HUGO GERNSBACK, *Editor*

RADIO CRAFT

ATOMIC PIONEER
SEE PAGE 22

In this issue—

Color Television Systems

"Alarm" for Intermittents

Smallest Radio Equipment

JUN
1947

25¢
CANADA 30¢

RADIO-ELECTRONICS IN ALL ITS PHASES

SYLVANIA NEWS
RADIO SERVICE EDITION

JUNE *Prepared by* SYLVANIA ELECTRIC PRODUCTS INC., Emporium, Pa. 1947

RADIO SERVICEMEN! SYLVANIA'S COLORFUL NEW CLOCK BIG AID IN SERVICE SALES

Specially Designed Famous-Make Clock Identifies Quality Stores Stocking Sylvania Tubes

- Bright white face... black numerals!
- Minute and hour hands in black... unique second hand in attractive red!
- The words "RADIO SERVICE" in green and black. The word "SYLVANIA" in identifying green!

- Fifteen-inch diameter!
- Radio tube in silver and black... design of carton in familiar green and black!
- Telechron movement sealed in oil; case in brown crinkle finish with silver-colored rim around face! Nominally priced at only $7.50!

Once you place this big, colorful Telechron electric clock—with its "Radio Service" face—in *your* window, you'll have an attractive sales aid that identifies your business . . . every second of the day . . . as carrying the finest line of tubes made.

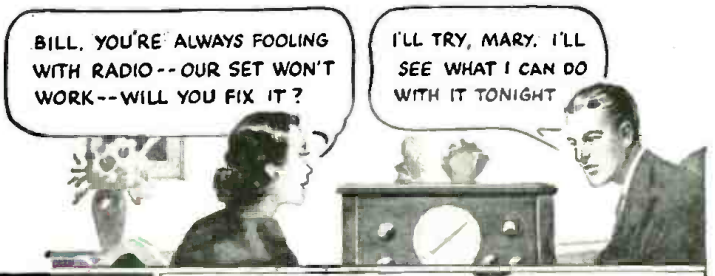
Through far-reaching advertising campaigns, your customers are being advised of the advantages of placing Sylvania "quality-controlled" radio tubes in their equipment. By displaying this on-the-spot sales help you're telling them you sell these highest quality tubes. Get this wonderful sales aid now!

ORDER FROM YOUR SYLVANIA DISTRIBUTOR or write SYLVANIA ELECTRIC PRODUCTS INC., Emporium, Pa.

SYLVANIA ELECTRIC

MAKERS OF RADIO TUBES: CATHODE RAY TUBES; ELECTRONIC DEVICES; FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES; ELECTRIC LIGHT BULBS

A FREE LESSON SHOWED BILL HOW HE COULD MAKE GOOD PAY IN RADIO!



I will send you a Lesson on Radio Servicing Tips FREE

TO SHOW HOW PRACTICAL IT IS TO TRAIN AT HOME FOR

GOOD JOBS IN RADIO

I want to give you a copy of my Lesson, "Getting Acquainted with Receiver Servicing"—absolutely FREE! And with it, I'll send my 64-page illustrated book, "How to be a Success in Radio," also FREE. It describes many fascinating Radio jobs, tells how N.R.I. trains you at home in spare time, how you get practical experience with BIG KITS OF RADIO PARTS I send. MAIL THE COUPON!

Future for Trained Men Is Bright In Radio, Television, Electronics

It's probably easier to get started in Radio now than ever before, because the Radio Repair Business is booming. Trained Radio Technicians also find profitable opportunities in Broadcasting, Radio Manufacturing, Public Address work. Think of even greater opportunities as Television, FM, and many new, war-developed Electronic devices become available. Get the facts on all these opportunities. Send for FREE books now!

Many Beginners Soon Make Extra Money In Spare Time While Learning

The day you enroll I start sending EXTRA MONEY JOB SHEETS. You LEARN Radio Principles from my easy-to-understand, illustrated lessons—PRACTICE what you learn by building, testing and experimenting with parts I send—USE your knowledge to make EXTRA money fixing neighbors' Radios in spare time while still learning! From here it's a short step to your own full-time Radio Shop or a good Radio job!

VETERANS

You can get this training in your own home under G. I. Bill. Mail coupon for full details.

Find Out What NRI Can Do For You

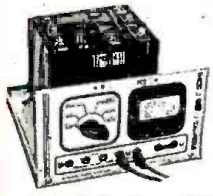
Mail Coupon for Sample Lesson and my FREE 64-page book. It's packed with facts about Radio's opportunities for you. Read the details about my Course. Read letters from men I trained, telling what they are doing, earning. See how quickly, easily you can get started. No obligation! Just MAIL COUPON NOW in an envelope or paste it on a penny postal. J. E. SMITH, President, Dept. 7FX. National Radio Institute, *Pioneer Home Study Radio School*, Washington 9, D. C.

OUR 33RD YEAR OF TRAINING MEN FOR SUCCESS IN RADIO

My Radio Course Includes Training in TELEVISION • ELECTRONICS • FREQUENCY MODULATION

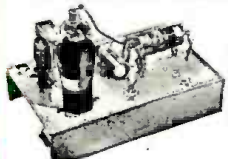
You Build These and Other Radio Circuits with BIG KITS OF PARTS I SEND YOU!

By the time you've conducted 60 sets of Experiments with Radio Parts I supply, made hundreds of measurements and adjustments, you'll have valuable PRACTICAL Radio experience for a good full or part-time Radio job!

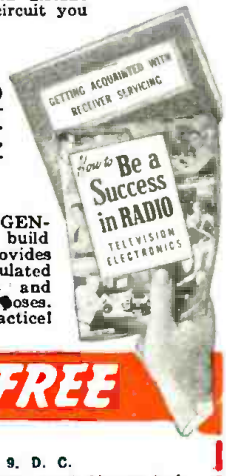


SUPERHETERODYNE CIRCUIT (right) Preselector, oscillator-mixer-first detector, i.f. stage, diode detector—a.v.c. stage, audio stage. Bring in local and distant stations on this circuit you build yourself!

MEASURING INSTRUMENT (above) you build early in Course. Use it in practical Radio work to make EXTRA money. Vacuum tube multimeter, measures A.C., D.C., and R.F. volts, D.C. currents, resistance, receiver output.



A. M. SIGNAL-GENERATOR (left) build it yourself! Provides amplitude - modulated signals for test and experimental purposes. Gives valuable practice!



GET BOTH 64 PAGE BOOK SAMPLE LESSON FREE

Mr. J. E. Smith, President, Dept. 7FX
NATIONAL RADIO INSTITUTE, Washington 9, D. C.

Mail me FREE, without obligation, Sample Lesson and 64-page book about how to win success in Radio and Television—Electronics. (No salesman will call. Please write plainly.)

Age .....

Name .....

Address .....

City ..... Zone..... State.....

APPROVED FOR TRAINING UNDER G.I. BILL

11 SHORT CUTS TO SERVICING

"Quick, easy and efficient" . . . that's how servicemen describe IRC's 11 Tap-In Shafts. No fiddling or fussing with shaft inserts or "build-ups" . . . no money tied up in stocks of exact replacements. A smart tap of the hammer and the tapered surfaces of control and shaft lock together, forming a permanently tight attachment.

In combination with the IRC Century Line of Volume Controls, these 11 Tap-In Shafts are the logical answer for over 90% of your replacement problems. Save you time and money. Time saved means extra time for other money-making jobs . . . money saved means greater profits. The latest edition of the popular IRC Volume Control Replacement Manual is now available. Contains information on nearly all models up to 1946, complete listings for the 1941-42 sets coming in now for repair. 156 pages. 25c at your IRC Distributor. International Resistance Company, 401 N. Broad St., Philadelphia 8, Pa. *In Canada:* International Resistance Co., Ltd., Toronto, Licensee.

YOU'RE ON THE AIR! A sensational new one minute spot announcement to boost service business has just been released by IRC through IRC Distributors. Listen in and cash in on this promotion!

INTERNATIONAL RESISTANCE COMPANY

IRC

Wherever the Circuit says Ω

tips right out of the horse's mouth

The editor of "The Capacitor" probably won't like being referred to as a "horse's mouth." However, that's only our way of "plugging" the scores of hot ideas for servicemen that he includes in every issue of "The Capacitor."

Here's a magazine that's published for servicemen only. Every month it is *loaded* with ideas for speeding up service procedures — for increasing store traffic — for adding new dollars to your income. Its convenient, pocket-size pages contain valuable technical data — information on the new type tubes — notes on trouble shooting. Yes, and also dozens of helpful hints that will help you to repair any radio ever made, easier, better and twice as fast.

Accept "The Capacitor" with C-D's compliments. Put it to work in your shop speeding up repair jobs — building bigger profits. *Don't wait! Mail coupon below NOW, so your FREE subscription will start at once! Cornell-Dubilier Electric Corp., Dept. RC-6, South Plainfield, New Jersey.*

mail coupon below for your free subscription to the C-D capacitor

TITLES OF ARTICLES IN RECENT ISSUES — These articles are typical of the ones you'll find in "The Capacitor" *every month: How to Use Audio Oscillator and Signal Generator to Simplify Tests — New Requirements of FM and Television Servicing — Hum Elimination — Aligning Superhets.* Think how such articles will help *you* — mail coupon NOW.

FINDS "THE CAPACITOR" OF GREAT INTEREST — Washington, D. C. service shop owner writes, *"I wish to thank you for mailing me 'The Capacitor.'* The special items are of particular interest because of their easy reading and their simplification of complex circuits."

FREE ADS FOR SERVICEMEN — Yes, that's right — your ad will be run absolutely free in The Trading Post which appears in all issues of "The Capacitor." Use this service to buy that new tester you've been wanting — to sell that spare 'scope — or to work out a swap with other servicemen.

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PAPER

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1910 1947

CORNELL-DUBILIER

WORLD'S LARGEST MANUFACTURER OF

CAPACITORS

CLIP THIS COUPON—MAIL AT ONCE

Cornell-Dubilier Electric Corporation Dept. RC-6
South Plainfield, New Jersey

Please start my FREE subscription to *"The Capacitor"* at once.

Name.....

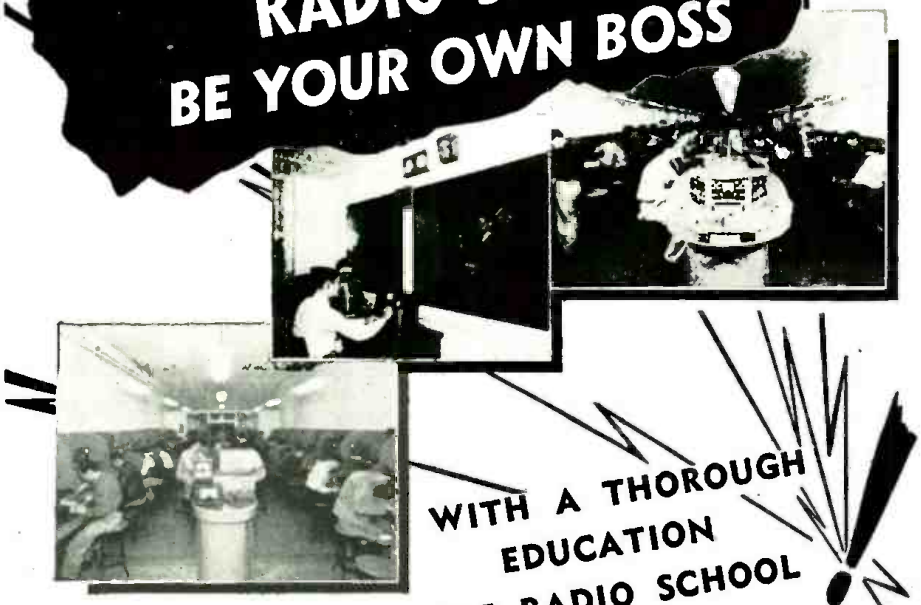
Address.....

City.....Zone.....State.....

Announcing

THE NEW ADDITION TO OUR *RADIO* SCHOOL

OWN YOUR OWN RADIO SHOP BE YOUR OWN BOSS

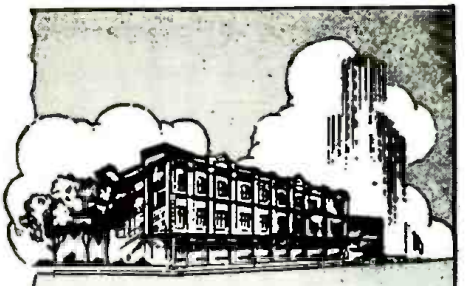


WITH A THOROUGH EDUCATION FROM OUR COMPLETE RADIO SCHOOL

Radio (and its allied fields—electronics, television, radar) now looms as a major industry in the United States offering a constant and ever-expanding field of wealth and opportunities. Each new development points the way toward further improvements and an increasing demand for men and women, specialized in this field.

The Radio courses offered by the Tyler Commercial College are highly specialized to enable you to enter many branches of radio, both as your vocation or your profession. The present courses listed represent a partial list of the extensive and complete training offered by the Tyler Commercial College who have had over 30 years experience in the Radio Training Field.

They invite you to examine the content of their catalogue and determine for yourself how radio training at Tyler Commercial College will enable you to find your own place in one of the many interesting and profitable jobs in the vast radio industry.



GENERAL RADIO COURSE

The course in General Radio is designed to provide a broad foundation for careers in the technical radio field. Among the various job objectives are Radiotelephone Operator (broadcast, police, or airline), Radiotelegraph Operator (marine, zone police, or airline), and Radio-Electronics Technician (industry). Success in qualifying for F.C.C. Radiotelephone or Radiotelegraph License is a requirement for graduation; therefore, an extensive study of radio theory, essential radio mathematics, and laws and regulations governing radio communications is included in preparation for operator license examinations.

Average Time to Complete Course . . . 12 Months

RADIO MAINTENANCE AND REPAIR COURSE

The Radio Maintenance and Repair Course offers preparation for a career as radio receiver repairman, sound-system technician, and radio service shop operator. Accurate, up-to-the-minute knowledge of radio principles and practice is essential for future success in this important field of radio. After a thorough introduction to radio and electrical principles, emphasis is directed to modern trouble-shooting methods, notable "signal-tracing." A section on facsimile receivers, frequency-modulation (FM) receivers and television sets is provided to bring the repairman up-to-date on recent developments. A wide range of topics is covered in this course, all of which are important to the modern repairman.

Average Time to Complete Course . . . 10 Months

Send for Free Catalogue

For full details and catalogue regarding this unique school, write to The Tyler Commercial College, Radio Department, RC, 115 South College, Tyler, Texas.

Attach this to your letter head or card.

MAIL TODAY

TYLER COMMERCIAL COLLEGE
115 South College Tyler, Texas

APPROVED BY VETERANS ADMINISTRATION

A STATE APPROVED INSTITUTION

Like having an EXTRA MAN in your shop

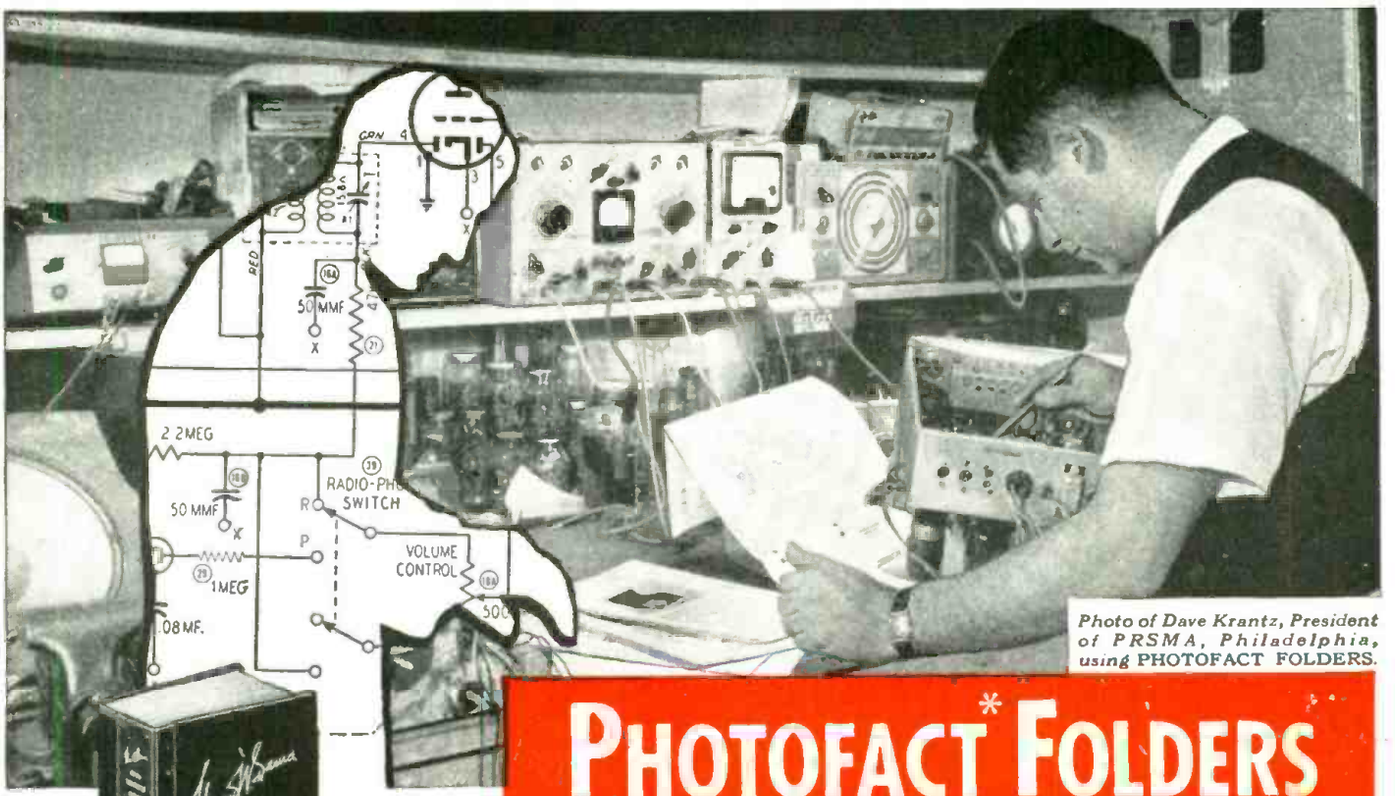
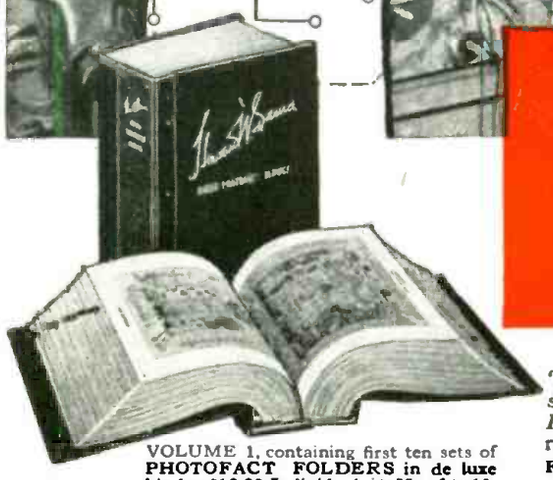


Photo of Dave Krantz, President of PRSMA, Philadelphia, using PHOTOFACT FOLDERS.

PHOTOFACT* FOLDERS

HELP YOU EARN MORE MONEY . .

Cost less than 9¢ a day



VOLUME 1, containing first ten sets of PHOTOFACT FOLDERS in de luxe binder, $18.39. Individual sets Nos. 1 to 10, $1.50 each. De Luxe Binder alone, $3.39.

"Like having an extra man in my shop" . . . "The kind of 'specialist' I need" . . . that's what hundreds of radio servicemen say about PHOTOFACT FOLDERS. Yet this indispensable "hired help" *actually costs less than 9 cents a day!*

Here are the straight facts: PHOTOFACT FOLDERS offer *the best information ever prepared for radio servicemen*—complete, accurate, up-to-the-minute, easy to use. They save you hours of time and effort because they place at your fingertips ALL the information you need to do a better job. And that means you can earn MORE MONEY.

The information in PHOTOFACT FOLDERS is *right* because it is based on *actual analysis of sample sets* right in our own laboratories. It is *complete* and *current*, too, because it covers *all* radios, phonographs, record changers, recorders, communications systems and power amplifiers as they reach the market.

PHOTOFACT FOLDERS come to you in sets of 30 to 50 at only $1.50 per set. Low as this price is, it also includes membership in the Howard W. Sams Institute.

Set No. 19 will be ready for mailing May 10th. Set No. 20 on May 25th. Sets Nos. 11 to 18 inclusive, also priced at $1.50 each, are available for immediate order.

Actually, PHOTOFACT FOLDERS cost you nothing since they pay for themselves again and again. They're ready to help you *now*—at the most difficult time in servicing history. See your distributor or write us today. In Canada, address A. C. Simmonds & Sons, 301 King Street East, Toronto, Ontario.

*Trade Mark Reg.

COMPLETE ✓

Everything you need in one handy, unified form—large schematics, pictorials keyed to parts lists and alignment data, complete listings of parts values and replacements, alignment, stage gain, circuit voltage and resistance analysis, *coil resistances*, dial cord stringing, disassembly instructions, record changer analysis and repair.

ACCURATE ✓

All sets are actually taken apart and analyzed by experts in the Sams laboratories. Every part is measured, tested and triple-checked for accuracy. All data is original. This means the data you get is *right.*

CORRECT ✓

PHOTOFACT FOLDERS are issued twice monthly, as the new receivers come off production lines. You don't have to wait for information. As receiver changes are made, you get correction and addition sheets for your files. Your data is always up to the minute.

READY TO USE ✓

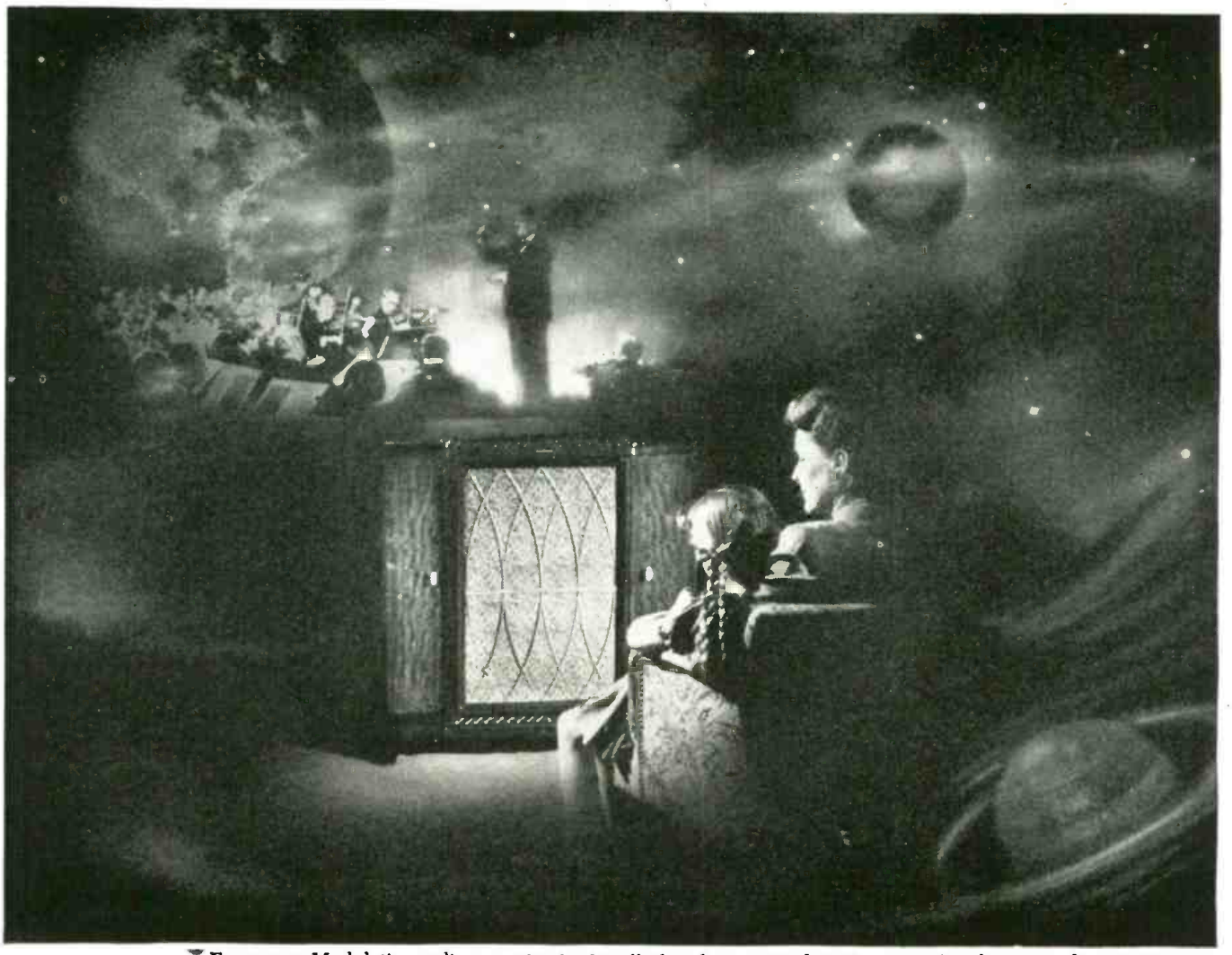
All diagrams and pictures are coded to numbered parts lists. Everything is positively identified for fast work. All folders are set up in uniform, easy-to-follow style: big type, big illustrations—no hunting, guessing or eye strain—no more loss of time and temper.

HOWARD W. SAMS & CO., INC.

2924 EAST WASHINGTON STREET, INDIANAPOLIS 6, INDIANA

PHOTOFACT SERVICE

"The service that pays for itself over and over again"



Frequency-Modulation radio reception is virtually free from natural static—even thunderstorms do not interrupt.

FM Radio—another world in listening pleasure!

It's as though the orchestra were right in the room with you—and the room suspended in the silence of space. When you listen to music over RCA Victor FM, *you hear FM at its finest.*

Natural static interference ordinarily caused by thunderstorms does not mar FM radio reception. You are in a different, new world of utter quiet where you hear only the lifelike music. Moreover, you enjoy the same perfect reception day or night.

The vast experience, research and skills at RCA Laboratories, such as aided in the development of RCA Victor FM, are constantly applied to all RCA products, so that each one is always at the top of its field.

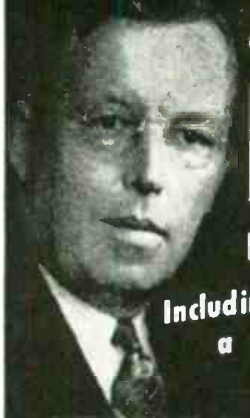
And when you buy anything bearing the RCA or RCA Victor name—whether it's a radio (standard, or FM, or both), a television receiver, Victrola radio-phonograph, a phonograph record or a radio tube, you know you are getting one of the finest of its kind that science has yet achieved.

