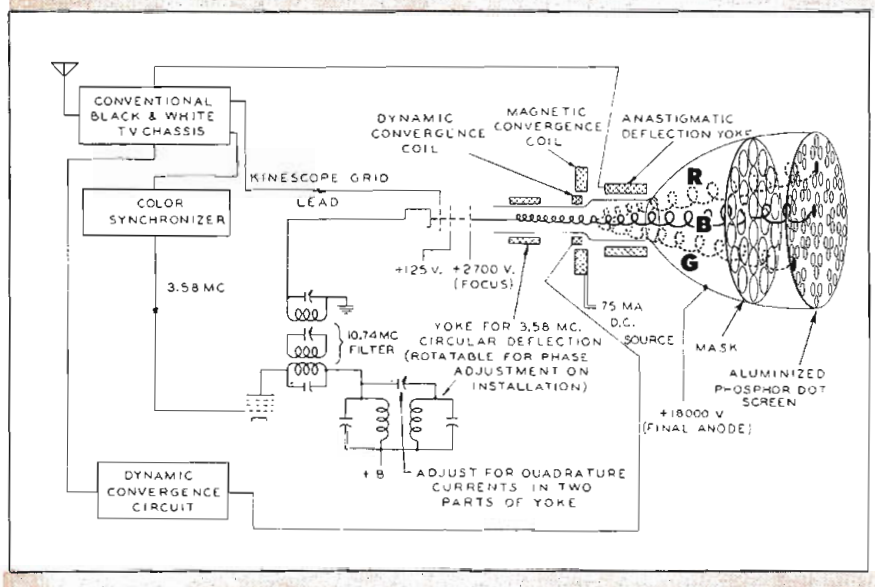


Fig. 3: Diagram of control circuits and scanning arrangements for single gun tube. The spiral beam path shows how rotating the beam controls the angle of its passage through the mask and hence selects the color dot which is illuminated on the fluorescent screen

Conventional Deflection Circuit

The deflection circuitry is conventional. Minor changes in deflection-tube types have been made to supply additional deflection power required by the increased kinescope second-anode potential (18 kv). The deflection yoke is of the anastigmatic type and has an internal diameter of two inches to accommodate the converged beams from the three guns.

Registration in this three-gun tube is obtained by the proper registration of the masking apertures with their corresponding groups of phosphor dots. Means are also provided to converge the three beams to the same point on the phosphor screen during scanning. This is done for the undeflected beams by a convergence electrode, operated at 9,000 volts, and, when necessary, by small correcting magnets. Because of the essentially flat face of the phosphor screen, simple geometrical considerations show that slightly less convergence is desirable as the beam is deflected from center. This dynamic convergence is accomplished by deriving a voltage from vertical and horizontal deflection circuits of the receiver and applying it to the convergence electrode through a capacitor.

An r-f type anode voltage supply provides a potential of 18 kv for the kinescope final anode, 9 kv for the electrostatic converging electrode and approximately 3.5 kv for the parallel-connected first anodes which produce initial electron-beam focus.

(*Continued on page* 61)

How the CAA Flight

Modern VHF Omnirange installations require very precise attention more involved they are capable of much greater efficiency

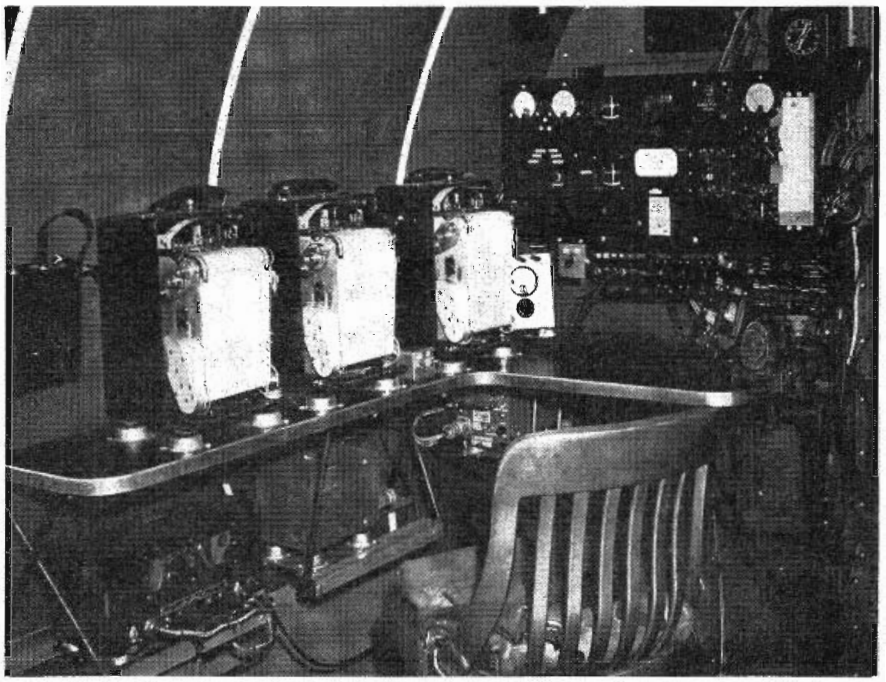


Fig. 1: The VOR test equipment setup in a CAA DC-3 aircraft. Left to right, Esterline Angus recorders record either receiver AVC voltage or 75 MC marker audio modulation, and course line information. On right are center zero instruments for courseline data.

By ARTHUR E. JENKS, *Chief, Facilities Flight Inspection Branch CAA, Region I, New York, N. Y.*

SINCE the first installation of directional radio aids on the Federal Airways, there has been the necessity of proving the course alignment, usable distance and course characteristics by actual flight. Ground measurements were only about 60% reliable and were unreliable in determining split courses or "multiples" in space.

Prior to 1940, ten specially trained pilots were able to patrol the existing airways, reporting on the performance of approximately 300 range stations every sixty to ninety days. With the advent of VHF radio aids, however, the problem has become more diversified and, at the same time, more difficult. It might be stated that with the majority of radio transmission, the prime function is to obtain area coverage as in the case of broadcast stations, or point-to-point coverage as in communications. No special attention is given the signal, providing it is received, and has sufficient quality for the service desired. Directive radio not only necessitates coverage but the signal must be in the same azimuth at the receiving point as it was when it left the transmitting antenna array. If the received signal and the azimuth identification point do not agree, within prescribed limits, a careful and comprehensive analysis must be made in order that the error can be traced to either transmitter or terrain difficulty and corrective action taken. This means that the modern airways patrol plane is virtually a flying laboratory equipped with, in addition to the required receivers, special meters, antenna combinations, Esterline Angus recorders, recorder amplifiers and tone actuated amplifiers for ground marking of recordings. The crews to man this equipment are specially trained and are chosen from high calibre pilot level with an electronics background. The entire staff forms the Airways Flight Inspection Division of Federal Airways, Civil Aeronautics Administration, U. S. Department of Commerce, with branch offices located at each C.A.A. Regional Office.

The ground station provides no course line indication in a true sense. It simply radiates two signals, one of constant phase throughout all azimuths, the other of variable phase in all azimuths. The receiver, by means of phase comparison and the delivery of this intelligence to suitable cockpit instrumentation, then furnishes course line information, ambiguity and right-left sensing.

Station Layout

A VOR transmitting station consists of a small building about the size of the average living room housing the transmitting equipment and standby power system. The antennas are located on a 15 ft. tower adjacent to the building and the "whole" is situated at the center of a cleared area with a minimum of 700 ft. to the nearest trees or buildings. Two complete sets of transmitting equipment are located in the building. The antenna system is comprised of Alford loops set on five pedestals. The tallest pedestal holds the center antenna (carrier antenna) and is bolted in the center of a 30 ft. metal counterpoise. The four sideband antennas are arranged in a square as close to the carrier antenna as electrically possible and supported on pedestals slightly shorter than the carrier mounting and approximately $\lambda/2$ wavelength above the counterpoise. The entire array is protected from the weather by a small non-metallic building.

The carrier antenna radiates the 30 cycle reference phase, station voice or broadcast channel and station identification. The identification consists of a 1020 cycle modu-

Tests VOR Ranges

to terrain features during siting. Although the initial work is and navigational safety than the original four-course ranges

lated tone keyed with the appropriate Morse code identification characteristic. The 30 cycle reference signal is produced by a 9960 cycle signal superimposed on the carrier and modulated at 30 cycles. This is accomplished by a synchronous motor-driven tone wheel which has 332 teeth arranged around the periphery and revolves at 1800 rpm. The spacing between the teeth of the tone wheel gradually diminishes from maximum, reaching the minimum spacing diametrically opposite the maximum tooth spacing on the balance of the circumference, the spacing increasing again to the maximum point. These teeth pass through the field of a permanent magnet over which is wound a coil of wire. As the teeth of the wheel pass the pole piece, a varying magnetic field is produced around the magnet which induces a voltage in the coil. The output of the tone wheel is then fed to the modulator driver and used to amplitude-modulate the carrier. This signal is referred to as the 10 KC FM subcarrier. On the same shaft with the tone wheel there is a rotating goniometer, the rotor blades of which are cut to provide sinusoidial modulation of the r-f that is supplied to the sideband antennas. This is also at 30 cps and provides the rotating or variable phase.

Fig. 2. Typical VOR Transmitter site at Philipsburg, Pa. Although the actual installation is small a large clearing around the antenna is essential to prevent radiation shadows.

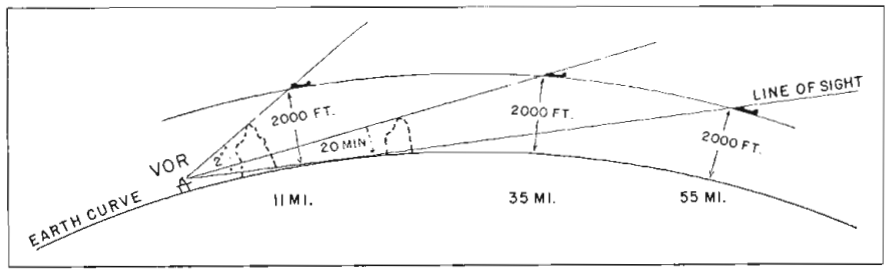


Fig. 3. Graphic illustration of effect of terrain or even trees on transmission characteristics of signal from VOR, on aircraft flying at 2000 feet, at distances of up to 55 miles.

Transmitter Design

The transmitter used in the VOR is of conventional design having a power output of 200 watts in the frequency range of 108 to 118 MC. It is crystal-controlled, the output frequency being either 18 or 24 times the crystal frequency, and capable of 100% modulation. The transmitter is normally modulated 30% by the 10 KC subcarrier and 10% by the 1020 cps identification signal. Voice modulation of about 30% may be used simultaneously with the former. The 1020 cycle identification is automatically interrupted when the broadcast feature is in use.

In the aircraft receiver the 10 KC FM subcarrier detector output is fed to an amplifier limiter and FM discriminator to obtain a 30 cps reference signal, which is independent of the receiver bearing with respect to the station. The reference signal is fed through a phase splitting circuit to provide two equal voltages with a phase difference of 90°. These two voltages are then passed through a manual phase shifting control which is the course selector on the pilot's instrument panel. The resultant reference signal at the output of the course selector is fed to the phase detector circuit where it is mixed and compared with a filtered and amplified variable phase signal to obtain plus or minus d-c current indications. These currents are then fed to a crosspointer instrument which supplies the pilot with a course line indication. When the crosspointer indicator is centered at any particular azimuth, the phase difference between the reference and variable signals is shown on the course selector as the bearing of the aircraft to or from the station. The TO and FROM ambiguity indication is supplied by a third instrument known as a "sense indictor" connected to the output of a separate phase detector which operates with a phase relationship of 90° from the crosspointer phase detector circuit.

With a fixed course facility such as the low frequency range or the VHF four-course range, the pilot had to maneuver the aircraft in order to intercept, and remain on the courses. To the pilot, an omnirange is a two-course visual range the alignment of which he can control directly from the cockpit. This, in itself, opens many possibilities in the diversified problem of aerial navigation and traffic control.

Before discussing the flight analysis or space measurement of this

TESTING VOR RANGES (Continued)

facility, it is necessary to present some of the facts involving a VHF directive radio aid at ground level providing navigational information to an aircraft in space 50 to 150 miles distant. Radio signals at 112 to 118 MC tend to propagate slightly beyond line-of-sight. This means that with a range station ideally located in the center of a flat plain with a horizon angle of 0°, as viewed from the antennas, an aircraft 55 miles away and at a 2,000 ft. altitude would be on the fringe of line-of-sight signal. This is the ideal location — most of the locations, especially in hilly or mountainous areas, have obstructions on the antenna horizon profile that vary from a vertical angle of 20 minutes to slightly more than 2°. These low angles may appear insignificant but their imoprtance from the viewpoint of station coverage can be readily seen when a 20 minute plus angle determines the line-of-sight distance at a 2000 ft. altitude as 35 miles, 2° plus reduces the distance to 11 miles at this altitude. From the above example, it should be noted that there is a difference of 20 miles between zero angle line-of-sight at 2000 ft. and 20 minutes plus angle line-of-sight to the same altitude. This difference is strictly mathematical, in actual measurement of signal strength at these frequencies the exact cutoff point could not be detected at this flat an angle, and as a consequence any horizon angle of 20 minutes or less can be considered as zero degrees from a practical viewpoint.

Horizon Profile Data

The data on the horizon profile are secured and utilized in the following manner: The horizon profile, as viewed from the antenna, is measured by transit at every 5° of azimuth and these data are then plotted on polar-coordinate paper with the range station as the center, using 50-mile scale and an assumed flight altitude of 2500 ft. The resulting plot of vertical angle vs. line-of-sight to 2500 ft. then gives the true line-of-sight coverage of the station for this altitude. These profile characteristics help determine the possible course distortion in the shadow area. For example, a constant vertical angle of 1° plus, throughout any azimuth greater than 20° will give a sharp and uniform cutoff at the line-of-sight and result in a uniform and undistorted signal in the shadow area. Profiles wherein the vertical angle varies from 30 minutes to 2° or more over any given amount of azimuth, plus being extremely ragged, will produce signal distortion in the shadow area. The most violent disturbance occurs just beyond the line-of-sight point. Well out in the shadow area the distortion tends to diminish, and in certain instances extreme range in the shadow area has been found to be relatively smooth. In other cases, the disturbance is extremely violent out to the

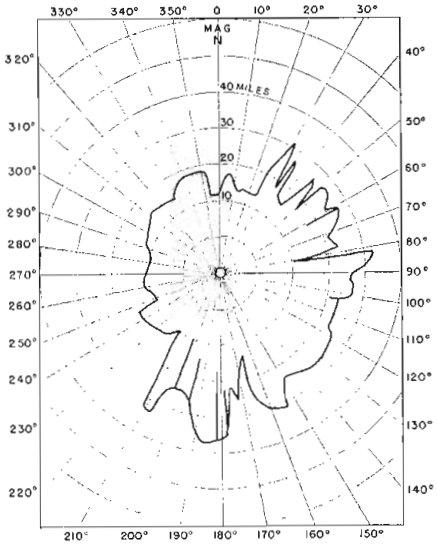


Fig. 4. Typical antenna radiation shadow area of antenna plotted from 2000 ft. above station

point of complete attenuation. In the latter cases, the initial disturbing factor on the profile may be close to the station in an area of relatively high signal strength, and the initial disturbance amplified by additional terrain breaks in the shadow area.

The first important step in the flight calibration of an omnirange is the theodolite check. This is accomplished in the following manner: The theodolite is set up at a desirable spot adjacent to the transmitter building and orientated on magnetic north. The 1020 cycle tone identification keying is removed and a control connected to the theodolite position. This permits the theodolite operator, by means of a suitable key or switch to control the tone signal from the station. The aircraft flies around the station at sufficient altitude to be in view of the theodolite operator throughout the entire 360° of azimuth and at a distance of six to eight miles. The operator tracks the aircraft by setting the theodolite an even 5° ahead of the aircraft. At the instant the nose of the aircraft intercepts the vertical crosshair of the theodolite, the operator closes the switch key for approximately ½ second. This broadcasts a 1020 cycle tone from the VOR station. The operator then resets the theodolite 5° ahead and repeats the operation when the aircraft's nose again crosses the vertical crosshair. In the aircraft, one of the flight crew pilots the airplane on the circle track around the station adhering to the track as closely as possible and maintaining a constant altitude.

Recorder Operation

At the recording position, the receiver course line indication is recorded upon an Esterline Angus recorder. As the azimuth is constantly changing during the flight around the station, the recorder operator resets the course selector in even 10° increments as the flight progresses, noting on the recording each azimuth setting, i.e., 320°, 310°, 300°. The 1020 cycle tone pulses which are received as an indication of every 5° of magnetic azimuth, as viewed by the theodolite, are fed through a filter unit and amplifier and then used to actuate a marking pen on the side of the course recording. Voice communication between aircraft and ground is utilized to identify the theodolite tone markings. This portion of the flight check is completed when the entire orbit of 360° is flown plus a slight amount of overlap. From the analysis of these recordings, by comparison of receiver indication and theodolite marking, an error curve can be constructed showing the station error throughout 360°. In the initial tuneup of the station, the error may be found all on one side of the zero reference line meaning all plus or all minus. This is easily corrected by the adjustment of the magnetic pickup coil in respect to its positioning on the periphery of the tone wheel.

Upon completion of the theodolite check, station courses coinciding with the existing airways are flown out to the point of usable signal attenuation and the course line indication recorded and verified over ground reference points. The course sensitivity is checked several times at different distances from the station during this operation and periodic readings of the receiver voltages for the reference and variable signals are taken: The course alignment and quality are

(*Continued on page* 56)

MAGNETIC SOUND on 8mm FILM

A new approach to the old problem of how to put sound on sub-standard film. Not only does it offer sound to the 8mm user, but it points up the latest thinking in the realm of 35mm theatre motion pictures

By MARVIN CAMRAS, Armour Research Foundation, Illinois Institute of Technology

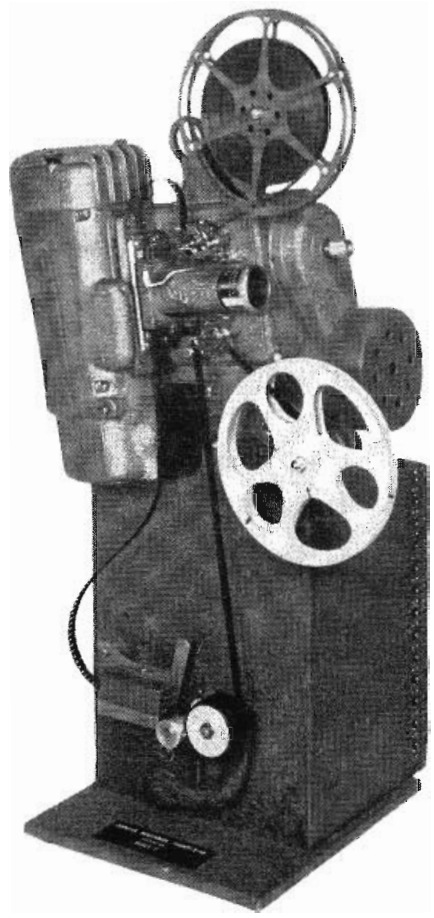


Fig. 1. Experimental 8 mm projector equipped for magnetic sound recording and playback. The base contains the stabilizing flywheel and mounts the playback, recording and erase heads

EIGHT-millimeter movies are the the only ones that have remained silent up to the present time. This is remarkable because the total amount of eight-millimeter photography done annually probably exceeds all other cinephotography. By 1949, about 900,000 cameras and a comparable number of projectors for eight millimeters had been sold.

Optical sound has been available in both thirty-five and sixteen-millimeter films for about twenty years. A typical optical sound system is shown in Fig. 5. For eight-millimeter films the problems of slow projection speed and limited area available for sound track are so great that optical sound was never introduced.

There is another consideration which is sometimes overlooked. With the optical sound now available on sixteen-millimeter equipment, the user must show commercially produced films. He cannot make his own sound on film, except with apparatus and technics that are so costly as to be out of reach for most people. Yet, the idea of easily-made sound films is so attractive, that many devices for this purpose have appeared from time to time. These include phonographs and magnetic recorders synchronized with the projector, embossed grooves in the side of the film, etc. None has become popular.

Recently a new approach to the problem has been made by depositing a magnetizable strip on the edge of the motion picture film as in Fig. 2. Although the coating can be put on either edge, the location just outside the sprocket area is favored because there is no interference with the picture. A magnetic head on the projector contacts the magnetic strip and can record, play-back, or erase the track as many times as desired.

An experimental eight-millimeter projector equipped for magnetic sound is shown in Fig. 1. The projector itself is conventional, and is mounted on a base which contains the erase-record-playback heads, a stabilizing flywheel, and the amplifier unit. A block diagram of the electrical and mechanical section of the magnetic unit is given by Fig. 6. The film passes from the optical projection gate into the sound head unit which consists of an erase head and a record-playback head. Just beyond the heads is a rotary stabilizer, consisting of a film drum and flywheel mounted together on the same shaft which rotates in ball bearings. A rubber pressure roller mounted on a pivoted arm, presses the film against the flywheel drum to insure that no slippage occurs between film and drum. With the film wrapped around the movable roller as shown, the pressure increases if the film tension is increased, and thus counteracts the tendency to slip. On the other hand, when the projector is stopped or when the film is removed, the roller drops freely, out of contact with the flywheel drum, and does not develop any flat spots.

With a magnetic sound projector as described, the user can operate his camera and films exactly as with silent pictures.

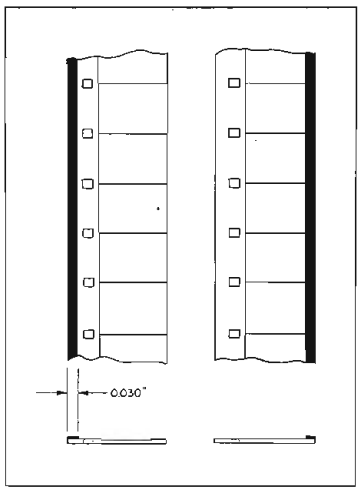
When the film is sent to be developed, the user specifies that in addition to the usual processing, he would like a magnetic track put on the edge of the film. The film is returned with such a track, and can then be edited as desired. It is now ready for the sound record. The sound record is made by running the film through the projector with the selector in the "record" position. While watching the picture, the commentary is spoken into the microphone. The next time the film is shown, it will have the sound as well as the action. Changes in all or part of the script can be made by erasing and re-recording as often as desired.

Track Added to Old Films

Not only new films, but also old reels that were made in the past can have the magnetic track added, since the track is outside of the picture area and does not interfere. Old silent films can thus be made into sound productions.

Sound records on films may be classified in three categories:

Commentary that describes what is taking place, or about to take place in the picture, and orients the



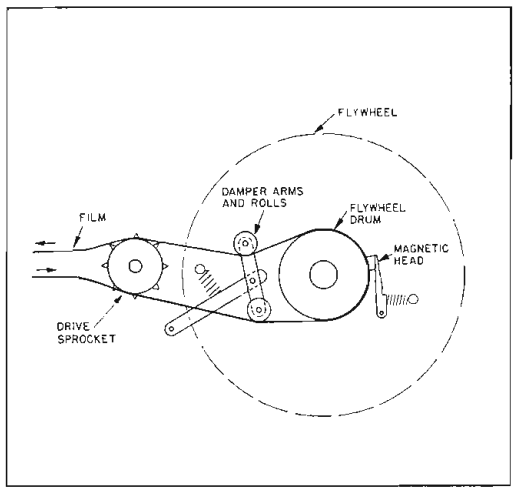


Fig. 2. (left) Two possible positions for the magnetic track. Placing it on the outside edge of the sprocket holes is preferred because it does not reduce the picture areas.

Fig. 3. (right) Optimum construction of sound reproducing head in which the film passes over the flywheel and is contacted by the head while in a stable position.

listener by giving details that are not supplied by the picture alone. Appropriate background music and sound effects can be used to create atmosphere and realism. Sound pictures of this kind are most easily made since the sound production is done after the pictures are complete and close synchronization is not needed. Ninety per cent or more of the eight-millimeter films will probably be of this kind. The only new equipment required is a magnetic sound projector.

Commentary plus sounds from the original scene which do not require perfect synchronization. In this class are sport events, speakers photographed from a distance, and many of the usual scenes filmed under condition where the person who is speaking is not shown so prominently as to require perfect sound synchronization. Here, one of the lightweight portable magnetic recorders is handy for recording the original sounds, which are later re-recorded on the magnetic film.

Sounds from the original scene that require lip synchronization. This type of the work is the most difficult, because it presents acoustical as well as synchronization problems. Pickup should be made with a directional microphone held near the subject and following his movements. Noise made by the camera may be objectionable and should be deadened or isolated from the microphone. Sound movies of class (3) can use the same equipment as class (2) except that more care is required to synchronize the sound when it is re-recorded on to the film.

The sound track can be coated on the original film before it is exposed, since the track is unaffected by photographic developing solutions. With such film, a camera can be designed that will record the sound simultaneously with the picture. This is the ideal arrangement for many applications, but is not as flexible for editing purposes. A third possibility is "post-synchronization." Here the subject in the picture records the dialogue while he watches the projected image, and matches his speech to the lip movements. A number of attempts usually are made before a perfect "take" is accomplished. Magnetic sound film is especially convenient because it can be spliced into a loop and projected over and over again, while the switch is in the record position. Every time the scene is repeated, the subject tries again, and makes a new record while the old is erased. As soon as a satisfactory record is made, the switch is thrown to playback, and the operation is complete.

Film Sale & Rental

The economic aspects of ready-made sound films for sub-theatre entertainment are rather interesting. Optical sound is now available in sixteen millimeters, but the cost of sound films, bought outright, ranges from $80.00 to $250.00 per hour. A collection of films which would give several hours of entertainment represents a sizeable investment. Film rental services are therefore an important factor in the sixteen-millimeter field.