• • •

Radio Corporation of America, RCA Building, Radio City, New York 20 . . . Listen to The RCA Victor Show, Sundays, 2:00 P.M., Eastern Time, over NBC. "Victrola" T.M. Reg. U. S. Pat. Off.

With the new RCA Victor AM-FM sets you'll hear FM radio—and standard AM radio too, at their finest. Ask your RCA Victor dealer for a demonstration of the fine new Crestwood series of Victrola AM-FM radio-phonographs.

RCA **RADIO CORPORATION of AMERICA**

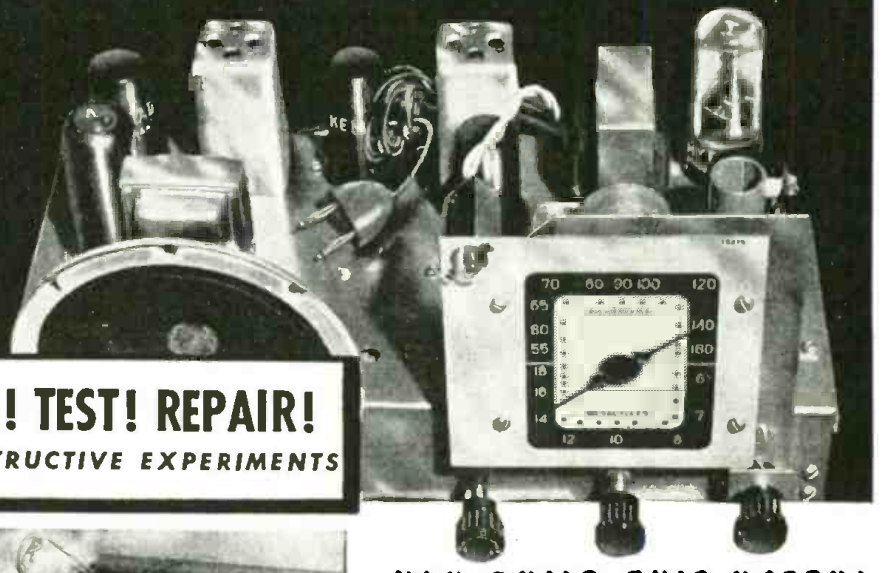


NOW! An Amazing Opportunity to LEARN RADIO AT HOME

I SEND YOU 8 BIG KITS OF RADIO PARTS

Including a **COMPLETE 6 TUBE SUPER-HETERODYNE RECEIVER**

I TRAIN YOU RIGHT by PUTTING YOU TO WORK with REAL PROFESSIONAL EQUIPMENT!



LEARN HOW TO BUILD CIRCUITS! TEST! REPAIR!
YOU DO OVER 175 INSTRUCTIVE EXPERIMENTS

HERE'S THE EASIEST, MOST PRACTICAL WAY OF ALL TO PREPARE FOR GOOD PAY in RADIO ELECTRONICS and TELEVISION!

I train your mind by putting you to work with your hands on a big 6-Tube Superheterodyne Receiver. And, believe me, when you get busy with real Radio Parts — 8 big Kits of them — you really LEARN Radio and learn it RIGHT! You get the practical stuff you need to be useful in Radio, and that's what it takes to make money. You don't have to worry about what to do with these 8 Kits of Parts. Step by step, I show you how to build circuits, test, experiment, trouble-shoot. And you don't need any previous experience. The Sprayberry Course starts right at the beginning of Radio! You can't get lost! Simplified lessons, coupled with real "Shop" practice, makes every subject plain and easy to understand and remember. Soon after you begin Sprayberry Training, I'll send you my sensational BUSINESS BUILDERS.

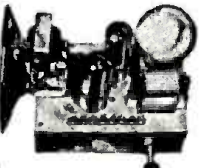
A BUSINESS OF YOUR OWN . . . OR A GOOD RADIO JOB

You'll find out how to get and do neighborhood Radio repair jobs for nice profits and rich experience while learning. This sort of work can easily pave the way for a Radio Service business of your own. But with Sprayberry Training, you're not limited. You can swing into any one of the swiftly expanding branches of Radio-Electronics INCLUDING Radio, Television, FM, Radar, Industrial Electronics. Be wise! Decide now to become a fully qualified RADIO - ELECTRONICIAN. Get full details about my Training at once! Mail coupon below for my 2 big FREE Books.

YOU BUILD THIS USEFUL TEST EQUIPMENT!

I give you a fine, moving-coil type Meter Instrument on Jewel Bearings — with parts for a complete Analyzer Circuit Continuity Tester. You learn how to check and correct Receiver defects with professional accuracy and speed.

Soldering, wiring, connecting Radio parts . . . building circuits — you can't beat this method of learning. When you construct this Rectifier and Filter, Resistor and Condenser Tester, etc., you get a really practical slant on Radio.



You'll get valuable experience and practice building this Signal Generator and multi-purpose Tester. Makes a breeze out of fixing Radios and you don't have to spend money on outside, ready-made equipment.

GET THESE VALUABLE FREE BOOKS

"How to Read Radio Diagrams and Symbols"

Here's a valuable and wonderfully complete new book which explains in simple English how to read and understand any Radio Set Diagram. Includes translation of all Radio symbols. Send for this volume at once. It's free! Along with it, I will send you another Big Free book describing in detail my Radio-Electronic Training.

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F. L. Sprayberry, President, Room 2067, Pueblo, Colorado

Please rush my FREE copies of "How to MAKE MONEY in RADIO, ELECTRONICS and TELEVISION," and "HOW to READ RADIO DIAGRAMS and SYMBOLS."

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Address .....

City ..... State .....

(Mail in envelope or paste on penny postcard)

B-19 Radio Receiving and Transmitting equipment. Has 3 different sets—made for U. S. tanks.
#1. Transmitter and Receiver 2 to 8 Mc.
#2. 235 Mc. Transceiver.
#3. Intercommunication system — our price for the B-19 Complete....$78.50
Power Output CW 35 Watts
Phone 25 Watts

RM-29B Remote Control Units to control transmitters. Can be used for telephone intercom work. Has bell ringer. Two RM-29 or similar RM's in combination with two handsets like regular telephone. Total $21.00

SCR 610 FM Transmitter-Receiver. Frequency range 27 to 38 Mc. Crystal Controlled. Operates on 6 or 12 V DC or Battery input. Complete to last detail. Used condition $69.50

Condensers
Pyranols Dykanols — Etc.

1 mf	300 vdc	$ .20
2 mf	300 vdc	.25
4 mf	300 vdc	.30
4 mf	400 vdc	.50
5-5 mf	400 vdc	1.05
2 mf	550 vdc	.25
.25 mf	600 vdc	.20
.85 mf	600 vdc	.25
1 mf	600 vdc	.30
.1-.1 mf	7000 vdc G.E. Pyr.	2.00
2 mf	600 vdc	.35
4 mfd	600 V.	.60
10 mfd	600 V.	.85
1 mf	1000 vdc	.75
.1 mf	1000 V.	.25
2 mf	1000 vdc	.89
1 mf	1500 vdc	.95
.4 mf	1500 vdc	.15
2 mf	660 ac/1000	.85
4 mf	1500 vdc	1.20
1 mf	2000 vdc	1.00

Tube Special

Tube Type	Your Cost	Tube Type	Your Cost
2API	$3.75	837	$1.35
3BP1	3.95	872A	2.45
3FP7	3.50	3B24	3.95
5BP1	4.95	3C45	5.95
5BP4	7.95	705A	6.75
5CP1	4.95	241-B-WE	30.00
5FP7	4.25	861	39.00
		304 TL	8.00

Sockets for 5CP1, 5BP1, 3BP1, 705A, 829 ..... .95 ea.

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Pulse
High Voltage
Power Supply
Audio

Raytheon Pulse Transformer UX 4298 E. Pri: 4 KV, @ 1 microsecond: secondary: 16 KV @ 16 amps. Filament pri: 115 V/400 cycles $15

W.E. HI Volt input pulse transformer #D169271 .....$9.95

G.E. Radar pulse transformer K2731. Diameter app. 11". Vertical cooling fins $19.50

Prim: 117 V./60 Cycle. Secondary: 500-400-0-400-500 @ 250 ma. and 6.3 V. @ 1.5 amps. Dimensions 5" x 4" x 6" app. $6.95

Prim: 117 V/60 Cycle—3.8 amp. Secondary; 980 V. @ 450 ma. no C. T. Dimensions app. 5½" x 6" x 5" $4.95 ea., $9.00 pr.

Prim: 117 V/60 cycle. Sec. 6.3 V. @ 9 amps, center tapped; 6.3 V. @ 2.2 Amp; and 6.3 V @ 2.2 amps. Three secondaries, app. 4" x 4½" x 5" $3.75

Filament Transformer Raytheon #UX6809. Primary 115 V/60 cycles. Secondary #1—5 V. @ 5.5 amps. Secondary #2—5 V. @ 5.5 amps. Tested for 29,000 Volts insulation $12.95

2KVA Transformer and choke primary 110V/60 Cycles. Single phase. Output 17,000 volts @ 144 ma. Choke 4.000 Hy @ 0 current. DCR 4500 ohms. Dimensions 26" x 29" x 13". Amertran $74.50

Here's an unusual transformer special! AC in, DC out. A rectifier unit is incorporated inside the transformer. You will find many money-saving uses for this rectifying transformer. Made by Federal Tel. #RA 7067-1. Primary 117V/50 to 62 cycles. Secondary: 62 V DC @ 3.5 amps. Use it with a rheostat to run DC units directly from your house line. A buy at $3.95

115 Volt/60 cycle pri.—Secondaries: 470V. CT @ 60 ma and 6.3 V. and 5 V. $1.50

6 Henry choke—60 ma—to match above 65c

Utah—small Blocking oscillator type transformer—either 9218 or 9308.....ea. 75c

A special buy for you if you can use 400 cycle transformers. We have most of our small 400 cycle transformers on sale at 50c each. Larger sizes proportionately low. Send us your approximate voltage requirements. We'll fill your order.

Audio Transformers, modulators, etc.
Modulation Transformer, 807 to pair of 807s $1.00
Line to Voice coil transformer. Pri: 600 ohms: sec: 6 ohms.
Sub Sig. Type #CRP 30448 .....$1.00
UTC Type #83718—Primary 600 ohms CT. Secondaries: 4.000 ohms and 150 ohms. Each .....only 50c

"Communications" MICROWAVE SPECIALS

MICROWAVE PLUMBING
Three Centimeters

Wavemeter (Maguire Industries #1539TFX-21GA) 3 centimeter cavity. Vernier Driven Dial	$20.00
Wave guide 15° bend 16" long cover to cover	3.00
Wave guide 30° bend 10" long choke to cover	3.00
"T" Section	5.50
Wave guide 90° bend E Plane 18" long	5.50
Wave guide 180° bend with pressurizing nipple 12½"	4.00
Wave guide "S" curve 18" long cover to choke	3.50
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Section Rigid coax 18" 58 ohm Z has ¼ wave section	4.00
Pick up loop with adjustable tuning section used in duplexer	1.50
Brass choke Opening 1" x ½"	.60
5 feet 3 cm wave guide per foot	1.95

Ten Centimeters

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Signal Generator I-138 made by Western Electric. 2700 to 3000 MC. Operates on 115 V/60 cycles. Regulated power supply and has output meter	75.00

1.25 Centimeter

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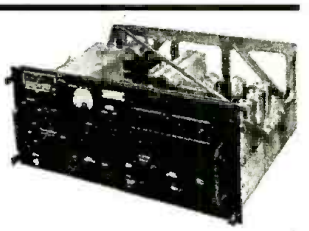

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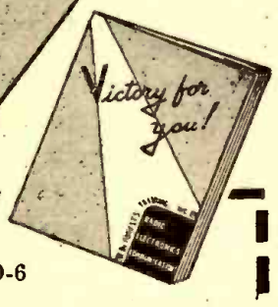

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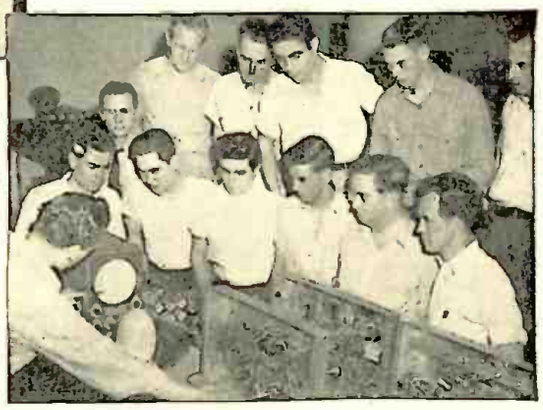

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SPRAGUE TRADING POST

SWAP—BUY OR SELL

FOR SALE—Hallicrafters SX-25 receiver with bass-reflex speaker, $100; also 50 ft. co-ax cable, $1.75. L. C. Zaret, 6246 N. Oakley Ave., Chicago, Ill.

WANTED—Circuit diagram for Navy Oaks sonar unit. Have many small parts for sale. Peter Wnukowski, 344 Ridge Ave., Kingston, Pa.

WANTED—The following German tubes: DCH-11; DF-11; DAF-11; DL-11; UY-11; Arthur Hellmann, 15 Argle Rd., Brooklyn 18, N. Y.

FOR SALE—National 1-10 receiver complete with tubes and power supply, $40. Geo. E. Anthony, 878 Gilbert St., Columbus 6, Ohio.

WANTED—Meissner pre-aligned tuning unit 13-7616. John Wainwright, Greenmount, Md.

FOR SALE—AC SW-3 complete with coils for 20-40-80 mtr. bands, power supply; also good 50-watt rig, 6V6 xtal osc., pair 61.6's final, 40 & 80 mtr. xtals, power supply. F. Bou W3ESX, 3131 N. Percy St., Philadelphia 33, Pa.

WANTED—Small relays to operate at 1 mil. or less; tiny motors; tiny Thyratrons, sub-miniature tube sockets 5AX, 6AX, 7AX; tiny i.f. cans, freq. unimportant. Buy or swap. L. Kurshner, 1915 Franklin Circle, Hollywood 28, Calif.

TRADE—Have misc. radio parts, new and used in trade for mimeograph machine, legal size. Ed. Howell, Rt. 2, Dillon, S. C.

SELL OR SWAP—Model airplane and motor; also parts from Ellison power unit; a few radio parts; some midget tubes: 6C4, 6AK5, 6AQ6. Jim Rosche, 3215 Davo N. C., Cedar Rapids, Iowa.

WANTED—Hallicrafters SX-25 Super Defiant, new or used. State price. Jose Vazqvez, 2640 S. 9th St., Philadelphia, Pa.

FOR SALE—Ultra portable "Lucy" receiver, without BFO, completely wired, with speaker transformer, including Navy phones, 2.5 to 12.5 mc., $20. Father Geffen, Norwalk, Conn.

WANTED—Technical books or ham gear. Cash or trade. Eddie Howell, 501 W. Harden, Graham, N. C.

WANTED—Army and Navy clocks, 12 or 24 hour; chronometer. Cash or trade radio and amateur-radio equipment. Wm. Hansen, 165 Silverbrook Ave., Niles, Mich.

WANTED—Code practice machine with tapes, continental morse, condition immaterial. Cash. Fix-it Shop, Bird Island, Minn.

WANTED—Instruction manuals on Army SCR-274N and SCR-522; also want to buy freq. meter BC-221. Al. AK. or AR. J. H. Oxford, Southern Air Services, P.O. Box 290, Memphis 1, Tenn.

WANTED—Speed key (bug) electronic or mechanical. In good condition. J. Jurkowski, Horseneck Rd., Caldwell, N. J.

SELL OR SWAP—Several home-study radio courses; commercial, sample multiple choice questions and answers for radio 'phone 1st class, and radio-telegraph 2nd class 10 for $10. Want Rider manuals, photo enlarger, commercial x'mitter. W6WIJ, Box 1298, Hollywood 28, Calif.

SELL OR SWAP—Instructograph, 10 tapes, like new; Federal 219 enlarger, excellent condition. Want receiver, good condition. B. Simon W2UUN, 7 Madison St., Port Washington, N. Y.

FOR SALE—New Amertran power x'former PF-25A, 100, 110, 115, 120 V. pri., 600 V. sec. c.t., 4-3.75 V. windings at 1.25 amp. each, high-voltage winding at .120 amp., 60 cy. Fred Marrow, 3495 Broadway, New York 31, N. Y.

WANTED—Dead or alive short-wave receiver; volume expander; large speaker with tweeters or Jensen Co-axial or similar speakers. Have car radios, manuals and some testers—what do you need? Glenn Watt, Chanute, Kans.

WANTED—BC-610 converted for 10-mtrs. Have misc. radio parts and supplies. E. Howell, 501 W. Harden St., Graham, N. C.

SWAP—Mar. 1932—Dec. 1946 QST's for useful surplus. A. J. Urban, 283 Garden St., Hartford 5, Conn.

FOR SALE—Used 14-tube Navy type RBS receiver a-c operation, complete with instruction book. Covers 2-20 mc., in 4 bands, r.f. and a.f. level control, BFO, noise limiter, precision dial, tuned plate r.f. stage, link coupled to mixer. $75 f.o.b. J. B. Fell, W7IKE, 517 Ave. G, Billings, Mont.

WANTED—Any good ham x'mitter like RC-610; HT-4E or HT-9. Have new test equipment for part trade. Donnld Clark, Blackfoot Radio Shop, Blackfoot, Idaho.

URGENTLY NEEDED—Auburn (chassis 441) or r.f. or oscillator coil for same; Auburn (chassis 320) or i.f. transformers for same. Cash or swap. Lewis W. Robinson, 3781 3rd Ave., New York 56, N. Y.

FOR SALE—S-38 in perfect condition, $35; also S-41 W. L. Colby, 122 Main St. Oswego, N. Y.

SWAP—Longines pocket watch, $125 value for good communications receiver equal value; also Webster 56 record changer for ham equipment. Art Meek, 1430 Elton Rd., Jennings, La.

FOR SALE—Collins AN/ART-13 x'mitter, less tubes, power supply, calibration x'tal, $100; also 3 CFI units for AN/ART-13, $1.50 ea.; dynamotor 28 V., 32 amp., d-c/750 V., 0.35 amp., 400 V., 0.75 amp., a-c, $5. E. Lovick, 907 W. Nevada, Urbana, Ill.

WANTED—New or used Stancor transformers A4206; A4404; portable recorder with play back. Will pay top price. Riley Parsons W2SBR, Raquette Lake, N. Y.

WANTED—Hallicrafters short-wave receiver in good condition. Have electronic volt-ohm-milliammeter, excellent condition for trade. Write stating price, etc. Paul Cowins, Blackburn St., Lynchburg, Va.

WANTED—Used amateur x'mitter in good condition. Will pay in monthly installments. Will furnish bank and other references. Louis A. Vas, Rt. 4, Middle Rd., Ashtabula, Ohio.

FOR SALE—Gordon A-C turntable 10 to 100 rpm and magnetic pickup; radar motor 28 V. D-C or 110 V. A-C, 12,000 rpm, new; Shure P-935 and Astatic L-75-S. E. Colo, 215 N. Lorel Ave., Chicago 44, Ill.

SELL OR SWAP—Mercury 35 mm. camera, F3.5, 1/1000 sec. 18" to infin., with leather case, sync flash gun, attached light meter. Sell for $30, or trade for new BC-875-E trans., BC-348 receiver, or BC-654-A Rec.—Trans. G. E. Oden, 217 Marshall St., Wauseon, Ohio.

FOR SALE—2 307-A's, 3 sockets, $5; Simpson 0-3 r.f. meter, $2.75; 2-832's, 2 sockets, $7.25; 7010 kc. xtal, $2.25; 8155.715 kc. xtal, $2.25; 28 V. dynamotor unit, $6. Ralph N. Huse, 820 Hunt Ave., Sumner, Wash.

SWAP—1 ea. 611-F walkie-talkie (3875 kc.), new, for BC-348-Q receiver. Need not be converted. State difference in price, if any. Also want conversion data for BC-457, 458A series. Francis Goresen, 2224 W. Adams St., Chicago, Ill.

SELL OR SWAP—Hallicrafters SX-28-A receiver complete with speaker and cabinet. Will trade for Speed Graphic 4 x 5 or 3¼ x 4¼ complete. RCA TMV 97C sig. gen., Rider's manuals 1 & 2, Abbott transceiver with pwr. pk., 2 mtrs. M. J. Curley Jr., 412 Forest Ave., W.B. S.I. #1, New York, N. Y.

FOR SALE—Up to 30 lbs. radio parts, i.f., r.f. coils, transformers, speakers, etc. per package $3, as long as they last. You pay postage. Ruzicka, 924 17th Ave., Cedar Rapids, Iowa.

FOR SALE—Meissner 150-B transmitter, complete with Meissner sig. shifter, key, mike and spare parts. Operates on 80-40-20-11-10 mtrs. H-2129X receiver. Both used less than 50 logged hours, $450, f.o.b. W5HGF, 720 W. Kleberg, Kingsville, Texas.

FOR SALE—Hallicrafter FM-AM S-37 VHF, 130-210 mc. Thrift Appliances, 1831 Southern Blvd., Bronx 60, N. Y.

FOR SALE—German radio, in good condition, looks like small suitcase, parts can be substituted as well as tubes. A-C, D-C, has tone control, 3-band switch, phono-amplifier. Made by Nora Radio Corp. $40. D. W. Andrews, Box 105, Kingfish, Okla.

FOR SALE—New 4-band Hallicrafters marine transceiver, 13 tubes, 30-watts, 1651 kc. to 2800 kc., $125; 3 Motorola 30D transmitters, used, with tubes, dynamotor for 6V. operation, $25 each. 3 for $65. Robert Skell, 510 Castano Ave., San Antonio 2, Texas.

SELL OR SWAP—Back issues QST: June-Dec. '33; Jan.-Dec. '34; Jan.-Dec. except Sept. '35; Jan.-Dec. '36; Jan.-May, '37; type 841 tube. Want misc. parts, tubes, etc. Carl England, Jr., 50 Lyme Rd., Hanover, N. H.

SELL OR SWAP—New 14-watt p.a. system using 6SJ7, 6SC7, 5Y3G, Pp 6V6's. Phono top with Shure Glider pick-up, 12" 18-watt Utah p.m. speaker, floor mike stand. Cash or trade for 'scope or ham eqpt. T. J. Erwin, 3735 Milwaukee Ave., Chicago 41, Ill.

FOR SALE—Weston meters 301; transmitting condensers; tubes; transformers; other supplies; Collins transmitter 3-A, $175. Write for list. Leo F. Kersey, White Sulphur Springs, W. Va.

FOR SALE—Handie-talkie, complete with tubes, coils, xtals, mike, receiver. No cases, $30 pair. Portable amplifier 15-watt complete with 12" Jensen Speaker, 6 tubes, 2 inputs, tone control, $35. H. W. Meridith, 1482 Granrillo Ave., Chicago 26, Ill.

FOR SALE—Complete sets dating back 10 yrs.; QST; Electronics; I.R.E.; Communications magazines. All perfect, intact. P. Rosenblatt W2AKF, Box 905, Hoboken, N. J.

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FM AND ALTITUDE

FM Race for Altitude Is On

By HUGO GERNSBACK

FREQUENCY MODULATION, which before the war had already made excellent progress, is now going ahead in earnest with greater and more rapid strides than ever.

According to the latest reports of the Federal Communications Commission, there are now in operation more than 200 FM transmitters in the U. S. against over 1,000 AM transmitters. The FCC estimates that by the end of this year there will be 700 FM transmitting stations on the air. How many more there will be next year is not possible to predict exactly at this moment.

That FM is going ahead by leaps and bounds is further attested to by the Radio Manufacturers' Association, which in a statement, as we go to press, estimates that the output of FM receivers for the year 1947 will be between 1,800,000 and 2,100,000 units.

We have mentioned a number of times in this space that to satisfactorily blanket the United States with FM transmitters would require a minimum of 1,500 stations against the 1,000 odd AM transmitters. As is well known, due to the shorter wave lengths used by FM, the range of the transmitter is dependent on its horizon. FM transmission normally does not extend much beyond this point, and if there is FM reception much beyond the horizon, it is a freak action. Thus the average FM transmitting tower of about 500 to 600 feet covers a satisfactory range of only about 35 miles.

If a given FM transmitter wishes to increase its range, there is at present only one way to do so. The transmitter has to gain altitude—its antenna must go higher. The higher the transmitter, the greater the coverage. For this reason, all FM transmitters strive for as high an elevation as possible. Thus, in New York City we have an FM transmitter on top of the 1,250-foot Empire State Building. This immediately gives a larger coverage for the transmitter which now can reach an audience within approximately a 55-mile radius from the transmitter.

Wherever there is a high natural elevation, the FM engineers are anxious to locate on it, if at all practical. For example, in New England we have an FM Station on Mt. Washington where its transmitter is at an elevation of 6,288 feet. This gives the station a transmitting radius of 120 miles.

It is probable that the United States will soon be dotted with FM stations on many mountain tops. We give here a short tabulation of a few high points in the United States and their location, showing where eventually FM transmitters might be located. The radius of transmission is also given.

HIGH MOUNTAINS IN U.S.

	Elevation Ft.	Has FM Station	FM Average Range
Mt. Washington, N. H.	6,288	yes	120 miles
Mt. Davis, Pa.	3,213		90 miles
Mt. Mitchell, N. C.	6,684	yes	130 miles
Cheaha Mountain, Ala.	2,407		85 miles
Granite Peak, Mont.	12,850		170 miles
Mt. Elbert, Colo.	14,431		180 miles
Mt. Whitney, Calif.	14,495		180 miles
Mt. Rainier, Wash.	14,408		180 miles

This, of course, is only a theoretical evaluation. In some cases it will not be expedient to place transmitters on these or other high peaks, for the following considerations:

It is one thing to get altitude for a transmitter but quite another thing to place it in a practical and an economical location. Areas around many mountain peaks are often sparsely inhabited, to such an extent that no one would wish to build an expensive FM station just for the privilege of transmitting to a few thousand listeners. As a rule, the higher and more elevated the location, the more extensive the mountain range and the sparser the population.

Other factors also make it undesirable or unwise to place transmitters at extreme altitudes. First, we may have difficulty in reaching the peak which may be snow- and ice-bound over large parts of the year. Second, there is the high cost of erecting transmitters on such uninhabitable and difficult elevations.

It would therefore seem that extremely high mountainous regions will not prove attractive for FM transmitters except under exceptional and special conditions.

There are other solutions to the problem. One of the most spectacular will be the erection of extremely high steel towers in various parts of the country. Already, Station KRNT of Des Moines, Iowa, is planning a tower 1,530 feet high—280 feet higher than the Empire State Building. This, indeed, would make it the highest man-made structure in the world. Even higher towers than this can be constructed, if there is a demand for them.

There is no technical reason why towers of this type, even several times the height of the Empire State Building, cannot be erected, if the owners are willing to pay the price. Needless to say, such towers would be extremely expensive, but if a much larger territory can be covered by the FM transmitter—particularly in a populous district—it might pay to do so.

It will be noted that whereas the average broadcast AM transmitter mast usually runs only a few hundred feet high, the average FM transmitter antenna already runs from 600 to 800 feet, and this spread between their heights may be expected to increase.