Eight-millimeter productions have the same potentialities with respect to television, as phonograph records have in relation to radio programs. It gives the user "the video he wants when he wants it". The potential use of eight-millimeter entertainment is very great, if it can be provided at sufficiently low cost.

Technical Problems

Surprisingly enough, frequency response is not a major problem of eight-millimeter sound in spite of the low film speed of only about 2½ inches per second. The response shown in Fig. 4 is typical. Listeners have commented that the response compared very favorably with present sixteen-millimeter optical sound.

A more serious problem is the wow and flutter. To get the same performance as at higher speeds, the drive system requirements are far more severe. Two kinds of stabilizing systems are the most popular. The one used on the projector of Fig. 1 and shown in Fig. 6, uses a set of heads that are separated from the flywheel stabilizer by a short distance. The separation is convenient from a constructional standpoint, but does not allow the flywheel to have perfect control over the film motion.

The second system, shown in Fig. 3, uses a head which contacts the film while the latter is on the flywheel. Considerably better control is possible with this arrangement, even though the construction may be somewhat more complicated than with heads separated from the flywheel.

Coating the film with a smooth homogeneous track is another problem. The quality of the sound depends to a large degree on the quality of the track. It appears that for the average user, at least, the coating of film will be done by processing laboratories. Film manufacturers will undoubtedly make available films which already have a magnetic track. With such films

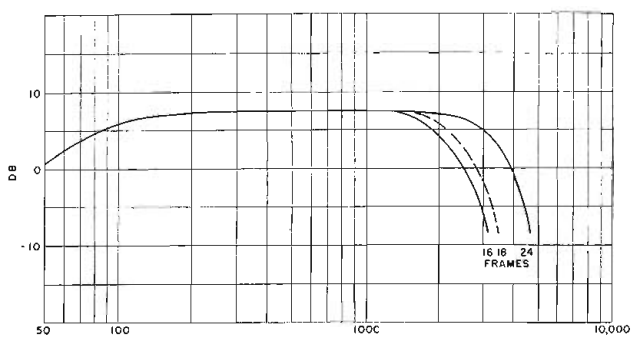


Fig. 4. Frequency response curve for film speed of about 2.5 in. per second. Although the top cut-off is about 2,000 cycles many listeners rate it as good as 16 mm

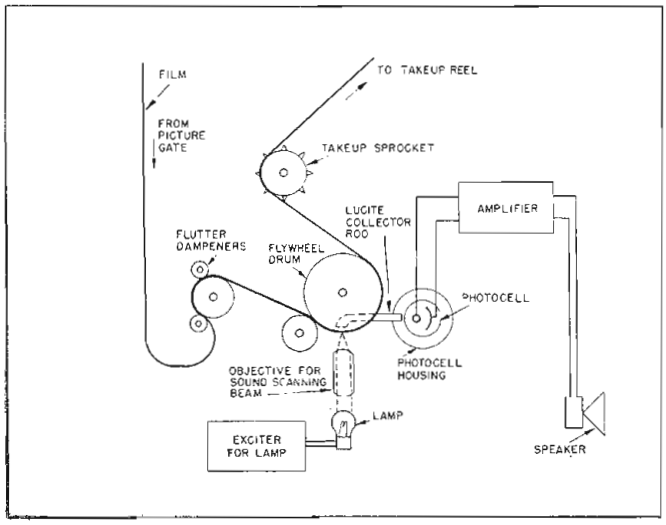


Fig. 5 (left), Typical sound-on-film system for normal projection methods. Low speed of 8 mm. film makes it useless for this system.

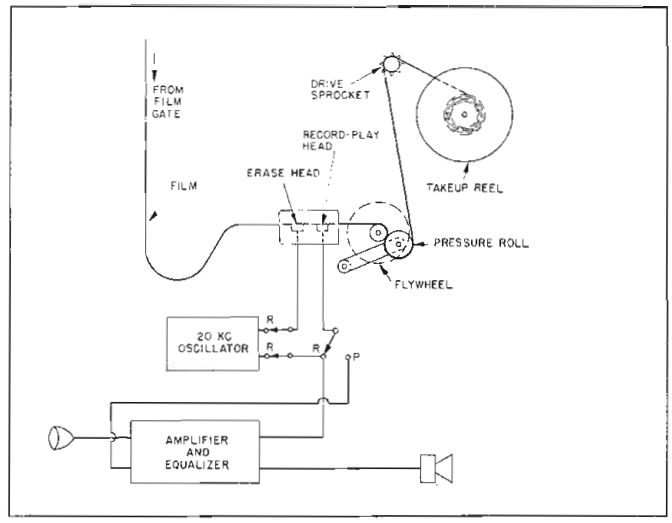


Fig. 6. (right), Sound on film installation using magnetic recording, note the similarity of parts layout for the two reproducing systems.

the recording can be made while taking the picture, or it can be made after the film is developed.

Standardization

Unlike optical sound, which had to be completely standardized as soon as it appeared, magnetic sound does not need to be absolutely interchangeable as long as the user makes his own recordings and plays them on the same projector that made the record. But when commercial films become available, they should be playable on all machines.

In order to obtain proper synchronization the distance between the picture gate and sound head should be standard. In optical sound these distances were established long ago, and any new designs must fit these standards. With magnetic recording on eight-millimeter film there is no precedent, and it would be wise to make a choice that would allow greatest flexibility in design. Some factors to be considered are:

(1) Head should be far enough from projector motor to prevent noise and hum pickup.
(2) Editing is easier, the closer the sound is to the picture.
(3) The distance should be long enough to allow filtering out of the picture gate flutter.
(4) Placing the sound head before instead of after the picture gate may simplify flutter problems.
(5) On most projector designs, the sound unit is most conveniently placed below the picture head. This is especially desirable if adapters for present silent projectors become available.

Taking all these into consideration a spacing of approximately one foot, with the sound following the picture, seems to be the location that is most favored at present.

Speed standardization is also important. Eighteen frames per second is proposed because most users have been found to show silent movies at this speed. This "silent" speed allows sound to be put on old films, and gives maximum economy. A twenty-four frame standard has also been suggested, in order to facilitate reduction prints from sixteen and thirty-five-millimeter sound films. Sixteen frames per second might allow reduction prints by the skip-frame technic and would still allow synchronized sound from the larger film.

At the present time, at least four of the larger manufacturers of camera equipment in this country are active in eight-millimeter projector design, and three are developing film coating methods and machinery. Some foreign manufacturers are also planning to offer eight-millimeter magnetic sound to the public. Indications are that such equipment will find widespread use as soon as it becomes available.

Water Vapor Lubricates Motor Brushes

GRAPHITE electric contacts or "brushes," used to feed current to moving parts in motors or generators on high-altitude aircraft, may have their useful life increased many thousands of times as the result of new lubrication methods devised by Robert H. Savage, in the General Electric Research Laboratory. His discovery about water, in the form of vapor, for the lubrication of graphite has changed accepted ideas that this solid and "slippery" material was a good lubricant in itself.

Graphite consists of layers of atoms which can slide easily over each other, and it was formerly supposed that this property was inherent in the graphite alone. In testing brush wear against a revolving copper disk in a vacuum chamber, it was found that dry graphite brushes wear as fast as an inch per hour. When a small amount of water vapor was admitted to the chamber, this rate was reduced to less than 0.001-in.

For electric motors and generators working on the ground, the wear of brushes is no great problem, since there is generally enough water vapor in the air to provide the lubricating film of moisture. But modern aircraft, such as jet aircraft, fly at great altitudes in rarefied air at such a low temperature that water vapor is almost completely absent.

A means has been devised for shielding the parts of electric equipment where the brushes are used, and supplying water vapor around them. In tests with this equipment, brushes which wear out in an hour without water vapor will last from 2000 to 8000 hours. Certain organic vapors are more effective than water by a factor as large as 1000, so that extremely small concentrations (in parts per million) provide lubrication.

Noise Generators

Discussion of noise factor measurements and the limiting sensitivities

By I. J. MELMAN,*
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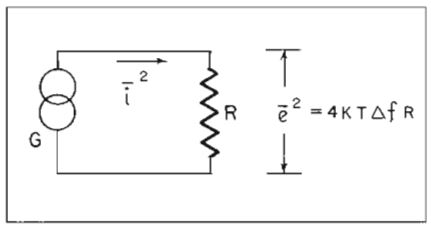

Fig. 1: Equivalent noise circuit of a resistance

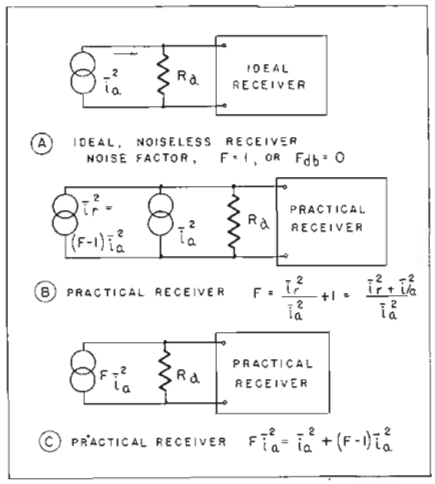

Fig. 2: Equivalent receiver noise circuits

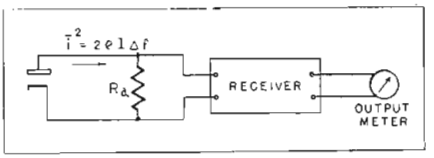

Fig. 3: Basic diode noise measuring circuit

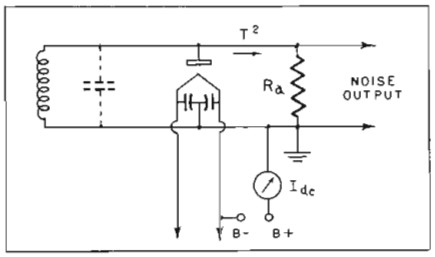

Fig. 4: Unbalanced noise diode circuit

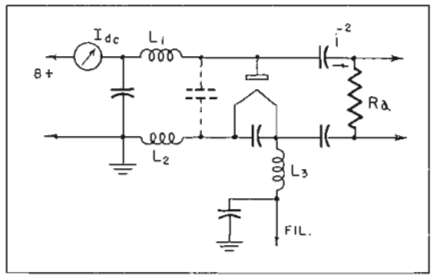

Fig. 5: Balanced noise diode circuit

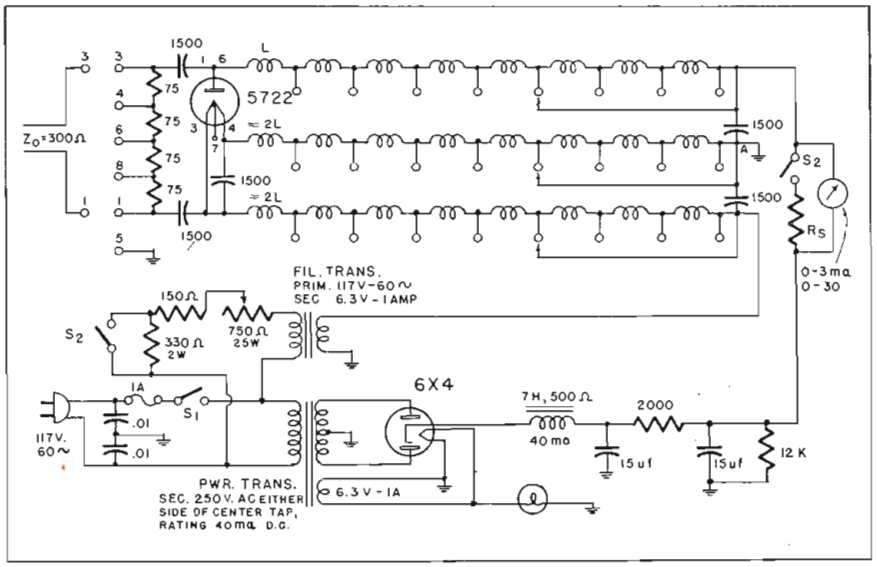

Fig. 6: Complete schematic of balanced noise generator, using basic circuits of Fig. 5

IN recent years "noise factor" has come into wide usage as one of the important performance characteristics of radio receivers and amplifiers. Increasing interest in the problem of improving the noise factor of television, FM, and communication receivers has required that a reliable and rapid technique be adopted for making the noise factor measurement. This article discusses the meaning of noise factor and describes the diode noise generator and some simple measuring techniques.

Two types of noise generator are described and they both cover the television, FM, and communication frequencies. They may be used with receivers having balanced or unbalanced input circuits with a wide range of transmission line impedances.

Receiver Sensitivity

The progress of the radio art is reflected in the changing concept of receiver sensitivity. In the earlier days the sensitivity or "sensitivity-test-input" was defined[1] as the input voltage (30% modulated) required to obtain a standard test output signal (0.05 or 0.5 watt). This definition, actually a measure of overall gain, was adequate so long as high amplification was difficult to attain. Improved tube design and circuitry soon made the inherent receiver noise the limiting factor rather than gain.

As the communication services and later the radio direction finding services moved into the higher frequency spectrum and utilized wider bandwidths, it became increasingly important to reduce the recciver circuit noise. At the higher frequencies the external noise (atmospherics, ignition, etc.) decreases, and the "capture area" of the antenna decreases. Thus the sensitivity becomes even more critically dependent on the internally generated receiver noise.

The use of the "signal-to-noise ratio" is very helpful in describing the receiver sensitivity. This ratio

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and Measuring Technics

PART ONE OF THREE PARTS

of receivers for TV, FM, and communication service.

expresses the amplitude of the desired output signal compared to the noise output for a given received signal. To obtain a complete picture of the circuit performance however, other information must be given along with the signal-to-noise ratio, such as input signal level, bandwidth, type of detection, circuit linearity, etc.

Another expression which is used to describe the "noisiness" of a receiver is the ENSI, or Equivalent Noise Sideband Input[2], which refers all the noise produced in the amplifiers to the antenna terminals and computes the noise signal in terms of a single sideband of noise voltage. The value of ENSI depends on the overall bandpass characteristics and will vary with selectivity and tone controls.

In FM reception the "noisiness" and sensitivity of a receiver are described by the "quieting sensitivity", which is the input signal required for an output signal-to-noise ratio of 30 db (input modulation 30%). This term is more descriptive of the real sensivitity of a receiver than the terms previously discussed. The "quieting sensitivity" depends on three factors: the "noisiness" of the radio frequency circuits, the noise rejection characteristics of the FM detector circuits, and the overall bandwidth of the system.

None of the terms thus far discussed gives an exact number which describes "noisiness" without involving extraneous factors. The "noise factor" does provide this information, and enables receivers to be compared directly with each other without regard to other performance characteristics.

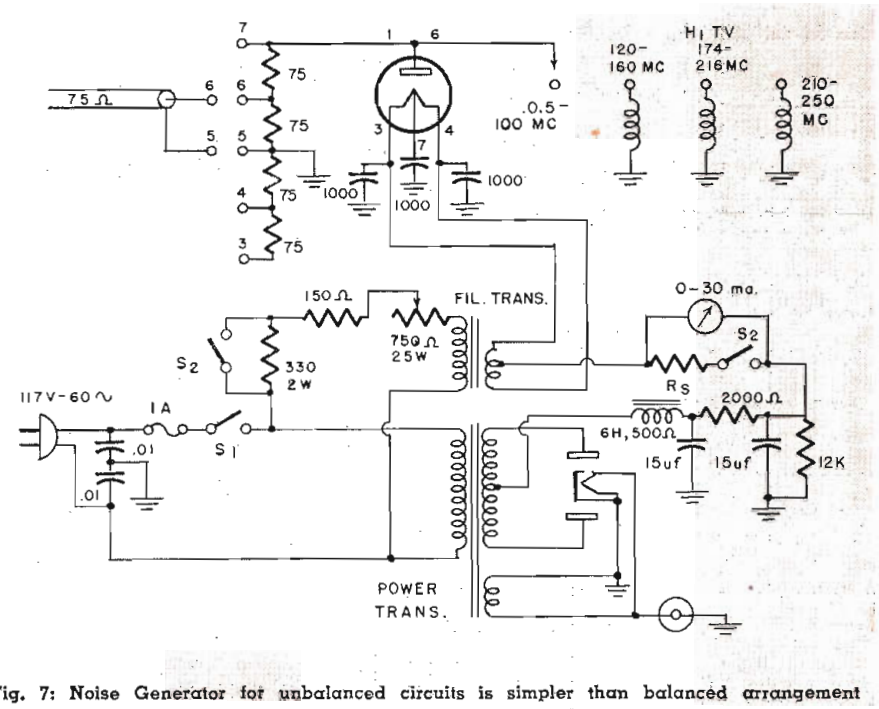


Fig. 7: Noise Generator for unbalanced circuits is simpler than balanced arrangement

Noise Factor

The sources of noise in an amplifier or a receiver are tube shot noise, thermal agitation noise in resistive networks, and at higher frequencies (above 30 Mc generally) induced grid noise. As the receiver noises are made to decrease, an absolute limit will be approached. This absolute limit is that due to the thermal noise of the resistive component of the antenna or input impedance. The thermal noise current of a resistance is given by:[3]

$$i^2 = 4KT\Delta f/R \quad (1a)$$

or $$i^2 = 1.6 \times 10^{-20}\ \Delta f/R \quad (1b)$$

for a room temperature of 17°C or 290°K. In these relations, i^2 = the mean squared noise current (amperes^2); K = Boltzmann's Constant (joules per degree Kelvin), 1.37×10^{-23}; T = temperature (degrees Kelvin); R = the resistance (ohms); and Δf = the bandwidth in cps. The equivalent noise circuit of a resistance is illustrated in Fig. 1, where i^2 is generated by an infinite impedance, constant current noise generator in parallel with with the resistance, R. Equation (1) may be applied to the radiation resistance of an antenna and the temperature T may be taken at the ambient temperature of the antenna.[4]

When the receiver noises are made equal to zero we have a theoretically ideal receiver (tubes, resistances, etc. assumed noiseless). However, when we connect an antenna (or a signal generator) to this ideal receiver, the thermal noise of the antenna (or generator) still sets a limit to the minimum signal that may be received. The noise power, P_a, generated in the antenna resistance, R_a, when not connected to a load, is:

(2a)

$$P_a = i^2R_a = 4KT\Delta f = 1.6 \times 10^{-20}\Delta f,$$

or for unit bandwidth,

$$P_a' = 4KT = 1.6 \times 10^{-20} \quad (2b)$$

Thus this antenna noise power P_a' (which is a constant for a given temperature) appears to be a common denominator for all receivers. We have, therefore, a basis of comparison for receiver circuits, independent of antenna impedance or bandwidth.

When the actual noise power output of any receiver is compared with the theoretical minimum which is due to the antenna thermal noise alone we have a number called the "noise factor". The term "noise factor" (sometimes referred to as noise figure) was first suggested about 1941 and has since attained wide usage.

The noise factor, F, may be defined as the ratio of total receiver noise output (measured with proper correction for any non-linear elements) to the noise output due to the thermal noise of the antenna alone. Thus

$$F = N_t/N_a = (N_r + N_a)/N_a \quad (3)$$

(*Continued on page* 58)

CUES for BROADCASTERS

Practical ways of improving station operation and efficiency

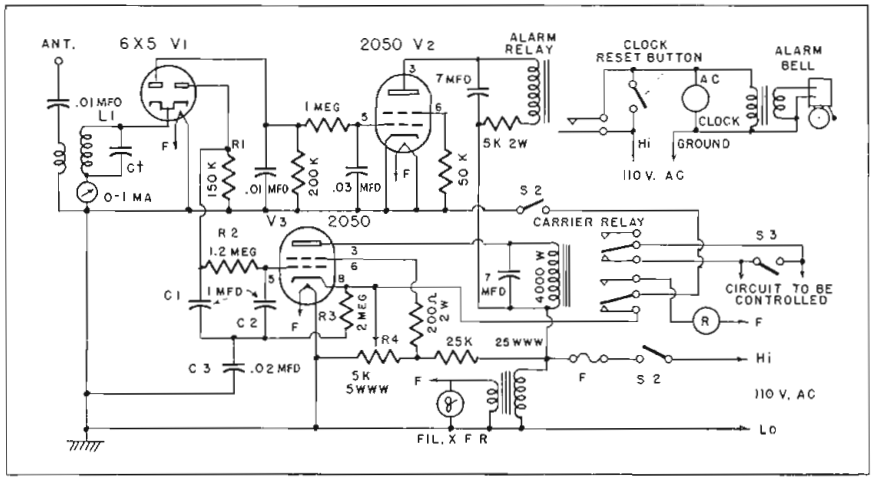
Plate Voltage Lightning Protection

N. HAGMANN, Chief Transmitter Engineer, WJZ, New York City

THE use of Vertical Radiators plus high carrier power present a serious problem during the summer lightning period. Horngaps at the tower will conduct the main lightning stroke to ground, but 50 kw of carrier power can maintain this arc and do damage and cause loss of program. A means to cut momentarily the plate voltage to the transmitter power amplifier to break this arc and then automatically restore the carrier is described below.

The equipment consists of a small pickup antenna located on the transmitter house (in our case about 400 ft. from the antenna), feeding a tuned circuit at the station's carrier frequency. As the unit is ac-dc operated, a condenser must be used in series with the antenna. Rack mounting is used with all switches and the meter mounted on the panel. The 0-1 MA meter shows correct tuning of this circuit. A 6X5 rectifier tube has its two plate circuits feeding two different bias circuits for two type 2050 thyratron tubes. Tube V2 has an alarm relay in its plate circuit. Failure of i-f will ring the alarm bell and also start the ac electric clock used as an outage indicator. The alarm and clock will continue to operate until r-f is restored. Thyratron tube V3 is connected differently since only a momentary break in the dc power fed to the power amplifier plate is required to break the arc or fault in the circuit. Operation is as follows: insufficient signal from the main antenna arrives at the unit antenna on the transmitter house roof. The rectified bias falls to zero and this fires both thyratrons. Tube V2 rings the alarm and starts the ac clock.

Tube V3 opens the controlled circuit as the relay closes and at the same time opens the direct cathode ground on V3. The heavy tube current during the firing of the thyratron flows from cathode through R4 to ground. This puts a high positive potential on the cathode and also through R3 to the junction of C1, C2 and C3, charging the three condensers. The negative charge on C1 and C2 is more than sufficient to bias V3 to cut-off and opening the relay and therefore returning the carrier to the air. However, since condensers C1, C2 and C3 have been charged, a bias is held on the grid of V3, which will prevent the tube from firing until such time as the transmitter is up to full power, even though the carrier starts out at low level. In the case of WJZ the dc power is supplied to the power amplifier starting at 10 kv and running up to 18 kv by means of an automatic voltage regulator. At 10 kv at the final plates, the r-f collected by the roof antenna would not be sufficient to keep the thyratron from firing. By adjusting R4 the amount of charging voltage on C1, C2 and C3 can be varied to give a desired recycling time. The values shown allow the use of from one tenth to three seconds. This allows complete time for power recovery. S1 is used to kill the unit at starting time and during shutdowns. S3 is a safety switch to close the controlled circuit in case of trouble within the unit.



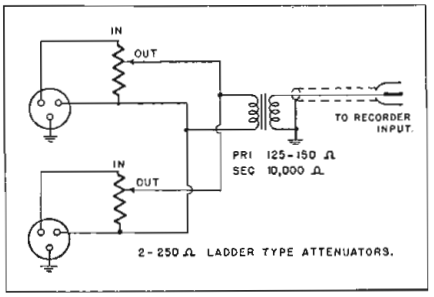
$$$ FOR YOUR IDEAS

Readers are invited to contribute their own suggestions which should be short and include photographs or rough sketches. Our usual rates will be paid for material used.

Load Impedance Input for Brush Recorder

WILLIAM F. ASKEW, Chief Engineer, WOBS, Jacksonville, Fla.

A METHOD of modifying a Brush Soundmirror tape recorder for use with low impedance microphones is shown in the sketch. It has been found that for most special events pick-ups two microphones were needed for good program production and it was decided to adapt the recorder for the same type of microphones as are used throughout the station.



The two cannon receptacles were mounted on the side of the recorder, with two ladder type attenuators mounted on the front for the operator's convenience. Any one of the miniature audio transformers may be used as long as it has a 125-150 ohm primary and high impedance secondary. The output lead from the transformer was brought out on the front panel and a suitable plug attached and plugged into the hi-impedance microphone input. In the event it is desired to record with a

single hi-impedance microphone the transformer lead can be removed from the jack and the microphone plugged into the jack and the recorder operated as usual.

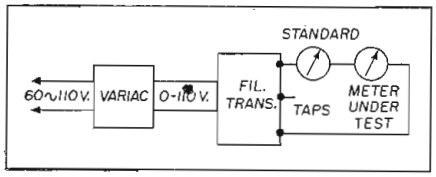
Operation with this arrangement has proved entirely satisfactory, with sufficient output being obtained from both microphones under all conditions.

Meter Checker

WILLIAM H. MEINERS, Chief Engineer, KRIO, McAllen, Texas.

FIELD experience has shown that a high percentage of r-f ammeters don't come up to 2% accuracy when originally installed or that they will eventually drift beyond the expected accuracy.

Where directional antennas are in operation r-f current should be checked at a number of points, and when a discrepancy is noted it is very important to know whether the drift is caused by an inaccurate meter or whether the components



in the r-f sections of the antenna system are at fault.

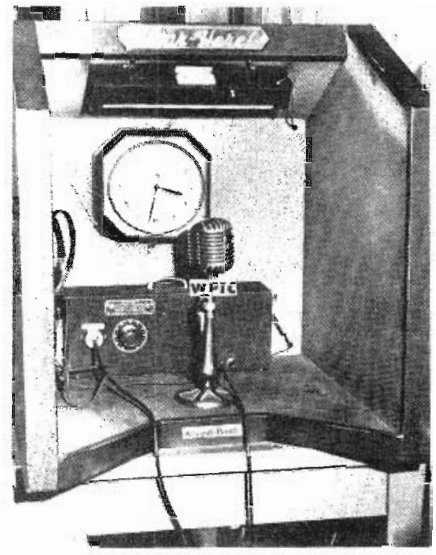
This information can be secured by having an ammeter calibrated by a reliable meter concern and using this meter as a standard to check the various meters in service. A testing unit may be set up comprising the calibrated meter, a filament transformer with taps such as 2.5 and 5 v. rated at the amperage required and a small variac.