High mountainous elevations, high man-made towers are not the sole solution to the FM altitude problem. A year ago the Westinghouse Electric & Manufacturing Corporation advanced a plan whereby the entire United States could be covered by a few large airplanes circling overhead constantly at a high elevation—five and three quarters miles up. Each plane thus would cover a radius of 200 miles. This scheme (in conjunction with television) the sponsors term stratovision. This proposal is as yet in its developing stage. *(Continued on page 74)*

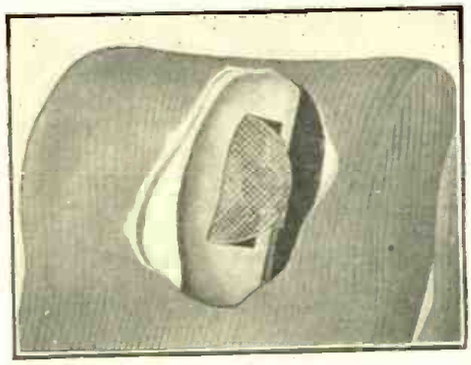
RADIO-ELECTRONICS

Items Interesting to

RAILROAD RADIO takes on a new meaning with the introduction of individual speakers for passengers, announced last month by the Budd Co. Their new passenger coaches are furnished with individual rubber-embedded speakers in the headrests of the seats. Since the speakers are placed at ear level low volume is ample for comfortable reception, and passengers in adjoining seats may listen to different programs.

The speakers are connected to a central receiving unit which permits passengers to select one of several programs with a multiple switch on the arm of the seat. Besides having a number of radio programs on tap, two programs of recorded music from a wire recording unit will also be available.

Controls of the railroad radio sets are mounted in the arms of the seats. Below—how the speakers are installed in cushions.



The same principle of selective listening is being used in the Rock Island Line's *Golden Rocket*, in which several low-powered speakers are mounted in the ceiling of each car. The speakers cover only a small space below them; thus several programs can be received without interference at different points in the same car.

FM RELAYING without special wire lines or relay stations was demonstrated last month at the first meeting of the newly-formed Frequency Modulation Association. The program originated in a small studio in Yonkers, N. Y., from which it was sent by a low-powered transmitter to Major Armstrong's station at Alpine, a few miles away. FM station WBCA, Schenectady, simply tuned in the program and rebroadcast it for the benefit of the FM conference meeting, which was in session in the Ten Eyck Hotel in nearby Albany.

Major Armstrong pointed out in a speech that FM's greater freedom from fading and interference makes it possible for one station to pick up a program from another in what he called "the chain reaction" without the help of expensive wire lines. It was stated that a chain of stations extending, for example, the full length of the Atlantic Coast could pass on the signals from one to the other, and it was hinted that a transcontinental network might be attempted in the near future.

FM IN BRITAIN takes its first step with the announcement last month that the Marconi company is to supply a 25-kilowatt frequency-modulated broadcast transmitter to the BBC. This is expected to be used on a regular service rather than an experimental basis.

SHIP RADAR will be made more effective by new microwave "lighthouses," General Electric reveals. A unit tested last month at New London, Connecticut, sends waves in all directions at a frequency of 3200 megacycles. These are picked up by the ship's radar, appearing on the screen as a very bright ray which shows the exact position of the beacon with respect to the ship.

It is expected that the microwave units will be installed in lighthouses. Skippers can then use the radar signals in fogs which render the light invisible. In either fog or clear weather, they also provide a useful distance indication not obtainable directly from a simple light.

ILLEGAL BROADCASTERS who operated a "network" of four stations found themselves in the hands of the United States Government last month. The broadcasts, of phonograph records interspersed with musical criticism and wisecracking in the best "disc-jockey" tradition, proved to have come from the transmitters of four Summit, N. J., high-school boys.

Receiving complaints of interference on airway and marine safety frequencies, FCC engineers quietly located each of the four stations, then, in company with United States deputy marshals, entered the four homes at the same instant. The transmitting equipment was found in all cases.

Three were found in possession of active transmitters. The fourth station had been closed down by order of the operator's mother, who had told her son to store the equipment in the attic till she could ascertain whether or not he required a license to operate it.

The boys, in view of their youth and ignorance of the possible serious consequences of their activity, were paroled by the United States attorney in the custody of their parents.

AMATEURS of the world will now form an unofficial arm of the United Nations, following an agreement signed last month between the assistant secretary-general of the United Nations organization and George W. Bailey, secretary of the International Amateur Radio Union.

Chief duty of the amateurs will be to compile reports on the reception and effectiveness of United Nations radio broadcasts to various parts of the world. They will also handle certain news broadcasts and other noncommercial point-to-point traffic for the UN, and will also take part in discussions on United Nations topics.

Radio amateurs who take part in the new net will be licensed as special United Nations Amateur Radio Aides. Details of the plan are being worked out by a four-man board, composed of Brigadier General F. E. Stoner, chief communications engineer for the United Nations, Peter Aylen, director of the radio division of the Department of Public Information, Kenneth B. Warner, secretary of the American Radio Relay League, and Francis E. Handy, the League's communications manager.

FM ALLOCATIONS are expected to be revised drastically following the hearings of May 8 and 9. The Federal Communications Commission proposes that stations be spaced four channels apart, because of interference in some areas where stations are working with less separation. Even where stations are two channels apart, receivers in areas near a number of FM stations suddenly jump from one station to another.

The FCC recognizes that the difficulty is to some extent due to receiver design, pointing out that operation on alternate channels "results in interference in many of the receivers being produced at the present time." Thus it appears that as more is learned about the design of high-frequency receiving circuits, it will be possible to allocate the channels now to be used as buffers.

MONTHLY REVIEW — *the Radio Technician*

U.S. SHORTWAVE broadcast activity runs second to that of Great Britain, the State Department revealed last month. According to a survey made by the Department, Britain used 16.5 percent of the total broadcasting time for the world and the United States air activity accounted for 9.2 percent of the time.

The third country was Soviet Russia, with 6 percent. France was fourth with 3.8 percent. Broadcasts from British stations were in 46 languages, while American broadcasts were beamed out in 24, with 3 more to be added shortly, according to the report.

SUBMARINE TELEVISION was successfully demonstrated for the first time last month when a broadcast was made from the *USS Trumpetfish* at the Brooklyn Navy Yard.

The ship's maneuvers were covered by Image Orthicon cameras as it submerged, conducted a mock torpedo attack, and finally surfaced. The program was broadcast over NBC's station WNBT, in New York, and carried by co-axial cable to Philadelphia, Schenectady and Washington, from which cities it was broadcast by WPTZ, WRGB and WTTG respectively.

NETWORK FM on a regular basis was introduced by the Army Air Forces Band in a special series of 7 weekly concerts which began early in April. The broadcasts originated at WASH in Washington and were relayed by land lines to Major Armstrong's W2XMN-W2XEA at Alpine, New Jersey. The programs were then picked up by radio by stations WBCA in Schenectady and WDRC-FM in Hartford, Connecticut; WGTR in Paxton, Mass; WBIB, New Haven, Conn.; WIZZ at Wilkes-Barre, Penna.; and WMNE, Mt. Washington, N. H.

The FM signals were also carried by wire to Rochester and Buffalo, from which they were picked up during one or more of the weekly programs by a number of stations. Thus the programs were heard in Syracuse, Utica and Hornell, and in Cambridge, Mass. The series ended May 7, after having broadcast weekly for seven weeks. Fifteen stations formed part of the network for one or more broadcasts.

RADIO RECEIVERS in the United States homes have reached the number of 52,000,000, the Columbia Broadcasting System reported last month. This figure excludes portables as well as automobile and other types which are not strictly home receivers.

One in every 5 families bought a radio in 1946, bringing the number of radio homes to 35,900,000. One-third of all U.S. homes had more than one radio.

COLOR TELEVISION on a 7½-by-10-foot theater screen was shown publicly for the first time in Philadelphia, April 30, by Radio Corporation of America, in a demonstration of its all-electronic color television system at The Franklin Institute. Color motion picture films and slides were projected.

Dr. V. K. Zworykin, Vice-President and Technical Consultant of the RCA Laboratories Division, who demonstrated the new system to illustrate his address: "All-Electronic Color Television" before the Institute, disclosed that the pick-up unit used in the demonstration incorporates the electronic "flying spot" which has been under development for nearly ten years. In this system, he explained, the flying spot of light is created on the screen of the kinescope by the electron scanning beam.

The light from this spot is projected through color slides or films, scanning the entire surface of the scene or object, point by point. As the light beam, then tinted with color, emerges from the film or slide, it passes through a series of filters which separate respectively the red, green and blue portions of the color in the beam.

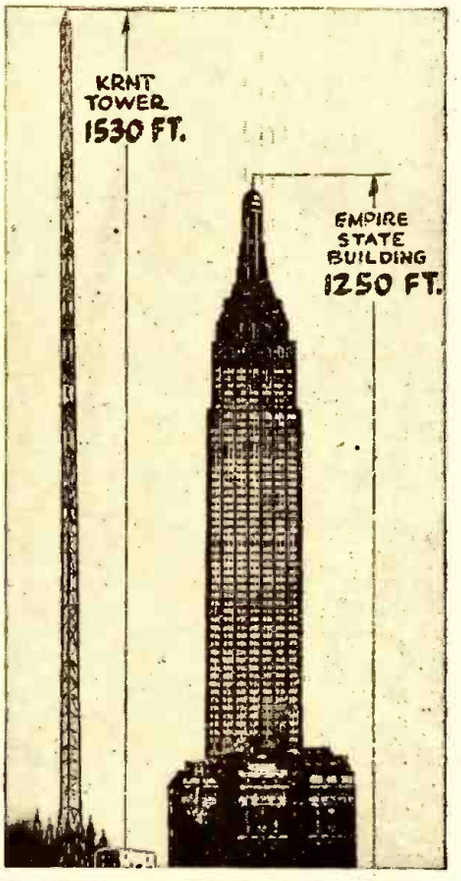
Each color then is reflected into photocells which change the light values into electrical signals for transmission to the receiver. The flying spot method, he added, assures perfect picture registration by permitting the transmission of the three color values of each picture element simultaneously.

At a press preview before the Institute meeting, correspondents asked a number of searching questions about the possible effects of large-screen television on the present moving-picture theaters.

In reply, David Sarnoff, president of RCA, stated that as opera and the concert hall had found that radio helped rather than harmed them, the moving picture industry might find television a great aid. The moving picture industry, he commented, had not been responsible for the introduction of the talkies, which came from the electronic industry. Possibly the moving picture industry people today are not fully alive to the possibilities of television, he suggested.

WORLD'S HIGHEST STRUCTURE is to be an FM radio tower, it was announced last month by Phil Hoffman, manager of Radio KRNT, Des Moines, Iowa. Construction of the tower depends on approval of the station's application for a construction permit.

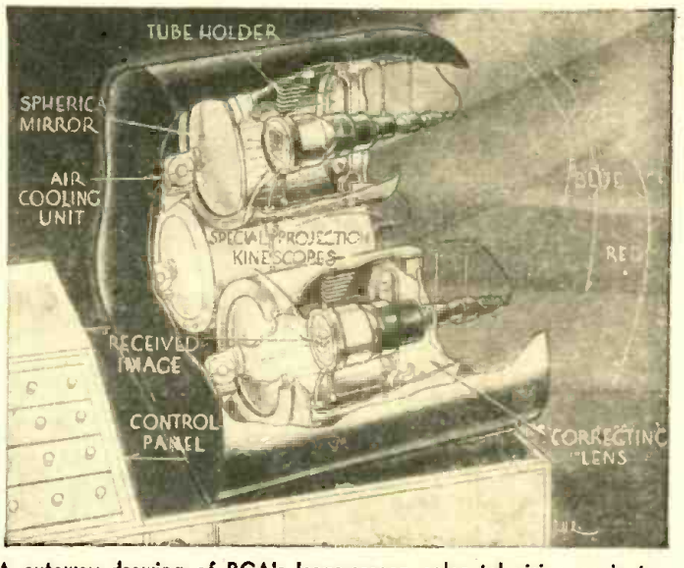
The new tower will be 280 feet higher



The KRNT tower and the Empire State Building.

than the Empire State Building, present holder of the height title. Broadcasts from it are expected to have a range of more than 120 miles, if the full authorized power of 157,000 watts is used.

The station is owned by the Cowles Broadcasting Co., already owners of the highest radio tower in the world—the 927-foot mast of AM station WNAX at Yankton, South Dakota, which has been in operation more than three years.



A cutaway drawing of RCA's large-screen color television projector.

COLOR TELEVISION

By
H. W. SECOR

PART 1

TELEVISION images in natural colors appeal strongly to the imagination of the radio public. It is not easy for the layman to understand why it is so much more difficult to reproduce pictures in color than in black and white. That difficulty does exist, but several means of surmounting it have been proposed and at least partly developed.

To begin with, stations transmitting color television images require a much wider frequency band than black and white (B & W) images. The present B & W pictures occupy a band only 6 mc wide, while 14.5 mc is necessary for the simultaneous (color) system and 16 mc for the sequential (color) transmissions.

The cost of color television receivers would be about *twice* that of B & W sets, according to engineers' estimates.

One strong point in favor of color television is that the same apparent definition is attainable with a smaller number of lines. For example, with the present 525-line image used in the sequential system (color image) the same apparent definition is obtained as when using 900 lines in a black and white image (as explained in Dr. Peter Goldmark's [CBS] report presented to the Federal Communications Commission).

The two principal methods so far demonstrated for producing color television are RCA's simultaneous system and the CBS sequential method. In the *simultaneous* system all 3 basic colors (red, blue, and green) are transmitted at the same time; in the *sequential* plan the 3 colors are sent one after the other.

The Columbia Broadcasting System's sequential method has been tested experimentally for a period of about three years at a cost of $2,000,000.

This extensively demonstrated system transmits the 3 basic colors (red, blue, and green) one after the other. In picking up a *live* subject before the camera at the transmitter, the scene is brightly illuminated and an orthicon tube scans the scene through a revolving color filter. See Fig. 1-a. The images are progressively transmitted as black and white signals over a carrier of suitable width. Color is finally restored to the reconstructed image at the receiver, by spinning a second color filter in front of the picture tube. The rotating color filters at the transmitter and the receiver must revolve in perfect synchronism; not only must the speed of both discs be identical, but they must be *in phase*. When the red filter is before the image reflected into the orthicon tube at the transmitter, the red filter must be in front of the image at the receiver. Perfect registering of the two color filters is secured by transmitting a synchronizing pulse or signal at regular intervals. This has no effect on the picture.

One 16-mc carrier (see Fig. 2-a) is used to transmit the 3 colors in the sequential system. One color follows another in rapid sequence. In many of the CBS tests the sound was transmitted by injecting FM bursts or pulses on the picture signal carrier, without interfering with the image transmission. (Later tests as reported by Dr. Goldmark, have indicated that it is preferable to transmit the sound on a separate subcarrier. One of the advantages of the separate sound transmission is a greater signal-to-noise ratio under all conditions.)

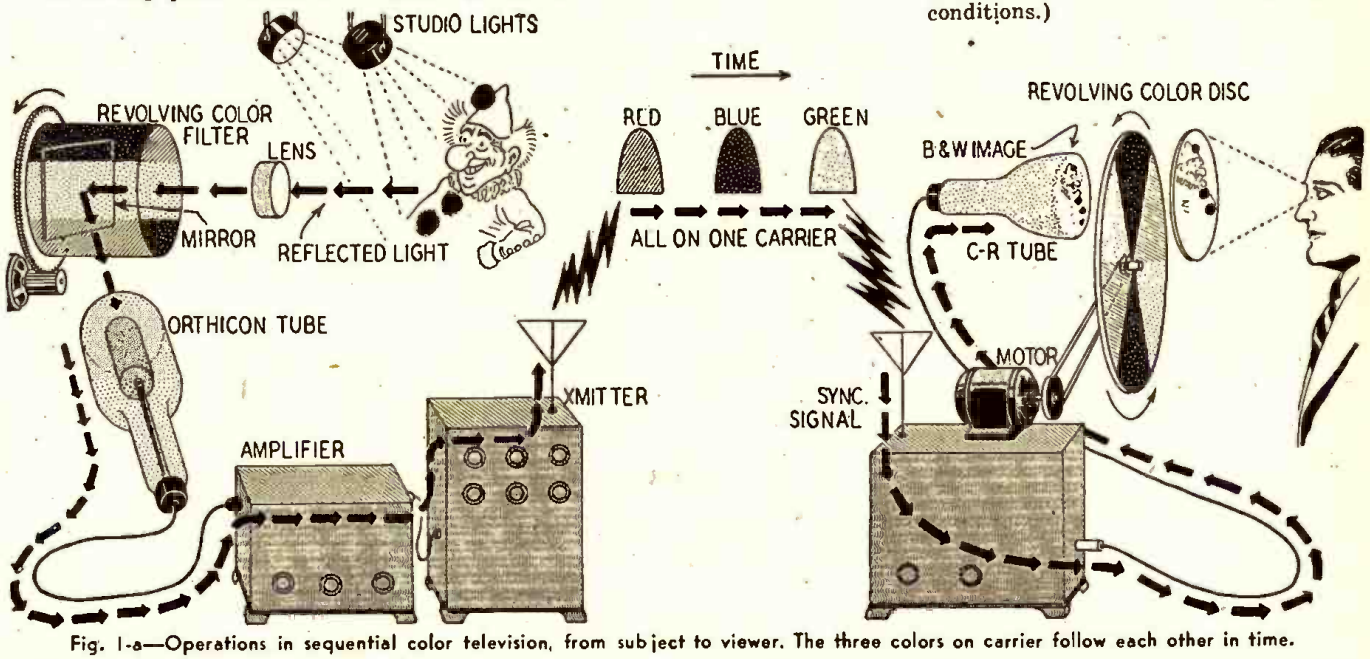


Fig. 1-a—Operations in sequential color television, from subject to viewer. The three colors on carrier follow each other in time.

The sequential system images are transmitted at present with 525 lines and 48 frames per second. The successive color tone images follow one another so rapidly that when they are superimposed on one another at the receiver, they produce a satisfactory color image, similar to that scanned by the camera at the transmitter.

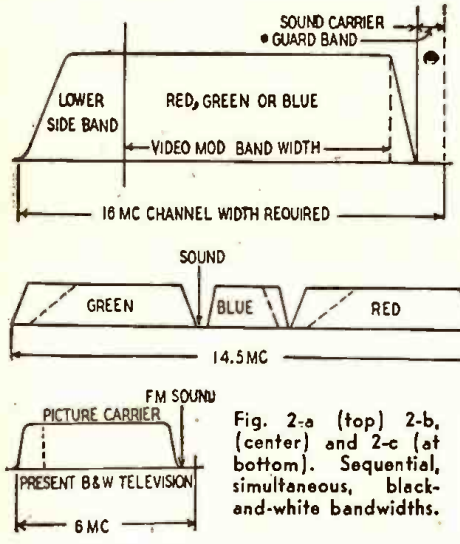


Fig. 2-a (top) 2-b, (center) and 2-c (at bottom). Sequential, simultaneous, black-and-white bandwidths.

The method of scanning the odd and even lines of the image progressively is shown in Fig. 3. At 48 color frames per second, each color scanning will occupy 1/144 second. Six color fields are shown in progressive scanning sequence. First the odd lines are scanned for red (by the red filter) in 1/144 second; next the even lines are scanned for blue. Third, the odd lines are scanned for green. In the fourth color field the even lines are scanned for red, in the fifth the odd lines are scanned for blue, and in the sixth field the even lines are scanned for green.

A complete color picture takes 1/24 second, as the diagram shows. This value was chosen as a happy medium—too low a number of pictures per second introduces an objectionable flicker; too many pictures per second unduly increases the carrier band width required.

Images with 525 lines have been found fairly satisfactory in the tests and demonstrations made by CBS; increase in detail has not been found to be in proportion to increase in the number of lines employed. Besides, as the lineage is increased, carrier band width goes up proportionately, thus reducing the number of stations that can operate in an assigned band.

Photos A and B show the CBS color television receiver; a diagram of the receiver appears in Fig. 4. This set is arranged for *diplex* (combination video and sound) reception. A color synchronizing separator amplifier is used to maintain the color disc motor in perfect step. The balance of the components corresponds to those found in the present black and white receivers.

One of the criticisms of the sequential receiver has been that it could not pick up B & W images by stations now on the air. The CBS report shows a *dual-band* CBS receiver that can receive both color images on the new u.h.f (480-920 mc) band and B & W pictures on the low-frequency (40-220 mc) band, by the addition of *four tubes*. A later circuit for a dual-band receiver submitted by Dr. Goldmark permits the reception of color and B & W images *without the addition of any tubes*. Suitable ganged switches are provided for changing the set for receiving either color or black and white pictures.

It is interesting to note that B & W images can be reproduced on the tube used for color images. *If the color disc is removed, a black and white image is observed on the screen of the cathode-ray tube.*

The size of the color image on the sequential receiver demonstrated by CBS was 7½ x 10 inches, the picture being magnified about 40 percent by a lens placed in front of the revolving color filter. The standard direct-viewing model color receiver (CBS sequential) employs 31 tubes, with a 10-inch picture tube. (The image size is 7½ x 10 inches.) Larger images, measuring 15½ by 21 inches, have been produced by a *projection-type* receiver (see Photo C and Fig. 5) utilizing a Schmidt optical system with a *truncated cone* revolving color filter. A recent model of such a receiver produced color images nearly the same size and used but 34 tubes.

(Continued on page 40)

Photo A—Color television receiver by CBS.

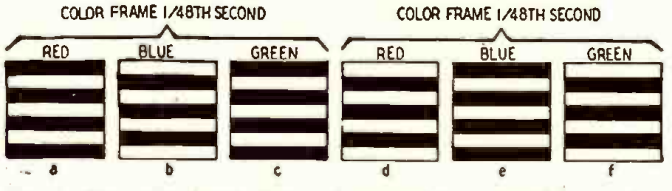


Fig. 3—The color interlacing method used in sequential scanning.

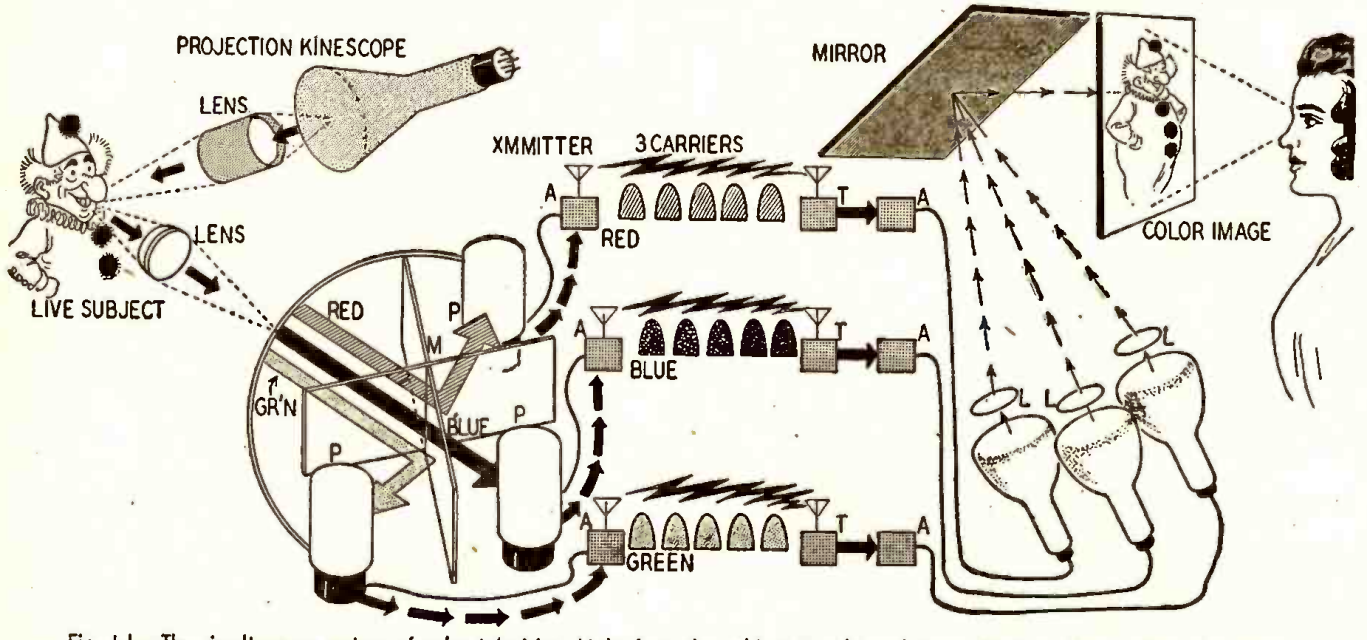


Fig. 1-b—The simultaneous system of color television. Light from the subject is split and transmitted on three adjacent carriers.

Cover Feature

Pioneer Atom Splitter

ELECTRONICS has played and is playing so great a role in nuclear research that it is impossible really to separate electronics and nucleonics. Thus it is not surprising to see on our cover one of the world's most distinguished atomic physicists checking a piece of obviously electronic apparatus.

The pictured equipment is installed in the Argonne Laboratory, University of Chicago, where two nuclear chain piles are now in operation. The electronic end of apparatus used in selecting, counting and studying neutrons, it is still in the "restricted" class. No detailed description of it can as yet be printed.

The physicist is Dr. Enrico Fermi, who has perhaps a shade better claim than half-a-dozen others to be considered the man who started the whole atomic ball rolling. He it was who first discovered that by slowing down neutrons, they could be made to penetrate the center of even the densest atom.

With an extra neutron in its nucleus, the unstable atom of uranium shook itself, gave off an electron, and became the new element Neptunium (No. 93) with an atomic weight of 239 (approximate). Other new *transuranic* elements never before known on earth were produced as the metamorphosed uranium atom tried to settle down.

Experimenting with the new transuranic elements, Drs. Lise Meitner and Otto Hahn of Berlin actually succeeded in splitting atoms. Fortunately for the future of the world, they did not fully understand at once what they had done. Meanwhile the Nazi secret police had discovered Dr. Meitner's Jewish ancestry, and she found it wise to leave the country. Spending some of her new leisure time in calculation (some say on the train which took her to Copenhagen) Dr. Meitner realized that the results she and Dr. Hahn had achieved could be due only to actual atomic fission.

Meanwhile, Fermi had also been repelled from the totalitarian field, and was in New York when Dr. Meitner and

Dr. Enrico Fermi, leader in atomic research.

O. R. Frisch announced from Copenhagen that the atom had been divided experimentally. The news came in a letter from Frisch to Professor Bohr, head of Copenhagen's Institute of Theoretical Physics, who was also a visitor to New York at the time.

Drs. Fermi and Bohr determined to check the results themselves, and arrangements were made to repeat them at Columbia. There, on the 25th of January, 1939, Professor Fermi had the satisfaction of seeing his slow neutrons break up atoms of uranium, releasing in the process the hundreds of millions of volts of energy that were later to supply power for the atomic bomb.

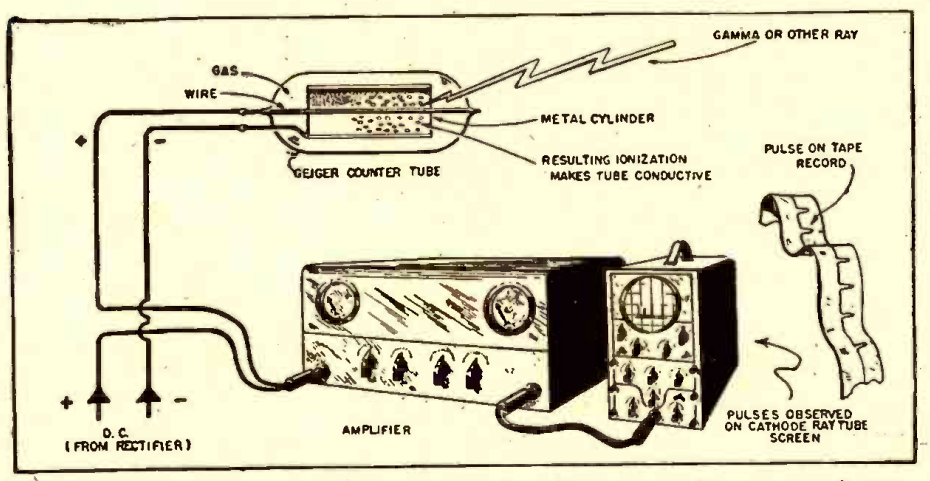
Fermi almost immediately discussed the possibilities of atomic power with the U.S. Navy. Armed with the new evidence of atomic fission, the scientists were able to interest the government. From that time little was heard of Professor Fermi until after the war. His important work on the atomic bomb was recognized by the United States by an award of the Medal of Merit on March 20th, 1946. The citation to Dr. Fermi reads:

> "As the pioneer who was the first man in all the world to achieve nuclear chain reaction, and as Associate Director of the Los Alamos Laboratory, Manhattan Engineering District, Army Service Forces, his essential experimental work and consulting service involved great responsibility and scientific distinction. A great experimental physicist, Dr. Fermi's sound scientific judgment, his initiative and resourcefulness and unswerving devotion to duty have contributed vitally to the success of the Atomic bomb project."

Atomic research apparatus

No less important than the personalities involved in the discovery of atomic fission are the electronic devices which made that discovery possible. The neutron itself is produced by bombarding atoms with heavy particles of hydrogen. The *cyclotron* in which this bombardment takes place is thus one of the most powerful of all atomic fission research weapons.

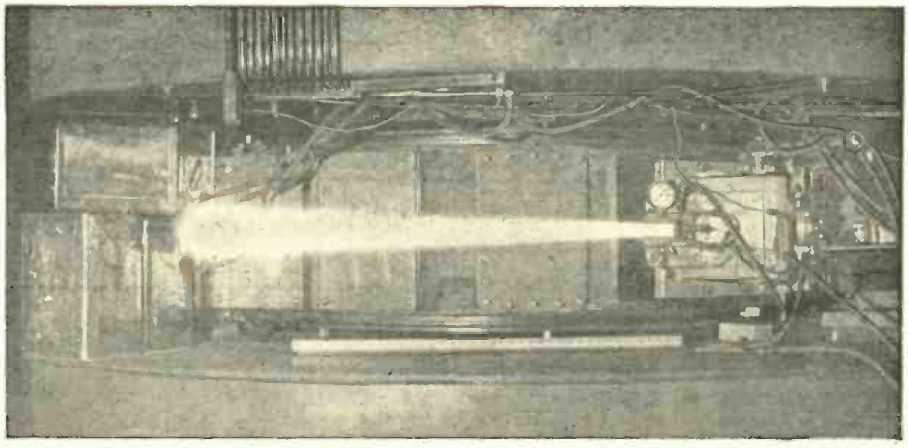
In its simplest terms, a cyclotron is a very large vacuum tube with a pair of hollow dee-shaped electrodes connected to a circuit oscillating at a high radio frequency. Heavy positively-charged ions of hydrogen (deuterons) are introduced into the tube from outside, and are attracted first by one of the electrodes, then the other, as the oscillating field changes in polarity. The whole tube is situated between the poles of an enormously strong magnet, whose field is in such a direction as to push the deuterons at right angles to their course. The result is that they travel in circles of increasing diameter. Each time they leave one dee and enter the other, they are speeded up by the attraction of the voltage ahead of them, caused by the r.f. field which changes polarity in step with the progress of the particle. Before the end of their course they have become veritable atomic bullets, or better, super-speed battering rams, ready to knock elec-



Simplified representation of a Geiger counter using cathode-ray oscilloscope as indicator.

trons, protons or neutrons out of the atoms they strike at the end of their path.

Another special type of electron tube much used in nucleonic search is the cathode-ray oscilloscope. The first news of atomic fission was flashed on a cathode-ray tube screen, in the form of voltage indications so high that no known force could have produced them. The scientist (Frisch) looking at the screen knew he could be seeing only one thing—the energy liberated by atomic fission.



Beam of deuterons emerging from the U. of C.'s Crocker Radiation Laboratory cyclotron.

The Geiger-Muller counter

If the cyclotron is a greatly-modified vacuum tube, the Geiger-Müller tube is a very ordinary one. It has been publicized to such an extent as to be possibly the best-known piece of atomic research equipment. Well known as a safety device to check radioactivity in factories which produce atomic fission materials, the terrain surrounding atomic bomb explosions, and similar areas, it is more important as a research instrument, and its invention was one of the notable steps in the advance of nucleonic science.

In its most common form, the tube is a small metal cylinder with a centrally-located wire, filled with various gases and pumped to a low vacuum. A high voltage is set up between the elements, with the central wire usually acting as the anode. Now any stray electron or negative ion will be attracted toward the filament-like anode, as in any other vacuum tube, and will appear as a current in the external circuits.

The voltage is held below the critical point at which the gases in the tube would ionize and produce a cold-cathode current (as in neon tubes and such rectifiers as the 0Z4 or the old Raytheon BH). A particle from outside (electron, proton or neutron) plowing through the gaseous atmosphere of the tube, leaves a trail of ionized particles behind it. Free electrons immediately move toward the central filament, knocking more electrons from the atoms they encounter on their way. The ions thus created drift toward the outer shell, and the electrons reach the central wire and create a brief pulse of current in the external circuit. The positive ions either reach the outer shell or recombine with electrons from other atoms, and the gas is again free from ions, ready for another "count."

By properly designing and adjusting the counter and its associated circuits, it may be made particularly responsive to certain types of particles. Thus one tube may have a heavy metal shell which stops anything but cosmic rays. Another may have a thin window to facilitate entry of weak, short-range emissions. Some Geiger tubes have even been made to operate in open space at atmospheric pressure, with no envelope. A steady stream of helium gas from a pressure tank directed between the two plates provides the type of gaseous atmosphere required.

By selecting the type of envelope, the gas content of the tube and the operating voltages, the counter may be made to register one type of particle and ignore others.

One of the most important types of Geiger tubes counts slow neutrons. The tube is filled with boron trifluoride gas and the voltage is adjusted within certain rather critical limits. The pulse produced by a slow neutron is then much stronger than that produced by any other type of particle, due to the reaction with the atoms of boron trifluoride. The counting circuit may be adjusted to select pulses caused by those slow neutrons and ignore the other particles. It is hardly necessary to comment on the value of such an instrument, in view of the crucial importance of the slow neutron in atomic research.

Standard vacuum tubes

The Geiger-Müller tube was invented before amplifiers came into general use. Its usefulness on its present level dates from the day its output was fed to vacuum tubes for amplification. With sensitive amplifiers, the tube may be made to record on a tape or otherwise

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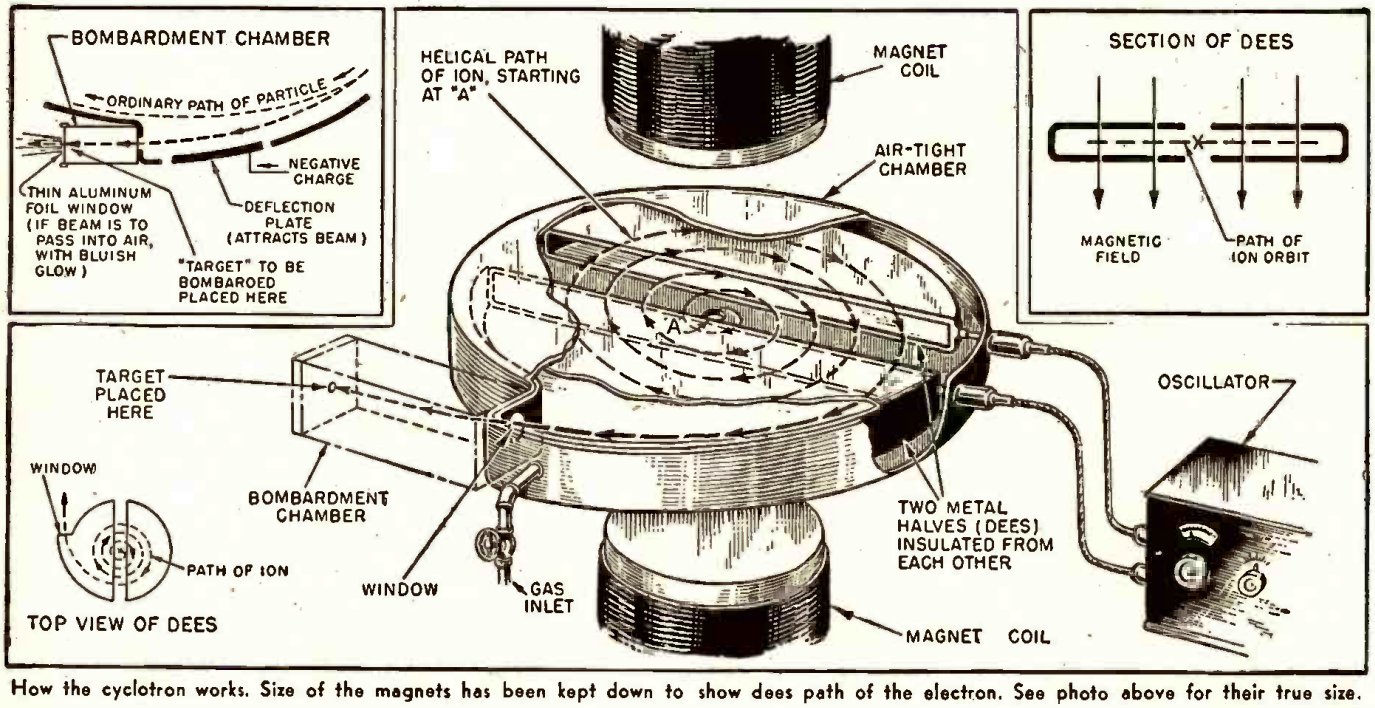


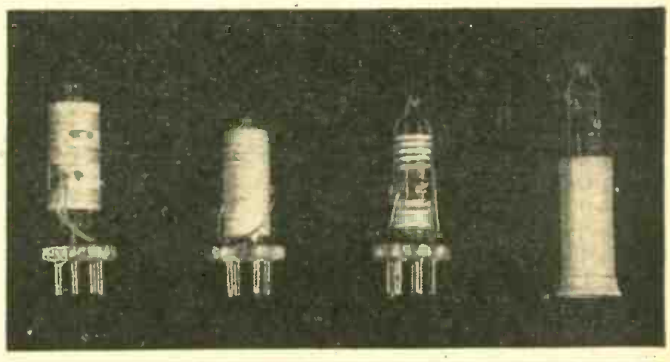
How the cyclotron works. Size of the magnets has been kept down to show dees path of the electron. See photo above for their true size.

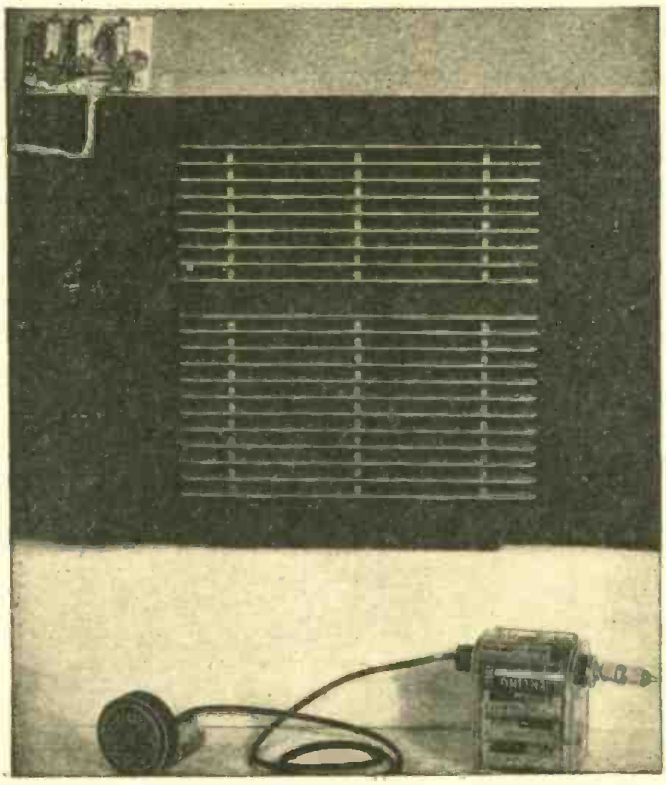
NEW SUBMINIATURE PRINTED CIRCUITS

PRINTING of electronic circuits is one of the important new techniques to evolve from research and development during the war. The practicability of the printing technique was first demonstrated in a program carried on by the National Bureau of Standards leading to the development of a tiny generator-powered radio proximity fuse. A paper written by Dr. Cledo Brunetti and W. J. Cronin, of the Bureau, describes construction methods and shows circuits of a number of very small transmitters and receivers made by the printing method. This article is largely an abstract of that paper. Since the war the art has advanced to the point where complete circuits may now be printed not only on flat surfaces but on cylinders surrounding a radio tube or on the tube envelope itself.

Several types of miniature microphones, speakers, and batteries are available as suitable components to complete the operating units. The units also operate satisfactorily with standard size microphones or speakers. The transmitter and receiver of Photo A were set up for demonstration before a large audience at the National Convention of the Institute of Radio Engineers in New York City, March 5, 1947. The transmitter is plugged into a comparatively heavy-duty power pack, while the standard size carbon microphone with matching transformer is plugged into the other end. The 2 x 3-inch receiver mounted on the 10-inch console speaker had sufficient power to operate the speaker so that it could be heard clearly throughout the crowded auditorium.

Logical auxiliary components for a portable unit would be a set of small hearing-aid batteries and a miniature crystal speaker or hearing-aid type of earphone. If the combination is to be used as a personal telephone, the transmitter and receiver may be combined to operate with the same set of miniature batteries. In this way a very compact portable unit is possible, which, including batteries, microphone, and speaker, may be easily slipped into a package the size of a man's ordinary wallet. Since arrangements can be made to insert batteries in flashlight manner, reserve battery capacity is usually unnecessary.





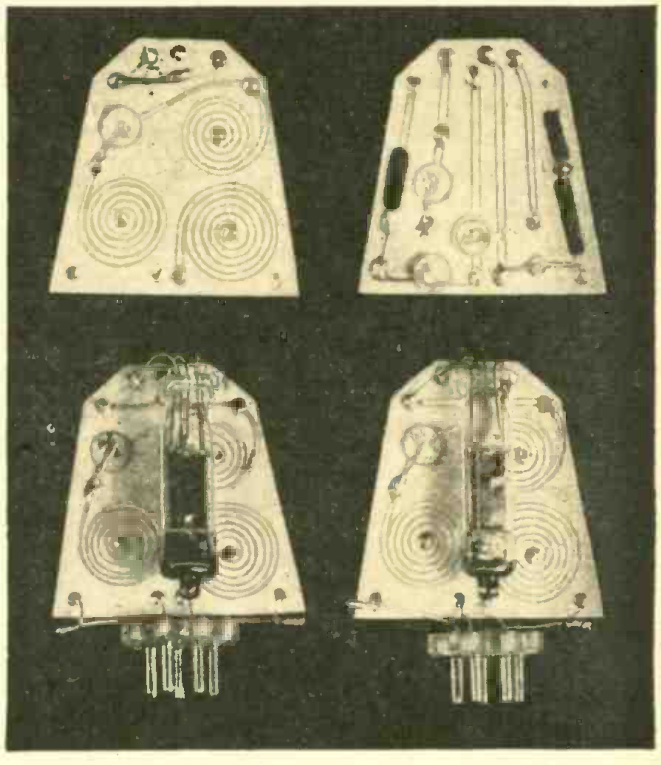


Photo A, below—Ten-inch console speaker operated by tiny 3-tube receiver, with signals from lipstick transmitter, shown plugged into its power pack. Photo B, right, top—A series of lipstick transmitters; below—Development of a printed-circuit steatite-plate transmitter.

Jobs for subminiature sets

For many uses, such as when taking inventory in department stores and speaking in public, two-way conversation is unnecessary. In such cases the portable unit consists only of a transmitter made up of a tiny battery pack, a subminiature tube with circuit painted on its envelope, and a tiny crystal microphone. The microphone conceivably could be clipped to a man's tie with a pair of light wires leading to the remainder of the unit, which may be housed in a package slightly larger than a penny matchbox and carried in the user's shirt pocket. The transmitted voice may be picked up on a standard receiver in an adjoining room and fed to a recording unit, to loudspeakers of an auditorium, or to any desired reproducing system.

In other cases, where distance of transmission is small or where conversation between a variable point and a fixed high-power transceiver is desired,

the complete portable unit could be extremely compact. An example is the case in which a field crew maintains contact with a base station or with mobile units, such as trucks or aircraft carrying moderate-powered transceivers. In another application, such portable units would dispense with the usual flagging methods of lining up commercial aircraft after landing or in assisting planes taking off or landing on aircraft carriers.

Personal radiotelephones could be valuable in many applications—for example, in factory and store, on farms, and by surveyors, hunters, and explorers. In addition there are numerous applications in crime detection and traffic regulation, in limited ship-to-shore communication, and in emergencies such as forced landings or isolating floods.

A simple 2-tube unit consisting of an oscillator and amplifier stage may suffice for these applications. One such unit constructed at the Bureau employs a microphone operating into an amplifier which modulates an oscillator coupled to an antenna. Pressing a button converts the unit to superregenerative reception. For receiving, a magnetic earphone may be operated from the amplifier stage.

Lipstick transmitters

Figs. 1 and 2 are the circuits of the first four transmitters of Photo B. They operate in one of the Government bands —132 to 144 mc—and were used in public demonstrations at Columbus, Ohio, and New York. On at least two instances, these subminiature transmitters "went on the air" over national networks with excellent results.

The sets of Fig. 1 are made in two types. The circuit is painted on the tube envelope in Type I, and on a steatite cylinder surrounding the tube in Type II. Sylvania or Raytheon miniature triodes are used for both types. In both transmitters, B is 120 volts, and C is a 7.5 μμf high dielectric ceramic capacitor, ⅛ inch in diameter by 0.030-inch thick. It is attached directly to the tube in Type I. M is a carbon microphone and T is a miniature microphone transformer. R is 50,000 ohms in each transmitter. Plate current in both sets is 3 ma and filament current is 0.2 ampere.

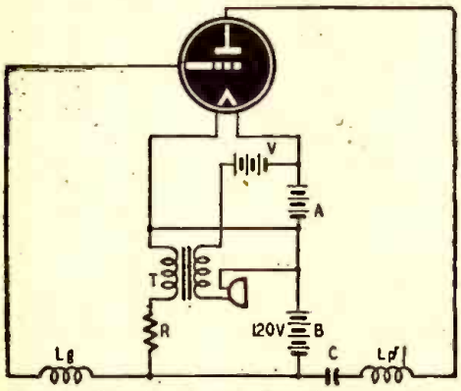


Fig. 1—Circuit of the lipstick transmitter.

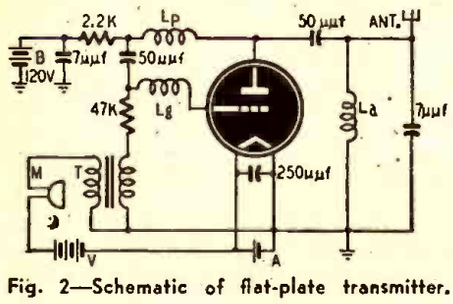


Fig. 2—Schematic of flat-plate transmitter.

Type I uses a Sylvania 6K4 triode, with 6 volts on the filament. Microphone battery V is omitted, since the 6-volt filament battery is sufficient. Lg is 4 turns and Lp 5 turns, of silver paint on the tube, as can be seen in Photo B. The 50,000-ohm resistor is also painted on the tube, with graphite paint.

A battery-type Raytheon subminiature triode is used in the transmitter of Type II, which has its circuits painted on a steatite cylinder slipped over the tube. Battery voltage A is 1.5, and an additional battery V of 4.5 volts is added for the microphone. Lg is 3 turns and Lp 6 turns painted on the cylinder, at approximately 16 turns per inch. The cylinder is 1 inch long, ½-inch outside diameter, and 1/32-inch thick.

The Type III transmitter (Fig. 2) is large by comparison, being printed on a flat steatite plate 1½ inches high by the same width at the bottom. It is shown in the lower section of Photo B. The battery-type triode with 1.5 volts on the filament is used in this set, and the coils are spiral-wound (painted) on the plate. (Old-timers who saw the helix go out forever in the '20s will reflect that there is indeed nothing new under the sun!) Lg and Lp are 4¾ turns each, "wound" to 7-16/inch outside diameter, and La is 5½ turns, ⅝-inch outside diameter. Frequency of the transmitter is 140 mc and that of tubular transmitters is 136 mc.

The lower part of Photo B shows the development of the flat-plate transmitter (both sides). The upper side carries the three spiral coils and a 50-μμf coupling capacitor. The lower side bears the remainder of the circuit wiring, including three resistors (the dark rectangles) and four capacitors. One of the resistors, though not shown in the circuit diagram, is connected to the grid coil. It serves as a blocking resistor for measuring the oscillator grid voltage.

The receivers in Photo C are wired with the circuit in Fig. 3. Two of the units shown in the photo are on steatite plates 2 x 3 inches (bottom) and 2 x 5 inches (center), respectively, while the third is on a 2 x 5-inch lucite plate. They employ a square-law detector stage followed by two stages of pentode amplification and a triode output stage feeding the loudspeaker. The input tuning is broad to allow reception over the complete band of 132 to 144 mc. If sharper tuning and additional sensitivity is desired, the input stage may be converted to one employing superregenerative detection.

Painting the circuits

Several types of paints were used, most of them obtainable commercially. A satisfactory silver preparation is a sodium-silicate paint known as Sauereisen Conductulute. Another suitable silver paint consists of powdered silver in lacquer solution, the consistency being adjusted with an acetate solvent. About 65 per cent of silver powder is used. Silver plating is found to increase the conductivity of the painted coils.

A resistor paint which dries at room temperature may be made of 27.5 percent graphite powder, 34.5 percent methyl-methacrylate lacquer, 29 percent toluene and 9 percent lampblack. More

(Continued on page 65)

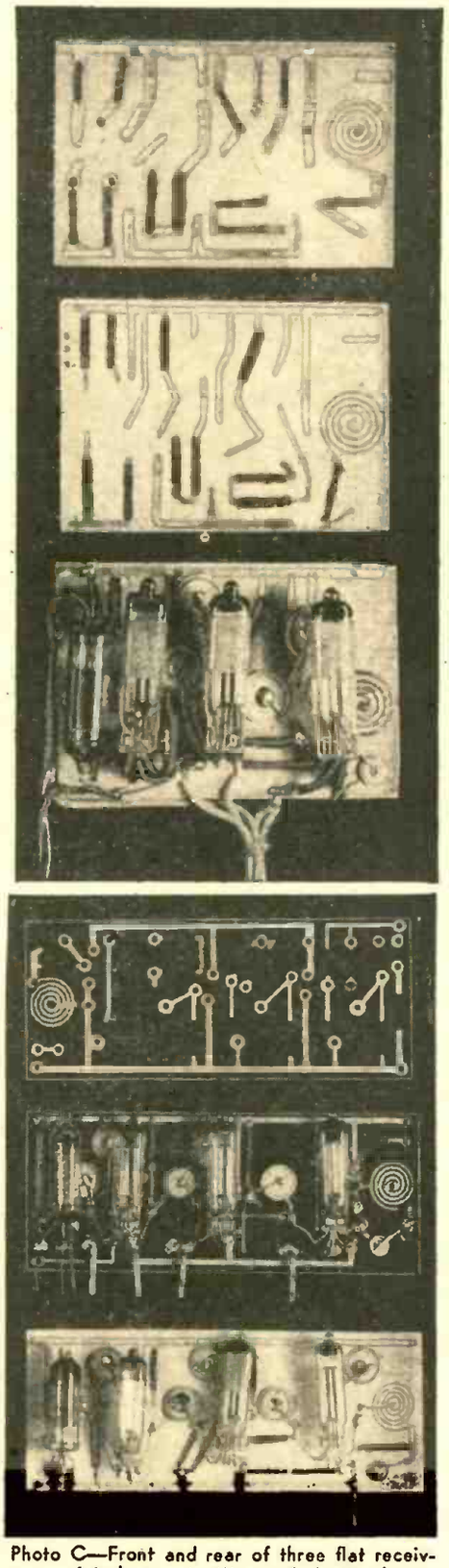


Photo C—Front and rear of three flat receivers, printed on steatite, and lucite bases.

"Shooting Stars" Tracked By Radio

By S. R. WINTERS

NOT being content with having transmitted signals to the moon, radar researchers are now contacting shooting stars as they plummet to earth! Or, more accurately stated, the National Bureau of Standards is employing radar as a means of studying ionization produced by showers of meteors as they shoot through space.

On scopes or screens of radar equipment at the Bureau of Standards' station at Sterling, Virginia, echoes from the meteor shower identified with the Giacobini-Zinner comet were plainly visible during a 5-night period between October 7 and 12, 1946. The signals were intercepted by a standard Signal Corps SCR-270-D radar outfit, functioning at 107 megacycles and sending 25-microsecond pulses at a rate of 400 per second. The maximum power employed was 100,000 watts. The radar antenna, composed of 32 dipoles arranged in a rectangular fashion, was adjusted at an azimuth of 315 degrees and at a height of 45 degrees. The width of the main beam of the antenna was about 40 to 20 degrees between half-power power points. The major axis was vertical.

Radar signals were viewed on both the A and PPI oscilloscopes. A photographic impression was kept of the PPI manifestations. The A scope or screen was operated by an experienced technician, who maintained a record of the time, range and duration of the pulses. The shower of meteors, according to a forecast by astronomers, was expected to attain its peak on the night of October 9. Actually, the rate of the shooting stars climbed from about 8 per hour between 7:30 pm and 8:30 pm to a maximum of more than 1 per minute between 10:30 and 11 pm. The recorded facts coincided with the anticipated period of 10 o'clock for the greatest intensity of the Draconid comet shower. Following this peak, the rate of occurrence dropped to about 20 meteors an hour after 11:15 pm. The distance range was from 60 to 209 miles. The transient radar reflections lasted generally about 1 second or less, although an appreciable number had a duration of several seconds. The Bureau of Standards reports that only a few of the signals seemed to change distance during the period that they could be seen on the screen, and this slight shift was only 5 miles or less.