It has been found that testing r-f ammeters at 60 cps is quite accurate for practical purposes in the AM broadcast band.

Newsroom Broadcasts from Open Phone Booth

STATION WPIC, which is operated by the "Sharon Herald" Broadcasting Co., makes use of a novel installation of a Scout Model Acousti - Booth permitting the broadcasting of news direct from the newsroom of the newspaper rather than from the WPIC broadcast studios. This use of the Acousti-Booth which is a small acoustically treated phone booth like those installed in some subways, airports, factories and other noisy locations, makes a very compact and workable broadcast news studio.

The booth has been simply



equipped with a fluorescent lamp, radio clock, a microphone and speech equipment. The booth is mounted on a table and at air time its announcer sits in front of the booth and delivers news right from the floor of the newsroom.

Time Signal and Clock Synchronizer

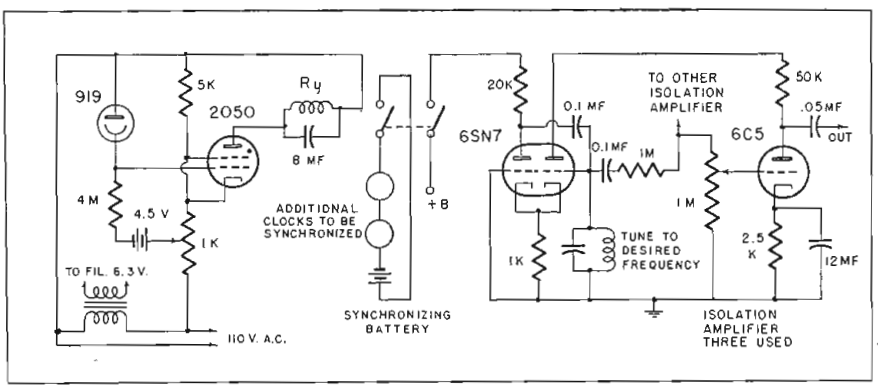
ALAN SOBEL, The Electronic Workshop, Inc., 351 Bleecker St., New York City

AT WKCR, campus radio station of Columbia University, an hourly time signal was required. Western Union time service is available in New York City and was used as follows: WU provides a clock, manufactured by the Self Winding Clock Company of Brooklyn, New York, which is synchronized every hour, on the hour, by a dc impulse (amplitude 3 volts, duration 1.5 seconds). There is also a light on the face which is energized by the synchronizing impulse. A photocell-thyratron combination makes this impulse available for other uses. In addition to providing a 440 cycle tone superimposed on program material, an extra pair of contacts on the keying relay is used to synchronize a station-owned self winding clock located in the studio. Synchronism between studio and control-room clocks is thus assured at all times.

The circuit diagram shows the arrangement employed. A vacuum photocell type 919 provides a triggering signal to a 2050 thyratron. Thyratron and photocell are located at the clock, the photocell being electrically and optically shielded by its metallic tubing mounting. The 919 photocell is rather large, precise timing somewhat difficult. Use of the miniature phototube 1P42 is suggested in new installations. The 1000 ohm adjustable resistor in the 2050 cathode circuit adjusts the bias so that the tube is cut off when no light is falling on the photocell—it also helps compensate for tube variations. An 8 μf condenser across the relay was necessary to prevent chattering.

At WKCR, the two transmitters can be fed from any of three program busses, so it was necessary to provide three isolation amplifiers for the oscillator signal. At the transmitter line amplifier feed points these busses are 500 ohms unbalanced (a very convenient feature, since recorders or supplementary line-feed amplifiers can be bridged across the line without the use of a bridging transformer—a high impedance grid being all that is required). Because of the unbalanced load, simple triode amplifiers can be used for isolation (only one is shown in the diagram). The oscillator is a cathode-coupled circuit which keys without annoying chirps on either make or break—all dc to the unit is keyed by the relay.

DC is taken from the console power supply, ac from the line and a self-contained filament transformer. As a precaution against undesirable program interruptions, a 1 revolution-per-hour motor driving a cam and microswitch arrangement is used to apply ac to the time signal unit for only ten minutes out of the hour.



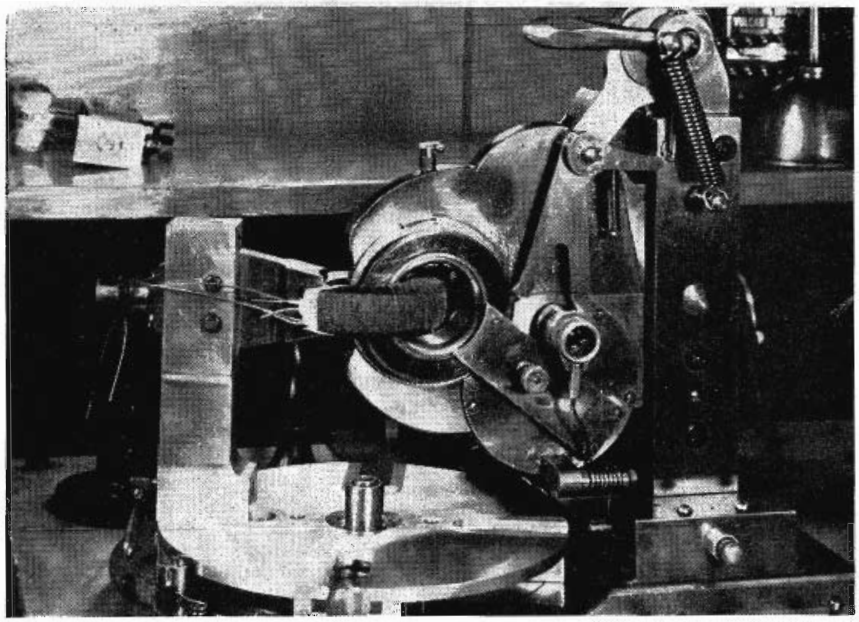


Fig. 1: Multilayer winding machine for making small toroidal inductors and transformers

By *HORATIO W. LAMSON*
Engineer, General Radio Co.
Cambridge 39, Mass.

Test data shows superiority
ism and minimized leakage

Advantages of Toroidal Transformers

IT is quite evident that the transformer plays an important role in the field of communication engineering, both for conductively isolating but magnetically linking circuit networks operating at the same impedance level, and for coupling together networks having different impedance levels so as to transmit energy between them with a minimum of loss in the transducer. As far back as most of us can remember, the conventional method of fabricating such an iron cored transformer consisted of using a so-called "shell-type" core, composed of stacked F, or E and I shaped laminations. The central leg of this core carried superimposed primary and secondary windings which had previously been wound on a hollow form of rectangular cross section.

For many years, however, the Bell Telephone System has made successful use of the toroidal inductor core, popularly called the "doughnut" core. The excellent properties of such toroidal cores have recently inspired a more universal interest. Toroidal cores are usually rectangular in cross section and are frequently molded toroids composed of ferro-magnetic powder in an insulating binder medium. They may also be assembled either by stacking annular ring-shaped laminations or by winding spiral-wise strip stock of appropriate width. Stacked ring laminations present no air gap to the flux which they carry. The spiral wound toroid, known proprietarily[1] as a "centricore", introduces a very small effective air gap into the flux path which is ordinarily quite negligible, although it functions in a manner to equalize more nearly the flux density throughout the cross-section of the core. Centricores permit the utilization of the excellent magnetic properties of grain-oriented ferro-magnetic media. Full use of such grain-oriented materials cannot, obviously, be made in shell-type cores unless we are willing to construct the core from rectangular strips.

[1] Magnetic Metals Co., 21st Street at Hayes Ave., Camden, N. J.

Single-Layer Winding

Ordinarily, toroidal inductors must be wound on the assembled core which is, admittedly, more complicated than the simple cylindrical winding required for subsequent assembly on a shell core. However, with present day toroidal winding machinery, it is quite feasible to apply a single layer winding onto a toroidal form—witness the popular Variacs. Furthermore, by subjecting the core to an advancing rotary oscillation about its major axis during the winding operation, we can apply a progressive multilayer winding. This minimizes both distributed capacitance and copper loss and is ideal for many communication transformers.

It is important to realize certain advantages which the toroidal transformer possesses over one built with the familiar shell-type core. First, when properly wound, a toroidal inductor is less sensitive to pick-up from stray magnetic fields. When operating at low energy levels, which are subsequently followed by considerable amplification, this can be an important feature in our laboratories which are usually and unavoidably permeated with a very appreciable 60-cycle magnetic field. If you are skeptical about this, try finding a location in your own laboratory where the 60-cycle field intensity is less than a millioersted, or a spot in your radio or television cabinet where it is less than 10 millioersteds. Conversely, toroidal transformers broadcast smaller magnetic fields at the frequency at which they are energized than do equivalent shell-type transformers. Toroidal units can thus be located much closer to each other with a minimum of cross-talk between them. Expensive low-frequency magnetic shielding, often required by shell cores, can frequently be eliminated by substitution of toroidal units.

Secondly, with toroidal transformers, a higher coefficient of coupling between the primary and secondary windings can be obtained in contrast to the shell core. This means that the magnitude of the leakage reactance (which ultimately limits the high-frequency characteristic) will be smaller.

Now it is readily possible to build a shell-type communication transformer which shows less than one decibel drop from its flat character-

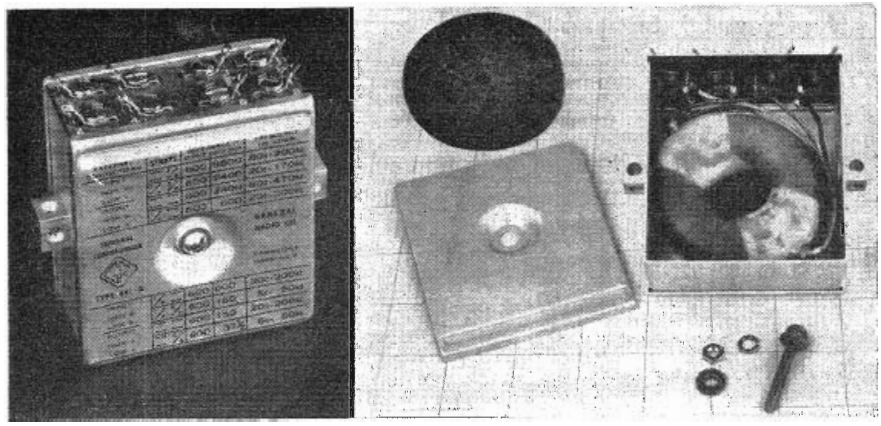


Fig. 2: (Left) Duplex toroidal transformer unit that is designed for matching 600 ohms with 9600, 2400, 600, 150, and 37.5 ohms. (Right) Interior view of the transformer shows the impregnated toroid that is clamped between felt washers in an aluminum housing

of "doughnut" cored units over conventional shell types with respect to astatic-reactance. Precautions for measuring tight coupling coefficients are analyzed

in Communication Engineering

istic over a frequency range from say, 20 cps to 20 KC, or more significantly over a frequency span ratio of one thousand to one. Since the human ear can just about discern a one decibel difference in level, since most of us are deaf above 20 KC, and since we are generally not interested in sounds below 20 cps, such a transformer, a priori, would seem altogether suitable, on this score, for ordinary audio communication systems. However, if we wish to introduce degeneration into the system without undue phase shift difficulties, or if we would like to have a transformer which is *simultaneously* good for the audio and well up into the ultrasonic range, one possessing a drop less than one decibel over a frequency span ratio of ten thousand to one would be more desirable. A toroidal core makes this practical.

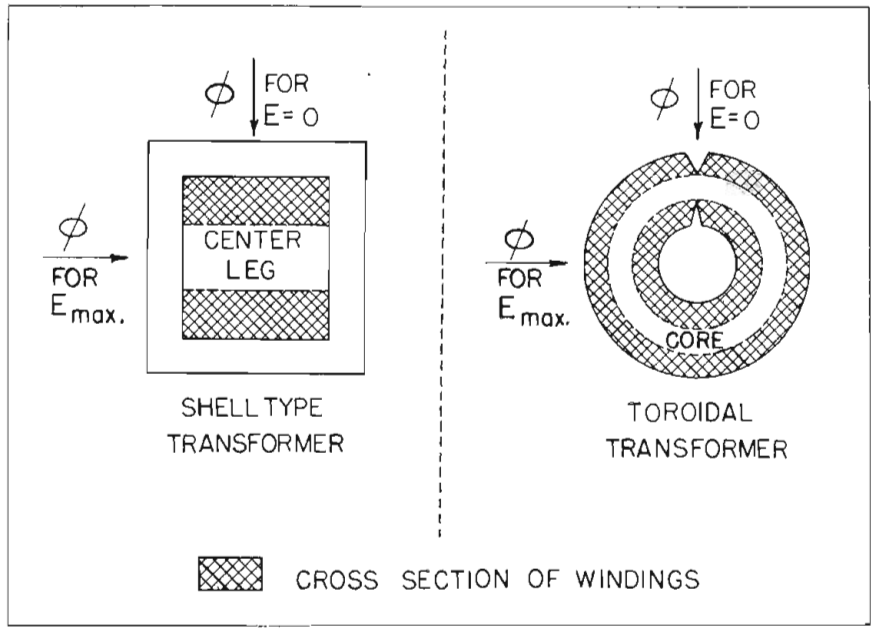
Transformers Compared

To substantiate the foregoing, consider some data taken on a pair of transformers, each designed with good engineering for the same purpose, namely: to serve as isolation transformers between a 600-ohm generator and a 600-ohm load and having, therefore, a unity turns ratio. Both were designed to give a one decibel drop at about 20 cps. The shell transformer was wound with the primary interleaved between the two halves of the secondary, to afford the maximum coupling economically attainable with this type. In the toroidal transformer, which had a centricore, the primary and secondary were progressively wound multilayer windings, one on top of the other, and each covering essentially the full circumference of the core.

To measure the susceptibility of these two transformers to a uniform external magnetic field, an air core solenoid winding was connected across the 60-cycle mains to serve as a broadcasting coil. Either a small calibrated air-core pick-up solenoid or one of the transformers was connected across the high-impedance input of a wave analyzer tuned to 60 cycles, which afforded sufficient gain and selectivity for measuring the pick-up voltages. Then, after shutting off all nearby 60-cycle equipment (and disconnecting all telechron clocks) a point was found along the axis of the broadcasting coil, and about two feet from it, where the flux had a known direction and where the field intensity was uniform within 2% at 0.1 oersted over a region occupied by either of the transformers. Here the flux density was 0.1 gauss.

As shown in Fig. 3, it is obvious

Fig. 3: Diagram of flux directions for Astatic (E=O) and Nonastatic (E_{max}) conditions



that a shell transformer will be most sensitive to a uniform external field when the flux is parallel to the center leg of the core and the axis of the windings, while zero voltage will be induced in the windings if the external flux is perpendicular to this axis.

The toroidal transformer had a small discontinuity in the distribution of its winding at the circumferential point where the windings terminated, since no overlap at the extremities of the multilayer windings was desired. As anticipated, a maximum of pick-up voltage with the toroid was found to occur when the external flux was parallel to the major plane of the toroid and simultaneously perpendicular to the toroidal diameter passing through this point of discontinuity, while zero net pick-up was obtained when the flux was parallel to this diameter.

By careful orientation, the maximum pick-up voltage obtainable with each transformer was measured. Since the winding turns and core permeabilities of the two units were somewhat different, the most logical way to rate the relative pick-up of these two cores was on a basis of millivolts per gauss per henry to the one-half power of the inductance of the winding. The data were:

Shell Core:

E_{max} = 55 millivolts/gauss/(henry)$^{1/2}$,

Toroidal Core:

E_{max} = 0.77 millivolts/gauss/(henry)$^{1/2}$,

demonstrating that the shell transformer had 65 times the maximum pick-up of the toroidal unit.

Theoretically, a perfectly wound toroid should have no pick-up from flux parallel to its major plane and only a very small pick-up, which is tnat equivalent to a single-turn loop in air having the mean toroidal diameter, when the flux is parallel to the major axis of the toroid. In the transformer described, this value was computed to be only 45 microvolts per gauss at 60 cycles, which we may agree is quite negligible.

Partially Wound Toroid Pick-Up

It should be emphasized that if we desire a minimum pick-up by a toroidal winding or a minimum of externally broadcast flux therefrom, each winding should be *uniformly and completely* distributed around the entire circumference of the toroid. To illustrate this point, one of these toroidal centricores was wound with a complete, uniform and single layer winding. Then by peeling off a few turns at a time, the rise and fall of the maximum pick-up voltage in a constant uniform external field as a function of the percentage of the full winding which remained on the core was observed. The results are shown by Curve A in Fig. 4.

It is of interest to note that Curve A has a lateral symmetry with respect to the mid-point. This means that, if we apply a given number of *turns per degree* of the toroidal circumference, we will obtain the *same* maximum pick-up voltage if we have the winding covering X% of the circumference or if we leave an unwound gap extending over X% of the circumference.

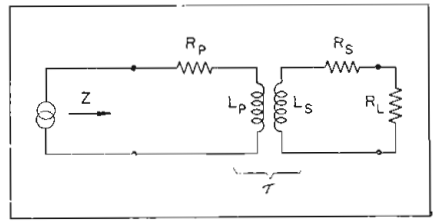


Fig. 5: Diagram representing thansformer with internal losses and resistive load

Now if each ordinate on Curve A is divided by the number of turns remaining, the normalized Curve B is obtained which gives the average value of the maximum pick-up volts per turn, and likewise shows how the total induced voltage for a given inductance progressively rises as the number of turns required are restricted to a decreasing portion of the circumference.

Curve A has the appearance of a half cycle of a sinusoid. Actually, it is somewhat steeper on its sides and flatter on the top than a true sinusoid. When turns were peeled from a wooden toroidal core of the same dimensions, the corresponding Curve A was found to be an exact sinusoid. It is easy to prove mathematically that this must be so when the core permeability is unity and the external field is not locally distorted. In this case the Curve B becomes the function, $\sin\theta/\theta$, which is represented by the normalized Curve C in Fig. 4.

When the external field *is* distorted by being "sucked into" a ferro-magnetic toroid, the induced voltage in a partial winding is increased several fold.

(*Continued on page* 56)

Fig. 4: Pick-up with partially wound toroidal code

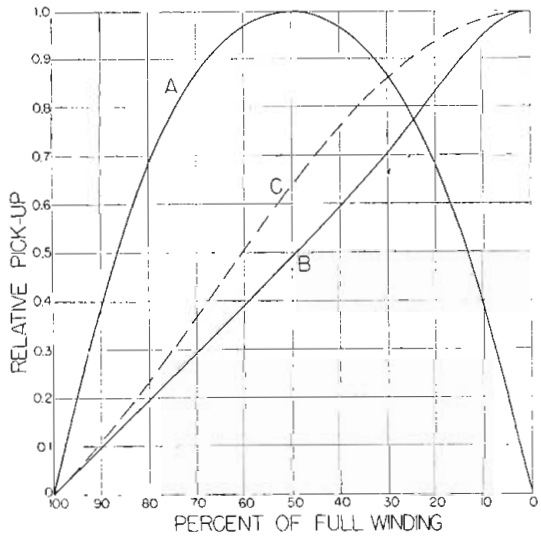
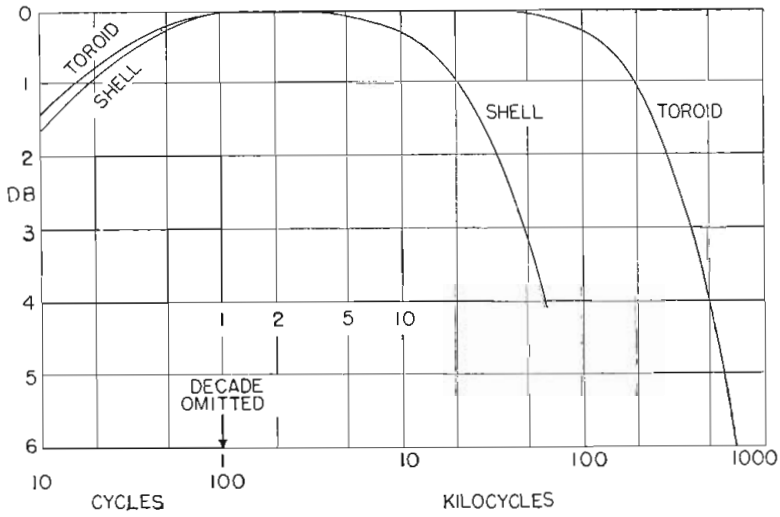


Fig. 6: Comparable shell and toroidal core transformer frequency characteristics



New Indicator Ion Trap for TV Tubes

Luminescent coating on the aperture disc of CR-tube gun assembly fluoresces on misalignment of the ion trap magnet. Use of the polka-dot generator as a laboratory tool is described

By C. S. SZEGHO
The Rauland Corp.
Chicago 41, Ill.

A RECENTLY published article[1] stresses the point that more attention should be given to efficient serviceability of television sets and emphasizes particularly the mechanical layout of the picture tube and other components on the television chassis. The following is an account of the application of "service engineering" to a field in which it thus far has made little inroad, namely, the construction of the cathode-ray tube itself.

Since the middle of 1945, the tilted lens type of ion trap (Fig. 1) has been adopted by some tube manufacturers to overcome the ion spot blemish in non-aluminized cathode-ray tubes. Neglecting for a moment the effect of transverse field components in the ion trap, electrons and ions start out from the cathode coaxially with the neck of the tube. The transverse component of the electrostatic field established in the gap between the second grid and anode deflects both the electrons and ions in one direction away from the axial path, whereas the transverse magnetic field in the vicinity of the second grid deflects the electrons alone and in the opposite direction from the axis, thereby accomplishing segregation of the electrons from the ions. The anode has a beam trimming aperture at the end remote from the cathode. The electron beam as directed by the conjoint effect of the electrostatic and magnetic fields may define a small angle with the tube axis and may not entirely clear this limiting aperture. A second but opposing magnetic field may be employed to steer the beam through the hole and position the undeflected spot at the center of the fluorescent screen.

Proper alignment of these two magnetic fields is important for several reasons. If the limiting aperture blocks part of the beam, there is a reduction in the brightness of the raster. Strong bombardment of the apertured disc may cause it to melt and vaporize, permitting the evaporating material to deposit and form dark areas on the fluorescent screen. Last but not least, if the beam, especially at larger currents when its divergence angle is large, enters the focusing coil and the deflection fields off center, the well known lens faults of coma and astigmatism assert themselves and the edge focus of the raster suffers especially. It is up to the Service Engineer in the field to guard against such difficulties and to align the beam by adjusting the ion trap and centering magnets correctly.

The best indication of alignment is obtained by observing the unfocused spot for optimum operating conditions: it must be in the center of the screen and be round at high beam current. Unfortunately, most television sets generate the anode voltage by rectification of high frequency pulses derived from the deflection system and consequently, unless the deflection system is operating, there is no anode voltage. Therefore, in the field it becomes necessary to resort to observing the raster instead of the undeflected beam spot and adjust for maximum brightness which is difficult to gauge accurately without a light meter. Moreover, to manipulate the centering magnet from the back of the set and observe the spot or raster from the front is in many cases, to say the least, an awkward procedure by itself. The result is an alignment falling short of best cathode-ray tube performance.