Bright traces on screen are meteor tracks.

Simultaneous but independent observations were made by the Signal Corps in New Jersey, employing radar sets at a frequency range of 600 to 1,000 megacycles. Results were apparently negative. But according to an appraisal of the Bureau of Standards, in final analysis these negative findings were significant in that they suggested "that the ionization density reached in these meteors is such that the upper limiting frequency which they could reflect is between 100 and 600 megacycles."

Detecting meteors by radar is not merely a spectacular "show". This radar investigation of meteors is being made because of the probability that meteors

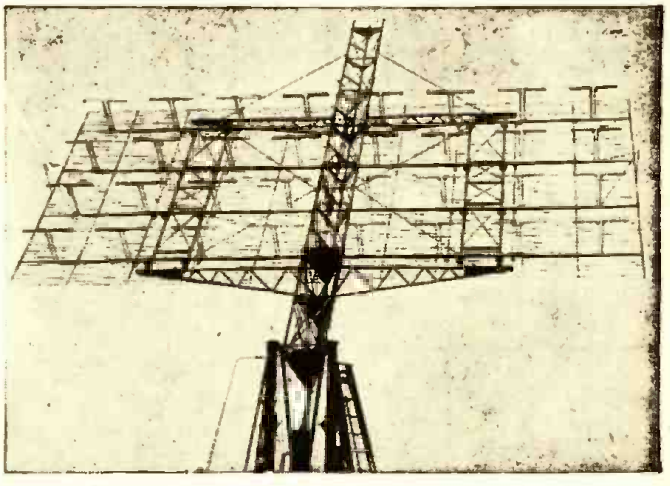
(Continued on page 72)

S. R. Winters, who claims to be "the oldest professional writer on radio subjects" in the United States, was born on a farm in Granville County, N. C.

Starting life as bookkeeper and freight handler, he learned the Morse Code and became station master in a small station. Later he worked his way through the University of

North Carolina as printer, also by writing sketches on scientific and biographical subjects connected with the University, thus beginning his career as scientific writer.

Began writing on radio telegraphy before broadcasting started, publishing articles in Wireless Age and later in Radio News. Since then has contributed to practically all the radio and scientific publications in the United States, his articles having been published in more than a hundred magazines and papers.



Receiver console and antenna of the SCR-270-D radar used by the Bureau of Standards to track meteors. The hooded equipment is the camera.

ANTENNA PRINCIPLES

PART VII---Parabolic reflectors as antennas

By JORDAN McQUAY

U. S. Army Signal Corps Photo

Photo A—An antenna for 10-centimeter waves.

DIRECTIONAL antennas operating in the true microwave region —at frequencies higher than 1,000 megacycles—take on physical and electrical aspects entirely different from those operating at lower frequencies.

Radio waves only a few centimeters in length have many of the characteristics of infra-red light waves. They are reflected by almost any surface or object with little or no loss of power. The waves may be refracted by differences in air layers between transmission points, or by reflected impedances along a transmission path. Many of the principles of optics—particularly laws governing the operation of lenses—are applicable to microwaves. After being focused into a narrow beam of energy, microwaves can be propagated from point to point like a narrow beam of light. Microwave antenna systems make use of all these quasi-optical properties of centimeter waves. Microwave propagation—from point to point—is always along *direct* or semioptical paths. There is no ground wave. And the sky wave is of no practical use in propagation.

The usual laws of antenna reciprocity apply to u.h.f. technique: a good radiator or transmitting antenna is a good receiving antenna. Both function more than 30 or 40 wavelengths above ground. Thus, microwave antenna systems can be considered as operating in free space, without ground effects.

Polarization is important only in that both transmitting and receiving systems must be identically polarized. In practice, horizontally polarized microwaves are more generally used.

Directional antenna arrays* are inadequate for operation at wavelengths less than about 30 centimeters (frequencies greater than about 1,000 megacycles)—because of the close proximity of elements of the array and general structural difficulties. At shorter wavelengths (or at higher frequencies), entirely new systems of microwave transmission are necessary.

Progressing downward, in terms of wavelengths, there are three principal types of such systems.

Parabolic reflectors are the most widely used means of transmitting and receiving microwaves in the region between about 30 centimeters and about 3 centimeters.

Electromagnetic horns function in the region between about 20 centimeters and 1 centimeter. Theoretical rather than practical, use of such horns is largely confined to the experimental laboratory. However, some are used to *feed* parabolic reflectors.

Metal lens systems — newcomers to the microwave field—are practical for operation in the region between 10 centimeters and less than 1 centimeter, providing extremely narrow beams of microwave energy.

Parabolic reflectors

A highly directional beam—for radiating and receiving quasi-optical microwaves—follows the laws of optical reflection.

Light waves are so reflected from a smooth mirror surface that the angle made between the reflected wave and the surface is equal to the angle made between the incident wave and the surface.

A concentrated beam of parallel light waves is formed when a point source of light is surrounded by a mirror-surface of such shape that—due to the above law of light reflection—parallel waves are produced in a very intense and directional beam.

A reflecting surface satisfying this requirement is a rotational parabola (Photo A), a type of mirror having an *axis* and a *focal point*. The focal point is located along the center axis of the parabola.

When a source of light is situated at the focal point, all light waves incident on any part of the parabola will be reflected in such a way that they travel outward, parallel to the axis of the parabola (Fig. 1.) The source of light waves must be small to obtain a well-focused beam.

To concentrate *all* radiated light into the parabolic reflector, a very small hemispheric reflector is used (Fig. 1) to prevent outward radiation from the point source of light and thus limit the beam to the desired parallel waves.

The analogy with microwaves is identical. They can be reflected and focused exactly as in Fig. 1, using a rotational parabola as a reflector behind a source of u.h.f. radiation. When the source is situated at the focal point of the parabola, a narrow beam of microwave energy can be directed toward a similar receiving parabolic device.

The reflector should be *at least* 10 wavelengths from edge to edge.

The antenna in Photo A operates at a wavelength of about 10 centimeters, and is used for the transmission and reception of radar pulses. The complete equipment is used by the U. S. Army for tracking down aircraft, and a considerable part of its accuracy depends upon proper functioning of the antenna system. A dipole radiator is contained in a small weatherproof enclosure at the focal point of the parabola. And the entire antenna system can be rotated and moved in elevation to provide high power gain in any direction.

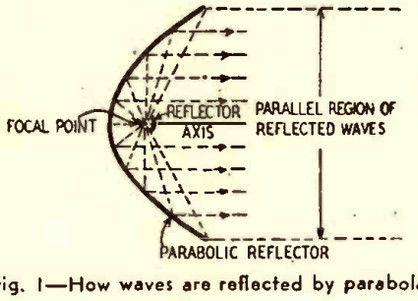


Fig. 1—How waves are reflected by parabola.

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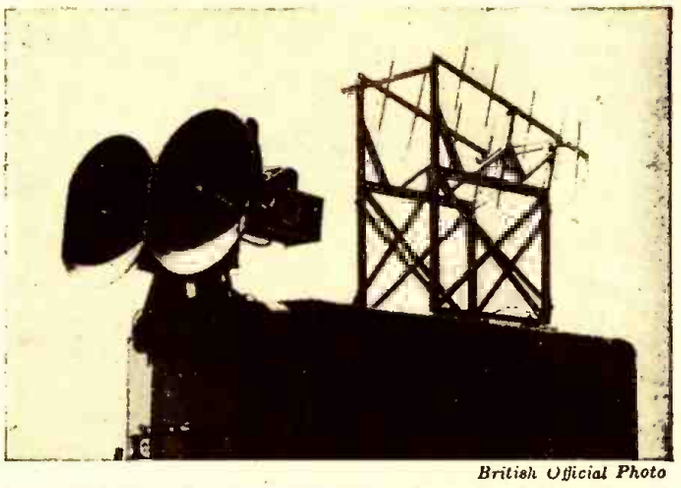
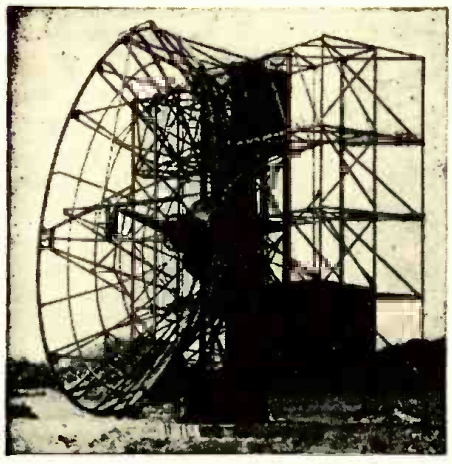


British Official Photo

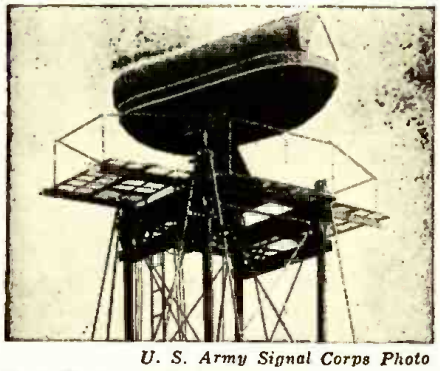
Photo B—Twin reflectors used in 9-centimeter anti-aircraft radar.

*Discussed in the April and May issues of RADIO-CRAFT.



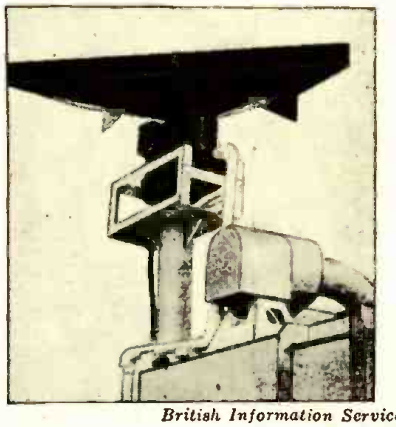
British Official Photo

Photo C—A 35-foot parabola for 50-cm waves.



U. S. Army Signal Corps Photo

Photo D—A modified-parabola radar antenna.



British Information Service

Photo E—Radar antenna on Queen Elizabeth.

A *pair* of dipole-fed parabolic reflectors (Photo B) are used in British anti-aircraft microwave radar equipment, operating at a wavelength of less than 8 centimeters. One transmits u.h.f. pulses, the other is used for receiving.

Parabolic reflectors are restricted normally to wavelengths of less than about 10 centimeters. However, a number of systems were developed during the war which operate as high as 40 or 50 centimeters, with corresponding increase in the physical size of the structure and components. One such arrangement (Photo C) is the antenna system used with fighter-director radar and ground-control equipment by the Royal Air Force. The antenna is a dipole-fed parabolic reflector 35 feet in diameter. An almost-invisible screen is used as the reflecting surface of the parabola. Remainder of the antenna consists of structural supports and rotational gear for moving the antenna in azimuth.

The inner or reflecting surface of any parabolic reflector must be metallic—preferably copper or other highly conductive metal. Small parabolic reflectors may be constructed of any solid weather-resisting substance, provided the inner reflecting surface is smooth and coated with copper or other conductive metal. However, the presence of holes or perforations in the reflector does not alter its effectiveness, if such apertures are no greater than ⅛ wavelength in diameter. Thus extremely large parabolic reflectors (as in Photo C) can use any sort of wire mesh or screen meeting these aperture requirements.

Perforations, holes, or openings—when no greater than ⅛ wavelength—do not detract from the operation of the parabolic reflector. They serve principally to minimize wind resistance for certain outdoor installations, or when sheet metal may not be available or desirable.

Other parabola types

A reflector consisting of a rotational parabola (A in Fig. 2) is circular in shape when viewed along its axis, and concentrates energy almost equally in all planes. Thus the horizontal and vertical radiation patterns are practically similar in shape—providing almost equal directivity in both horizontal and vertical fields.

To concentrate a high percentage of the u.h.f. energy in either the horizontal or vertical field, a *cylindrical parabola* (B in Fig. 2) is used—having a focal *line* instead of a focal point. A cross section of this type of reflector appears as a parabola *in only one dimension*—and that dimension is the plane of greatest directivity of the u.h.f. beam. Often the open ends of the cylindrical parabola are closed to provide slightly greater power gain.

Other variations (C and D in Fig. 2) consist of narrow sections of rotational parabolas, having closed ends or closed sides. These are known as *sectional parabolas* (sometimes called *cheese-boxes!)* and are found in an extreme variety of sizes.

They provide extreme directivity in particular planes of the radiation pattern. In general, the beam width is inversely proportional to the width of the sectional parabola. And the resulting radiation beam is sometimes known as a "fan" beam.

Often parasitic elements are added to one of these parabolas to further improve or in some way influence the pattern of radiation according to some particular microwave requirement. Such an antenna (Photo D) provides a beam of extreme directivity for radar searching purposes, but the beam in the vertical plane is affected by the parasitic (lower cylindrical) element so that none of the energy is dissipated downward.

Sectional parabolic reflectors are generally fed by an open-ended wave guide or by an electromagnetic horn terminating a wave-guide system. Either method provides a "spray" of u.h.f. energy against reflecting portions of the parabolic surface. The resulting directional (output) pattern, however, is determined largely by the physical shape and dimensions of the reflector itself.

A very narrow sectional parabola is used on the flying bridge of the British liner *Queen Elizabeth* (Photo E), providing a short-range but high-definition searching beam for the ship's radar equipment. The parabolic reflector functions on about 7 centimeters, and is fed by a conventional wave-guide system. The radiation pattern is narrow in the horizontal plane, much wider in the vertical plane, making the antenna system useful for precision sea-search radar. A long-wave long-range radar for detecting and locating aircraft uses a parabolic antenna, and completes the radar installation on the Queen Elizabeth.

An "open" sectional parabolic reflector (photo F) is used with Western Electric radar designed for American

Photo by Western Electric

Photo F—Radar antenna for merchant marine.

ships, now in service on inland waterways. This is just another of the endless variety of shapes and sizes of parabolic reflectors.

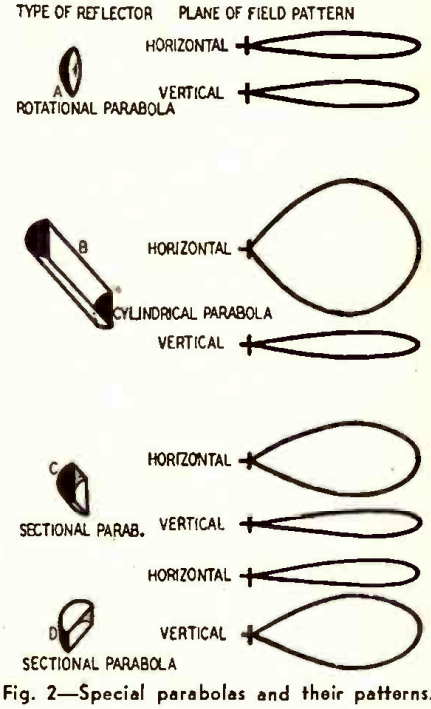


Fig. 2—Special parabolas and their patterns.

NOISE ELIMINATION

By JACK KING

NOISE in many receivers, particularly in large cities, presents one of the serviceman's hardest jobs, in getting the noise out of the radio, or in reducing it to so much lower level that the customer can notice a decided improvement.

If the noise is in the receiver the job may not be very difficult, but if it is due to external causes getting rid of it is likely to be a difficult matter.

One of the best ways of attacking the problem is to listen to the noise. Make an effort to identify the noise generator by its characteristic sound. Vacuum cleaners produce a sort of whining or whirring noise, electric razors produce a series of loud sputterings much like an old-time spark transmitter, and neon signs and various other types of devices produce sounds which, with experience, can be identified. For example, the noise of a d.c. motor is easily recognized once it has been identified and associated.

A small portable receiver, battery-powered and equipped with a loop antenna, may be used to run down the noise. When the loop is in the same plane as a line drawn toward the noise source, noise pickup will be strong, and when the loop plane is at right angles to the source, minimum noise will be heard. When the approximate direction of the noise source is known, the field is narrowed down considerably and time is saved.

In some cases, a little adroit questioning may lead directly to the cause. If the customer states that it is heard only at definite times of the day or night, the time is a clue. If the noise is heard only when a telephone is dialed or a refrigerator swings into action, the sources are perfectly obvious. If trouble appears only when the drugstore downstairs is open and its neon sign is lighted, it requires no great stretch of the imagination to decide that the neon sign is causing the trouble. This can be checked with the druggist's cooperation.

It is good practice to take the portable receiver with you to check the sign. If the noise dies out on it when the sign is shut off, it is probably defective and should be gone over by a sign man.

Usually the owner of the sign will listen to reason and will be glad to do anything practical if not too expensive to get rid of the interference. In some cases this may involve merely having the sign company put the sign in proper working order. In others it may call for the application of a heavy-duty filter to the sign to cut down the noise.

The basic circuit of a simple filter is shown in Fig. 1. In some cases the high-voltage transformer may develop leakage and the leakage current may result

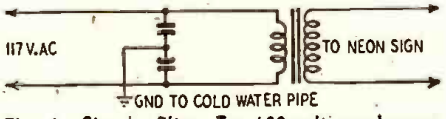


Fig. 1—Simple filter. Try 600-volt condensers from .01 to 2 μf, smaller sizes first.

in excitation of the distributed L and C to produce damped oscillations. Replacement of the transformer will get rid of the noise without a filter in such cases. If the filter is used, the radioman will often find it more practical to get an electrician to install it with BX cable and a box rather than attempt to handle the heavy wiring himself. Of course, if you have an electrician's license you can do it yourself.

Sometimes a human problem is involved. The whole neighborhood may be bothered by the noise, but no one wants to pay to get rid of it. If a number of people chip in and present the owner of the sign with the filter, he will usually cooperate by letting it be installed—

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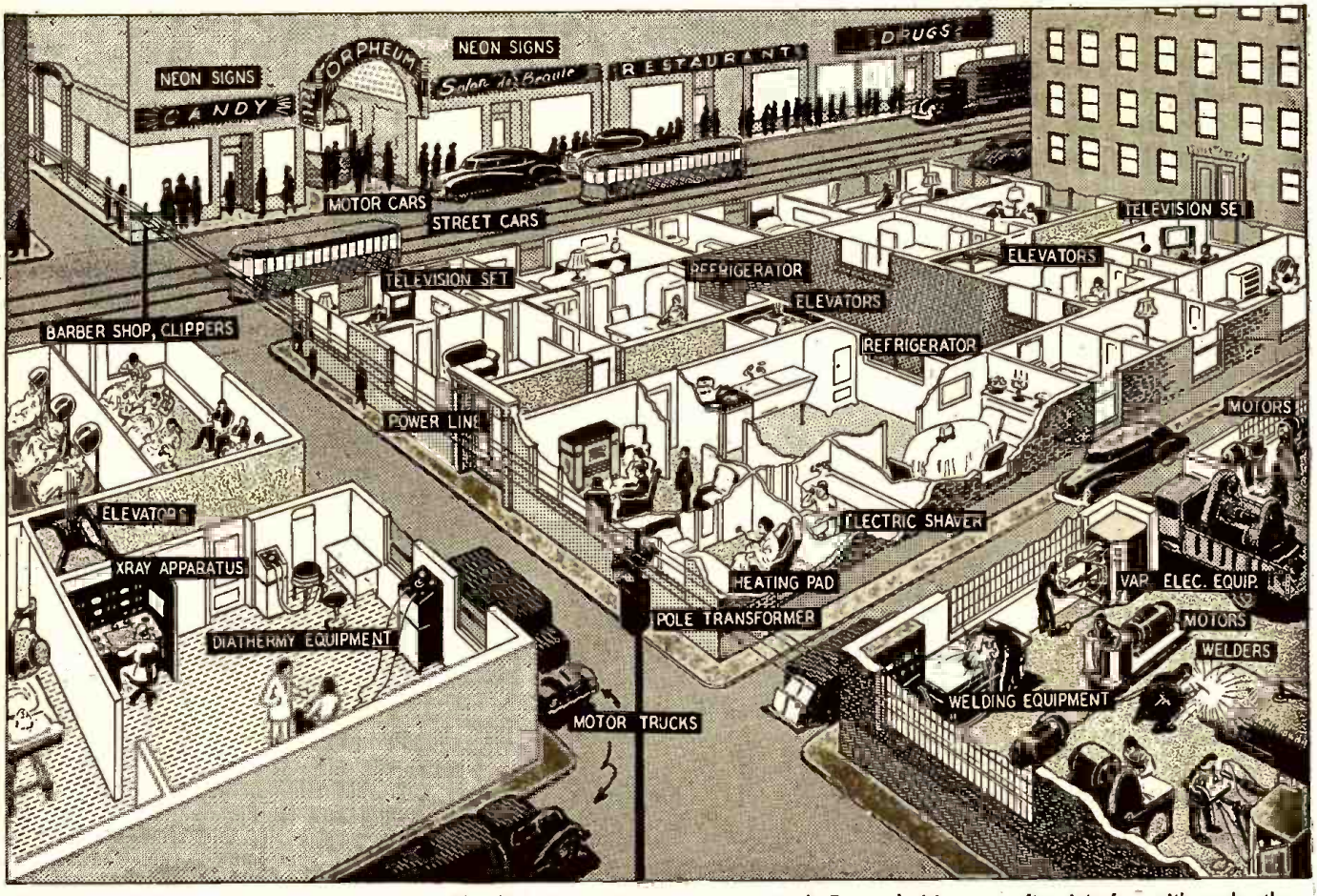
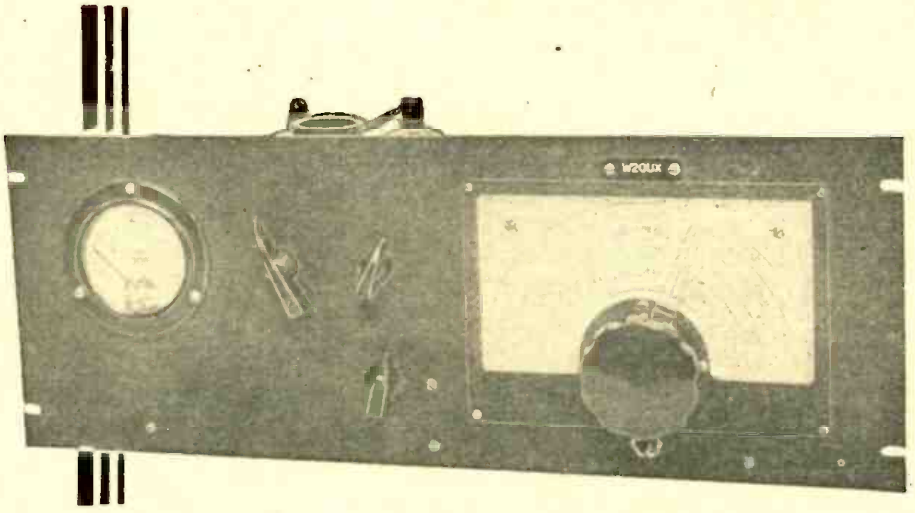


Just a few of the many types of interference with which the serviceman must contend. Even television sets often interfere with each other.



V.F.O. EXCITER OR TRANSMITTER

Part I—Variable-Frequency Oscillators

By I. QUEEN, W2OUX

BEFORE the introduction of quartz crystals, all transmitters were controlled by variable-frequency oscillators. The advantages of the crystal oscillator over the old Hartley or tuned-plate, tuned-grid circuit were so great that the crystal reigned supreme for a number of years.

With the increase of QRM which has come with the great upsurge in the number of operators on our narrow bands, even a transmitter with several crystals cannot guarantee a clear channel for a reasonable part of the time. Many hams have turned again to the variable-frequency oscillator (v.f.o.) as a solution to the problem. Of course the modern rig is incomparably more stable than the old self-excited transmitter circuit.

We have built and operated several v.f.o. transmitters here at W2OUX during the past few months. This means of frequency control has a number of definite advantages. The disadvantages are equally definite, and at first glance seem far more numerous than the advantages. Fortunately these problems can all be solved very satisfactorily, and the few advantages far outweigh all the disadvantages combined.

Variable-frequency control is at its best in a simple, low-power rig. These suffer first and worst when QRM begins to cover the band, but a highly "mobile" frequency permits change in frequency as required. Since a channel that is clear one minute may be hopeless a few minutes later, quick tuning is necessary. There is no advantage in frequent retuning if "umpty" amplifiers, doublers, or quadruplers must be resonated each time. In a multistage transmitter it may be better to incorporate 10 or more crystals and switch in the one that gives the best opportunity for QSO at the time.

There is no question about the superiority of the crystal transmitter where stability is concerned. It is simple to design, especially since harmonic type crystals have become available. A single tube can give an output at 15 or 20 meters, to be further divided as desired. A v.f.o. requires 2 or 3 stages to obtain the same output as that of a crystal stage. Turning a dial to reach a desired frequency is not as easy as throwing a switch. The variable-frequency oscillator usually is designed to operate at 80 or 160 meters and this requires a whole row of doublers or quadruplers to reach the higher frequencies. Any slight instability (such as chirp or drift) is then multiplied by the order of the harmonic.

Some hams have been quick to adopt and keep v.f.o. technique, while others maintain that crystal control is far superior all around. This difference in opinion is reflected in modern amateur transmitters, both commercial and home-built. Some are designed for exclusive crystal control, others feature v.f.o. control; with crystal control as optional in other cases. A 3-stage, highly stable v.f.o. rig is now being operated at W2OUX with very satisfactory results. Reports are "T9 crystal" and the tuning is as easy as with any crystal rig we ever built. This transmitter will be described in a following issue.

Oscillator design

The basic difference between the two types of control is in frequency stability. Mechanical and electrical disturbances have little effect on a quartz element, but special precautions must be taken with self-excited oscillators. The v.f.o. stage must be completely shielded and its tank must be high C in order to obtain a high-Q circuit. At 80 meters about 500 μμf of capacitance should be available. With such a high-C tank, changes in resistance or capacitance in the following stages have little effect on frequency. Likewise, mechanical disturbances such as table vibration are negligible, because the large tank capacitor masks the effect of minor changes in capacitance.

In precrystal days, the large capacitance was made up by an enormous variable condenser, often of 1,000-μμf maximum capacitance. The modern method is to use a fixed capacitance as well as a variable condenser. This is possible only when low-temperature-coefficient condensers (ceramic type) are used.

Even in a well-designed transmitter, there will be a slight reaction on the oscillator from succeeding stages. Therefore all stages should be of rugged construction with short, direct wiring.

Isolation precautions

The oscillator must be carefully isolated from other stages and from antenna radiation pickup. A strong field will block the oscillator and cause a chirpy note on continuous wave. Completely shielding the oscillator will eliminate this difficulty and will prevent direct pickup from succeeding stages.