A simple expedient to overcome these conditions is to deposit fluorescent material around the limiting aperture of the anode, as shown

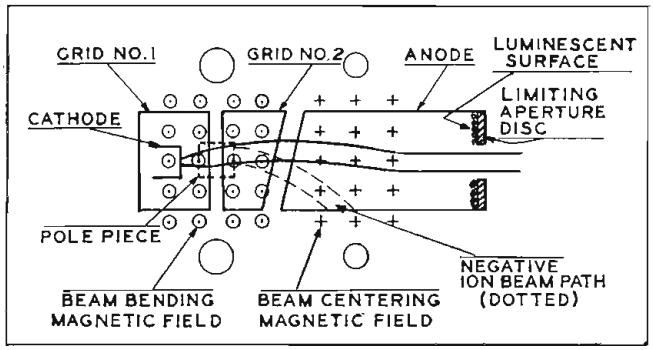


Fig. 1: Tilted lens type ion trap, which features coating of luminiscent material applied over limiting aperture disc

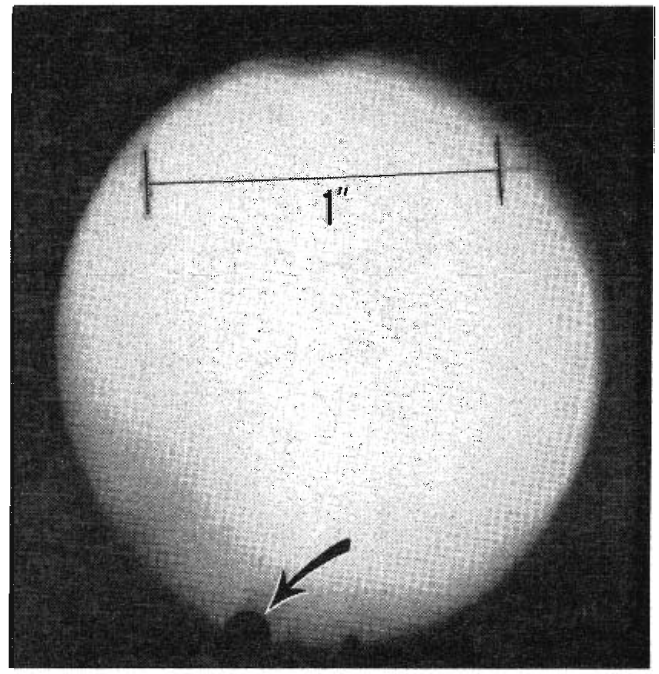


Fig. 2: Unfocused spot showing seration caused by negatively charged particle on inside wall of limiting aperture. →

INDICATOR ION TRAP (Continued)

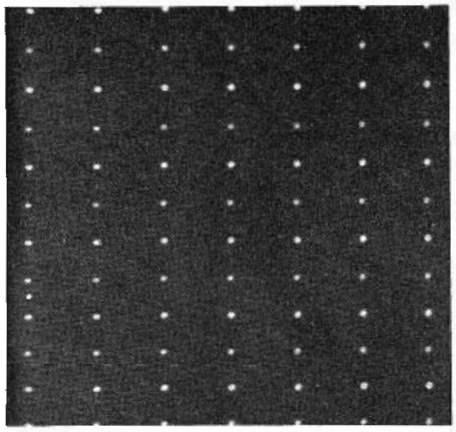


Fig. 3a: Raster with polka dotes in the pattern on picture tube correctly aligned

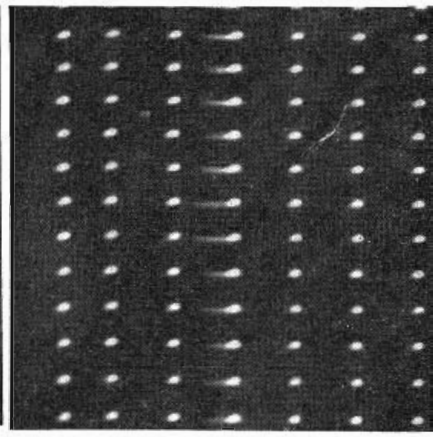


Fig. 3b: Raster with polka dotes in picture tube pattern incorrectly aligned

on Fig. 1. If the beam is correctly aligned, it passes through the aperture and does not excite the fluorescent powder. However, a misaligned beam lands on the powder and the resulting fluorescent light reflected from the walls of the anode tube can be clearly observed by looking into the anode cylinder through the gap between the second grid and the anode. If the first magnet is placed approximately in the correct position, over the poleshoes on grid 2, and is moved along the tube neck back and forward, the glow will go through a minimum and slight rotation of the magnet will extinguish it, indicating correct alignment. For more precise adjustment, the beam current should be increased by turning the brightness control up and the above procedure repeated. Near zero bias some glow will remain if the limiting aperture fulfills its function of trimming the beam.

Zinc orthosilicate, which fluoresces in a green hue, is preferred as the indicating material because zinc sulphide may be poisonous to the tube cathode. When a smattering of the willemite is applied to the apertured disc in the manufacturing process, care must be taken in order not deposit power on the inside wall of the aperture. Fluorescent particles present there acquire negative charges and produce "ragged edge" of the beam. Fig. 2 shows what happens if particles of the size of a few microns are in the aperture. A dark serration which is larger than the shadow of the obstructing particle itself appears on the periphery of the unfocused beam. No deleterious effect has been noticed from prolonged high power bombardment of the powder deposit if it adheres well to the apertured disc. Should the emission drop somewhat upon incidence of a strongly misaligned beam, probably due to oxygen liberated from the silicate, the emission recovers almost instantaneously if the alignment is corrected. This observation conforms with a recently reported behavior of oxide cathodes.[2]

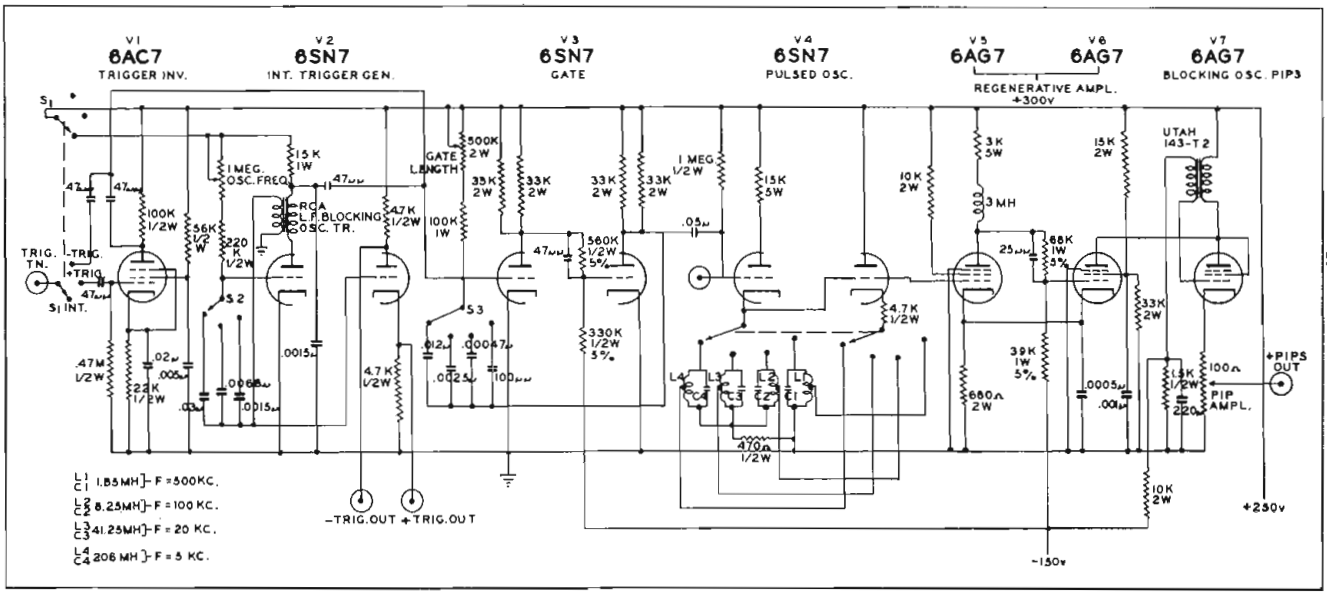
Fig. 3a shows a polka dot pattern on the screen of a correctly aligned cathode-ray tube fitted with indicator ion trap, and Fig. 3b represents the same pattern if the beam is misaligned. The peak current in the dots was adjusted in the first case to 200 μa. This corresponds to a certain brightness. In the misaligned case, the beam current was increased to a value which gave the same brightness as in the first case, as this is what a viewer would do using a misaligned picture tube.

Polka Dot Generator

The polka dot generator is a very convenient laboratory tool for investigating the influence of alignment or performance of deflection yokes. Fig. 4 is the circuit diagram of this generator.[3] The modulation voltage to produce a given highlight current in the dots can be adjusted by giving the cathode-ray tube itself as a slideback indicator instrument. First, the cutoff voltage of the tube is measured, and then the bias voltage at which the desired beam current paints a plain raster. The voltage difference is added to cutoff, and the tube biased back to this value. The amplitude control of the pip generator is now advanced until the dots just begin

(*Continued on page* 56)

Fig 4: Circuit diagram of polka dot generator—a very convenient laboratory tool for investigating the performance of deflection yokes.



Modern aeronautical navigation equipment requires new types of testing apparatus which are basically miniature transmitters, employing unusual modulation systems.

By JOHN H. BATTISON,
Associate Editor

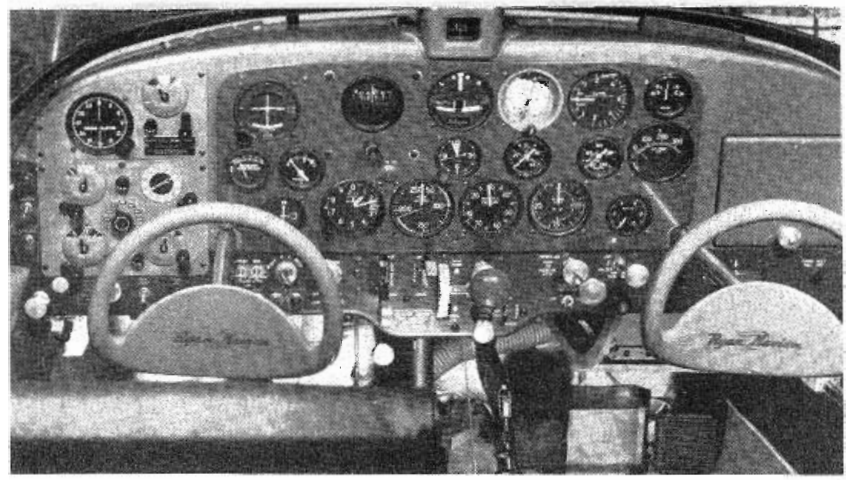


Fig. 1. (Above) Typical aero radio navigation installation in Navion aircraft belonging to Aircraft Radio Corporation. VOR and LF range receivers are installed together with tower receiver and 10 Channel VHF tower transmitter on left panel.

Fig. 2. (below) Instrument panel of American Airways Martin 404 showing course selector top right and cross pointer meter, center.

VOR Signal Generator

IT is apparent to all interested observers that the trend in air navigation and communication equipment is continually towards the higher frequencies. From the well tried and established low frequency radio range with its four course legs, "A" and "N" sectors and fixed orientation along defined courses from one range station to the next, the art has progressed to the HVF Omni Range, or VOR. Although this aid operates in the VHF band it is by no means at the top of the frequency table and even now the trend is towards the UHF band especially for precision position fixing equipment.

The original "A" "N", low frequency ranges suffered from the defect that only along one of the four legs was it possible to use the facility properly, by flying in the "twilight" zone of "A's" and "N's", thus keeping adequate check of the aircraft's position. On all other headings the sector transmission could be used only as a "homing" heading on which to fly to reach the range station. In the VOR complete course information is available to the pilot of a properly equipped aircraft, and he can navigate from a station in any direction with even greater ease than can the pilot of an aircraft using the low frequency radio range. The problem of split beams is avoided since there are no directed beams or legs as such, but merely two transmissions with fixed and rotating patterns. To fly the range the pilot has only to tune in the desired destination station, set the required track on the course selector and fly the track by reference to the Cross-Pointer Meter.

Receiving equipment usually consists of a standard VHF receiver tuning between 108 and 135 MC, the necessary apparatus to filter the various modulations appearing in the output, presentation meters, and earphones to monitor voice transmissions. Two components appear in the output of the receiver; a 30 cps voltage known as the variable channel, and a signal of 9960 cps modulated at a 30 cycle rate to plus and minus 480 cps. The latter is filtered and limited, and known as the reference 30 cycle signal.

The navigation theory of the equipment is based on phase difference between two 30 cycle signals. The variable 30 cycle signal is so arranged that when the receiving antenna is bearing 0° from True North it is in phase with the reference 30 cps signal. On other bearings the phase difference varies up to a maximum of 360°. It will be seen therefore that the 30 cps modulation on the 9960 cps signal forms the reference voltage which is transmitted omni-directionally while the variable channel has a rotating antenna pattern.

The Course Selector Meter is a phase measuring device which indicates the phase difference be-

VOR SIGNAL GENERATOR

(Continued)

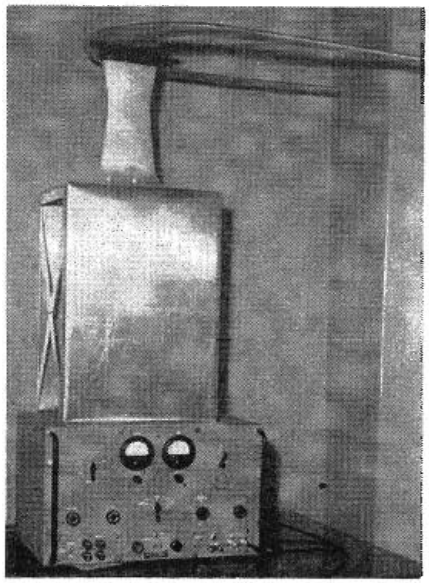


Fig. 3. Installation of H-14 Signal Generator at American Airways Communications Test Center at La Guardia Airport, New York. Located in hangar, weak signal is radiated to test equipment in hangars or on ramps

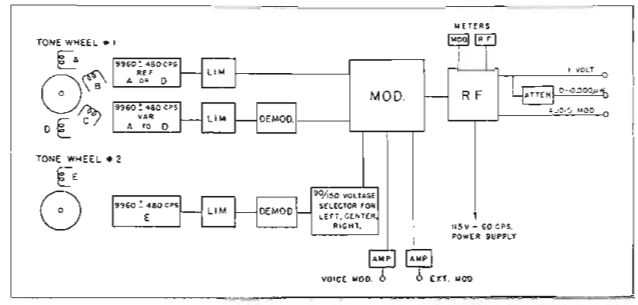


Fig. 5. Block diagram of the signal generator circuit. Tone wheels are used to generate the Variable and Reference signals as well as the Phase Localizer test signals. Coil "A" is the reference coil for 0°, 60°, 120°, and 180° omni track test voltages. Coil "D" is the reference for 240° and 300° courses. Phasing pickup coils, A, B, C, and D, plus reference coil are used for each course

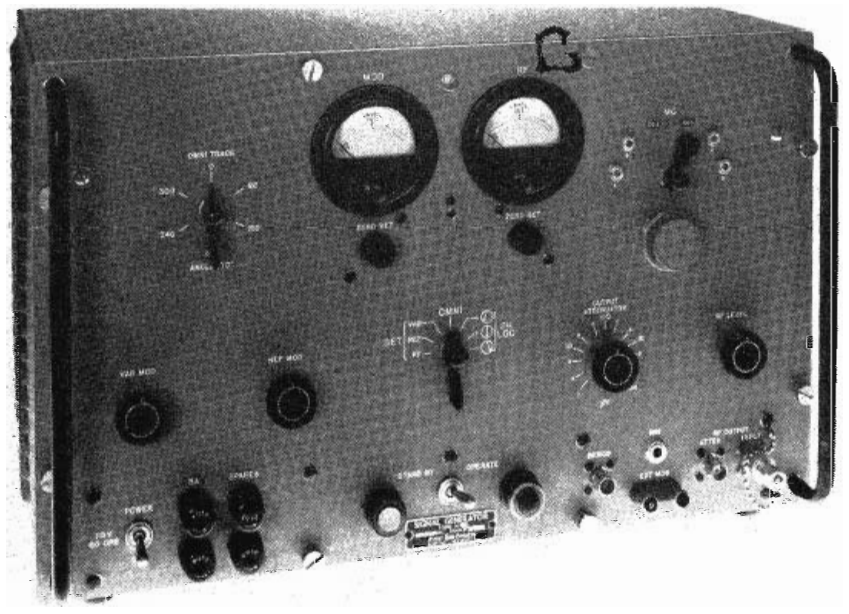
tween the variable channel and the reference channel. The vertical needle of the Cross Pointer Meter is used to indicate course right or left. The Cross Pointer Meter is a center reading dc instrument working out of a "watt-meter" circuit which produces center or zero reading when the phase of the two 30 cps signals is exactly 90° apart. While the phase difference between the VAR and REF signals determines zero setting the relative amplitude of the two voltages determines the "off-course" sensitivity.

Conditions governing the location of VOR stations and the method of flight testing for proper operation have been described elsewhere in this issue. While the receiving equipment is comparatively simple it is always reassuring for the pilot to be able to check his set before taking-off, especially if there is any likelihood of running into bad weather; for although most parts of the circuit are non-critical it is always possible for errors to occur due to breakdown of components. A recent development in this field is the Type H-14 Testing Generator developed by Aircraft Radio Corporation of Boonton, N. J. In line with TELE-TECH's policy of covering all phases of radio communication the company's assistance was enlisted in making facilities available for the author to obtain material for an article complementary to "Flight Testing VOR Transmitters".

The general external appearance of the signal generator is shown in Fig. 1, while Fig. 2 shows the interior. As is the case with all signal generators the instrument is actually a very low power transmitter which may be directly coupled to the equipment under test. However, as is always the case in test equipment for receivers of this type it has to include special signal sources for checking the functioning of navigational indicators as well as possess unquestionable accuracy.

Precise, simulated, omni and localizer signals for testing VHF navigation receiving equipment in the aircraft or on the test bench are provided. The generator also contains all sources of r-f and modulation necessary to produce simulated omni and phase localizer courses. Selection of function is accomplished by means of a seven-position switch. In the omni position any one of six courses is available by means of the six-position omni track switch. The output of the signal generator is sufficient to transmit these standard navigation signals over short distances, such as to aircraft on the field, or, from an inside antenna, to aircraft in a hangar. Voice modulation can be injected simultaneously with test functions for communication purposes.

Fig. 4. Aircraft Radio Corporation's type H-14 Signal Generator. The center switch makes any type of signal available for testing all units of airborne radio navigation equipment.



Navigational Facilities

The standard VHF navigation receiving equipment comprises a complete unit which is capable of accepting and utilizing signals of widely different forms. Descriptions of these units and the manner in which the signals are generated for test purposes follows.

Previously described, the VOR receiver makes use of a transmission containing fixed and variable reference signals, the phase difference being used to indicate angular bearing from the transmitter. Two test modulation signals are generated. The reference, or REF, signal is obtained in a similar manner to that used in the transmitter. A 9960 cps signal (known as the 10 kc subcarrier) modulated at

30 cps with a deviation of plus or minus 480 cps is produced by a tone wheel driven by a synchronous motor. This signal is applied to the modulator at the standard level of 30%. The variable 30 cps signal is produced in the same manner by the tone wheel and pickup coil. After limiting and demodulation the 30 cps component of the 9960 subcarrier, plus or minus 480 cps, becomes the 30 cps variable signal. Referring to Fig. 1, it will be seen that by proper selection of the coils shown any desired phase difference can be obtained. For example: Zero phase difference is produced by applying "A" output to two separate limiter demodulators, result is two 30 cps output with zero phase difference. For 180° phase difference coils "A" and "D" are used, for 60° difference coils "A" and "B" are used, and for angles greater than 180° "D" is used as a reference instead of "A".

In the Omni position the reference and the variable modulating voltages are mixed and applied to the modulator to provide a simulated Omni signal. Six Omni Track angles are available by means of the Omni Track switch, shown in Fig. 2. The angles indicated on the switch are for a To-From meter indication of "To". These angles are determined precisely and permanently by means of the angular location of pick-up coils around the periphery of the tone wheel. The "Zero phase" relationship is established at the factory and need never be reset except in the event of failure of certain components.

VHF 90-150 cps (Amplitude) Runway Localizers

These are the standard runway localizers and have been in use for several years. Generally known as AMP LOC's they operate by comparing two modulations on one carrier—90 and 150 cps—and presenting the information on the vertical needle of the Cross Pointer Meter. A second tone wheel on the same drive shaft with its own pickup coil generates a 9960 cps subcarrier frequency modulated at a 90 and 150 cps rate. The output after limiting and demodulating provides 90 and 150 cps for testing this section of the equipment.

Intended to replace the AMP Locs eventually, the PH Loc operates in a manner similar to the Omni-range. But instead of transmitting a rotating REF signal it is fixed in phase with the VAR signal on one side of the runway and 180° out of phase on the other. Exactly down the center of the runway the two signals cancel, and only the carrier influences the Cross Pointer Meter.

The three most clockwise positions of the function switch provide "reference" and "variable" modulation mixed in the correct percentage and phase required to produce

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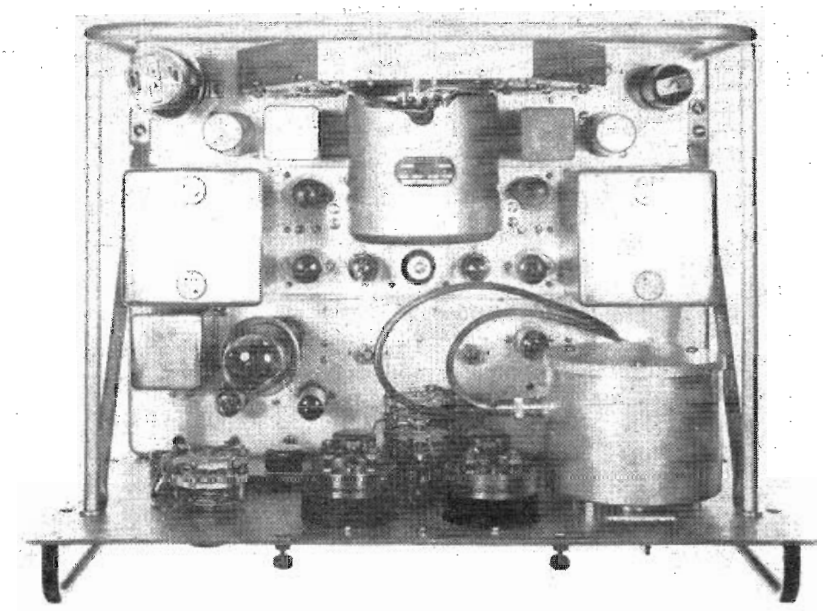


Fig. 6. Interior view of type H-14 signal generator. The pickup coils and tone wheel are housed in the casing at the rear of the chassis. In operation only a very faint 10 KC whistle is heard from the tone wheel. Thorough shielding prevents stray r-f pickup or radiation

"Bisignal" Transmission for FM Stations

RAYMOND M. Wilmotte, consult- engineer of Washington, D. C., has filed a petition with the FCC requesting the amendment of the rules to permit every FM broadcast station to transmit two FM signals of different intensity within their allocated frequency band. The second signal is to be sufficiently weak that normal receiving sets are unaware that a second program or signal is being transmitted. A special receiver will be required to receive either program at will.

Mr. Wilmotte points out that in the past it has been possible to receive an FM signal free from other FM signals because of differences in frequency, and that his work during the last few years has been on methods for separating FM signals because of differences in amplitude.

The new method of dual transmission has been given the name of "BISIGNAL", and provides the following:—

(a) Voice or Music. When both the strong and the weak signals are modulated by voice or music, operation has been achieved with substantially no cross talk and with an intensity ratio between the signals of ten to one. Ratios as high as one hundred to one have been used satisfactorily.

(b) Control Signal. Special signals are being transmitted today by many FM stations in the form of supersonic "Beep" or pulse for controlling the intensity of the sound out of the receivers. In this direction, Mr. Wilmotte has been able to send similar control signals but has used the weaker of the two transmissions, so that the control signal is completely secret since it cannot be detected by a normal receiver. By this means three independent operations using the same number of tubes and simpler circuits than presently used in "Beep" systems can be controlled. Additional controlled operation can be obtained with relatively simple circuit additions.

The importance of this development lies in its ability to transmit an additional communication and hence would permit broadcasters to provide a number of services to be paid for by a rental or a subscription arrangement; such as programs fitted to minority tastes or special needs, and communication to mobile units. It would also provide "Beep" type of operation without danger of pirating.

For MANUFACTURERS — New

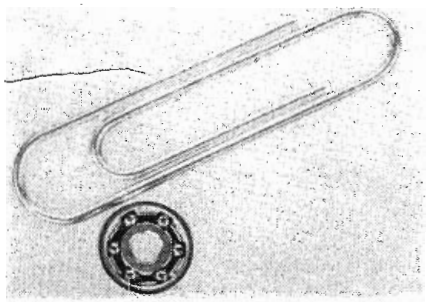
Practical suggestions for increasing production,

Edited by
BERNARD F. OSBAHR

Anti-Friction Bearings

REPORTED to represent a 33% reduction in size from the smallest of its type previously available in this country, the new MICRO Ball Bearing number R 1-4, of Conrad (retainer) design, reduces friction to 1/3 that of next larger size.

The bearing is fully ground, measuring ¼-in. O.D. by 3/32-in. wide with a bore diameter of 5/64-in. Both diameters are held to tolerances plus zero, minus 0.0002-in. from nominal.



Extremely small size of R1-4 Micro Ball Bearing can readily be seen by contrasting against accompanying paper clip in photo

The retainer, or separator, often considered the heart of this type, is of pressed and hardened beryllium-copper, with a tensile strength of 180,000 p.s.i. as against 40,000 for the usual pressed steel type, and with similar superiority in fatigue and wear-resistant qualities. Design was developed over a period of three years by New Hampshire Ball Bearings, Inc., of Peterborough, N. H.

$$$ FOR YOUR IDEAS

Readers are invited to contribute their own suggestions which should be short and include photographs or rough sketches. Our usual rates will be paid for material used.

"Tandem Timer"

THE "Tandem Recycling Timer", manufactured by Industrial Timer Corporation, of Newark, N. J., is a new timing device having two individual timing elements, each able to control a specific operation, accommodated in a single housing. When timer dials are set to respective time intervals required, each cycle of operation will follow the other continuously in sequence.

For example: If two successive production operations require 4 minutes and 2 minutes respectively for their completion, the timer dial of one element is set for 4 minutes, and that of the other for 2 minutes. Upon lapse of the 4-minute interval, the first element not only actuates whatever mechanism is necessary to bring the operation it is controlling to an end, but simultaneously actuates the second timing element in order that the second operation can be immediately commenced. Similarly, upon completion of the 2-minute period, the second element "hands back" the job of control automatically to the first.

The complete Control Cabinet measures 11½ x 9 x 7 inches, and contains two sockets into which the timing elements are plugged so that they control a single-pole, double-throw load relay. The contact circuit of this relay is unpowered, permitting application of the particular voltage and current necessary for test or production.