The oscillator frequency may be as stable as that of a crystal when no loading is present. When buffers and amplifiers are added, their loading effect may vary (as during tuning). Even slight changes in antenna loading caused by swinging may be fed back through amplifier stages to cause a corresponding frequency change. It is good practice therefore to follow the v.f.o. stage with at least one class-A buffer, in which the grid never goes positive and therefore does not take any power from the oscillator.

Reaction on the oscillator may take place through grid-plate capacitance coupling in the buffer tube. Best buffer action is obtained by using tubes which have a low grid-plate capacitance. Type 802 is one of the best for this purpose, but it is expensive and is not available as a surplus item. Fortunately, the 6F6 is also excellent, its capacitance being only about half that of the beam tubes 6V6 and 6L6. Beam tube 807 is rather large for a buffer but it makes a good final or exciter for a higher-power final because it has a low capacitance.

Tone quality

Under ordinary conditions the output of a high-C oscillator with an amply filtered power supply will be T9X, but conditions are not always "ordinary." During early experiments we ran into an unusual difficulty in this respect. Monitoring showed that the output of the v.f.o. rig was "crystal" until an antenna was connected. The quality then dropped to a rough, modulated T7, although a crystal rig set up alongside and using the same power supply sound-

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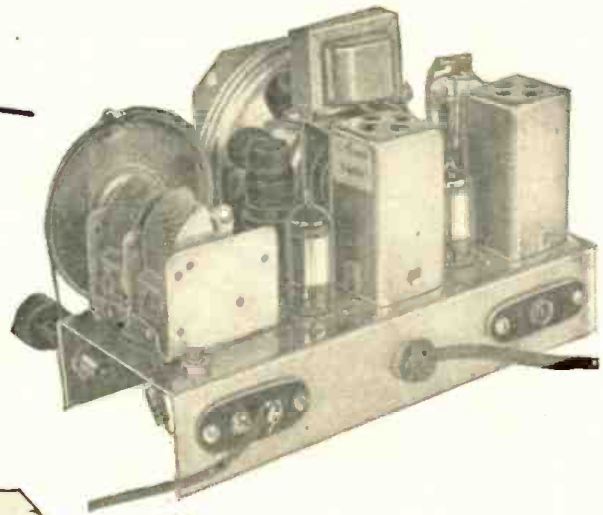
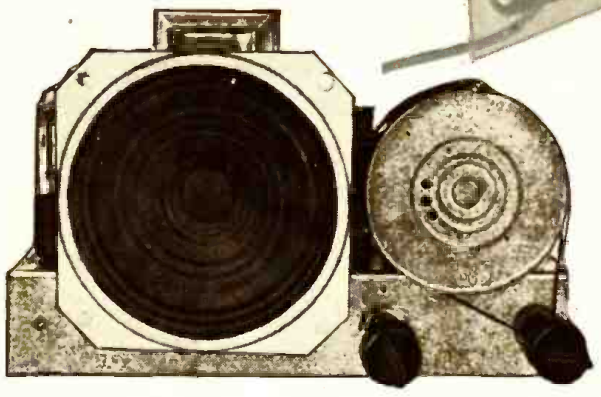
Battery Superhet Uses Three Tubes

By WILLIAM HEDRICH





The little set, built on a base 8 x 3 inches, is well laid out. While number of tubes is low, this circuit often gives excellent results. A little regeneration may add to sensitivity greatly.

THREE tubes are used to give full 4-tube results in this small portable superhet. Operating on but one small 45-volt B-battery, and two flashlight cells, this set makes an ideal vacation companion, regardless of how far you are from the power lines.

The little set was designed around the three following modern battery-type tubes, requiring a plate and screen potential of only 45 volts: 1R5 as mixer-oscillator; 1T4 as i.f. amplifier; 1D8-GT serves as 2nd detector and 1st and 2nd audio stages. The battery drain is very low, A drain being 200 milliamperes, and B drain being about 7 mils. The set makes an ideal personal portable for the beach, the summer cottage or picnic. It also makes an ideal bicycle radio, using a fishpole automobile-type aerial. In this case use the bike frame as a ground.

A piece of sheet steel or aluminum, 6 x 8 inches, serves as a chassis. The author used 20-gauge aircraft aluminum, which was very satisfactory. It is well to lay out and drill all holes before bending the sheet. Lay out the various lines on the chassis with a sharp-pointed instrument such as a scriber. Never use an ordinary pencil for this work, as the sharp point will wear away, causing inaccuracies. Be sure and center-punch all holes before drilling. Bend sheet back 1½ inches each side, to give a finished base 8 inches long x 3 inches wide x 1½ inches high.

Mount all the parts before doing any wiring. This will save your temper if later on you find that the volume control has to be removed and the oscillator coil put in first.

Standard parts are used throughout. Any good set of antenna, oscillator, and i.f. coils will work. Those on the set were Meissner 14-1022 antenna, 14-4034 oscillator, 16-6658 input and 16-6660 output i.f. transformers. A 2-gang 365-μμf variable condenser with trimmers is used, and the padder condenser has a maximum capacity of 350 μμf.

Good soldered connections are a "must" in a set of this small size. Use a good grade of stranded hook-up wire and keep all grid and plate leads as short and direct as possible. Be especially careful in soldering to the small miniature tube sockets used to support the 1R5 and 1T4 tubes. Use only enough solder to make a good sound connection, and do not let solder or rosin run over to adjacent terminals. Grounds are made to soldering lugs placed under screws. Stick to the layout as closely as possible, as this will permit short leads. There are no coils to wind, and either a built-in loop aerial or a midget antenna coil may be used.

Wire the set in the conventional manner—filament circuits first, then grids and plates. Although there is no trick in wiring or building this little set, it is well to take your time, unless you are familiar with wiring multitube circuits.

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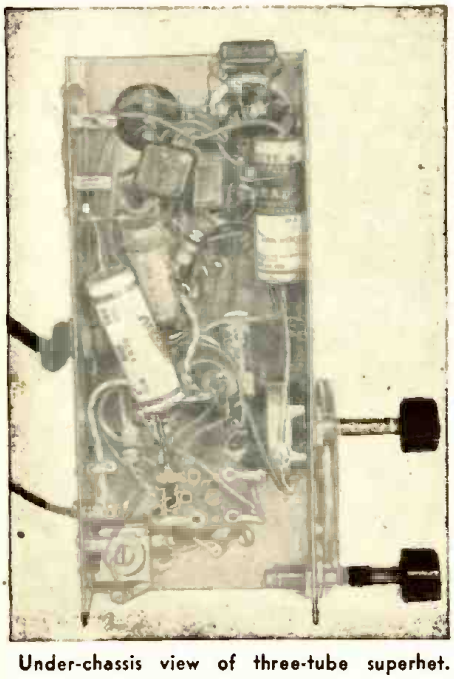
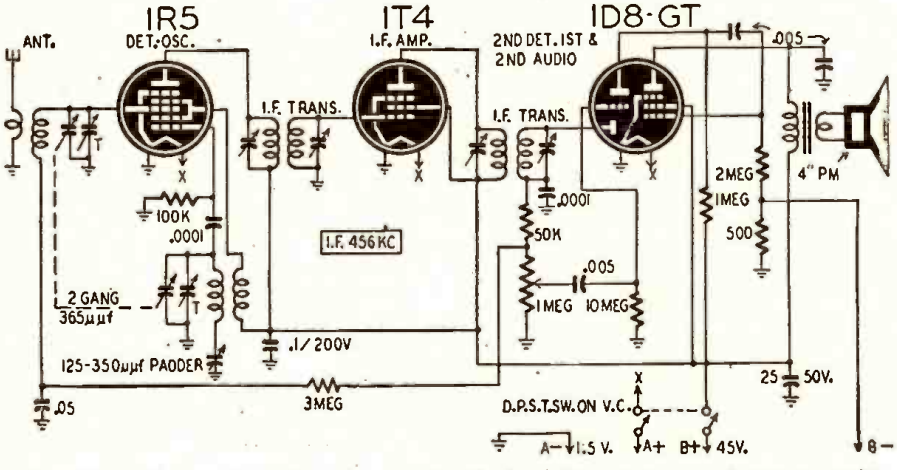


Under-chassis view of three-tube superhet.



Schematic of the receiver. Fixed bias used with the 1D8 output tube improves quality.

A Small Recording Studio

PART IV—Operating the recording equipment. Speed, needle and record cut considerations.

By J. C. HOADLEY

TO insure consistently good recordings, preventive attention should be given to the possible problems before they occur. First check carefully alignment of the lead screw assembly and its working parts. Be sure there is no binding of any of the gears, however slight, as it will cause wow. It is feasible to use a little grinding compound to lap the gears into a perfect fit. Of course, this should be done cautiously, or excessive play will be produced.

Be sure the cutter carriage moves smoothly and contains no excessive oil. Be certain there is no play in the cutter mount bearings, as even a small amount may cause bouncing of the cutting head —see Photo A for example of the results. It should move freely in a vertical direction, so as to follow—without variation in cutting depth—the contour of a slightly warped blank.

After you are sure the mechanism is operating properly, adjust the motor drive (if it is adjustable) until it delivers sufficient power without excessive vibration. Adjusting the motor too tightly against the idler wheels on a rim-drive recording motor causes transmission of excessive vibration and also a slight reduction in the speed of the turntable. Be sure that the rubber idler wheels are clean and free from oil—see Photo B. They should not be over-oiled. If they need cleaning, use carbon tetrachloride or gasoline. Be sure also that the turntable rim is smooth and clean. Even a small insect mashed against it can cause considerable noise and wow.

The cutting needle

The next important consideration is the insertion of the cutting needle in the head. Sapphire and stellite needles are the types to use; sapphires will yield slightly quieter recordings and will last several times longer. They come in two lengths and it is necessary to choose the proper needle as specified by the manufacturer of your cutter.

The needle should be inserted into the chuck as far as it will go, with the flat on the needle shank pointing forward where it will be engaged by the setscrew. The flat side of the cutting point should face *the back of the cutter head.* The angle of this flat with the surface of the disc should be approximately vertical. The angle varies between 88 and 90 degrees. There is a particular angle which will produce the quietest cut with any individual needle. This angle can be found by making test cuts with no groove modulation and observing the noise by playing back the blank groove.

The easiest way to observe when the needle is vertical is to lower the cutter on a blank disc and observe the reflection in the surface of the disc. Compare the reflection with the needle (see Photo C). A slight deviation from vertical can be readily noted. *Warning:* Be sure that the needle does not point even a fraction of a degree toward the turning record as it will immediately dig into the record, which will inevitably tear off the point of a sapphire stylus. The angle of the stylus is changed by raising or lowering the cutting head on some recorders, and by moving the needle in and out of the chuck on others.

Cutting the record

When the angle is properly adjusted, the depth of cut should be regulated so that a 60-40 relation exists between groove and land. The rule of thumb is: make the cut as light as possible, consistent with the playback pickup's ability to track the resulting recording. The chip should throw from the needle at an angle and lie flat on the disc at least ¼-inch from the stylus (see Photo D). The stylus is designed to throw the chip

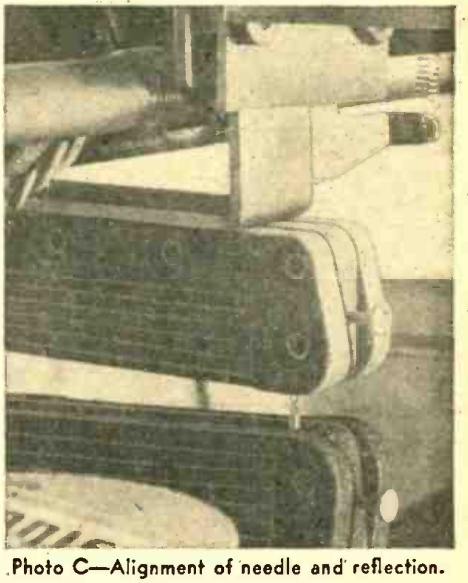


Photo C—Alignment of needle and reflection.

away from its point. If it does not, it should be replaced or twisted in the chuck slightly.

The chip should approximate a human hair in thickness and should be about 0.002-inch in width and depth. The average playback stylus has a tip with a 0.002 to 0.0025-inch radius. It is de-

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Photo A—The uneven grooves near the edge indicate pickup bounce.

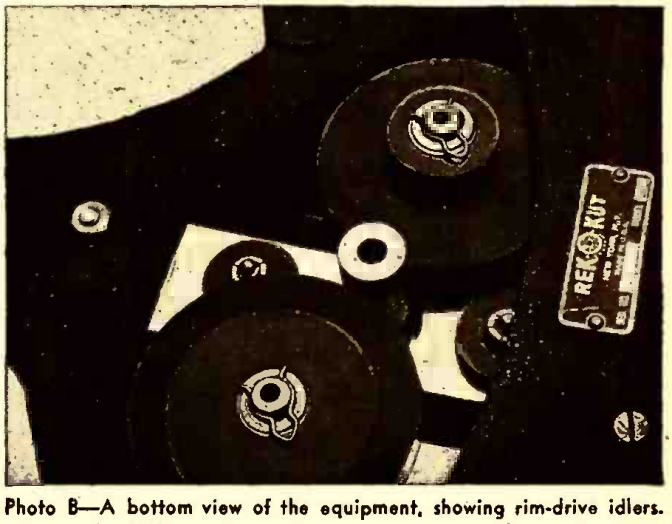

Photo B—A bottom view of the equipment, showing rim-drive idlers.

Transatlantic News

From our European Correspondent, Major Ralph Hallows

"full frequency range recording!" Read "for the first time in any publication," the full story of Decca's new system. It combines sound engineering and new ideas to raise recording to higher levels.

THEY spell it with small letters: ffrr. It stands for *full frequency range recording*. More important still, it stands for *full range frequency reproduction*; for it is one thing to cut on a wax disc spiral grooves which record the whole range of audible frequencies and quite another, as we shall see, to find a way of making a phonograph reproduce everything that is put on to the wax. I admit freely that when I first heard of ffrr I was not greatly excited. I am much too old a bird of the radio and phonograph worlds to flutter blindly into decoys baited with sales talk about "The Very Soul of Music," "Reproduction That Is Real," "Every Sound in the Studio Brought to Your Home" and that kind of thing. On investigation the perfect

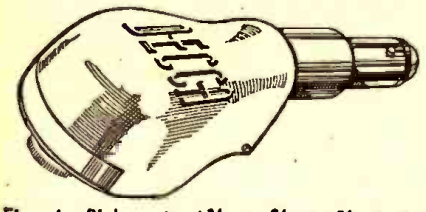

Fig. 1—Pickup is 1¾ x ¾ x ⅝ inches.

reproduction promised is too often found to depend upon a.f. amplifiers with a complete cut-off at or below 5,000 cycles, a false bass produced by cabinet and other resonances, and harmonic distortion—second and (far more distressing) third—ranging from 10 to 15 percent or more.

I am the first technical writer to have the opportunity of investigating the British Decca ffrr system. I approached the investigation in a distinctly sceptical frame of mind, but before it was ended I was convinced that they have tackled the problems of the phonograph in an entirely new way and that they have achieved improvements so outstanding that they may almost be classed as revolutionary.

The main defects of the phonograph as we now know it may be summarized as follows:

1. Surface noise, or needle scratch spoils the beauty of music by its annoying background.
2. Even the best of ordinary records deal very poorly with the upper audio frequencies.
3. Transients, such as the sounds of tympani, *pizzicato* on strings, or the clean-cut notes of the cornet are not realistically reproduced.
4. Transients, in fact, are often reproduced as very unpleasant sounds, jarring on the ear.
5. Sound contrasts are unduly compressed: the phonograph is very far from bringing out the real contrasts between *fff* and *ppp* that actually occur in the course of an orchestral performance.
6. The reproduction distorts, sometimes very unpleasantly, the sounds of music.

Believe it or not, most of the six defects enumerated have one and the same origin: surface noise. It has long been realized that surface noise was one of the greatest enemies of the phonograph; but not until these recent researches were made was the extent of its evil influence fully grasped.

Surface noise consists of impulses giving rise to purely random waveforms, which cannot be analyzed into any combination of sine waves. It is, in fact, the sound-wave counterpart of static and its effects on a pickup are similar to those of static on an antenna. Static, as you know, shock-excites an antenna, causing it to oscillate at its natural frequency. Surface noise shock-excites a pickup making it produce a strong response at any frequency at which it has a resonance.

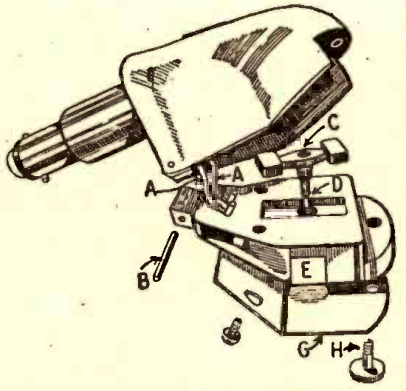

Fig 2—Pickup exploded. A—leads from coil; B—hinge pin; C—rubber mount for armature; D—the armature; E—magnet; G—cover plate.

The response curves of most pickups show marked resonance peaks well within the audio frequency range and usually towards the upper limit of their compass. For that reason they reproduce surface noise as a high-pitched hissing sound. Besides its unpleasantness this hiss is sufficiently strong to drown the upper audio frequencies when the recording level of sound is low. Hence it has been necessary when making recordings to monitor severely, keeping the sound level of the music always *above* that of the noise; in other words contrast compression must take place in the recordings.

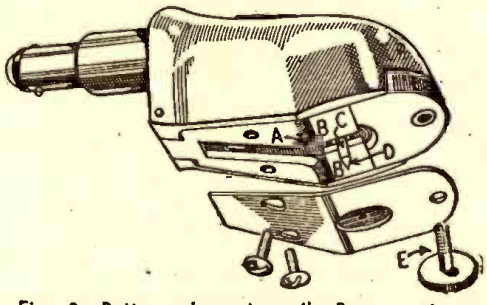

Fig. 3—Bottom view. A—coil; B—magnets; C—armature; D—sapphire; E—milled screw.

Until comparatively recently no record contained any worthwhile amount of frequencies above 5,000 cycles and few radio phonographs were able to bring out audio frequencies even as high as that. The reason is simply that a better response at the upper end of the scale would have meant giving greater prominence to surface noise hiss.

In theory the proper reproduction of transients can be obtained only if all the harmonics right up to infinity are present. In practice perfectly acceptable reproduction is had if the harmonics within the audible range—say up to 15,000 cycles—are brought out. But transients sound unreal and lose their characteristic crispness if there is a cut-off much below 15,000 cycles. With its 5,000-cycle cut-off the radio-phonograph cannot do them justice. And matters are often made far worse by the listener's use of the tone control. In self-defence against the hiss which he dislikes the listener often turns the knob as far as it will go, producing in some cases a cut-off as low as 3,500 cycles.

You will see now how strongly surface noise militates against good reproduc-

(Continued on page 66)

INTERMITTENT ALARM

Now you can play your intermittent radios silently. The "Signalometer" will tell you when they fade or cut out.

By J. JACOBSON

IF all the time that radio servicemen have wasted waiting for radio sets to fade were converted into cash and added up, it would go a long way toward paying the national debt.

Types of fading are as various as they are annoying. The customer complains, "I was listening to a quiz program, but the set kept fading on all the answers." An uneducated radio, no doubt, but typical of the complaints the average radio shop gets day after day. Or perhaps the radio just quit cold after being on an hour. In any event, the true intermittent radio has to be working for a certain length of time before it fades or quits altogether.

Examined on the repair bench, all indications are normal. You look at the resistors and they look back at you with an innocent expression, as if to say: "Sure, one of us is bad, but you'll have to wait till it gets good and ready to quit." You test and tap tubes, check voltages and condensers, bounce the set up and down on the bench, to no avail. The only way the set can be made to quit is to throw the switch.

You know that eventually the radio will fade or stop playing, because no customer will spend money just to make a false claim. So you let it play, meanwhile attending to another repair, and keeping one ear on each set. This can be very annoying, as concentration is required in many repair jobs, for instance those in which you have to contend with hum or other low-level complaints, which outside noise can mask out easily.

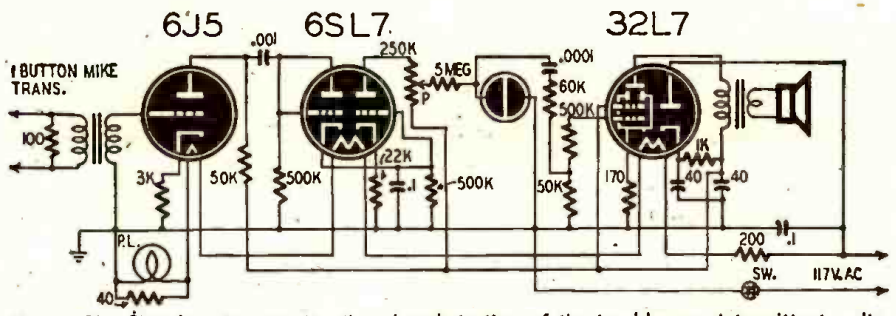

Fig. 1—The Signalometer permits silent bench testing of the troublesome intermittent radio.

Alarm for intermittents

Here is a device that is both a time saver and nerve soother. Just connect a radio to it and the radio will play at either low or top volume *silently*. No interfering with you or the technician working on the next bench. The radio will continue to play silently until it fades, then it will let you know. It will inform you with a warning tone signal from the Signalometer. You can then switch off the warning tone and examine the set while it is in its fading condition.

The Signalometer is a simple instrument. A modulated signal from any signal generator is fed into the input of the radio in question. The frequency setting of the signal generator is unimportant unless you have reason to believe that fading is due to oscillator instability at some particular frequency. To put the Signalometer into the picture, simply connect its two test clips across the primary of the output transformer.

Examination of the circuit (Figure 1) shows the output transformer of the set under test then will be very heavily loaded. This is to reduce the audio signal across the voice coil to below the point of audibility. A small residual voltage is amplified in the 6J5 circuit. The output of the 6J5 is fed into half a 6SL7 which operates as a diode rectifier. A varying positive voltage from the diode rectifier output is fed into the negatively biased grid circuit of the other half of the 6SL7. The plate load of this half is a 250,000-ohm potentiometer, the movable arm of which goes to a 1/25-watt neon bulb. The neon tube, which works as a relaxation oscillator, feeds into the grid circuit of the 32L7, which is a combined amplifier and rectifier power supply tube. The frequency of the warning tone depends mainly upon the capacity of the 32L7 grid-coupling condenser, the grid resistor, and the neon voltage.

Operating instructions

To operate the Signalometer, follow this step-by-step procedure:

1. Turn radio dial to a frequency where no broadcasting station can be heard.

2. Connect modulated r.f. signal generator to radio input.

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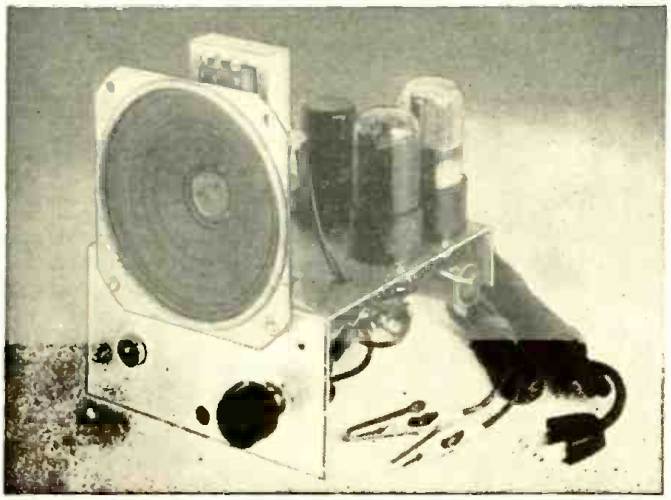
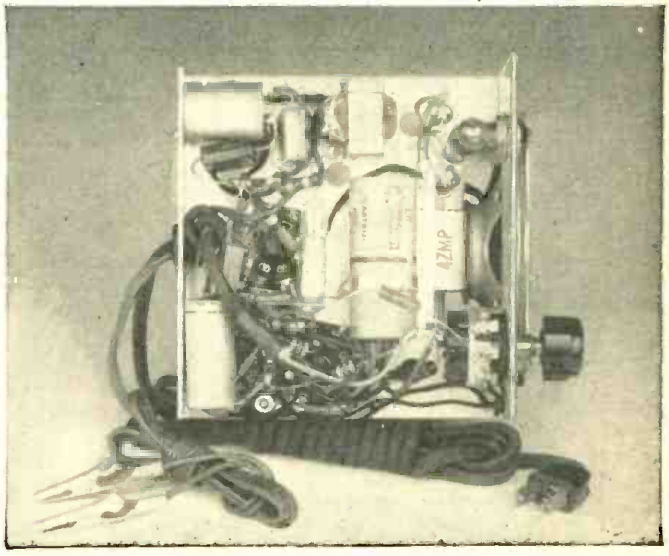
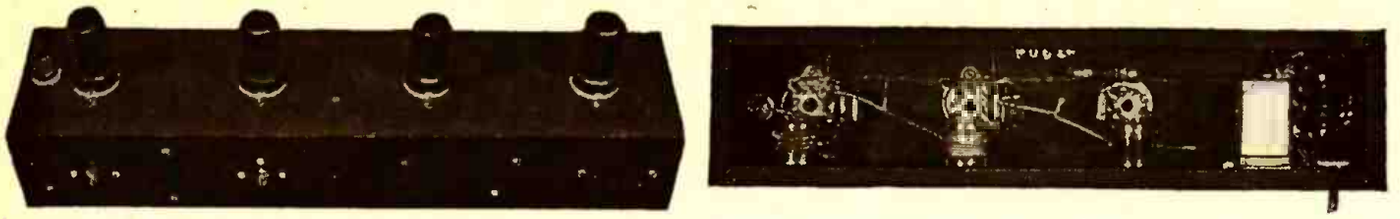




Front and bottom views. Neon tube is seen in under-chassis photo.



Top and bottom views of frequency-modulated transmitter. Coils are efficiently placed to keep oscillator and multiplier leads short.

Demonstration Transmitters

By HAROLD McDUFF and GEORGE PYLE*

WHAT is FM? This is the question most frequently asked by the general public whenever the subject of broadcasting is discussed. To answer this question the FM demonstration unit shown in Fig. 1 was constructed. Although there are a number of FM applicants in the Peoria area, there was no immediate prospect of any FM signals for receiver demonstration.

Two miniature units, one the FM and the other the AM, were designed and constructed, using the same tube complement so far as possible on identical chassis 17 x 4 x 3 inches, using similar short whip antennas, and powered by a common power supply to present practically an identical appearance. The power output of the two transmitters was adjustable so that equivalent signals at the receiver terminals could be obtained. Program material consisting of wide-range electrical transcriptions originating in one of the radio station's control rooms was transmitted continuously over an equalized telephone line to the demonstration point and fed simultaneously to each transmitter. Although these units were built as simply as possible, using standard parts, certain problems had to be solved.

The schematic diagram of the AM unit is shown in Fig. 2. It consists of a tunable oscillator coupled to an amplifier stage and modulated by a pair of 6J5 tubes in parallel. Since there are no modulation transformers available for this tube complement, modified Heising modulation was employed.

The coils were made from Barker-Williamson Miniductors Type 316. The oscillator had 55 turns, tapped 20 turns from the grid end. The tank coil consisted of 70 turns, on which the antenna was tapped by experiment. Fixed mica condensers resonated the coils at a clear spot in the broadcast band.

The FM unit shown in Fig. 1 employs a reactance modulator working with a 6C5 oscillator on 5 mc which is tripled twice to 45 mc, the output frequency employed. The old-band FM receivers can pick up the fundamental output frequency, and a harmonic of this is used if the receiver has only the new 100-mc band.

The FM unit coils were all wound on 1-inch diameter tubing. The oscillator coil was close-wound with 27 turns of No. 28 enamelled wire, the first tripler with 9 turns of No. 22 d.c.c. spaced to ¾ inch and the second tripler uses 4 turns, of No. 20 d.c.c. spaced to ⅝ inch. A 1-turn coil couples this to the antenna. The oscillator coil is tapped at 9 turns from the grid end.

For reception, one of the automatic tuning buttons of the demonstration receiver was adjusted to the frequency of the AM unit, while the manual tuning control was tuned to the FM signal. Thus changing the FM-AM selector switch on the receiver picked up whichever transmitter was desired, leaving no other adjustments to be made, at

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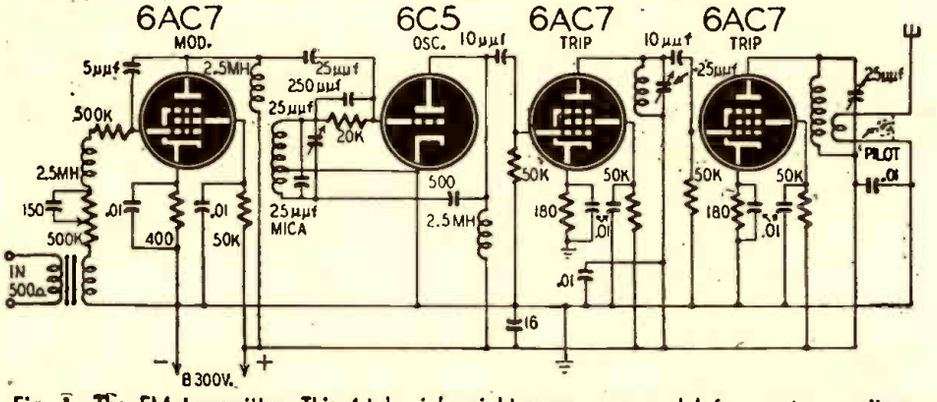

Fig. 1—The FM transmitter. This 4-tube job might serve as a model for amateur exciters.

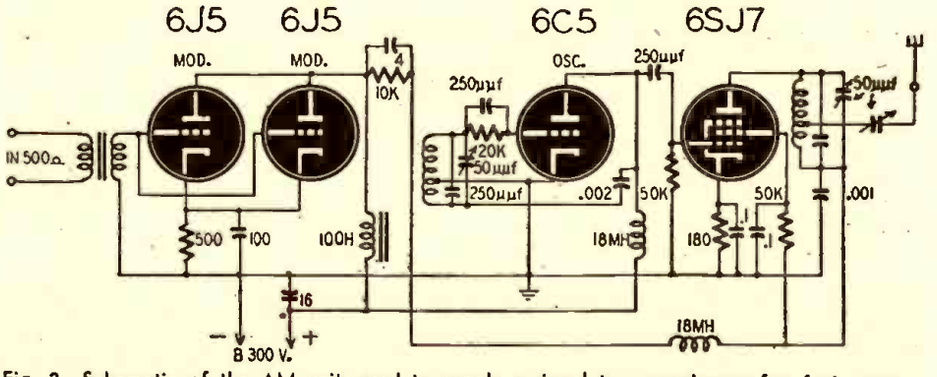

Fig. 2—Schematic of the AM unit, used to supply a signal to a receiver a few feet away.

*Peoria Broadcasting Co. (WMBD)

The AM unit resembles its FM opposite number closely, excepting for component sizes. The output is ample for short-range demonstrations.

TELEVISION FOR TODAY

PART XIII—Problems of the cathode-ray tube

By MILTON S. KIVER

THE cathode-ray tube in the television receiver is comparable to the loudspeaker in the sound receiver. It is much more intricately tied in with the operation of the television set than the loudspeaker is with its receiver. Such factors as operating controls, sources of high voltage, and methods of focusing and deflection require careful adjustment if a good image is desired.

The basic operation of the cathode-ray tube has been described many times in literature. To repeat a principle briefly, the electrons emitted by the cathode are formed into a high-velocity beam by electrostatic or electromagnetic means, or both, and then projected at the fluorescent screen. The beam is deflected electrostatically with deflection plates or electromagnetically with deflection coils. Fig. 1 shows the inside structure of a typical electrostatic deflection tube. For electromagnetic deflection, the plates are omitted.

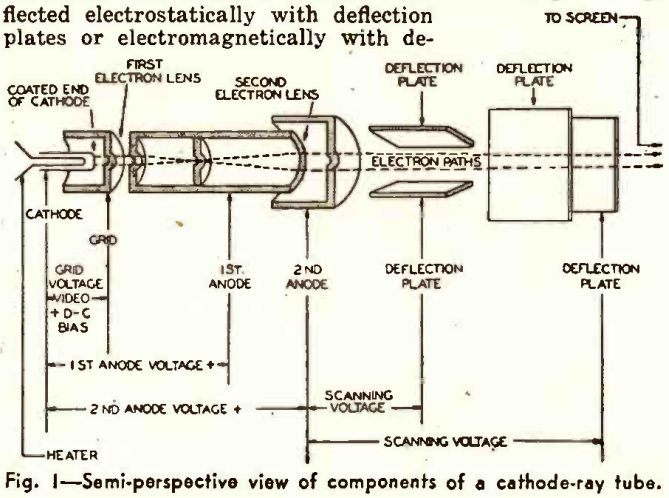

Fig. 1—Semi-perspective view of components of a cathode-ray tube.

The most acceptable screen for television is one which emits white light when excited by an electron beam. This does not exclude screens emitting light of other colors, for some of these have been and are being used. However, black-and-white images are considered less fatiguing for the eyes, especially for long-sustained viewing periods. The already familiar motion picture also played an important part in the choice of this set of color values.

An electron gun, once constructed, can be subjected to considerable misuse without being permanently affected. On the other hand, failure to grasp the significance of certain precautions required to protect the fluorescent screen can readily result in a shortened period of usefulness as well as unsatisfactory operation throughout the life of the tube.

A tabulation of the most common phosphors in use in oscilloscopes, television receivers, and radar equipment is shown in Table 1. For television, a combination of zinc sulphide and zinc beryllium silicate is used, this combination giving higher conversion efficiency than most other known compounds. It is interesting to note that the electron beam remains at any one point for only approximately 0.1 microsecond, yet the light emission continues for two to three hundredths of a second, indicating that the zinc sulphide and zinc beryllium silicate are responsible through their phosphorescence for essentially all of the emitted light seen by the observer. Fig. 2 is a zinc sulphide persistence curve.

The principal object in designing a cathode-ray tube is to produce an image having good brightness and high contrast. When the electron beam strikes the back of the fluorescent screen, the light which is emitted distributes itself in the following approximate manner:

1. 50 percent of the light travels back into the tube.
2. 20 percent of the light is lost in the glass of the tube by internal reflection.
3. Thirty percent reaches the observer.

Thus, of all the light that is produced by the electron beam (and this itself is a highly inefficient process), only 30 percent reaches the observer.

Image contrast also is impaired because of interference caused by light which is returned to the screen after it has been reflected from some other point. Some of these sources of interference, listed in order of importance, are:

1. Halation
2. Reflections due to screen curvature.
3. Reflections at the surface of the screen face.
4. Reflections from inside the tube.

Effects of halation

If we examine minutely the light pattern produced by a stationary electron beam in a cathode-ray tube, we find that the visible spot is surrounded by rings of light. These rings of light are due to *halation*. See Fig. 3. The light rays which leave the fluorescent crystals at the inner surface of the tube face travel into the glass and are refracted. Those rays which make an angle greater than ϕ do not leave the glass when they reach the outer surface, but instead are totally reflected back into it. At each point where these reflected rays strike the fluorescent crystals, they scatter. It is this scattering of the rays that produces visible rings on the screen. These rings cause a hazy glow in the region surrounding the beam spot and reduce the maximum possible detail contrast. Contrast, it will be remembered, is the ratio of the brightness of two areas, one of which is being bombarded by the electron beam, the other not. This ratio should be as high as possible to have "rich-looking" or high-quality images. Due to the scattering of the light, however, areas which should be in total darkness receive some light. The result is a reduction in the contrast ratio. A distinction is usually made between

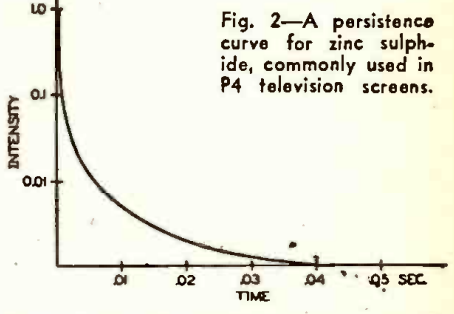

Fig. 2—A persistence curve for zinc sulphide, commonly used in P4 television screens.

TABLE I

RMA Designation—Substance	Activator	Fluorescent Color	Phosphorescence (seconds)
P1—Zinc silicate	Manganese	Green	Med. -0.03-0.05
P2—Zinc sulphide	Copper	Blue-green	Long
P3—Zinc beryllium silicate	Manganese	Yellow-Gr.	Med. -0.05'
P4—P3 and zinc sulphide	Silver	White	Short 0.005
P5—Calcium Tungstate		Blue	Very short 5μsec. med. 0.005
P6—Zinc sulphide Zinc cadmium sulphide	Silver Silver	White	
P7—Zinc sulphide Zinc cadmium sulphide	Silver Copper	Blue Yellow	Med. -0.006 Long
P11—Zinc sulphide	Silver with a nickel quencher	Blue	Very short 10_{μ} sec.

the detail contrast ratio, which is defined on opposite page, and the over-all field contrast, which compares two sections of the screen which are widely removed from each other. Halation affects only detail contrast.

Screen curvature reflections

Loss in contrast due to reflections arising from the curvature of the screen is shown in Fig. 4. The remedy for this is to use a flat screen. Many adaptations in this direction have been made, since the screen curvature greatly restricts the useful image area. One example is the large 20-inch tube television sets currently being offered to the public by one prominent manufacturer. A good portion of the image is, in this writer's opinion, useless because of the optical distortion introduced by the screen curvature. A flat-face 10-inch tube seems preferable to the 20-inch curved screen.

Reflections from screen surfaces

Light rays, when they travel from one medium to another, lose a certain amount of energy at the intersection of the two media. At the cathode-ray tube screen, some light is reflected when it reaches the dividing surface between the air and the glass of the tube. The reflected light travels back to the inner surface and then back to the outer surface and then back to the inner surface again. At each dividing surface, some of the light continues onward and some is reflected back into the glass. Absorption and dispersion quickly reduce the strength of these rebounding rays.

In Fig 5-a we see how reflections from the inside surfaces of the tube can act to decrease the field contrast of the image. The loss in contrast from this source of interference can be made low

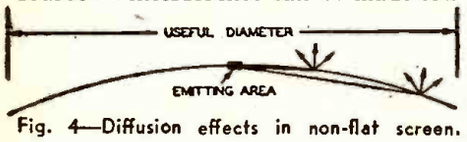

Fig. 4—Diffusion effects in non-flat screen.

by special shaping of the bulb walls, as shown in Fig. 5-b, and by the use of black aquading coating. The latter coating is also useful for electrical purposes, acting as a shield and a path for the return of the secondary electrons emitted from the fluorescent screen.

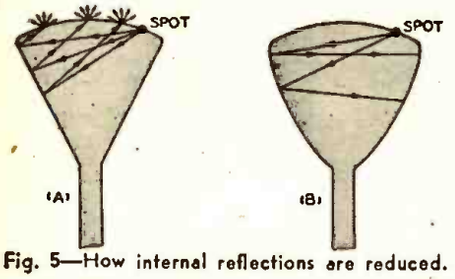

Fig. 5—How internal reflections are reduced.

A recent step toward improving screen brightness and contrast has been the addition of an extremely thin film of aluminum on the back of the fluorescent screen. The film is sufficiently thin to permit the electrons in the scanning beam to reach the fluorescent crystals. It will, however, prevent any of the light

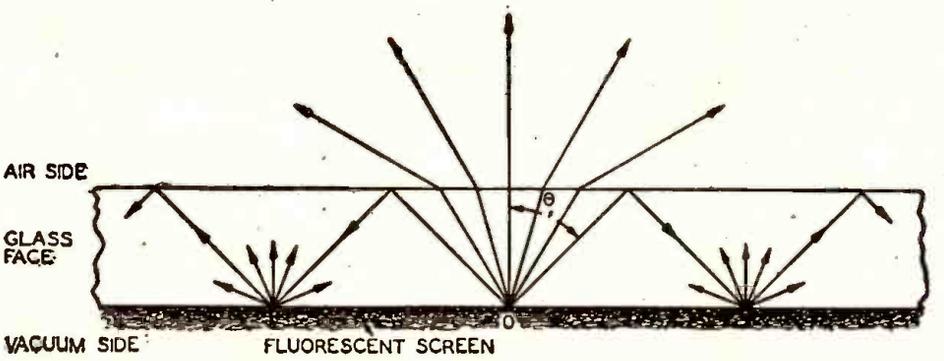

Fig. 3—Illustrating how reflections between the two sides of the glass can cause halation.

generated by the screen crystals from traveling back to the tube. This is shown in Fig. 6. The light which previously went back into the tube is now reflected toward the observer.

The metal film is extremely thin, in the order of 3,500 x 10^{-8} centimeters thick. Since even a layer this thin does interpose a barrier in the path of the electron, high accelerating voltages must be used. In Fig. 7, the efficiency curves of screens having the metallic layer and those which do not are compared. At low accelerating voltages, the energy lost by the electrons in penetrating the layer decreases their efficiency below that of similar electrons in tubes without this layer. The poorer efficiency continues until we reach the point where the curves intersect.

Beyond this region, the screen with the metallic layer is much superior to the ordinary tube. The rapid rise in efficiency is due to a decrease in energy lost at the metallic barrier plus an increase in the over-all brightness due to the light-resisting characteristics of the layer itself.

A matter of considerable importance is the elimination of the ion spot in tubes using electromagnetic deflection. No matter how carefully a tube is degassed or how well the cathode coating is applied, ions will be present in the electron beam. These ions are either gas molecules which have acquired an electron, or else molecules of the outside coating material of the cathode. The ions have the same charge as the electrons and are sensitive to the same accelerating voltages. In tubes employing electrostatic deflection, the ions and the electrons are similarly deflected and for all practical purposes may be considered as one. However, when electromagnetic deflection is employed, it will be found that these heavier ions are barely deflected. Consequently, they tend to strike the center of the screen in a steady stream and produce a thin film of deactivated material on the area exposed. When the electrons in the scanning beam pass over this area no light is produced. To the observer this appears as a dark patch.

Several methods for preventing the ions from reaching the screen are in current use. First there is the bent electron gun, as shown in Fig. 8. Ions and electrons emitted by the cathode are accelerated to the first and second anodes. However, the cathode is inclined at an angle to the rest of the gun structure,

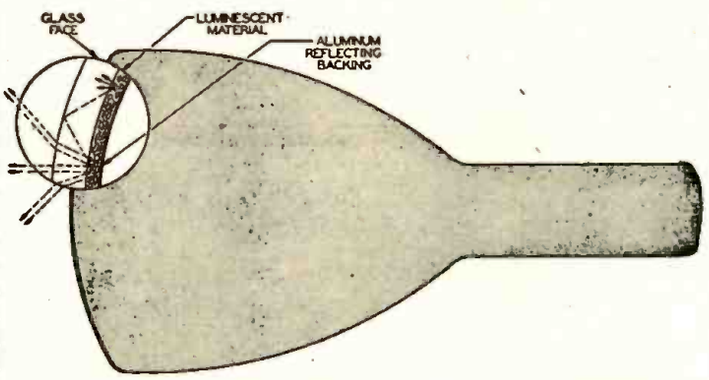

Fig. 6—Aluminizing the screen concentrates all the light forward.

and both particles, if permitted to travel in a straight line, would impinge on the side of the electron gun and never reach the screen. If a strong magnetic field is placed in the path of the particles, it is possible to alter the paths of the electrons sufficiently to have them to travel toward the screen. The heavier ions, however, are not sufficiently deflected. As a result, they hit the side of the electron gun. The magnetic field which

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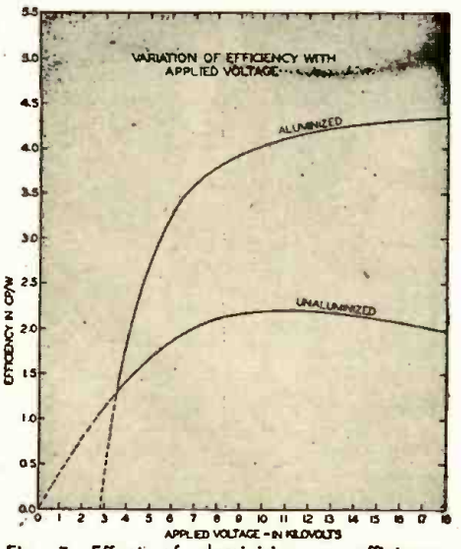
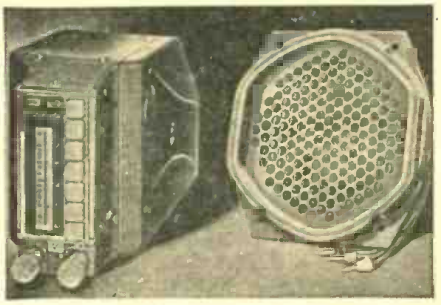


Fig. 7—Effect of aluminizing on efficiency.

RADIO DATA SHEET 347



MOTOROLA AUTO RADIO

1946 MODEL CR6

TUNING RANGE

535 to 1600 Kc.

ELECTRICAL CHARACTERISTICS

Power input: 10 amperes at 6.3 volts (including speaker field)

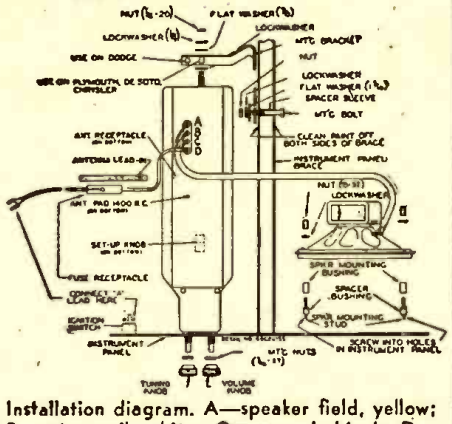
Power output: 9 watts

OVERALL SENSITIVITY

Frequency 1400 Kc., 1000 Kc., 600 Kc. Sensitivity 1.5 μv 1.5 μv. 1.0 μv. Standard output is to be 1 watt and is measured across the 3-ohm resistive load. (1 watt = 1.74 volts). Test is made with 30 percent 400-cycle modulation. Tone control is set to VOICE position and volume control at maximum.

TUBE COMPLEMENT

1	6SK7-GT	R.f. amplifier
1	6SA7-GT	Oscillator-Modulator
1	6SK7-GT	I.f. amplifier
1	6SQ7-GT	Detector—a.v.c.—a.f. amplifier
1	6SQ7-GT	Audio inverter
2	6V6-GT	Push-pull power amplifier
1	OZ4 or 6X5-GT	Rectifier

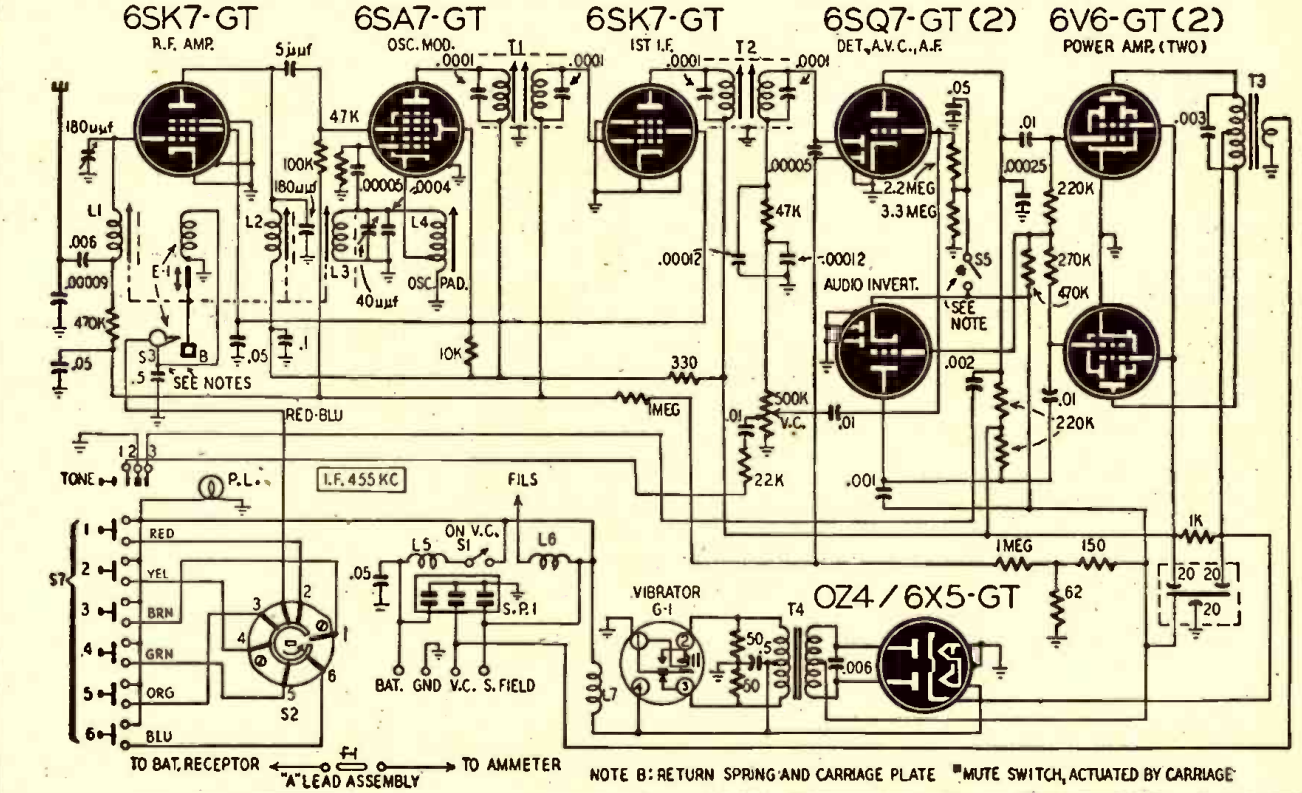


Installation diagram. A—speaker field, yellow; B—voice coil, white; C—ground, black; D—battery.

ALIGNMENT TABLE

STEP	TUNER POSITION SET TO	DUMMY ANTENNA	SIGNAL GENERATOR LEAD CONNECTED TO	SIG. GEN. SET AT	ADJUST FOR PEAK ON OUTPUT METER
1.	High frequency end (cores out)	0.1 μf at Sig. Gen.	Oscillator-Modulator grid (#5 pin)	455 kc	Primary and secondary of T-1 Primary and secondary of T-2
2.	High frequency end, tuning shaft against stop. Cores should be set to project 1⅛ inch from cans.	60 μμf at Sig. Gen. in series in 21-inch coaxial lead.	Antenna receptacle	1600 kc	Oscillator trimmer (across L-3) R.f. trimmer (across L-2) Antenna trimmer (across L-1)
3.	EXACTLY one full turn in from high frequency end. Use knob set screw as an indicator. Start measuring turn the moment tuner carriage starts moving inward.	"	"	1425 kc	Oscillator core of L-3 R.f. core of L-2 Antenna core of L-1
4.	EXACTLY four more full turns in (as indicated by knob setscrew)	"	"	Power turned OFF	Oscillator pad core of L-4 for maximum noise.
5.	Assemble and install receiver in car and connect car antenna. Turn the dial to approximately 1400 kc (not to a local station) and adjust antenna trimmer for maximum noise. This adjustment is referred to as Antenna Padder in receiver installation detail figure.				

NOTE: If oscillator padder core adjustment is too far off, repeat alignment procedure, steps 2, 3, and 4. It may be necesssary to repeat alignment more than once if padder adjustment has been indiscriminately tampered with.



NOTE B: RETURN SPRING AND CARRIAGE PLATE "MUTE SWITCH, ACTUATED BY CARRIAGE

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VOLT-OHM-MILLIAMMETER
and save !!

The Model-KT 20 kit provides ALL components, including meter, panel, cabinet, resistors, condensers, tip jacks, control, selector switch, copper-oxide rectifier, pre-cut wires—in fact every component and part needed to complete the unit.

Complete kit including ALL PARTS assembled and ready for wiring, circuit diagram, easy-to-follow instructions and detailed operating data for the completed instrument.

THE KIT COMES COMPLETELY ASSEMBLED. Can be wired in 15 minutes. Components and circuit guaranteed to meet the following specifications:

4 A.C. VOLTAGE RANGES: 0-15/75/300/1500 volts.
4 D.C. VOLTAGE RANGES: 0-15/75/300/1500 volts.
2 D.C. CURRENT RANGES: 0-15/150 MA.
2 RESISTANCE RANGES: 0-10,000 ohms; 0-1 Meg.

$9.50 NET

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SIGNAL GENERATOR

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Model B-45 uses a beautifully processed dualtone front panel. Comes housed in a heavy-gauge crystalline steel cabinet complete with shielded test lead, self-contained batteries and instructions.

THE NEW MODEL 670

SUPER METER $28.40

A Combination VOLT-OHM-MILLIAMMETER plus CAPACITY REACTANCE, INDUCTANCE and DECIBEL MEASUREMENTS

D.C. VOLTS: 0 to 7.5/15/75/150/750/1500/7500.
A.C. VOLTS: 0 to 15/30/150/300/1500/3000 Volts.
OUTPUT VOLTS: 0 to 15/30/150/300/1500/3000.
D.C. CURRENT: 0 to 1.5/15/150 Ma.; 0 to 1.5 Amps.
RESISTANCE: 0 to 500/100,000 ohms 0 to 10 Megohms.
CAPACITY: .001 to .2 Mfd., .1 to 4 Mfd. (Quality test for electrolytics).
REACTANCE: 700 to 27,000 Ohms; 13,000 Ohms to 3 Megohms.
INDUCTANCE: 1.75 to 70 Henries; 35 to 8,000 Henries.
DECIBELS: −10 to +18, +10 to +38, +30 to +58.
The Model 670 comes housed in a rugged, crackle-finished steel cabinet complete with test leads and operating instructions. Size 5½" x 7½" x 3".