Quality Control Indicator

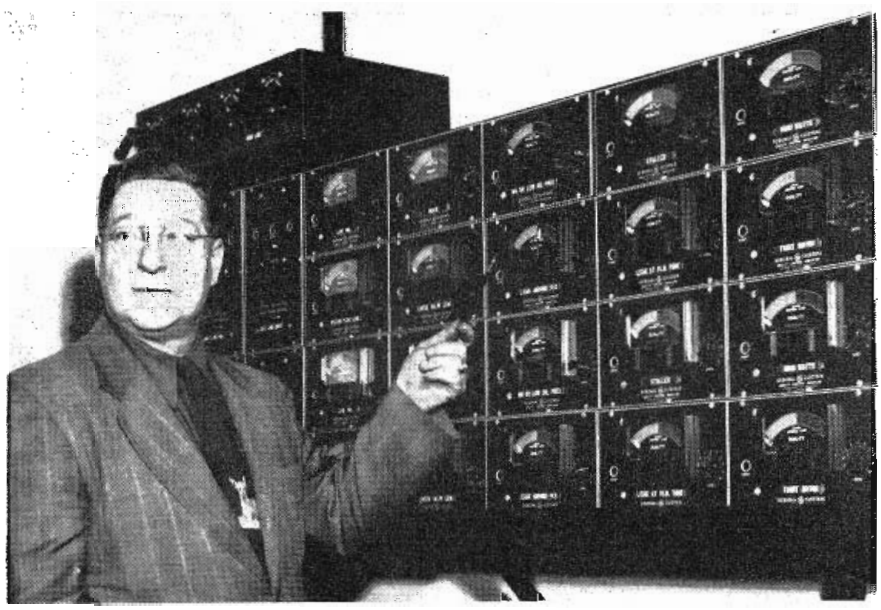
A NEW device, which can be instrumental in assuring the highest quality of most mass-produced items and reduce manufacturing costs at the same time, has been developed by the G-E General Engineering and Consulting Laboratory.

Termed the "Quality Control Indicator," and essentially an electric computer, the basic equipment consists of two units: a "totalizer," which counts the units inspected, and a "characteristic analyzer," which counts the rejects for a given characteristic checked by inspectors. The "quality" meter shows whether rejections are above or below a predetermined level.

In practice, the indicator uses various signalling devices, such as an "electric eye" or a switch tripped by passing objects, to count the number of articles produced. Every time an inspector rejects a unit, he pushes a button, and this causes a change of reading on the indicating meter. When the reject level at an inspection station exceeds a predetermined rate, the needle on the meter moves from the green half of the scale to the red half, indicating to supervisors that corrective action is needed.

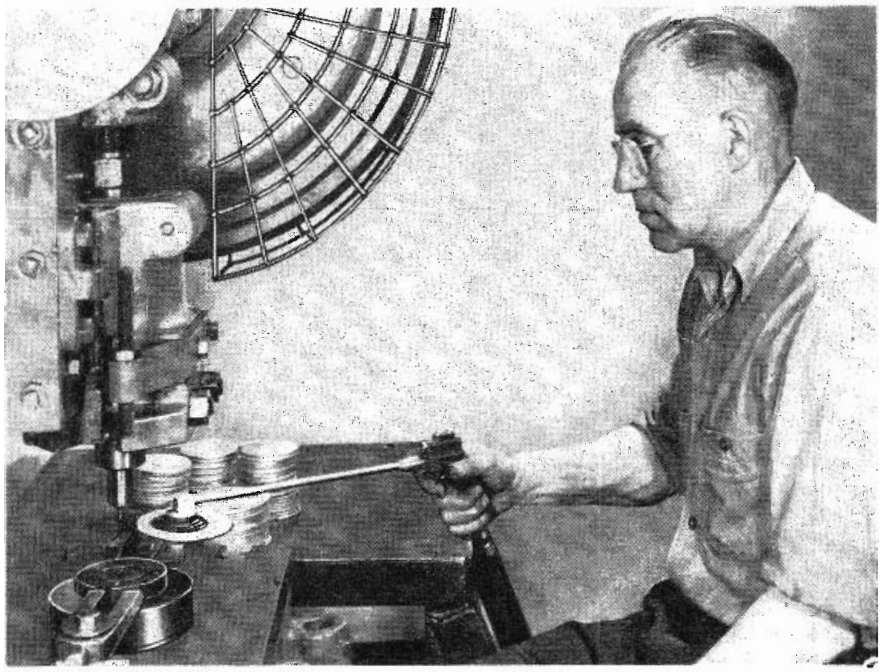
On the front panel of each characteristic analyzer is a selector on which the acceptable reject rate may be set. Reject levels ranging

Typical remote installation of Quality Control Indicators in a manufacturing plant. Characteristic Analyzers showing rejection rates at each inspection point are at right while Totalizer units that count the manufactured items are at left in the background



Methods, New Materials, and New Machines

improving quality and reducing costs



Pres-Vac Safety Feeder, made by F. J. Littell Machine Co., Chicago, Ill., in operation. Device avoids having operator's hands in danger area when hand-feeding a press. Small pieces are lifted by the vacuum obtained from passing compressed air through a venturi

from zero to 10% may be monitored. The quality level to be used is determined by previous production experience.

The characteristic analyzer is roughly the size of a shoebox; and the totalizer the size of a portable typewriter case. The equipment may be run on either 110-volt, 60 cycle ac or on dc and the indicating units need not be near the production line.

The count of total number of manufactured articles inspected is given on a dial seen through a small opening on the panel of the totalizer, and total number of rejections may be seen through an opening in the characteristic analyzer panel. At the end of 2000 unit production, device may be reset.

Oilless Wooden Bearings

AN interesting new engineering manual treating the principles and applications of 'oilless' wooden bearings in modern machine design has recently been published by the Paramount Oilless Bearing Co. of Worcester, Mass.

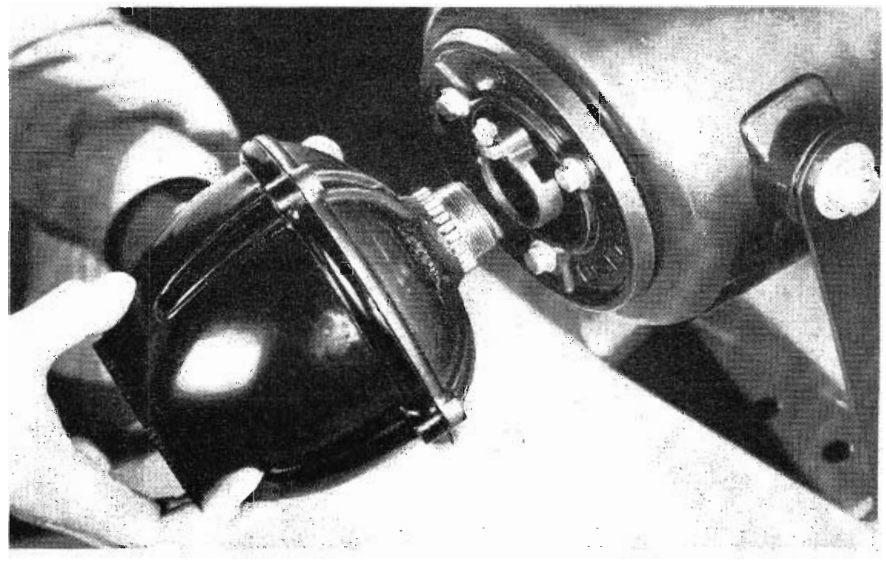
The book considers applications of wood bearings in certain electrical and electronic situations such as where dielectric qualities of the bearing itself are important; where oil drip or spatter from conventional surface-lubricated bearings would injure the efficiency of surrounding circuit components; use in inaccessible locations where bearings must remain self-lubricated for a number of years; where surrounding high voltages prohibit lubrication maintenance; and where elimination of noise is paramount.

The manual, first book of its kind, is being loaned to engineers and machine designers on request.

Plastic Housing Cuts Cost of PA System

A SAVING of 25% in cost of the bottom housings for public address system driver units has resulted from molding them of Bakelite (Union Carbide and Carbon Corp.) phenolic plastic. The unit illustrated is the first designed to operate with both constant voltage and constant impedance systems. Resistant to impact, rough handling, moisture, chemicals and fumes, the plastic housing has transformer terminals emerging from a block in the bottom which is an integral part of the molded case. The terminal block needs no sealing gasket. The housing itself requires no deburring, nor painting, since the glossy black color is part of the plastic itself. Capable of handling undistorted output of amplifiers up to 30 watts capacity without blasting or overloading, the driver units made by University Loudspeakers Inc., 80 Kenisco Ave., White Plains, N. Y., have a new diaphragm structure made possible by the use of Bakelite phenolic resin cements and binders. A new "W" shaped Alnico 5 magnet eliminates stray fields and provides a greater concentration of energy in the voice gap. Frequency response is 80 to 10,000-cycles.

Close-up of new speaker driver unit whose molded plastic housing costs 25% less to make



Dayton IRE Air Conference

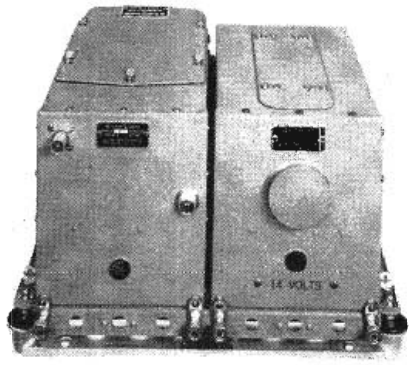
1950 Meet on May 3-5 features 56 papers on airborne communications; 22 exhibitors participating

A TECHNICAL conference on the airborne electronic art will be held under the sponsorship of the Dayton section of the IRE on May 3-5 at the Biltmore Hotel, Dayton, Ohio. Manufacturers of airborne communications components and associated test units will exhibit their equipment from 9:00 A.M. to 9:00 P.M. on the days that the conference is in session. Technical sessions are scheduled for the afternoon of May 3rd and the morning and afternoon of May 4th and 5th.

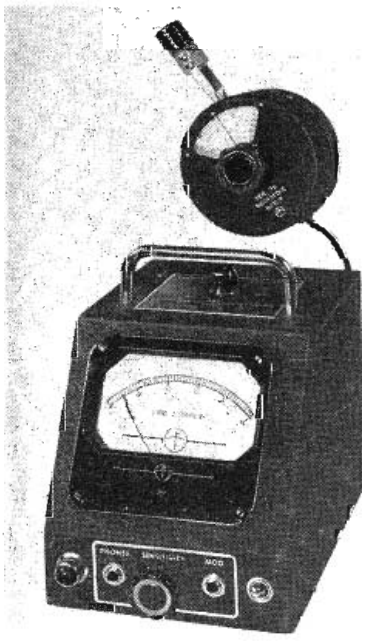
A welcoming luncheon is planned for May 3rd at 12:00 noon. The traditional banquet will be held at 7:00 P.M. on Thursday, May 4th at which a presentation—"Pioneer in Airborne Electronics" — will be made to the guest of honor. A special program has been arranged for the wives of guests which will include (in addition to the luncheon and banquet) a "Get Acquainted Tea", a tour of the Frigidaire Kitchens, and a tour of McCall Corporation's pattern department and plant.

A representative list of papers to be presented follows:

"The Slitted Cylinder Traveling Wave Antenna." D. R. Rhodes, Ohio State University Research Foundation.
"A UHF-VHF Tail Cap Antenna." L. E. Raburn, Electronics Research, Inc.
"Appl. of Slot Antennas." J. A. Albana, AMC.
"Problems in the Design of Very-High-Frequency Navigational Receivers." R. T. Adam and A. G. Kandoian, Federal Telecommunications Labs.
"A Frequency-Modulated Microwave Radio Altimeter." D. Blitz, Raytheon Manufacturing Co.
"The Analysis of Balanced Amplifiers with In-Phase Feedback." Prof. J. M. Cage, Purdue Univ.
"Cathode Ray Oscillography Above 100 Mc." R. C. Schwantes and M. M. Newman, Lightning and Transients Research Institute, and P. S. Christoldi, Allen B. Du Mont Laboratories, Inc.
"Slotted Waveguide Antenna Array." S. Hershfield and W. V. Foley, The Glen L. Martin Co.



Type 15B VHF Omni Range equipment will be displayed by the Aircraft Radio Corp., Boonton, N. J. Input power requirements are 2.9 amps at 28 v. dc, or 5.8 at 14 v. dc

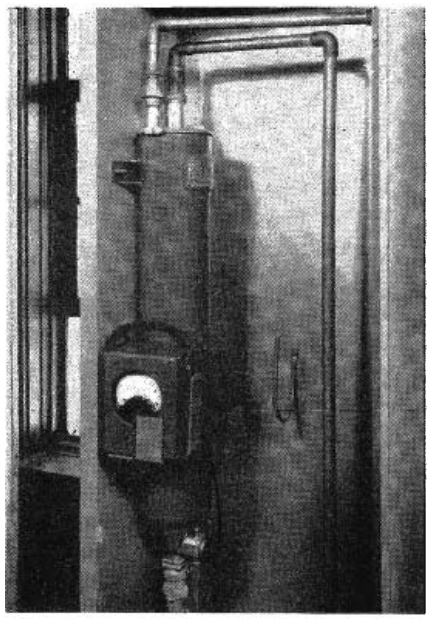


A megacycle grid-dip meter for 2.2 to 400 MC range will be shown by Measurements Corp., Boonton, N. J. Known as Model 59, it determines resonant frequency of tuned circuits, antennas and transmission lines

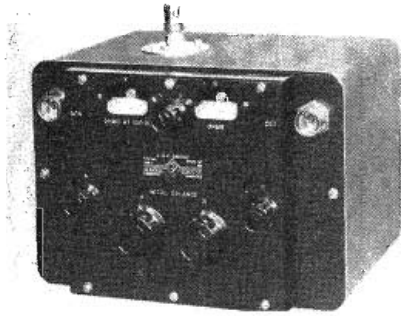
"UHF Non-Directional Slot Antennas for Missiles." H. Rowland, Workshop Associates, Inc.
"Development of a Flush Mounted Non-Directive Airborne Antenna System." S. M. Kerber and R. Krausz, North American Aviation, Inc.
"5 KW R. F. Termination Wattmeter for Television Use." Harold Stevens, Bird Electronics Corp.
"Aircraft Radio Interference Reduction." M. M. Newman, Lightning and Transient Research Institutes, P. W. Couch, AMC.

Collins Radio of Cedar Rapids, Ia., plans to show six pieces of aircraft radio equipment. Included among these is an airplane communication installation consisting of the 51 R, VHF receiver for VOR, Localizer and voice communication, and the 17-L, VHF Multi-Channel transmitter. Fitted with preset crystal control of 180 channels in the 118 to 135.5 MC band, it is complementary to the receiver. Landing aids are also included in the form of the 51-V Glide Slope Receiver. This is the first piece of equipment designed for reception on 20 different channels — ten presently operating, and ten in the future as more installations are made.

In the field of navigation equipment, the 560-A-1 Parallel Course Computer is a new device which will provide courses five miles apart up to 30 miles from any desired track for parallel course work. It is actually a DME unit or R-Theta Course Calculator. On display, but not demonstrated will be the 560-B-1 Pilot Steering Computer. This is an instrument to assist in interpreting the cross pointer meter as well as use on cross country flights, intercepting the glide path and flying the localizer. The last instrument they are showing, but not demonstrating is the Course Line Indicator. This shows, in connection with the flux-gate compass, position left or right of the desired course. It can also be used to show the relative position of the runway when using ILS.



Bird Electronic Corp., 1800 East 38th St., Cleveland 14, Ohio will feature the 824 Termaline R-F Wattmeter. Designed for use with TV transmitters, this unit operates with connector end down and mounting positions are provided as illustrated. Half inch pipe is used for water connections



General Radio Co., Cambridge, Mass., will exhibit measuring equipment for the r-f VHF and UHF ranges, with particular emphasis on instruments for impedance measurement. One of the featured units will be the 1601-A VHF Bridge (above), designed for measurement between 10 and 165 MC

WASHINGTON
News Letter

Latest Radio and Communications News Developments Summarized by Tele-Tech's Washington Bureau

EARLY-SUMMER COLOR-TV DECISION—The FCC evidently is aiming toward a target date of reaching a determination on color-television by late June or early summer. Because of the political maneuvering and battling between the different radio companies for the best publicity spotlight, not only was the Commission exhibiting a rather baffled frame of mind but also there was considerable concern among impartial observers at the eight-month hearings of a trend toward "face-saving" with the FCC decision to permit all the competing systems to participate in the inauguration of color television for public consumption.

SINGLE STANDARD DESIRABLE—Even though a concensus has been reached by topflight radio engineers and also by Senate Interstate Commerce Committee Chairman Johnson that a single color-video system would be in the best public interest, certain elements within the FCC appear to be jockeying toward a final decision under which multiple systems would be available. This was exemplified, it appeared, in the tenor of the questioning during the cross-examination phase of the hearings which lasted all April, especially in the interrogation of the principal radio industry technical witnesses and the chief radio manufacturing spokesmen such as RMA President Cosgrove and Philco engineering vice-president David B. Smith. Such ideas were illustrated in the questioning as to whether the FCC should prescribe that all color TV sets contain the Chapin-Roberts adapter (developed by the FCC laboratories scientists) which would premit CBS to use its system; whether all television should be moved "upstairs" into the UHF bands after a period of amortizing present VHF monochrome receivers, etc.

COMMUNICATIONS POLICY BOARD—First *piece de resistance* of the new Communications Policy Board will be the international communications merger, and that subject occupied practically entire agenda of its April 20 session. Meanwhile, major government departments interested in communications and radio have appointed key officials as liaison representatives with the Board—Major General H. M. McClelland, Communications-Electronics Director of Joint Chiefs of Staff, for Department of Defense; CAA Administrator Delos W. Rentzel and Federal Airways Director C. W. Horne for Commerce Department; Commissioner E. M. Webster for FCC; and Telecommunications Policy Staff Assistant Chief Cecil Harrison for State Department.

STREAMLINING FCC MOBILE RADIO PROCESSES—With the backlog of applications for mobile radio services in all categories, particularly in industrial power utilities and petroleum radio, the FCC last month was engaged in an intensive study of methods of expediting the processing in this field. Instead of lengthy applications on moving of base station locations, additional mobile units and similar routine extensions of mobile radio systems, the FCC staff has in mind very simple forms of applications, just requiring rubber-stamping by the Commission, and in the case of any changes of equipment no applications whatsoever if the type-approved equipment is used. It is estimated that this will cut the application load of some 20,000 applications a year in half and will permit the FCC technical staff to devote more time to frequency coordination and engineering problems. If the procedure is streamlined, it will not only mean Commission action on applications in two or three weeks, instead of four and five months now, but will also step up the expansion of mobile radio services with greater activity by the manufacturers.

AIR PICKUPS BY TELEVISION STATIONS—Individual broadcasting and television stations can engage in air pickups through radio relay links for network routes and then feed the video transmissions into telephone relay lines, the FCC has just ruled. This permits such air pickups as now used by DuMont between New York and New Haven and similar operations engaged in by about a dozen television stations in different sections of the country.

CONSULTING ENGINEER'S MOBILE RADIO PROPOSAL—A well-known radio engineer, A. D. Ring, former FCC assistant chief engineer for broadcasting, presented the FCC with an interesting mobile radio problem April 13 in his application to operate a Special Industrial mobile radio system in the field testing of broadcasting and television stations and in the erection of antennas. Because of the paucity of frequencies, the Commission determined to probe the usefulness of this service in mobile radio through a hearing.

LITTLE CHANCE FOR RACING BAN BY RADIO-TV—Possibilities of Congressional approval of bill which would prevent broadcasting and television stations from giving results of horse races for an hour after the race are most dim. Radio-TV interests were slated to join with the press that such a move would be a form of censorship. Hearings started before Senate Interstate Commerce Committee April 11.

National Press Building
Washington, D. C.

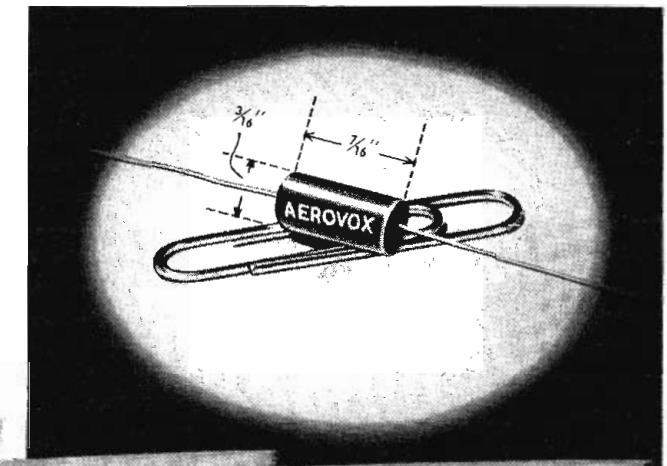
ROLAND C. DAVIES
Washington Editor

SMALLER THAN PREVIOUS "SMALLEST"...

PREDETERMINED ACCURACY...

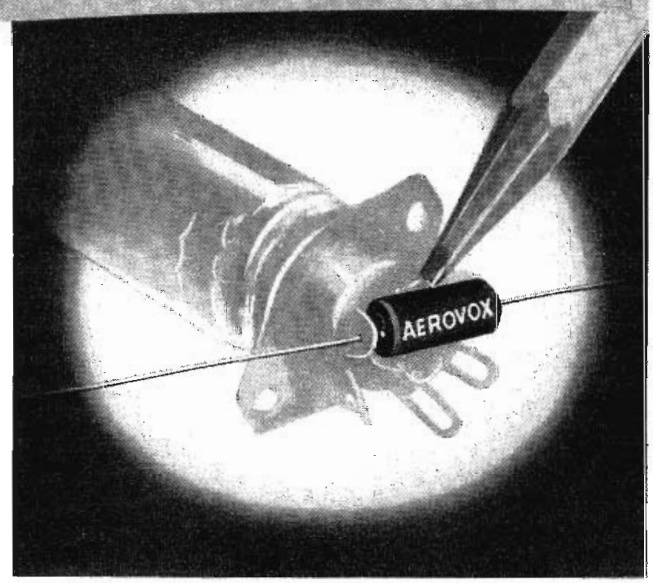
REMARKABLE STABILITY...

EXCEPTIONAL CHARACTERISTICS...



AEROVOX MICRO-MINIATURES

(TYPE P83Z AEROLITE® CAPACITORS)



● Smaller than a paper clip! Only 3/16" dia. by 7/16" long! Yet rugged, accurate, stable, exceptional.

Such is the story of Aerovox Micro-miniatures (Type P83Z Capacitors). Smaller physical size directly due to radically new *metallized dielectric*—a distinct departure from conventional foil-paper and previous metallized-paper constructions. Dielectric and electrodes combined *in one element*. Smallest capacitor available for capacitance range.

Aerovox Micro-miniatures are particularly applicable to radio-electronic miniaturization calling for high-frequency and by-pass coupling.

● *Try Aerovox Micro-miniatures in your miniaturized assemblies. Write Dept. FD-450 for engineering data, samples, quotations, and application engineering aid.*

F E A T U R I N G . . .

One size for all ratings—3/16" dia. by 7/16" long.

Hyvol K impregnated in humidity-resistant molded thermoplastic cases.

Operating temperature range from —15° C. to +85° C. without derating.

Power factor less than 1% when measured at or referred to frequency of 1000 cps and ambient temperature of 25° C.

Insulation resistance of 25,000 megohms or greater, measured at or referred to temperature of 25° C. Insulation resistance at 85° C., 500 megohms or greater.

Very high self-resonant frequency, due to remarkably small length of unit.

Life test: 1000 hours at 1.25 times rated voltage in ambient temperature at 85° C.

Meets humidity resistance requirements of RMA (REC-118, section 2, paragraph 2.38) for paper tubulars.

Meets RMA heat resistance test at 85° C. (REC-118, section 2, paragraph 2.39).

In 400 VDC (.0005 to .003 mfd.) and 200 VDC (.005 and .01 mfd.)

Other capacitance and voltage ratings will be made available in near future.

*Trade-mark

CAPACITORS • VIBRATORS • TEST INSTRUMENTS

AEROVOX capacitors *for Radio-Electronic and Industrial Applications*

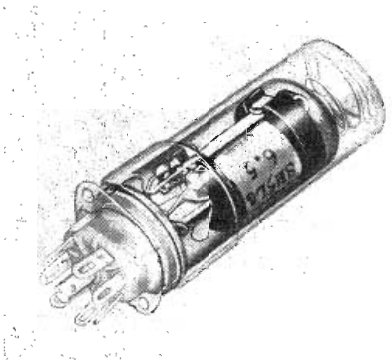
AEROVOX CORPORATION, NEW BEDFORD, MASS., U. S. A. • Sales Offices in All Principal Cities

Export: 17 E. 42nd St., New York 17, N. Y. • Cable: AEROCAP, N Y. • In Canada: AEROVOX CANADA LTD., Hamilton, Ont.

NEW EQUIPMENT for Designers and Engineers

Relay

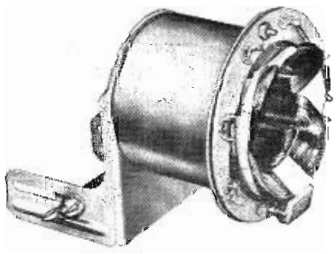
Construction of the series SM relay has been modified to permit its use with a miniature socket and shield with inner spring. This



provides a SPDT plug-in relay that will occupy only ⅞ in. chassis space, yet may be mounted in any position without danger of working out of socket. The SM series is offered with dc windings from 0.155 to 8000 ohms resistance with minimum adjustment to pull in on 3 ma at 75 milliwatts. Coil can be wound to dissipate up to 1.75 watts. The G version relay is hermetically sealed in miniature-tube glass envelopes with standard 7-pin bases. Open version relay is single screw mounted.—**Potter & Brumfield, c/o Ralph Brengle, Princeton, Ind.**—TELE-TECH

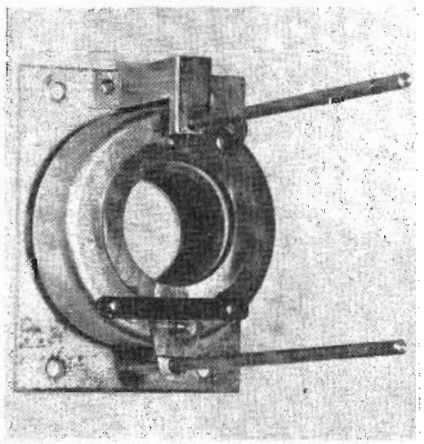
Sweep Yoke

A new sweep yoke has been designed to sweep up to 70° picture tubes with high efficiency. When this yoke is used in conjunction with associated G-E sweep components, the horizontal sweep system requires only 20 watts of horizontal input from a 250-v. supply. Horizontal inductance is 18 millihenries, while vertical inductance is 30 millihenries. It is available with either a laminated or ferrite core.—**General Electric Co., Syracuse, N. Y.**—TELE-TECH



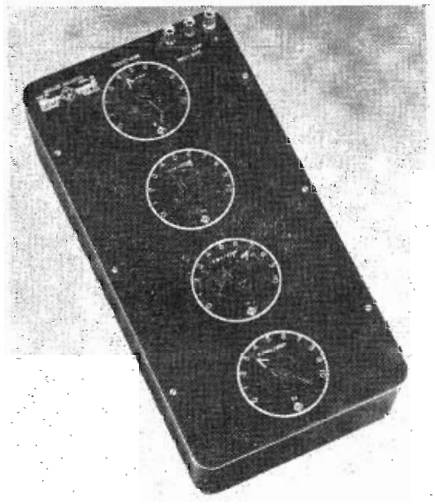
Focus Magnet

An adjustable focus magnet with picture positioning control has been developed for use with all TV tubes having magnetic deflection. Positioning control utilizes flux leakage and separate adjustments for focus and position can be made from the rear of the cabinet. Centering controls are eliminated, thereby cutting receiver costs. External flux leakage is extremely low. The magnet has high coercive force; magnetic field remains constant over years of operation.—**Heppner Manufacturing Co., Round Lake, Ill.**—TELE-TECH



Decade Inductor

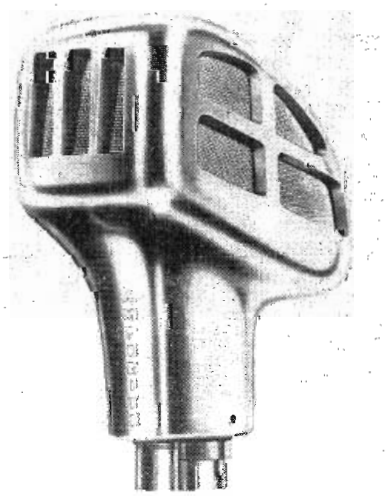
Available in single-decade units for building into other equipment and in three- and four-decade cabinet assemblies for laboratory



use, new decade inductors provide precise steps of inductance from one millihenry to one henry per step. Cores are molybdenum permalloy dust toroids with precisely adjusted, banked windings. Temperature coefficient of inductance is —24 parts per million per degree Centigrade over the normal range of room temperatures. Maximum storage factor, Q, is between 200 and 330. Accuracies range from 2% for the one millihenry steps to 0.25% for the one henry steps. —**General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.**—TELE-TECH

Studio Ribbon Microphone

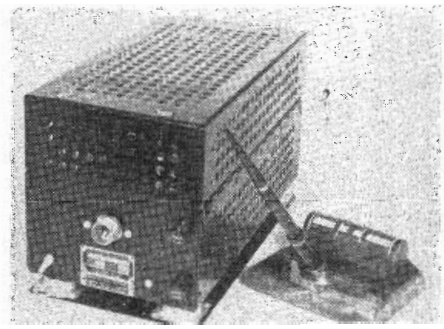
Capable of withstanding a great deal of mechanical abuse, this studio ribbon microphone has a frequency response from 40 cps



to 14 KC. Harmonic distortion is less than 1% and discrimination with angle—60 cps to 10 KC—is less than 1/10th that of a diaphragm microphone. Unit is shock-mounted in rubber. It is available in 200-ohm and high-impedance outputs. List, $32.00 to $80.00. Write for Catalogue No. T-M—**Amperite Co., Inc., 563 Broadway, New York 12, N. Y.**—TELE-TECH

Inverter

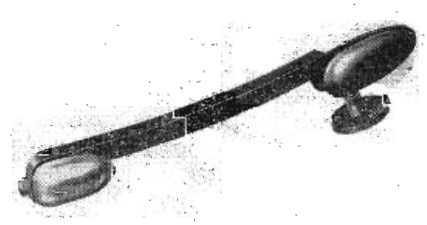
Model 421 Inverter transforms 28 v. dc to 400 cycle ac ±.1%, 115 v. ac ±1% single phase and/or 115 v. ±3% three phase. Fea-



tures are exceptional frequency and voltage stability over extreme ranges of temperature, altitude, load and input ranges, and complete absence of moving parts. Output is 100 VA; power factor .4 to .8 lag. Weight is 19 lbs. and overall volume is 620 cubic in. There are no revolving or oscillating switches, commutators, rings, brushes, governers, or vibrator contacts. The elimination of moving regulator parts, such as carbon pile regulators, decreases maintenance and inspection while increasing performance and accuracy.—**Varo Manufacturing Co., Box 638, Garland, Texas.** —TELE-TECH

Tone Arm

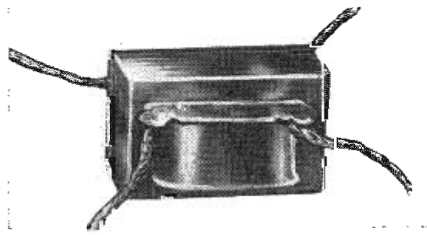
Provision for playing back 33 1/3, 45 and 78 rpm records is provided by the Turret-Head tone arm. Vertical, standard, lateral and



microgroove cartridges, in any combination of three, can all be mounted on a turret contained within the head of the pickup. A knob on the front of the head is rotated to select the desired cartridge. Stylus pressure changes automatically to conform with the requirements of the individual cartridges. The single arm eliminates the inconvenience of plug-in cartridges or extra pickups on the playback turntable, yet maintains optimum performance through the use of a separate cartridge for each function.—**Fairchild Recording Equipment Corp., 154th St. & Seventh Ave., Whitestone, L. I., N. Y.**—TELE-TECH

Audio Transformer

Said to be the smallest standard audio transformer in the world, the SSO has dimensions of .4 x .75 x .56 in. Five stock types



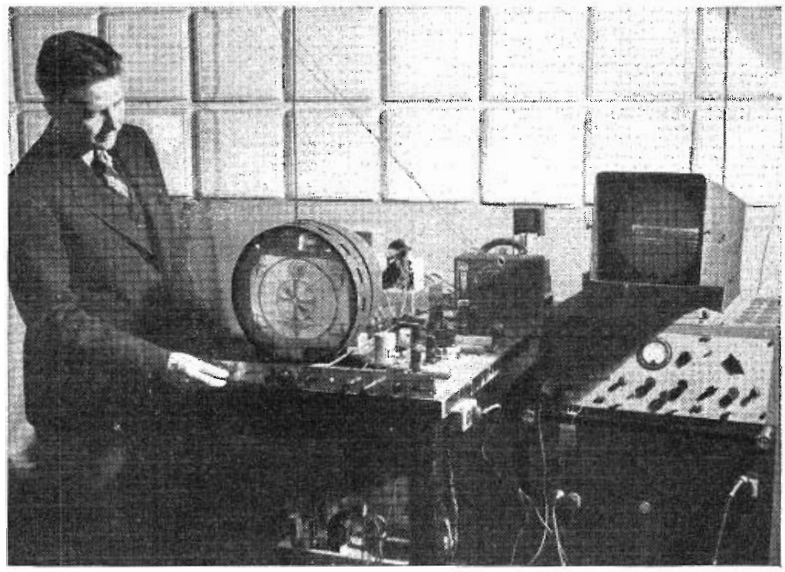
cover input, interstage, output, and reactor applications. Molded nylon bobbin and non-hygroscopic insulation are used throughout. All SSO transformers are vacuum impregnated to assure dependable operation under high humidity conditions.—**United Transformer Co., 150 Varick St., New York 13, N. Y.**—TELE-TECH

How electronic "paintbrushes" create pictures in our newest art form

There's not a single moving part in a Kinescope —but it gives you pictures in motion

No. 4 in a series outlining high points in television history

Photos from the historical collection of RCA

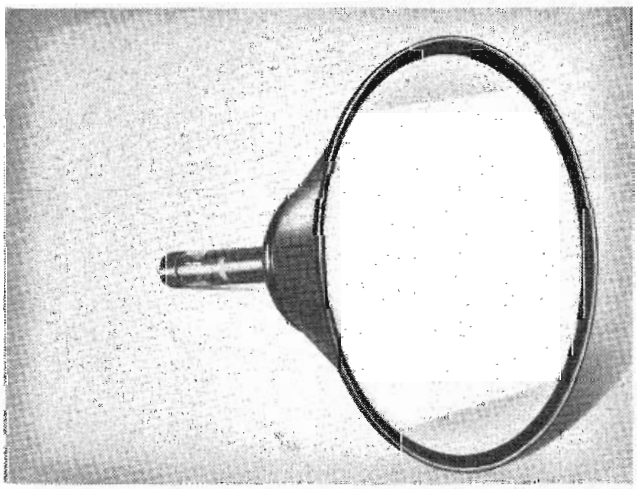


An experimental model of the kinescope—*developed by Dr. V. K. Zworykin of RCA Laboratories—is seen undergoing laboratory tests.*

● Ever watch an artist at work—seen how his brush moves over the canvas to place a dot here, a shadow, a line, a mass, or highlight there, until a picture is formed?

Next time you're asked how television pictures are made, remember the paintbrush comparison. But the "brush" is a stationary electron gun, and the "paint" is a highly refined coating of fluorescent material made light or dark in orderly pattern by electrons.

Developed by Dr. V. K. Zworykin, now of RCA Laboratories, the kinescope picture tube is one of the scientific advances which gave us *all-electronic* television . . . instead of the crude, and now outmoded, mechanical techniques.



New 16-inch *RCA glass-and-metal kinescope picture tube, almost 5 inches shorter than previous types, incorporates a new type of glare-free glass in its faceplate—Filterglass.*

Today, through research at RCA Laboratories, these complex kinescope picture tubes are mass-produced at RCA's tube plants in Lancaster, Pa., and Marion, Indiana. Industrial authorities call this operation one of the most breath-taking applications of mass production methods to the job of making a precision instrument.

Thousands of kinescope faceplates must be precisely and evenly coated with a film of absolutely pure fluorescent material . . . the electron gun is perfectly synchronized with the electron beam in the image orthicon tube of RCA television cameras . . . the vacuum produced in each tube must be *10 times more perfect* than that in a standard radio tube—or in an electric light bulb!

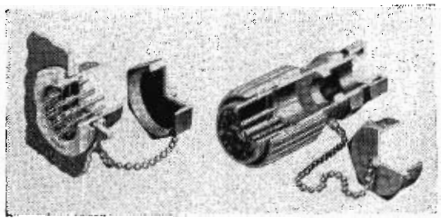
Once it has been completely assembled, your RCA kinescope picture tube is ready to operate in a home television receiver. In action, an electrically heated surface emits a stream of electrons, and the stream is compressed by finely machined cylinders and pin-holed disks into a pencil-thin beam. Moving back and forth in obedience to a radio signal—faster than the eye can perceive—the beam paints a picture on the face of the kinescope. For each picture, the electron beam must race across the "screen" *525 times*. To create the illusion of motion, 30 such pictures are "painted" in every single second.

Yet despite these terrific speeds, there are no moving mechanical parts in an RCA kinescope. You enjoy the newest of our arts because electrons can be made to be obedient.

Radio Corporation of America
WORLD LEADER IN RADIO—FIRST IN TELEVISION

Connector

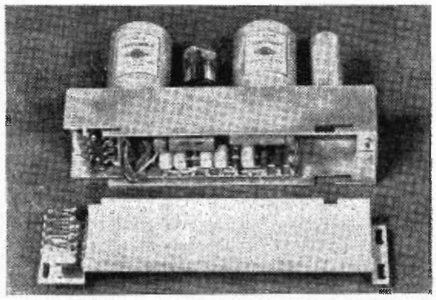
The "89 Series" is a rugged, heavy-duty, field service type of connector designed to meet the unusual demands of the government for field equipment. Even when completely



submerged in water, mud, or mire these connectors give efficient performance. Built-in rubber cable clamp and anodized finish provide maximum resistance to the elements. Coupling rings are long, providing a full hand grip, and are heavily grooved to prevent slipping when handled in rough weather. Flat sides are provided so that a standard open-end wrench can be used.—**American Phenolic Corp., Chicago 50, Ill.**—TELE-TECH

Plug-In Amplifier

Type 8862 plug-in amplifier chassis can be mounted in three positions: front or back of the relay rack with provision made for



horizontal plug-in through the front of the relay rack panel. When mounted front or back, chassis is latched vertically, similar to conventional telephone selector switch mounting. Companion mounting frames are available to accommodate either horizontal or vertical mounting.—**Cinema Engineering Co., 1510 West Verdugo Ave., Burbank, Calif.**—TELE-TECH

Universal Power Bridge

Type 650 direct-reading universal power bridge permits accurate determination of r-f power levels over a wide range. It may be

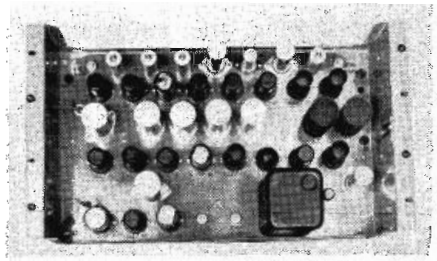
used with bolometers having either positive or negative temperature coefficients and with operating resistance in the range from 50 to 250 ohms. A range selector switch provides a choice of full scale deflection for 0.1, 1, 0, or 100 milliwatts.—**Polytechnic Research & Development Co., Inc., 202 Tillary St., Brooklyn 1, N. Y.**—TELE-TECH

FM Radiotelephone

Incorporation of instant-heating tubes in new 50 and 100-watt FM radiotelephones provide the advantages of greater power and range with a remarkable reduction in battery drain. An improved system of modulating the phase modulator tubes provides excellent voice quality with 100% modulation ±15 KC. A special circuit boosts the low tones rounding out the voice quality so that it has a naturalness not previously obtained with narrow band FM transmitters. The FM-39X is a double-superheterodyne receiver which uses one crystal to convert to the two intermediate frequencies. The higher intermediate frequency will lie between 5100 and 5900 KC, depending on the signal frequency, while the lower i-f is 455 kc. Frequency range is 30 to 44 MC; 72 to 76 MC on special order. Signal of approximately 0.4 μV. will cause 20 db noise quieting.—**Knar Engineering Co., Palo Alto, Calif.**—TELE-TECH

Stabilizing Amplifier

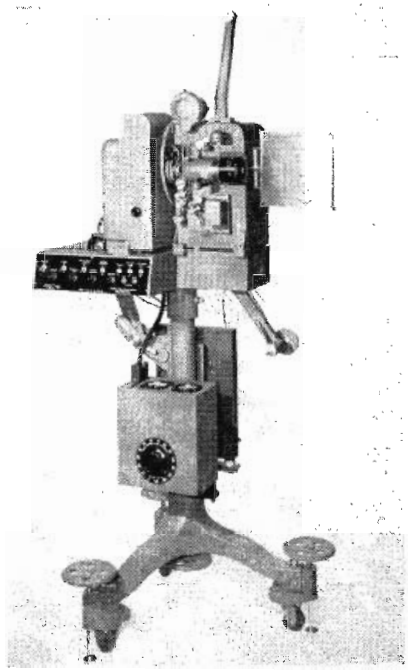
An improved stabilizing amplifier (TA 5C) has been designed to correct faults which may be introduced in video signals during



their transmission from the television camera to the input of the transmitter. It will correct many common disturbances such as hum or surges originating in power supplies, other random signals created by high-impedance grounding circuits or long cable sheaths, circuit saturation with resultant destruction of the proper sync-to-picture ratio, switching surges, and low-frequency distortion introduced by coupling circuits with inadequate time constants. The TA-5C clips a complete signal at blanking level and the video portion of the signal, with its cleaned-up blanking reference, is fed to a mixing amplifier stage, where the sync signal, likewise clipped and reshaped, is restored to it. Separate gain controls are used for video and sync portions of the signal to permit sync range setting of 0 to 50%.—**Radio Corporation of America, RCA Victor Div., Camden, N. J.**—TELE-TECH

TV Projection Equipment

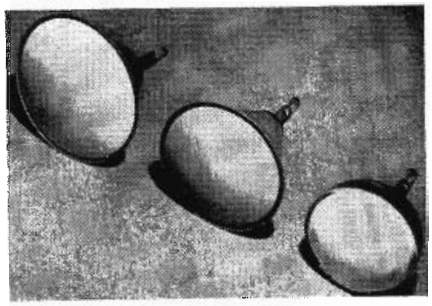
Outstanding feature of the new DuMont-Holmes "Superspeed Projector" is the extremely fast pulldown mechanism. The in-



termittent sprocket pulls down in approximately 2000 μsec., thus effectively reversing the present light-duty cycle and allowing pulldown during the blanking period of the tube. Despite the problems of inertia and strain accompanying intermittent motions of this speed, tests have proven the rugged mechanical design to have durability far superior to present normal-speed projectors. The rapid pulldown characteristic makes the projector a dual purpose tool for TV stations. As a direct projector for image orthicon camera pickup, it provides a film chain free from the spurious signal and shading problems inherent in present iconoscope pickup chains. The second purpose of the "Superspeed" projector is its use as a background projector for studio production.—**Allen B. Du Mont Laboratories, Inc., 2 Main Ave., Passaic, N. J.**—TELE-TECH

19-in. Metal TV Tube

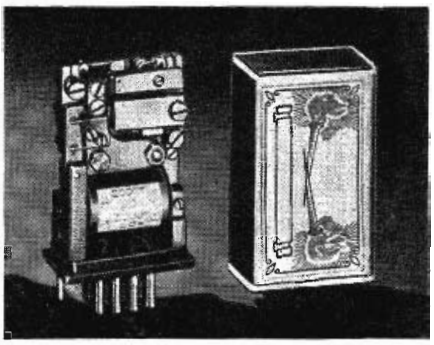
A new 19-in metal TV tube (19AP4) has been developed which provides a useful image 11¾ X 15¾ in. with high brilliance and defi-



nition. It is designed for magnetic focus and deflection and utilizes an electron gun with bent structure for use with a single external magnetic field to eliminate ion spot screen blemish. Anode operates at 13,000 v., grid no. 2 at 250 v., and grid no. 1 from —27 to —63 v. Photo shows the 19AP4 at extreme left with 16 in. tube in center and 12½ all-glass tube at right.—**Sylvania Electric Products, Inc., 500 Fifth Ave., New York 18, N. Y.**—TELE-TECH

Polarized Relay

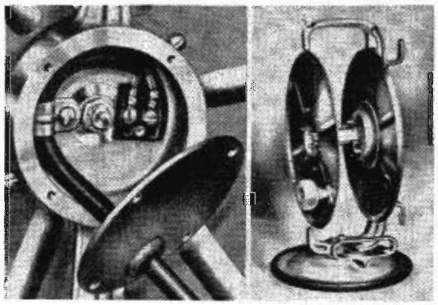
Capable of repeating, with high accuracy, feeble signal impulses of varying time duration, the Carpenter polarized relays main-



tain this ability for long periods without attention. These relays, manufactured by the Telephone Manufacturing Co., Ltd., London, England, are being distributed exclusively in the U. S. by C. P. Clare Co. The type 5 (illustrated) is a miniature relay of phenomenal performance in proportion to its size and weight of 4.8 oz. (This figure was incorrectly stated in a previous issue of TELE-TECH). Primarily developed for military and aircraft uses, it has exceptional thermo stability. Complete technical description can be found in Clare Bulletius 110-J11-112.—**C. P. Clare & Co., 4719 West Sunnyside Ave., Chicago 30, Ill.**—TELE-TECH.

Cable Reel

The Port-O-Reel is a time and money saving tool for remote and special events broadcast crews. It permits the handling of up



to 500 ft. of 2-conductor shielded microphone lead cord with the comparable ease of handling a short cord. Because the reel is designed for paying out or reeling in cord while broadcasting, the manufacturer has used special dual-running contacts that make no audible sound through the transmitter. The contact assembly is protected with a special patented formula coating that prevents interference due to moisture. Illustration shows screw binding posts for connection of feeder cord to units not equipped with receptacle in frame and a full length view of the real itself.—**Industrial Electrical Works, Omaha, Nebraska**—TELE-TECH

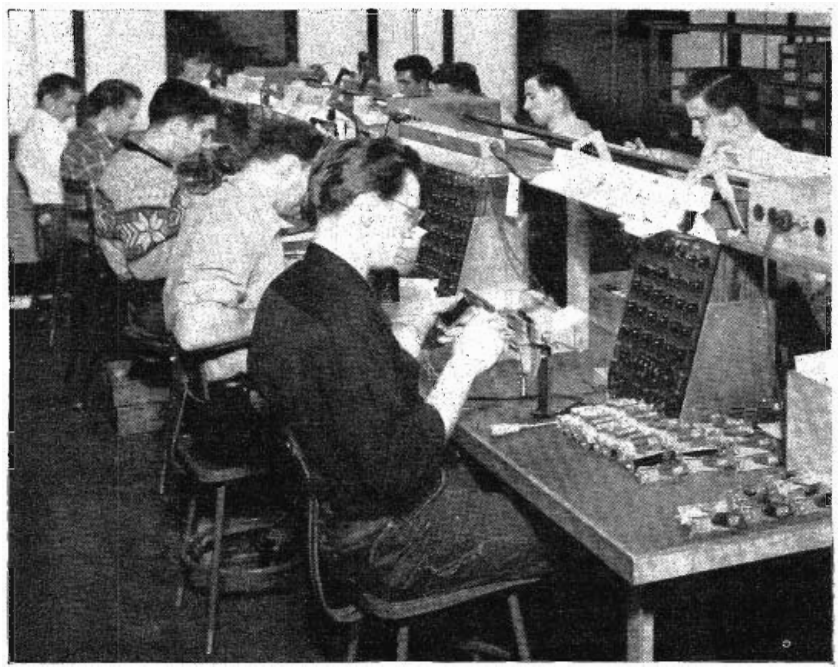
Here's Why...

you now get

Quick Delivery

on these

Top Quality



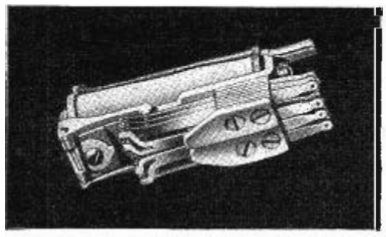
One of the assembly lines in our Relay Department

AUTOMATIC ELECTRIC

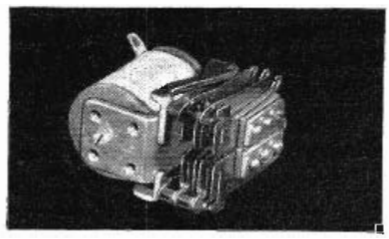
RELAYS SWITCHES

This special—*and separate*—department has but one function . . . to process *your* orders promptly and accurately. Here, stocks of all standard parts are maintained, ready for expert assembly in accordance with your specific requirements. "Engineering Samples" are shipped within 10 to 14 days after receipt of order (for hermetically sealed relays, allow 10 days more). Quantity shipments can start within 30 to 60 days on schedules to meet your requirements. With high-geared volume production, thousands of these superior components are being delivered quickly.

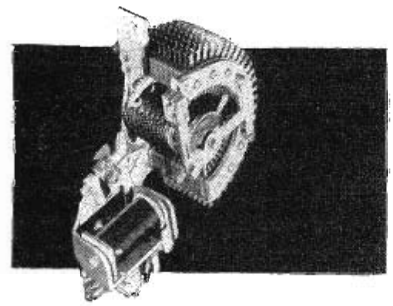
WHEREVER DEPENDABILITY COMES FIRST:—*The men who know insist upon Automatic Electric Relays and Switches for top quality. Here are a few examples:*



CLASS "B" RELAYS—For requirements up to 26 terminals—greater sensitivity, contact pressure, compactness, versatility. And here's dependable long life even under extremely high speed operation. Hermetically sealed, where desired, to maintain highest performance standards.



CLASS "S" RELAYS—For aircraft and other applications requiring small size, light weight, and hermetic sealing, if desired. Astonishing power in small space. Unaffected by extreme vibration, temperature changes, high humidity. Supplied with coils up to 10,000 ohms or more.



TYPE 45 ROTARY SWITCH—Up to 10 or more bank levels, adaptable to 25- or 50-point operation. Speed to 70 steps a second. Simpler . . . only one field adjustment. For d-c service or completely self-contained for a-c service to suit a wide variety of control applications.

For help on your control problems, call one of our field engineers, or write for literature. Address AUTOMATIC ELECTRIC SALES CORPORATION, Chicago 7, Illinois. In Canada: Automatic Electric (Canada) Ltd., Toronto.

RELAYS SWITCHES

AUTOMATIC ELECTRIC

CHICAGO

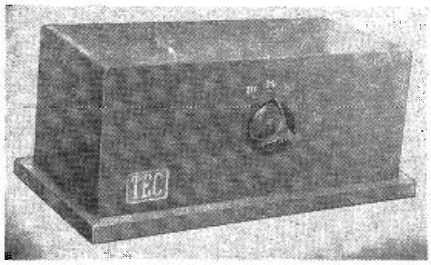
Volt-Ohmmeter

Model 303 vacuum tube volt-ohmmeter, designed for television applications, is approximately 60% smaller than other vacuum tube

volt-ohmmeters but has a large, sensitive 4½ in. meter. With a dc input resistance of 10 megohms for all ranges there is negligible circuit loading. It has 5 dc voltage ranges and 5 ac voltage ranges, 5 resistance ranges, 3 a-f voltage ranges, decibels from —20 to +63 in 5 ranges, a zero center galvanometer for FM discriminator alignment and other galvanometer applications, and an r-f voltage range with 20 v. maximum and flat frequency measurements between 20 KC and 100 MC. Accessory equipment includes a high frequency probe and a 30,000 v. high voltage probe. Dimensions are 5¼ x 7 x 3⅛ in.—**Simpson Electric Co., 5200-18 West Kinzie St., Chicago, Ill.**—TELE-TECH

TV Amplifier

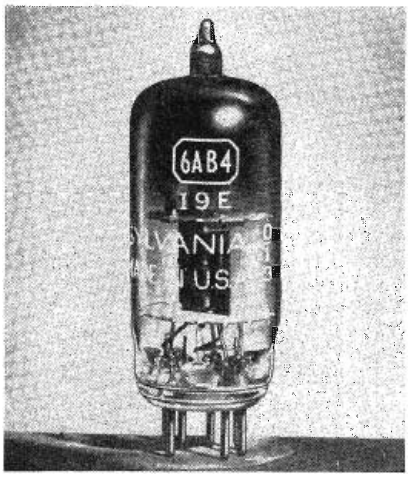
No tuning adjustments are necessary on the model S-504 Telebooster, a new television amplifier providing high gain and improved



signal-to-noise ratio. Amplification is of the order of 20 db over entire vhf TV range. It uses two 6AK5 vhf pentodes and one 12AT7 vhf duotriode.—**Television Equipment Corp., 238 William St., New York 7, N. Y.**

Miniature Triode

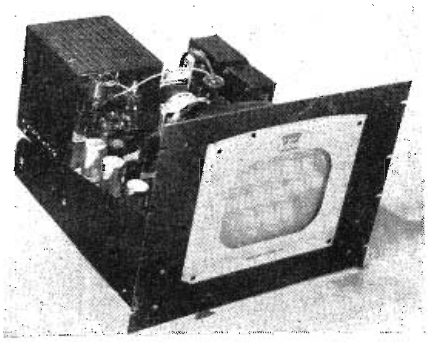
Type 6AB4 miniature triode, suitable for use as a grounded-grid r-f amplifier, frequency converter, or oscillator at frequencies



below 300 MC has a frequency range which makes it applicable for TV receiver circuits. High frequency performance is comparable to the types 6C4, 6J6 and 7F8. It is supplied with a 6.3 v. heater, 150 ma heater.—**Sylvania Electric Products, Inc., Emporium, Pa.**—TELE-TECH

TV Monitor

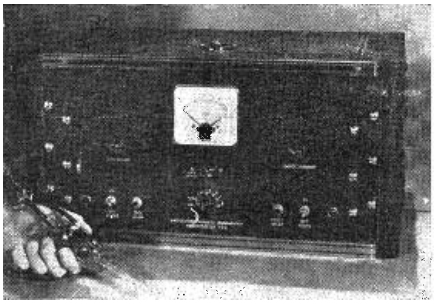
The 1T-100X "Private Eye" monitor has been developed as general purpose TV monitor working off either existing composite



video lines in studios or as a remote control viewer working off existing television receivers. Up to 15 units may be used in any single bridge circuit, and the same number of units can be operated with one cathode follower. Cathode followers are used when a regular TV receiver is used as the control circuit. Only low-level video and sound signals are required for operation and all high voltage circuits are incorporated within each unit. No high voltage cables are required between unit and master set. The only operating controls are the on-off switch and contrast control. All other adjustments are available at the rear without removal of the unit from the cabinet. Screw-driver front panel controls may be ordered.—**Television Utilities Corp., 1261 Broadway, New York 1, N. Y.**—TELE-TECH

Ionization Gauge Control

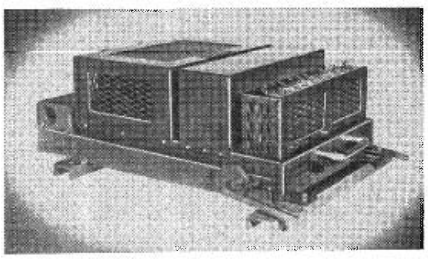
An ionization gauge control circuit, the DPA-38, has been developed which is capable of accurately measuring vacua below 10—7



mm Hg. Its lowest scale division represents 2 x 10—9 mm Hg. The DPA-38 features a direct-reading scale where the negative exponent of the number of millimeters is read on the range selector and the coefficient is read on the dial gauge. A heavy-duty, adjustable, automatic relay assures maximum life for the ionization tube. A contact automatically operates the relay to turn off the ionization tube filament and close the external circuit.—**Distillation Products Industries, Ridge Road West, Rochester 3, N. Y.**—TELE TECH

Vibrator Converters

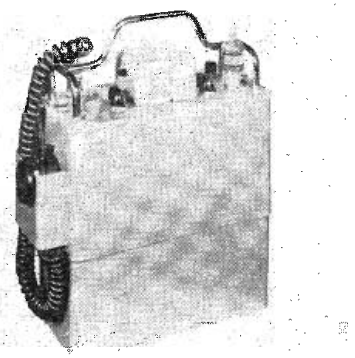
Designed specifically for railroad communications and power conversion requirements, a new line of C-D converters are available



for operation on 32, 54 and 120 v. dc. All units have an output rating of 115 v. ac, 60 cps at 375 va. Uninterrupted service is assured by a stand-by converter which is automatically put into operation at the end of the useful life of the service vibrator. Pilot changes from green to red after converter switches to stand-by vibrator. A unique circuit doubles vibrator life, and eliminates vibrator damage from overloads.—**Cornell-Dubilier Electric Corp., 2900 Columbia Ave., Indianapolis, Ind.**—TELE-TECH

2-Way FM Radio

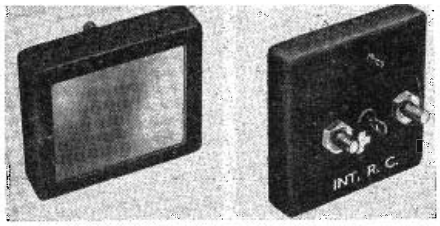
A new 2-way FM radio has been developed incorporating a 16-tube receiver and an 8-tube transmitter into a compact 19-pound



radio station, measuring 10½ x 13 x 4 5/16 in. Equipped with a tip-up loudspeaker, and a patented adjustable squelch circuit, it will broadcast directly over the operator's shoulder when carried on the back, or used as a semi-fixed installation. It is designed for the 25-50 MC band or the 152-174 MC band and is available in the following models: single frequency transmitter and receiver; 2-frequency transmitter, single receiver; and dual transmitter, single receiver. All are complete with batteries, antenna, and microphone.—**Motorola, Inc., 4545 Augusta Blvd., Chicago 51, Ill.**—TELE-TECH

Photocell

An average current sensitivity of 600 μamps at an illumination of 100 ft.-candles with a 100 ohm external circuit resistance is pro-



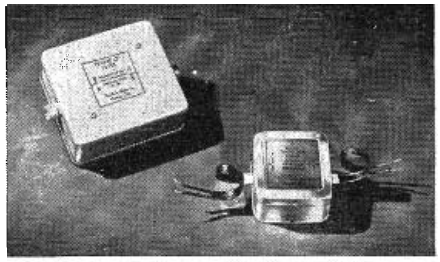
vided by a new hermetically sealed selenium photoelectric cell. An extruded brass case using a glass-to-metal seal facilitates perfect hermetic sealing. The space utilization factor of the unit is high as the case is square and measures 2 x 2 x 7/16 in. The active cell area is approximately 2.25 sq. in.—**International Rectifier Corp., 6809 South Victoria Ave., Los Angeles 43, Calif.**—TELE-TECH

Thermal Noise Test Record

A reliable and consistent source of white (wide-band thermal) noise recorded on a 10-in. 78 rpm disc is provided on the series 20 record, with transient energy evenly distributed on a velocity basis from 20 to 20,000 cps within 1 db. To facilitate rapid system transient analysis, bands of "switched noise" are recorded on one side. Switched bands rapidly alternate between white and gray noise, gray noises supplied extending to 12, 9, and 7 KC (low pass), 150, 80, and 40 (high pass).—**Cook Laboratories, 139 Gordon Blvd., Floral Park, N. Y.**—TELE-TECH

TV Interference Filters

A new line of low-pass and high-pass filters have been developed for use on amateur and experimental transmitters and TV receivers.



The high-pass filters (models TV-330-50HP for 300-ohm twin-lead and model TV-72-50HP for 72-ohm small coax) when installed in the antenna lead-in at the input to the booster or TV receiver attenuate amateur transmitter fundamentals from zero to 50 MC. Hence the i-f channel and video amplifier of the receiver are adequately protected.—**R. L. Drake Co., 11 Longworth St., Dayton 2, Ohio.**—TELE-TECH

ANNOUNCING

EIMAC TUBE TYPE 2C39A*

PLANAR CONSTRUCTION
HIGH-MU TRIODE

The new Eimac 2C39A triode is the culmination of over five years of research and application engineering. It is the outgrowth of earlier types 2C38 and 2C39.

Its high performance standards make it the standout triode for VHF and UHF CW service, pulse service and aircraft navigational systems.

As a power amplifier, oscillator, or frequency multiplier, this small high-mu triode exhibits excellent characteristics from low frequencies to above 2500 megacycles.

Let us send you complete data and application notes on the new Eimac 2C39A triode . . . then consider the advantages it offers in the design of compact, moderate power-output equipment.

**Conforms with newly issued JAN specifications.*

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode: Coated Unipotential	
Heater Voltage	6.3 volts
Heater Current	1.0 amperes
Amplification Factor (Average)	100
Direct Interelectrode Capacitances (Average)	
Grid-Plate	1.95 μμfd.
Grid-Cathode	6.50 μμfd.
Plate-Cathode	0.035 μμfd.
Transconductance (i_b = 70 ma., E_b = 600 v.) (Average)	22,000 μmhos

RADIO FREQUENCY POWER AMPLIFIER
Class-C FM Telephony or Telegraphy
(key-down conditions, 1 tube)

Maximum Ratings

D-C Plate Voltage	1000 Max. Volts
D-C Cathode Current	125 Max. Ma.
D-C Grid Voltage	—150 Max. Volts
Peak Positive R-F Grid Voltage	30 Max. Volts
Peak Negative R-F Grid Voltage	— 400 Max. Volts
Plate Dissipation	100 Max. Watts
Grid Dissipation	2 Max. Watts

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Follow the Leaders to Eimac TUBES The Power for R-F

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TELE-TECH's NEWSCAST

IRE, AIEE, and RMA Component Conference

Approximately 40 technical authorities in the radio and television field will discuss new component technics at the Conference on Improved Quality Electronic Components, May 9-11 at the Dept. of Interior Auditorium, Washington, D. C. It will be held under the joint sponsorship of the AIEE, IRE, and the RMA with the cooperation of the Dept. of Defense and the National Bureau of Standards. Following is a representative list of the papers which will be presented:

Why Not Dependable Electronics? F. R. Lack, Military Equipment Requirements, L. V. Berkner, Western Electric Co., New York, N. Y. Carnegie Institute of Washington, Washington, D. C.
The Need for Quality Performance in Laboratory Instruments P. K. McElroy, General Radio Co., Cambridge, Mass.
Hermetically-Sealed Amplifier Design and Application W. G. Wing, Sperry Gyroscope Co., Great Neck, L. I., N. Y.
Recent Developments in Potted Circuits W. G. Tuller, Melpar, Inc., Alexandria, Va.
Paper and Plastic Capacitors—Producers Viewpoint Louis Kahn, Aerovox Corp., New Bedford, Mass.
Mica and Ceramic Capacitors—Producers Viewpoint Byron B. Minnium, Erie Resistor Corp., Erie, Pa.
Electrolytic Capacitors for the Armed Forces Gordon V. Peck, P. R. Mallory and Co., Inc., Indianapolis, Ind.
R-F Inductors and Transformers—Users Viewpoint D. B. Sinclair, General Radio Co., Cambridge, Mass.
R-F Inductors and Transformers—Producers Viewpoint J. R. Mazzola, Automatic Mfg. Co., Newark, N. J.
Resistors and Potentiometers—Users Viewpoint P. S. Darnell, Bell Telephone Laboratories, Inc., Murray Hill, N. J.
Composition Resistors and Potentiometers—Producers Viewpoint Jesse Marsten, International Resistance Co., Philadelphia, Pa.
Wire Wound Resistors and Potentiometers—Producers Viewpoint G. M. Stapleton, Ward Leonard Electric Co., Mount Vernon, N. Y.
Electrical Connectors, Present and Future E. C. Quackenbush, American Phenolic Corporation, Chicago, Ill.
Indicating Instruments for Dependable Electronic Equipments John H. Miller, Western Electrical Instrument Corp., Newark 5, N. J.
Capacitors—Users Viewpoint C. E. Applegate, Leeds and Northrup Company, Philadelphia, Pa.

Tri-Dimensional Pictures Via TV

RCA has announced special filters which permit combining pictures on two TV screens and producing stereoscopic pictures. Application is intended specifically for use with the RCA Inductrial Television System. By using two cameras set at slightly different angles and viewing two kinescopes at corresponding angles the filter produces a single three-dimensional picture.

TV Gun Parts Pass Million and half Mark

The 1,500,000 mark has been passed in the production of sets of metal parts for electron guns used in television tubes by John Volkert Metal Stampings, Inc., Queens Village, N. Y. This figure represents over 35% of the total number produced for receiving sets at the present time.

INTERNATIONAL GROUP STUDIES DUMONT FACILITIES

Members of the Consultative Committee of International Radio are shown viewing equipment in the control room of the Adelphi Theatre during the group's tour of DuMont facilities in the New York City area. Left to right, Rodney D. Chipp, director of Engineering, Robert Jamieson, traffic director, and James L. Caddigan, director of programming and production for the Du Mont Television Network; Leslie Hayes, vice director of the CCIR; William H. J. McIntyre of the American Embassy in London, in charge of the American delegation; Dr. Belthzer Vanderpool, director of the CCIR, and (seated) Dr. Thomas T. Goldsmith, DuMont

Claude Neon Acquires Standard Electronics

Graybar Electric Company and Claude Neon have announced that the latter has acquired one hundred percent of the stock of the Standard Electronics Corporation which was formed recently to take over the broadcast transmitter business of Western Electric.

The president of the new subsidiary, Mr. Edwin M. Martin, said that the full facilities of the parent company would be at their disposal and that immediate deliveries of the new broadcast equipment would be made. He emphasized the importance of the tie-in with Graybar Electric, and Mr. George F. Hessler, vice president of Graybar stated that on the withdrawal of Western Electric from its broadcast field a long search had been made before they decided to obtain their new supplies of broadcasting and television equipment from the Standard Electronics Claude Neon group.

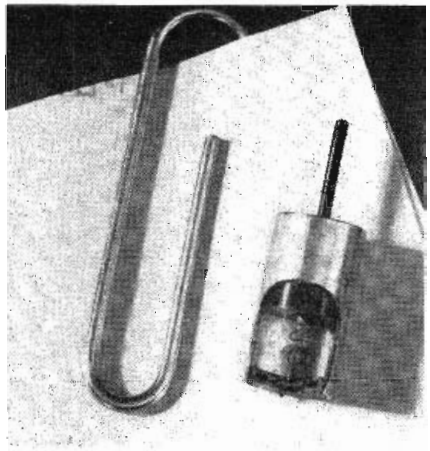
The new company will service and supply replacement parts for all Western Electric broadcast transmitters used throughout the US in addition to manufacturing new equipment; thus users will be assured of continuing first quality service for their Western Electric equipment. The president of Claude Neon, Mr. David T. Bonner, pointed out that his corporation also controls the Reeves Instrument Corporation which makes radar and computer apparatus, the Reeves Hoffman Corporation, a large producer of quartz crystals; the Hudson American Corporation which manufactures marine telephone equipment, and the American Transformer Company which not only supplies the general market, but has for years supplied transformers for all Western Electric equipment.

A. T. & T. Installs Philco Equipment

The Philco Corp. has supplied the Long Lines Dept. of the American Telephone and Telegraph Co. with television microwave repeater and terminal equipment for use in the telephone company's link between Richmond and Norfolk, Va.

The Philco microwave television relay equipment Model TLR-2A operates in the 6,000-MC band and utilizes a principle of heterodyne remodulation, which does not require converting the signal-to-video at each repeater point, thereby minimizing distortion and interference. A complete terminal or repeater equipment is enclosed in a single metal cabinet measuring 24" x 24" x 84". Power consumption of the complete unit is less than 1,000 watts at 115 volts, 60 cycles. The TLR-2A equipment was developed by the Philco Research and Engineering Laboratories and is similar to equipment supplied to Western Union for their two New York to Philadelphia circuits.

BELL'S ELECTRIC EYE



Smaller and sturdier than present photo-electric cells, this new electric eye has been developed by the Bell Telephone Laboratories research organization. Known as the phototransistor, its design stemmed from work on the recently-announced Transistor

Coming Events

May 3-5 — IRE Conference, Dayton Section, Dayton Biltmore Hotel, Dayton, Ohio.

May 12-13—Armed Forces Communications Association, Fourth Annual Meeting, Astoria, New York City, and Fort Monmouth, N. J.

May 22-25—Parts Distributors Show, Hotel Stevens, Chicago.

May 24-26—Telemetering Conference, sponsored by AIEE and National Telemetering Forum, Benjamin Franklin Hotel, Philadelphia, Pa.

June 6-8—Symposium on Theory of Electromagnetic Wave Propagation, sponsored jointly by New York University and Geophysical Research Directorate of Air Force Cambridge Research Laboratories, New York City.

June 12-16—AIEE, Summer and Pacific General Meet, Pasadena, Cal.

June 14-17 — Annual Colloquium of College Physicists, State University of Iowa, Iowa City, Pa.

June 22-24 — Acoustical Society of America, State College, Pa.

June 26-30 — American Society for Testing Materials, Chalfonte-Haddon Hall, Atlantic City, N. J.

July 1013 — National Association of Music Merchants, Annual Convention, Palmer House, Chicago.

July 24-26—Conference on Ionospheric Physics, Pennsylvania State College, State College, Pa.

August 23-26 — AIEE Pacific General Meeting, Fairmont Hotel, San Francisco, Calif.

August 28-31—Associated Police Communication Officers, Inc., National Conference, Hotel Hollenden, Cleveland, Ohio.

September 13-15 — IRE West Coast Convention and 6th Annual Pacific Electronic Exhibit, Municipal Auditorium, Long Beach, Calif.

September 25-27—National Electronics Conference, Edgewater Beach Hotel, Chicago, Ill.

October 17-21 — AIEE Midwest General Meeting, Netherland Plaza Hotel, Cincinnati, Ohio.

PERSONNEL

Roger Bowen, formerly with the U. S. Signal Corps, has been appointed chief engineer of the Cannon Electric Development Co., Los Angeles, Calif. **D. Frank Jackson,** acting chief since 1947, will continue in the engineering department as chief assistant to Mr. Bowen.

James N. Davis, formerly a senior research engineer for the physics laboratory of Sylvania Electric Products, Inc., Bayside, N. Y., has been appointed technical representative of the company at Washington, D. C.

Lynn C. Holmes is the new associate director of research of Stromberg-Carlson Co., Rochester, N. Y. and will share with director Benjamin Olney the guidance of the firm's research activities. He was senior electrical engineer since joining the firm in 1943

I. J. Melman has been named head of the advanced development division of Air King Products Co., Brooklyn 32, N. Y. He is a former RCA Laboratory technical staff member. **S. M. Decker** has been appointed assistant chief engineer of the television department.

John F. Harris has recently become chief transformer engineer of Langevin Manufacturing Corp., New York 23, N. Y. He has been engaged in transformer engineering for the past 20 years. Following graduation from Cornell, he spent several years with Bell Telephone Laboratories, after which he was associated with American Transformer Co. for 16 years.

Harry Milholland has replaced **Henry Fraser** as technical operations engineer of WABD, New York City.

The appointment of **Louis Kahn** as director of research has been announced by Aerovox Corporation, of New Bedford, Mass. Joining Aerovox in 1937, he has long been identified with the organization's research and engineering, first as electrical engineer and later as assistant chief engineer.

Allan Easton has been elevated to the post of chief engineer of the newly formed product engineering division of Tele-Tone Radio Corp. He had previously been assistant chief television engineer.

Alfred Zuckerman has been elected a vice president of David Bogen Co., Inc. of 663 Broadway, New York City. He continues as chief engineer in charge of all design and development for the company.

"Kettle Drum" Loudspeakers

As a means of improving transient audio response and eliminating undesirable cavity resonances, R. T. Bozak of 90 Montrose Ave., Buffalo 14, N. Y. has introduced a unique new "kettle drum" loudspeaker. This unit comprises a 12 in. woofer in conjunction with dual 2½ in. direct radiator type tweeters mounted in a hemispherical acoustically treated 32 in. baffle. The unusual baffle design was chosen because it is said to be free from standing waves. By designing the woofer cone to be free-moving and to have low mass a larger displacement for bass frequencies and a consequent improvement in transient response is obtained. The tweeters use combination metal and paper diaphragms and are arranged to cover a 120° field. Direct radiation is employed in order to eliminate phase distortion due to propagation variation encountered when sound waves pass through the constriction of a horn. The unit provides a fairly uniform frequency response from 40-13000 cps with a useful response to 16000. Crossover frequency is 2000 cps; input audio power 12 watts, peaks to 18 watts; input impedance 6-8 ohms.

New Audio Circuitry

Audio engineers attending the various exhibitions and conferences in recent months have expressed considerable interest in the unusual performance features of McIntosh amplifiers which come largely as the result of special output transformer design. The news that an eastern quality audio transformer manufacturer has been able to achieve similar results by using his standard units in special circuit arrangements should be of interest to all. Announcements are expected in about four months when all measurements have been checked and double checked.

Recording with Magnetic Tape

Continuing with the interesting data (April Tele-Tech p. 63) obtained from a recent direct mail survey, here, in order, are the six primary difficulties audio technicians encounter in working with magnetic tapes. a. Gumming of recording head surface. b. Variation in surface noise between tapes. c. Abrasion of head assemblies. d. Variation in erasibility. e. Deterioration of plastic base with age. f. Unexpected breaks in the emulsion.

FLIGHT TESTING

(*Continued from page 24*)

proven in the following manner. On one course, preferably one with zero error, a check point is chosen, exactly "on course" at approximately 12 to 15 miles from the station. The airplane is then flown over this check point in eight directions 45° apart, noting the exact receiver indication each time the check point is crossed. This is a measurement of "heading effect", and on most stations the error is less than 1°. Another type of check consists of flying exactly "on course" and banking the airplane to 40° or 50° right and left. Any deviation of the crosspointer is an indication of vertical polarization. The antenna array produces a horizontally polarized pattern and any vertical component caused by radiation from pedestals, r-f transmission lines or unbonded tower members can produce an erratic course indication; any evidence of this effect must be eliminated before station acceptance.

Concurrent with one of the course checks, the voice feature is checked exactly "on course" to determine the correct setting of the voice modulation levels. The station is also operated for a short period on standby power, supplied by the engine generator. This is done to insure no serious course disturbance occasioned by the use of this power source, the main factor being the frequency stability of the engine generator. A difference in frequency of one cycle can cause a course shift of approximately 1° as compared to the course alignment while on commercial power. So far, no mention has been made of the part the horizon profile plot plays in the flight check. In the analysis of the course recordings, the line-of-sight cutoff point can be determined and the course accuracy and characteristics in the shadow area compared with the same information obtained in line-of-sight.

At present, only the courses associated with the airways are checked due to the impracticability of flying all 360 courses individually. There is a flight check procedure under development which will prove all the courses to their usable distance with a minimum of 14-16 hours of flying per station. Space does not permit other than a very brief discussion of this procedure: It consists of flights around the station with the aircraft holding a constant radius of 20, 30, 40 and 50 miles. On each radius flight, simultaneous course and receiver AVC recordings are taken. Identified ground check points are marked on the recordings at the exact "overhead" on each point. Upon the return to the operating base, the recordings are mounted on a calculating device to obtain azimuth information in even increments based upon information from the check point data. The course deviation information can then be easily worked out and transposed to an error plot similar to the one used for the theodolite check data.

Ion Trap

(*Continued from page 36*)

to appear and finally the grid bias is reduced to the cutoff value. The dots will now carry the desired beam current.

The indicator feature described can also be used, of course, in ion trap guns which are of different construction from that illustrated on Fig. 1. For example, it will facili-

Toroidal Transformers

Horatio W. Lamson's article on toroidal transformers is continued on page 63.

tate correct alignment of the ion trap magnet in cases where the second, positioning or centering magnet is omitted but the entire gun is tilted with respect to the tube axis to make sure that the undeflected beam strikes the center of the fluorescent screen.

[1] E. Eugene Ecklund, Service Engineering for Television Proc. I. R. E. Vol. 38, pp. 4-5, Jan. 1950

[2] G. H. Metson, Reversibility of Oxygen Poisoning in Oxide Cathode Valves, **Nature**, vol. 164, pp. 540-541, Sept. 1949

[3] This circuit was developed by Dr. H. O. Marcy III, to whom I am thankful for reproduction privileges.
Trigger pulses at 1/15 the line frequency are supplied to a multivibrator gate generator which keys an r-f oscillator for the duration of one line, each 15th line on the raster. This provides adequate vertical separation between dots to permit close examination. The horizontal separation is determined by the oscillator frequency. The r-f sine wave is converted to a square wave in the following regenerative amplifier stage. This in turn triggers a blocking oscillator; the pips, essentially triangular in shape and of 0.1 micro-second duration, are taken from the cathode resistance of this oscillator.

VOR Signal Generator

(*Continued from page* 39)

phase localizer signals for Left, Center or Right deflection of the cross pointer (CP) indicator in the aircraft. Depth of modulation is such that the CP indicator pointer should deflect approximately to the extremes of the colored sectors.

For phase localizer testing the following modulation percentages and phase angles produce the indications shown:

Indication	% Reference Mod.	% Variable Mod.	Phase Angle
Left	30	7½	0
Center	30	0	—
Right	30	7½	180

Voice modulation may be introduced by means of a standard Air Force or Navy single button microphone plugged into the MIC jack. Voice modulation is superimposed on other modulation regardless of the setting of the function switch. Equipment of this type which can check the operation of one or a squadron of aircraft is very valuable in both military and commercial operations. In the case of the former, a brief test transmission from the one volt output stage of the generator could serve to prove the airworthiness of each aircraft's navigation equipment without radiating far enough to cause interference to other ranges. Normally, of course, the test channels would not be the same as those of the local facilities. For airline use it makes possible regular preflight tests which build pilot confidence in the proper functioning of equipment as well as providing a check on its condition.

The author observed the performance of this equipment from both a Navion and a Beechcraft at the manufacturer's airfield at Boonton. Over a distance of about three quarters of a mile on a simulated control tower test transmission the aircraft instruments responded accurately according to the generator signals. In a pre-flight VHF navigation instrument check 100% accuracy was proved in a very short time.

Sinclair Chief Engineer of General Radio

Dr. Donald B. Sinclair has been appointed chief engineer of the General Radio Co., succeeding Melville Eastham who retired from that post on February 15

Dr. Sinclair was born in Winnipeg, Manitoba, and was educated at the University of Manitoba and the Massachusetts Institute of Technology, receiving the degree of doctor of science from M.I.T. in 1935. He was a research assistant and later research associate at M.I.T. from 1932 to 1935, and he joined the General Radio engineering staff in 1936.

Air King Expands Production Capacity

D. H. Cogan, president of Air King Products Co., Inc., Brooklyn, New York manufacturers of radios, wire recorders and television receivers announced the acquisition of 40,000 additional sq. ft. of space in the Kenyon Building, 57th Street & 1st Avenue, Brooklyn, N. Y.

NOISE GENERATOR

(*Continued from page 29*)

N_t = total noise power output of the receiver

N_r = that portion of the noise power output due to the internal noise sources of the receiver

N_a = That portion of the noise power output due to the antenna resistance. N_a is a function of the impedance match at the antenna terminals, which determines how much of the antenna noise power is actually delivered to the receiver.

In this and the following definitions of noise factor it is required that the circuits be linear or that any circuit non-linearity be fully considered when the noise factor is determined. In a receiver the second detector is generally non-linear and the techniques for linearizing this circuit or making corrections for its non-linearity are discussed later.

Also throughout this discussion the temperature of the antenna radiation resistance is taken as room temperature 290°K, and in the measurement the antenna is replaced by an equivalent resistance at room temperature. Noise factors thus obtained are called "laboratory" noise factor (which may differ slightly from the "operating" noise factor for an effective temperature different from the standard temperature).

The noise factor can be similarly defined by referring all the noise in the receiver to the antenna terminals. In Fig. 2a the equivalent circuit of an ideal (noiseless) receiver is shown, and i_a^2 is the mean squared noise current, R_a is the antenna resistance. Fig. 2b shows a practical receiver in which the receiver noise referred to the antenna is represented by the constant current noise generator i_r^2 [$i_r^2 = (F-1)i_a^2$]. In Fig. 2c these two generators are combined into Fi_a^2.

The noise factor is also a measure of the degradation of the signal-to-noise ratio as the signal passes through the receiver, and may be expressed as follows:

$$F = (S_a/N_a)/(S_o/N_o) \qquad (4)$$

where (S_a/N_a) is the signal-to-noise ratio (power) at the amplifier input terminals, when the amplifier input resistance is assumed noiseless, so that N_a is that due solely to the generator resistance. (S_o/N_o) is the signal-to-noise ratio (power) existing at the output terminals of the amplifier.[5]

The noise factors give an accurate quantitative comparison of the performance of different receivers.

Measurement of Noise Factor

The use of a diode noise source makes the measurement of noise factor a comparatively simple operation. Other techniques for noise factor measurement which involve the use of an accurately calibrated signal generator[4,6] or a high temperature resistance noise source are much more complicated and will not be discussed here.

The Noise Diode

The internal noise sources of a receiver are essentially the "shot noise" of the vacuum tubes, the "thermal agitation" of the resistive components in the receiver circuits and at higher frequencies the induced grid noise. If the signal used to measure the receiver noise has the same characteristics as the above noises, then it would appear that the measuring technique may be made quite simple. This is the principle of the noise diode in which diode the normal electron current flow is accompanied by random fluctuations (or "shot noise") which are applied to the receiver under test.

When the current flow of the diode is temperature-limited the

(*Continued from page 58*)

"shot noise" may be accurately calculated from the direct current flowing through the diode. In temperature - limited operation the anode voltage is sufficiently high to draw all the electrons emitted from the filament (no space charge can accumulate) and thus the diode current is essentially determined by the filament temperature. Under these conditions the noise output of the diode is governed by the following relationship:[7]

$$\overline{i^2} = 2eI\Delta f = 3.2 \times 10^{-19} I\Delta f \qquad (5)$$

where, i^2 = the mean square noise current generated by the diode; I = the direct current flowing through the diode; Δf = the bandwidth; e = the electronic charge (1.6×10^{-19} coulombs).

The noise bandwidth, Δf, referred to in this article is obtained by integrating the power output versus frequency characteristic and dividing by the power output at the carrier or reference frequency. The difference between this bandwidth and the commonly used 3 db bandwidth depends on the shape of the frequency characteristic and the location of the reference frequency within this characteristic.

The principle of the noise diode measurement is illustrated in Fig. 3. The noise diode can be practically represented as an infinite impedance, constant-current generator, since the dynamic impedance of a tungsten filament diode is high compared to the antenna impedances commonly encountered. The resistance, R_a, is theoretically equal to the antenna resistance; however, in the practical application it is generally made equal to the impedance of the transmission line, which will be used with the receiver.

Basically the measurement is as follows. The noise diode is turned off and the noise output of the receiver alone is indicated on the output meter. The noise diode filament voltage is applied and increased until the meter reading indicates twice the noise power (1.4 times the noise voltage). The noise factor is then given by the formula:[8]

$$F = 20IR_a \qquad (6a)$$

or in db, $F_{db} = 10 \log 20IR_a \qquad (6b)$

where I is the direct current flowing through the diode. In actual practice the noise factor from Eq. 6b can be printed directly on the d-c meter scale.

If the noise factor of the receiver is particularly high and the noise diode cannot double the noise power output, then F may be determined by: $F = 20IR_a/(M-1) \qquad (6c)$

where M is the actual increase in noise power output. Since neither bandwidth nor frequency appear in Eq. 6, the bandwidth of the receiver need not be known and that of the output meter circuit is not an important factor. This accounts for the simplicity of the noise diode technique as compared with signal generator methods.

At the higher frequencies the inherent tube and circuit capacitances of the noise diode are resonated by the inductance L, Fig. 4. For measuring balanced input circuits the arrangement of Fig. 5 has been used.

Noise generators using both these basic circuits have been constructed using circuits Figs. 6 and 7. The unbalanced circuit is simpler; however, when it is adapted (as shown later) for measuring balanced circuits some of the accuracy of measurement may be forfeited. Both types of generators are equally accurate for making measurements on unbalanced input circuits. Photographs of the balanced noise generator will be shown in Figs. 12, 13 (Part Two) and 14, and of the unbalanced generator in Figs. 21 and 22 (Part Three).

1. Standards on Radio Receivers, Methods of Testing Broadcast Receivers, Institute of Radio Engineers 1938, 1948.
2. Ibid.
3. J. B. Johnson, "Thermal Agitation of Electricity in Conductors", **Physical Review.** Vol. 32, pp 97-110, July, 1928
4. D. O. North, "Absolute Sensitivity of Receivers", **RCA Review.** Vol. 6, p. 322, Jan., 1942
5. This definition, though equivalent, differs from the similar notation using "available signal" and "available noise" powers as given by H. T. Friis, "Noise Figures of Radio Receivers", **Proceedings of IRE.** Vol. 32, July, 1944
6. E. W. Herold, "The Signal to Noise of Radio Receivers", **Proceedings of IRE.** Sept., 1943
7. W. Skoltky, "Spontaneous Fluctations in Various Conductors", AnnPhysik, Vol. 57, p. 541, Dec. 20, 1918
8. Derivation of Eq. 6 in Appendix I

Part Two of this article will appear in the June issue.

Color TV

(*Continued from page* 21)

A block diagram of the single-gun tri-color kinescope circuit is shown in Fig. 3. A video signal from the output of the video amplifier of a conventional black-and-white receiver is applied to the control grid of the single-gun kinescope. Here, as in the previous receiver, a 3.58 MC sampling signal is produced. Circular deflection of the beam, which produces sampling automatically, is provided by a small deflection yoke having two sets of coil which are fed with quadrature currents at sampling frequency 3.58 MC to produce a rotating field.

(*Continued from preceding page*)

Adjustment of color phasing is provided by mechanical positioning of this yoke. The amplitude of the circular deflection is adjusted to produce the proper convergence angle as required by the mask and phosphor-dot screen. Duration of the sampling period is controlled by a signal having a frequency three times the sampling frequency, which is injected into the kinescope cathode circuit. The amplitude and phase of this 10.74 MC signal are determined by the alignment of a filter circuit which utilizes the third harmonic of the circular-deflection driver tube.

Because a single gun is used in this kinescope, color balance is achieved by proper deposition of the phosphor dots. The deflection circuitry and deflection yoke are the same as those employed in the three-gun receiver.

The research-type receiver employing the single-gun tri-color kinescope utilizes 37 tubes and consists essentially of a 27 tube black-and-white receiver to which have been added 10 tubes for color synchronization, beam rotation, and additional power supplies.

The kinescope gun employed is the same as that used in the commercial type 5TP4 kinescope. Potentials of 18 kilovolts for the final anode and 2.7 kv for the electrostatic focus electrode are derived from the kick-back voltage on the horizontal-deflection output transformer.

Convergence of the circularly deflected beam is produced by a magnetic lens in the single-gun kinescope instead of the electrostatic method employed in the three-gun version. A coil similar to the focus coil normally employed in conventional black-and-white receivers is used for this purpose. The dynamic convergence variation is likewise applied magnetically in this tube and is introduced by means of a smaller auxiliary coil located near the main convergence coil. As in the previous receiver, the dynamic convergence waveforms are derived from the deflection circuits.

Transmission Over Coaxial Cable

Switching was carried out which was equivalent to sending the color picture either through the 2.7 MC cut-off coax cable or transmitting it over the usual radio channel with a 4 MC video cut-off. The sampling frequency previously used by RCA was 3.58 MC and this of course was too high to be transmitted over say, the New York-

Washington cable. The result was that the color TV picture would emerge at the distant point in white-black.

The engineers had built sampling equipment which had a sampling frequency of 2.4 MC and which operated in tandem with the regular 3.58 MC sampler. The theoretical result, as far as the received picture was concerned, was that out of three consecutive samples, two were correct and one approximate. The lower sampling rate reduced the picture definition but did not alter the phase or correctness of the colors. In fact when the picture was viewed from more than 15 times the picture height it looked about as good when the definition was dropped by the cable cut-off as when transmitted in the wider 4 MC band. The expected drop in resolution however was very apparent when viewing a resolution chart at a distance of 4 times picture height.

According to A. T. and T. the matter of the 2.7 MC cut-off of their coaxial cables is a temporary situation, and one which may not be of much importance because better facilities will be available, when color broadcasting becomes widespread. However this demonstration before the FCC that the RCA color system now can be sent over the present coaxial networks with acceptable results removes one of the last arguments against the RCA system.

Toroidal Transformer

(*Continued from page* 34)

In a *power* transformer, for example, one which is used to energize a rectifier system, we are not concerned how much its coefficient of coupling may exceed, say, 99%. We are, however, frequently worried about the 60-cycle flux which such a shell-type transformer broadcasts into nearby sensitive audio circuits, thereby introducing a troublesome hum voltage which no amount of rectifier filtering can reduce. The obvious answer is, keep all the flux at home within the core. By its very geometry, a uniformly wound toroidal core is an effective flux prison in contrast to the partially open back and front doors existing at the extremities of the central leg of a shell core.

Comparing a shell transformer with a toroidal Variac, each having a 2-kva rating, and operating with a core induction of about 12 kilogausses, the field intensity was found to be 25.7 millioersteds at a distance of 18 inches from the "open

TOROIDAL TRANSFORMER

(*Continued from preceding page*)

door" of a shell transformer and to have a maximum value of 1.35 millioersteds at the same distance from the Variac, a ratio of 19 to 1. It should be noted that the Variac was by no means a completely wound toroid since it had an annular gap of 40° in its winding for mechanical reasons.

Leakage Inductance Comparison

The extent of the "flat" characteristic of a transformer into the high-frequency range is limited by the leakage inductance between its primary and secondary windings, which is a function of the coefficient of coupling, τ, existing between them. Rather special procedures and refined technics of measurement are required if we are to obtain a truly significant value of the coefficient of coupling existing between such tightly coupled windings. The problem is quite different from the measurement of τ in air core radio-frequency transformers.

First of all, the measurements must be made at a low frequency so that small capacitances shall not transmit any significant energy from the primary into the secondary system. In the second place, the variation of core permeability must be obliterated from the data by obtaining the actual *initial* values of inductance, that is, the inductance when the excitation level is zero, a value which obviously must be obtained by extrapolation. Fortunately, in the range of small values of magnetizing force, of the order of a few millioersteds, which we may designate as the *Rayleigh range*, permeability (and consequently inductance) are closely a linear function of the applied magnetizing force H. Hence, a few measurements at low known values of H, or some parameter which is proportional to H, permit the true initial inductance to be obtained from a simple linear plot.

By precise measurements on an Owen bridge energized at 100 cycles, for the toroidal and shell core transformers previously described, the initial values of the primary inductance L_p, the secondary inductance L_s, and the primary inductance L_{po} when the secondary was short-circuited were obtained. The latter value was *not* the leakage inductance, as is commonly supposed.

Fig. 5 represents a transformer carrying a resistive load, R_L. The series resistance R_p accounts for both the copper loss in the primary winding and all of the core losses, while the resistance R_s corresponds to the copper losses in the secondary winding. It can then be shown that the impedance Z looking into the primary winding is given by:

$$Z = R_p + \frac{\omega^2 L_p L_s R_s t^2}{Z_2^2} + j\omega L_p \left(1 - \frac{\omega^2 L_s^2 t^2}{Z_2^2}\right) \quad \ldots (1)$$

Wherein:

$$Z_2^2 = (R_s + R_l)^2 + \omega^2 L_s^2 \quad \ldots (2)$$

When the secondary is floating so that R_L and Z_2 are both infinite, the reactive component of (1) yields directly the measured primary inductance L_p.

When the secondary is short-circuited so that R_L is zero, the reactive component of (1) yields the measured inductance:

$$L_{po} = L_p \left(1 - \frac{\omega^2 L_s^2 t^2}{R_s^2 + \omega^2 L_s^2}\right)$$

$$= L_p \left(1 - \frac{t^2}{1 + D_s^2}\right) \quad \ldots (3)$$

The third member of (3) involves the dissipation factor of the secondary winding:

$$D_s = R_s/\omega L_s \quad \ldots (4)$$

In evaluating (4) at low frequencies, R_s may be taken as the dc resistance of the secondary winding. Solving (3) for τ^2 we have:

$$\tau^2 = \left(1 - \frac{L_{po}}{L_p}\right)\left(1 - D_s^2\right) \quad \text{..... (5)}$$

whence the *true* leakage inductance is given by:

$$L_l = (1 - \tau^2)\, L_p$$
$$= L_{po} - D_s^2 L_p + D_s^2 L_{po} \quad \text{..... (6)}$$

The *last* term in the right member of (6) may usually be considered negligible.

The data obtained were:

	Toroidal Core	Shell Core
L_p	5.683 h	2.2321 h
L_{po}	394 μh	6890 μh
D_s	5.7×10^{-6}	155×10^{-6}
L_l	359 μh	6540 μh
$1 - \tau^2$	63.7×10^{-6}	2930×10^{-6}
τ	0.999968	0.998533

The discrepancy between the true leakage inductance L_l and the erroneous value L_{po} (which neglects the term D_s^2) is apparent. It will be seen that the shell core transformer had 18.2 times the leakage inductance of the toroidal unit.

What this does to their frequency characteristics, when working between a one volt, 600-ohm generator and a 600-ohm load, is immediately evident in Fig. 6. The shell transformer showed a one decibel drop at 19 cps and at 20.3 KC or over a frequency span ratio of 1.07 times ten to the *third* power, while the toroidal unit dropped one decibel at 16 cps and at 193 KC corresponding to a frequency span ratio of 1.21 times ten to the *fourth* power.

Perchance comparative data of this sort will indicate the advantages of the toroidal form of core when *immunity to external fields* and/or an *ultra-wide-range frequency characteristic* is desired.

Duplex Transformer

From the foregoing, it follows that tapped or partial windings on a toroidal core will not be immune to external fields. However, it is quite feasible to have the primary and secondary each consist of two identical, semicircumferential windings which are used *not* individually, but always either in series or in parallel combinations, so that each winding physically circumscribes essentially the entire core in a uniform manner. I have proposed calling such an arrangement a "duplex" transformer. If we go a step further and make the total secondary turns of a duplex n times the total primary turns, we have a useful impedance-matching transformer which, by making proper connections to its eight terminals, gives us our choice of three generator - to - load impedance - matching ratios in either direction, namely: 1/1, n^2/1 and n^4/1. With either the n^4/1 or 1/1 ratios there is only one choice of connections. With the intermediate ratio n^2/1 there are two alternative choices, one favoring low and the other the high end of the frequency range.

Could you find an application for such a transformer? You must expect, however, that when this transformer is used with a large step-up ratio, the frequency span ratio, defined by a one decibel drop, will be shortened somewhat. For example: a duplex transformer for which n equaled 2 yielded a span ratio of 1.21×10^4 when operating from 600 ohms into 600 ohms and had its span ratio reduced to 0.33×10^4 when operating from 600 ohms into 9600 ohms, where the impedance ratio was $1/n^4$. When operating *step-down*, this transformer retained its high span ratio.

With the primaries connected in series the duplex toroidal transformer becomes an ideal push-pull output transformer. If the secondaries are then joined in parallel a desirable tight coupling between the two halves of the primary winding will be obtained. It may likewise serve as a well-balanced input or interstage transformer in push-pull systems.

BULLETINS

Silicone Compound

A new 16-page booklet published by Dow Corning Corp. Midland, Mich., describes and illustrates some of the many aircraft and electronic applications for DC 4 Silicone Compound. Its general usefulness as a waterproofing and lubricating dielectric is indicated by the unique combination of physical and dielectric properties reported in the text and in graphs. One graph shows the relative frequency range. Another shows volume resistivity values in the order of 1012 to 1014 ohm-centimeters at temperatures ranging from 50° to 230° C.

UHF Measuring Equipment

General Radio Co., Cambridge 39, Mass., has released a new bulletin covering the General line of UHF measuring equipment. These units have been designed for research and development laboratories, consulting engineers, antenna measurements, and for measurements of oscillators, amplifiers and components.

Hydraulic Bender

The Di-Acro Hydra-Power bender, a product of the O'Neil-Irwin Manufacturing Co., is described in a new bulletin published by the company. This simple, hydraulic power unit will perform not only one or two specialized operations, but many of the bending jobs which arise in chassis fabrication.

Centering Reel

The F. J. Littell Machine Co. 4197 N. Ravenswood Ave., Chicago 13, Ill., has just printed a 2-color, 4-page circular describing their Standard Automatic Centering Reels for coiled metal stamping stock. The reels illustrated and described in this circular are for holding coils of from 300 to 6,000 lbs.

Remote Control Amplifier

A bulletin describing the 12A3 10-watt remote control amplifier has been published by Brook Electronics, Inc., 34 DeHart Place Elizabeth 2, N. J. Its audio characteristics make it suitable for laboratory or commercial applications where exacting engineering standards prevail.

Capacitors and Coils

The Electrical Reactance Corp., Franklinville, N. Y., manufacturers of HI-Q capacitors, resistors and choke coils, has announced that its new "Datalog" is ready for distribution to producers of television and radio equipment. In addition to complete HI-Q product information, it contains a great deal of helpful technical data carefully arranged for convenient quick reference.

Micarta Data Book

Copies of the recently-revised 36-page Micarta Data Book are available from the Westinghouse Electric Corp. Published as a working tool for the designer and user of industrial materials, the booklet (B-3184-D) presents clearly and completely the technical facts about Micarta. Write Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa.

Electrical Contacts

A new 36-page illustrated booklet containing information on electrical contacts of value to design engineers has been published by Fansteel Metallurgical Corp., North Chicago, Ill. In addition to six pages of fundamental notes for contact design, the booklet contains a thorough discussion of electrical contact materials, their properties, advantages and principal uses.

Microphones

Bulletin 949, describing the Turner line of microphones, is now available from The Turner Co., Cedar Rapids, Iowa. The Turner Co. manufactures a complete line of microphones and accessories for a large number of requirements and operating conditions.

Power Supplies

Furst Electronics, 12 South Jefferson St., Chicago 6, Ill., has released a brochure on its line of regulated power supplies. Operating characteristics of ten models are included.

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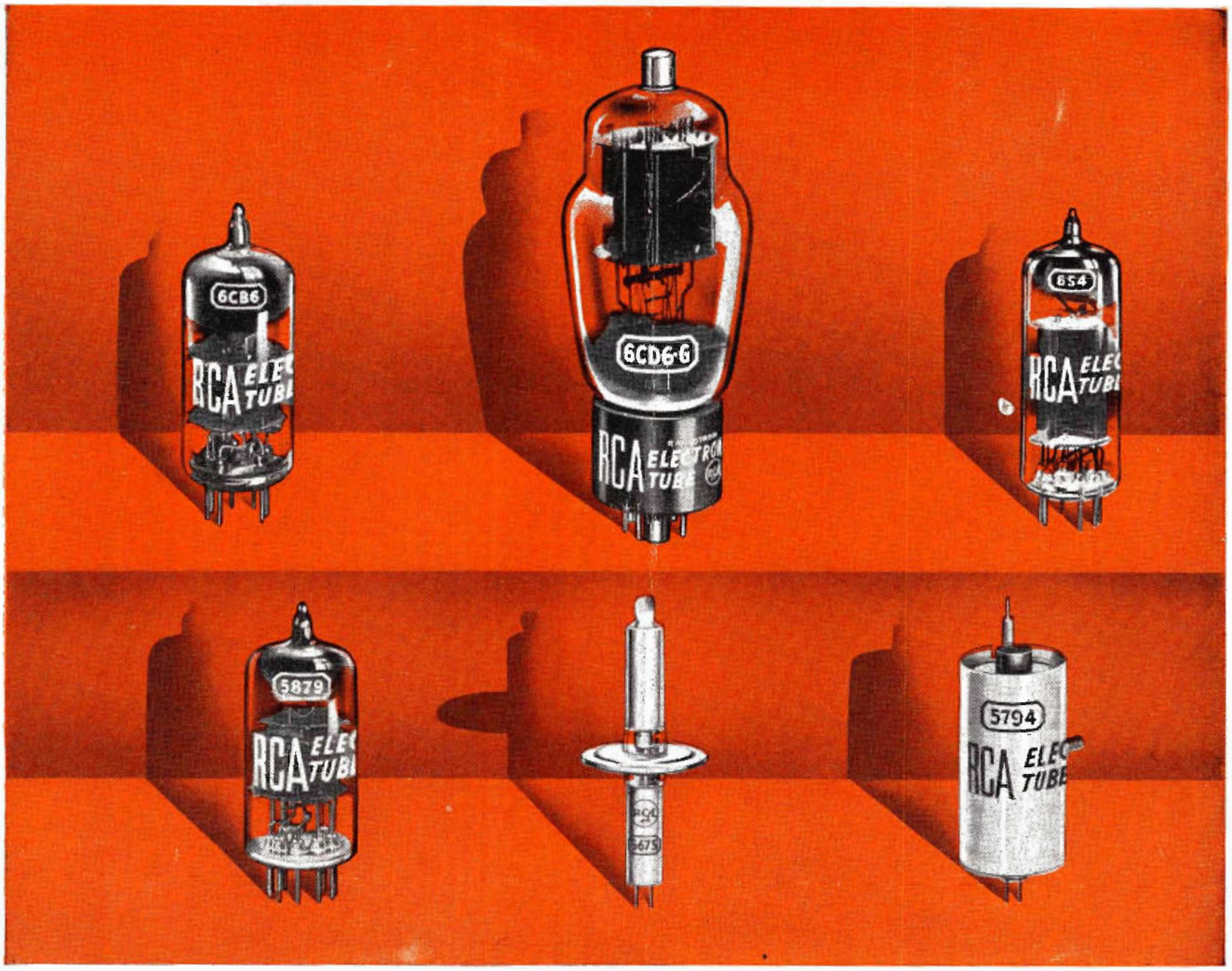

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RCA-6CD6-G Horizontal-Deflection Amplifier. For 16GP4 systems, and for other similar wide angle systems, it makes possible the design of efficient horizontal-deflection circuits in which the plate voltage for the tube is supplied in part by the circuit and in part by the power supply.

RCA-654 Vertical-Deflection Amplifier. A high-perveance miniature triode of the heater-cathode type. In suitable circuits it will deflect fully a 16GP4 or similar kinescopes having a deflection angle of 70 degrees and employing an anode voltage up to 14,000 volts.

RCA-5879 Sharp-Cutoff Pentode. Of the 9-pin miniature type, the 5879 is designed for a-f applications where reduced microphonics, noise, and hum are essential. It is especially useful in the input stages of medium-gain amplifiers.

RCA-5675 "Pencil-Type" Triode for UHF. Employs double-ended coaxial-electrode structure, for use in grounded-grid circuits. As a local oscillator, it will deliver 475 milliwatts at 1700 Mc. and about 50 milliwatts at 3000 Mc.

RCA-5794 Fixed-Tuned Oscillator Triode. Designed for Radiosonde Service, the 5794 employs two resonators integral with the tube. The output resonator is tuned to 1680 Mc. by means of an adjusting screw. The useful power output is in the order of 500 milliwatts.

For data on any of the tubes described above, write RCA, Commercial Engineering, Section E57R, Harrison, N. J.

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