THE NEW MODEL CA-11

SIGNAL TRACER $18.75

Simple to operate . . . because signal intensity readings are indicated *directly on the meter!*

★ SIMPLE TO OPERATE — only 1 connecting cable — NO TUNING CONTROLS.
★ HIGHLY SENSITIVE—uses an improved Vacuum Tube Voltmeter circuit.
★ Tube and resistor-capacity network are built into the Detector Probe.
★ COMPLETELY PORTABLE—weighs 5 lbs. and measures 5" x 6" x 7".
★ Comparative Signal Intensity readings are indicated directly on the meter as the Detector Probe is moved to follow the Signal from Antenna to Speaker.
★ Provision is made for insertion of phones.

The Model CA-11 comes housed in a beautiful hand-rubbed wooden cabinet. Complete with Probe, test leads and instructions.

THE NEW MODEL 450

TUBE TESTER $39.50

Speedy operation — assured by newly designed rotary selector switch which replaces the usual snap, toggle, or lever action switches.

SPECIFICATIONS

• Tests all tubes up to 117 volts. • Tests shorts and leakages up to 3 Megohms in all tubes. • Tests both plates in rectifiers. • New type line voltage adjuster. • Tests individual sections such as diodes, triodes, pentodes, etc., in multi-purpose tubes. • Noise Test-detects microphonic tubes or noise due to faulty elements and loose internal connections. • Uses a 4½" square rugged meter. • Works on 90 to 125 volts 60 cycles A.C.

EXTRA SERVICE—May be used as an extremely sensitive condenser Leakage Checker. A relaxation type oscillator incorporated in this model will detect leakages even when the frequency is one per minute.

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We do not advertise any unit which is not available for immediate shipment from stock. • Less flowery adjectives, more detailed specifications. • All units are sold subject to one year guarantee except when components are damaged through misuse. • We do not solicit orders for any unit that does not meet our requirements for accuracy and honest value. Any item purchased from us is sold with the understanding that it may be returned for full refund after a 10 day trial.

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GENERAL ELECTRONIC DISTRIBUTING CO.

DEPT. RC-6, 98 PARK PLACE, NEW YORK 7, N. Y.

COLOR TELEVISION

(Continued from page 21)

(Present-day B & W receivers of the direct-viewing type and using a 10-inch cathode-ray tube employ 30 tubes, thus the sequential color receiver compares favorably in the number of tubes.

A disadvantage of the sequential receiver is that it is not possible to pick up color images broadcast by the *simultaneous* system (without special design of the receiver).

The receiving aerials used to pick up the sequential color images were of simple design; in many tests a double-horn type proved efficient, dipole antennas being placed at the focus of the parabolic horns. The horns were made of latticed wire in some instances.

RCA simultaneous color system

In the simultaneous electronic system demonstrated by RCA the three basic colors (red, blue, and green) are transmitted all at the same time and continuously. No moving parts such as revolving color filters are used, the operation being fully electronic. Fig. 1-b and Fig. 2-b show how 3 separate carriers carry the three colors. The total band width of the 3 carriers is only 14.5 mc. (In a special test this was reduced to 12.5 mc.) Sound is transmitted on a relatively narrow band (a subcarrier of 524.1 mc), along with the video signals, as the figure makes clear.

At the transmitter, the film (or *live* subject) is scanned by a beam from a kinescope tube. After scanning the picture or subject, the beam is focused through a lens onto a system of semi-transparent mirrors and 3 photocells (Photo D). Each photocell picks up its respective color component and modulates the corresponding carrier.

For picking up *live* subjects a *flying spot* from a kinescope tube scans the scene, the reflected beam falls on a system of dichroic (color-selective) mirrors, which reflect the respective color components onto 3 photocells. These cells in turn modulate the 3 carriers used to transmit the signals. See diagram Fig. 1-b.

Each of the transmitted red, blue, and green images has the same number (525) of scanning lines and also the same horizontal scanning rate and picture repetition frequency of 30 per second, as in present B & W broadcasting.

At the receiver each carrier, modulated respectively by the red, blue, and green signals, is tuned in through separate band-pass circuits and amplifiers. One tuning control may be used to tune in the video signals. The 3-color signals are next fed into their respective cathode-ray tubes (each about 3 inches in diameter) on the ends of which appear the 3 images: one in red, one in blue, and the third in green. Each tube is made with a different phosphor on the screen which will respond to one color, one tube for the red, one for the blue, etc.

Magnifying lenses are placed in front

(Continued on page 56)

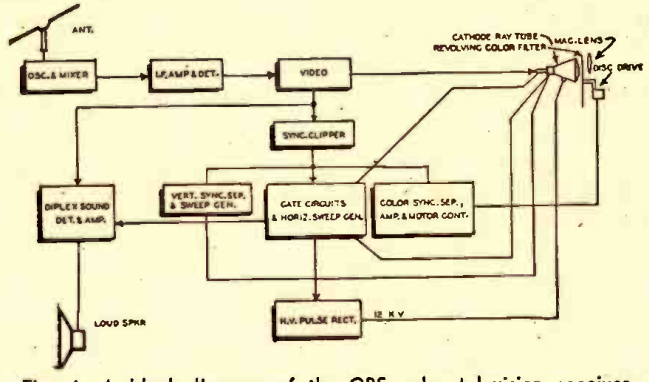

Fig. 4—A block diagram of the CBS color television receiver.

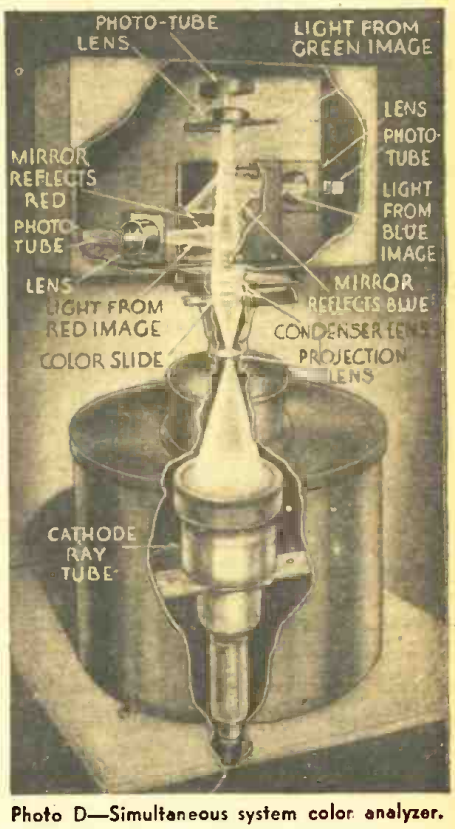

Photo D—Simultaneous system color analyzer.

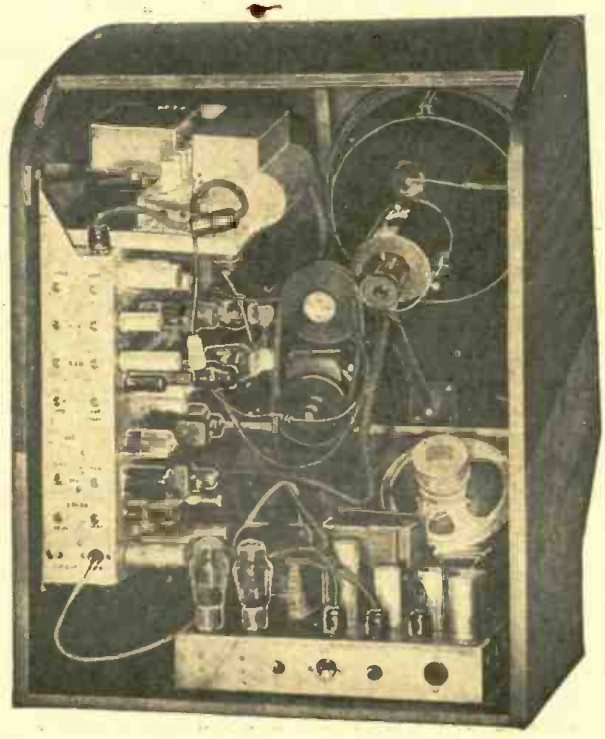

Photo B—CBS television receiver, rear view.

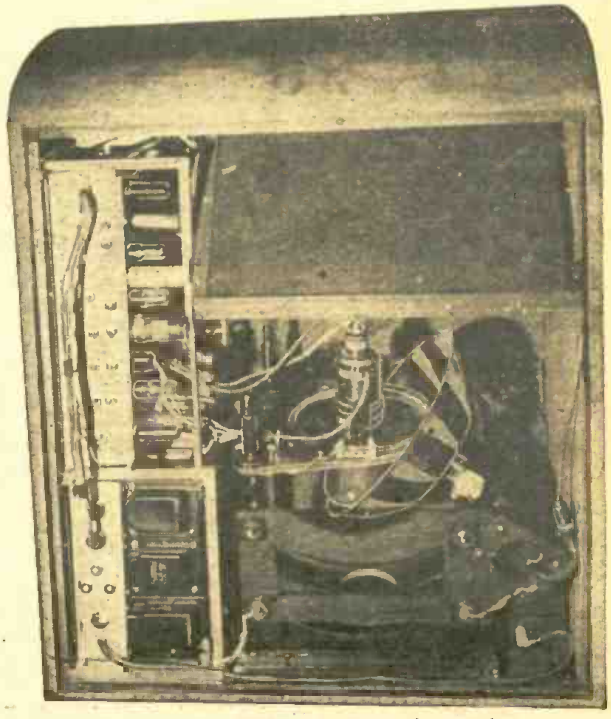

Photo C—The CBS projection color receiver.

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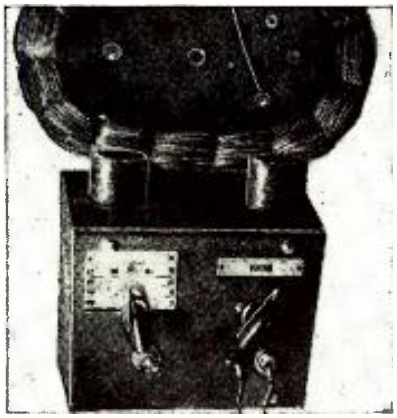
RADIO-ELECTRONIC CIRCUITS

TWO-TUBE PORTABLE

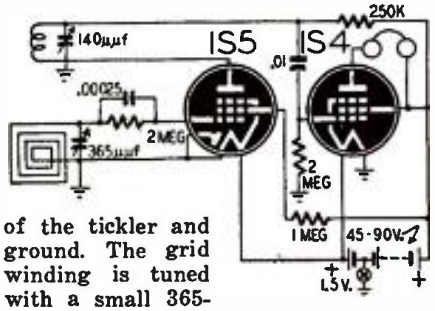
This regenerative receiver covers the broadcast band, without an external antenna and with enough power to drive a small speaker on strong locals. A standard broadcast loop antenna, mounted on the case with wooden supports, provides enough pickup for most purposes. The entire set, including batteries, is built in a box 3 by 4 by 5 inches.

It uses a 1S5 detector with a 1S4 a.f. amplifier. Regeneration is provided by winding a 10- to 15-turn loop, using



The 2-tube regenerator. Antenna is supported in slots in the two plugs on top of cabinet.

No. 28 wire over the grid winding. Volume and regeneration are controlled by a 140-μμf variable between one side

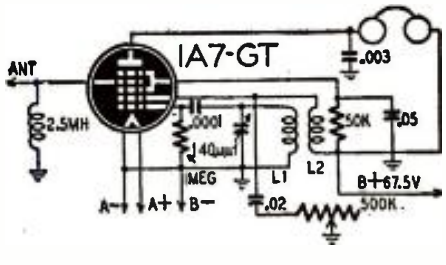


of the tickler and ground. The grid winding is tuned with a small 365-μμf variable. Plate voltages are supplied from a 45- or 90-volt B-battery, the latter supplying sufficient power for a speaker.

ARNOLD ETTINGER,
Brooklyn, N. Y.

NOVEL REGENERATOR

This compact 1-tube superregenerator provides a.f. amplification without an additional amplifier stage. It uses a



1A7-GT with the detector coils connected between the No. 1 and No. 2 grids. This permits the plate to operate at full voltage without the coupling resistor normally used for interstage coupling to an a.f. amplifier. The plate is coupled to the detector by the electron stream. Regeneration is controlled with a 0.02-μf condenser and 500,000-ohm potentiometer in series between the No. 2 grid and ground.

If a long antenna is used, it should be connected to the control grid, No. 4, which is returned to ground through a 2.5-millihenry r.f. choke. A short antenna works best when connected directly to the oscillator grid.

Coils are wound as follows

Wavelength (Meters)	Turns L1	L2
14- 25	4	6
23- 41	7	9
40- 85	14	12
83-125	23	23
120-200	36	36

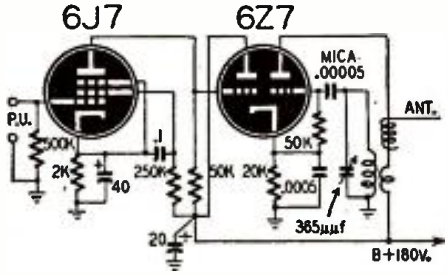
No. 36 d.c.c. or enamel wire is used on 1¼-inch forms. The windings are spaced ⅛ inch apart.

HAROLD R. NEWELL,
Bradford, N. H.

PHONO OSCILLATOR

This phono oscillator described reproduces the bass notes without noticeable hum modulation. A standard antenna coil is used in the tuned circuit. The antenna winding is several turns of wire around the oscillator plate lead. The grid winding is tuned by a standard broadcast condenser.

The preamplifier is direct-coupled to the grid of the modulator section of the 6Z7. With this connection, the grid is about 100 volts positive. This voltage is



reduced by using a 20,000-ohm cathode resistor in this stage. The modulator section is connected as a cathode follower grid modulating the oscillator.

GUENTER BORCHERT,
Sao Paulo, Brazil

SIMPLE PHONO AMPLIFIER

This phono amplifier can be built very compactly. It operates from a 117-volt a.c. line and uses a 25Z6 in a voltage-doubler circuit to supply the voltage for the plates of the tubes. The 10-μf condensers used in the doubler circuit may seem small for the required service, but they work well in this circuit. When

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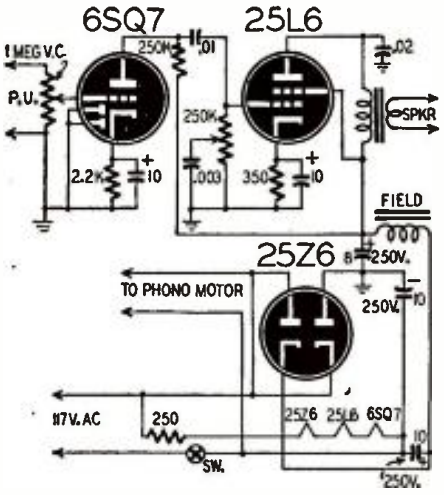
used with a 5-inch speaker, this set gives more than enough volume for the average room, as well as good frequency response. When using the tone control



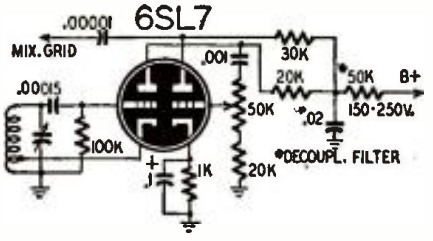
in the grid circuit of the 25L6, the total grid resistance should not be greater than 250,000 ohms.

LESTER M. GOOD,
Grove City, Penna.

(It should be noted that the plate and screen of the 25L6 are operated at voltages that exceed the maximum ratings specified by the manufacturer. Operation in this manner may shorten the tube life. Normal operation may be had by reducing the voltage to 110 volts and changing the cathode resistor to 150 ohms.—*Editor)*

CONVERTER CONTROL

Here is a simple method of controlling the strength of the oscillator voltage applied to the grid of the converter of a superhet. It permits the operator to maintain a desirable ratio between oscillator injection voltage and signal voltage in the converter tube, and reduces objectionable hiss that is common at low signal levels.



In this circuit, the oscillator of the set is replaced by one triode section of a 6SL7, the output of which is resistance-capacity-coupled to the remaining section through a variable control. The injection voltage for the converter is taken from the plate of the amplifier through a 10-μμf condenser.

It is imperative that the 50,000-ohm control be mounted very close to the socket of the 6SL7. An extension shaft may be used to bring a control out to the panel. Keep all other leads as short as possible in accordance with standard practice of oscillator construction.

The c.w. operator may use this circuit on his beat-frequency oscillator with the same advantages.

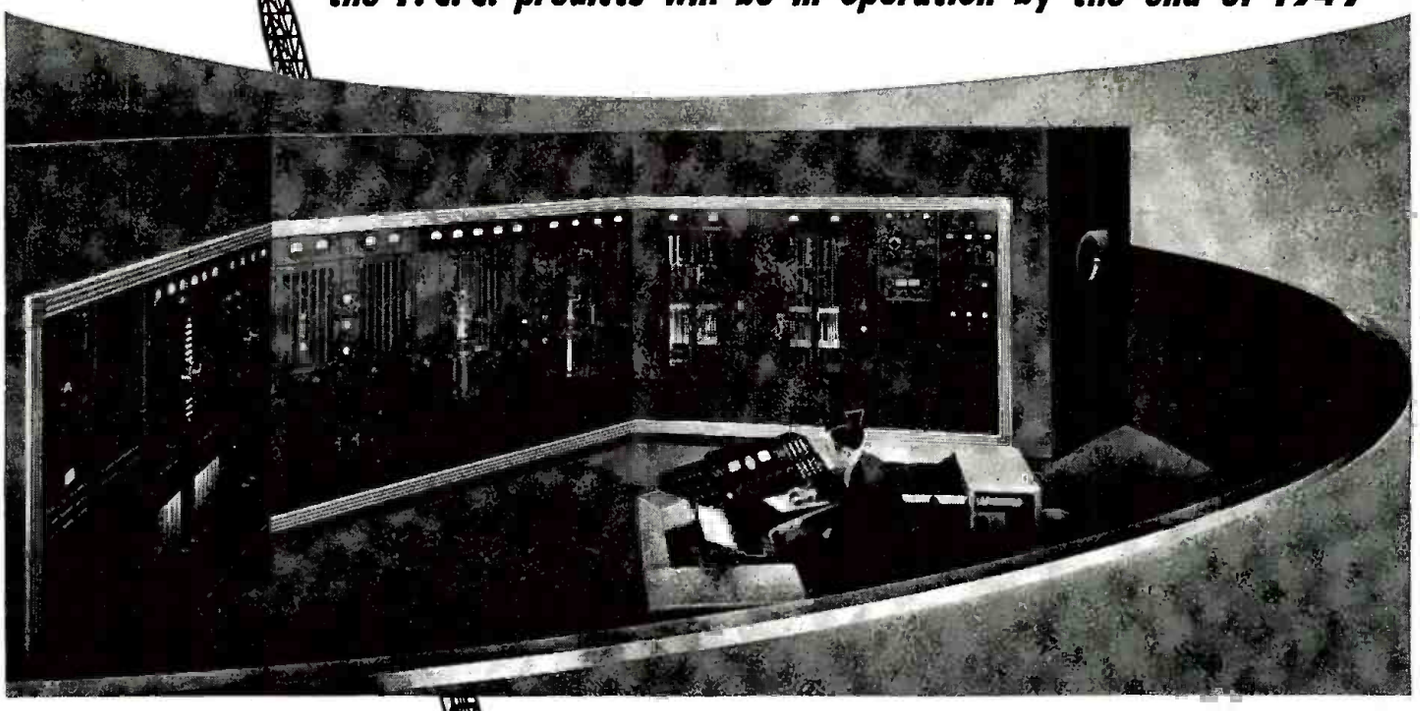
C. E. HENDERSON,
Balboa Beach, Calif.

WANTED! Chief Engineers,

Studio Engineers, Transmitter Engineers for

700 FM Broadcast Stations

the F.C.C. predicts will be in operation by the end of 1947



YES, Plenty of Good-Paying Jobs . . . But Only for Those Qualified

FM is actually coming into its own this year . . . 700 new stations, says the F.C.C. Standard broadcast stations have already passed the 1200 mark. By next year there will be 3 times as many broadcasting stations (AM, FM and TV), as there were before the war. Television receivers are rolling off production lines.

Radio is not only expanding in job opportunities but it is also growing in technical complexity. Rapid developments in the field of radio-electronics are leaving many old-time radiomen far behind the parade. These are the men who fail to realize that their technical knowledge must grow with the expansion of radio itself.

What does this mean to *you?* It means you must study not only to hold the job which you now occupy . . . but study to qualify for the better job you want. CREI modern technical training can (within a comparatively short time) qualify you for the better jobs and enable you to step ahead of those who have failed to improve their ability through technical training.

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TRY THIS ONE

COIL WINDING KINK

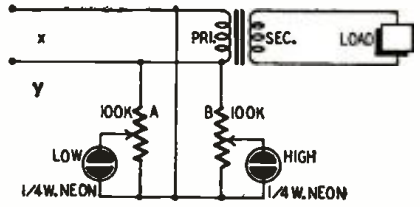
Recently I had my hand drill clamped horizontally in a vise, trying to rewind a transformer secondary with No. 42 wire. I tried using the table as a support for my hand while guiding the wire by letting it slide between my thumb and index finger. I found that by placing the thumb, holding the wire, on the edge of the table and the index finger under the table, I could move very slowly along the table and wind a closely-wound coil in very little time. It is best to leave at least four inches between the table edge and the winding.

I used a thin sheet of paper between each layer and held it in place with a small piece of Scotch tape.

RAY KIEFER,
Indianapolis, Ind.

VOLTAGE INDICATORS

In the radio shack or service shop, it is often desirable to know the line voltage within limits. For this purpose, I use a pair of neon lamps connected as shown. Quarter-watt neon lamps are available to fit standard pilot light assemblies and they present a neat appearance on the panel.



Two 100,000-ohm wire-wound potentiometers are connected in parallel across the a.c. line. The lamps are connected between the arm and one end of the potentiometer. If it is desirable to establish limits between 100 and 120 volts (for example), the potentiometer A is adjusted so that its neon lamp starts to glow when 100 volts is applied across X and Y. Potentiometer B is adjusted so that its lamp glows with 120 volts on X and Y. An autotransformer is useful in making these adjustments.

When the LOW indicator glows it indicates a voltage of 100 volts or more. When the HIGH indicator glows it indicates that the upper limit has been exceeded.

STANLEY E. WEBER,
Arcanum, Ohio

CHANGER SUPPORTS

Record changers are difficult to repair unless supported so that the underside can be reached with ease. To solve this problem, I obtained some lengths of sash chain and four hooks, normally used to attach the sash, and a screen door spring. The spring is cut into four 3-inch lengths and loops formed in each end.

Each spring is fitted with a hook on one end and a chain on the other. The free ends of the chains are fastened to the ceiling, over the workbench, on the corners of a square about the size of the popular changer bases. Of course, the lengths of chain are adjusted to support the changer level at a convenient height above the workbench. When in use, the hooks are slipped into the mounting holes of the changer base. The chains may be rolled up or pulled to one side when not in use.

ROBERT M. BOSCH,
Philadelphia, Pa.

POWER SUPPLY SAVER

Whenever I construct a power supply for receiver or amplifier, I insert a No. 47 pilot lamp between the negative side of each filter condenser and ground. When cold, the resistance of the bulb is negligible. If one of the condensers shorts, the resistance of the bulb will raise high enough so that the rectifier tube will not be ruined. The shorted condenser can be located merely by locating the condenser connected to the lamp that is lighted.

EHRICK H. WRIGHT,
Summit, N. J.

SPOTTING MOUNTING HOLES

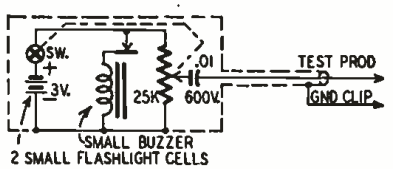
It is often difficult to locate accurately mounting holes on a chassis for radio components, particularly large transformers, chokes and variable condensers. This can be done quickly and simply by placing chalk dust in the screw holes, or on the mounting lugs, and placing the component gently in place. A sharp tap on the upper surface will leave clear impressions on the chassis and it is then a simple matter to drill the holes accurately.

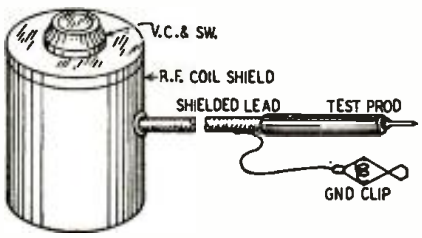
G. F. STONEMAN,
Chilliwack, B.C.

BUZZERATOR

Here is the circuit of a little device that I use instead of a signal generator for simple servicing and signal tracing. It consists of a small buzzer, 3-volt battery, volume control, and blocking condenser mounted in a coil shield. I find the unit useful for point-to-point tracing. The blocking condenser makes it possible to apply the test prod to any part of a circuit without danger of shorting.

LEON G. BROWN,
Benton Harbor, Mich.





• COMMERCIAL AIR LINES • AIR CHARTER PLANES • YACHTS
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Brand New Automatic Direction Finder
RADIO COMPASS SCR-269-F

$75.00 COMPLETE WITH COMPONENT PARTS

The radio compass SCR-269-F was designed to be the primary radio navigation compass for the United States Army and Navy Air Forces. Constant reception is possible day or night so that fixes can always be made to establish the plane's or ship's location.

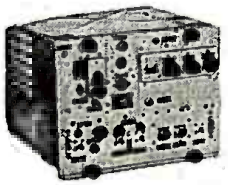
The azimuth indicator is divided into 360 degrees and is connected to the loop antenna, therefore making it possible to navigate the ship in any direction as preset on the dial.

Plotting fixes is accomplished by selecting two or more stations and plotting these on the navigation map. The point of intersection of these lines indicates the location of the craft.

This equipment comes complete with 17 tubes superheterodyne receiver which is tunable from 200-1750 KC in three bands. A complete instruction book for operation and maintenance accompanies this equipment.

COMPONENT PARTS

Quantity		S. C. Stock No.
1	Radio Compass Receiver BC-433-F	2C3016 F.1
1	Radio Control Box BC-434-F	2C3324 F.1
1	Mounting FT-213-A	2Z6721-213A
1	Mounting FT-224-F	2Z6721-224F
1	Loop LP-21-F (Includes Dehydrator)	2Z1921 F.1
1	Cord CD-365-A	3E1365
1	Indicator I-81-F	2Z5381F
1	Relay SW-172	2Z7672F
1	Plug PL-112	2Z7212
1	Plug PL-118	2Z7218
1	Plug PL-122	2Z7222
1	Dehydrator Hose, Fitting & Clamps 10 foot lengths	2Z8727
1	Operating & Maintenance Handbook	
1	Coupling MC-136	2Z3266
1	Tuning Shaft MC-124 (300°)	2ZA124-300
1	Insulator IN-79	3G579
1	Insulator IN-81	3G581
1	Shaft Casing and Spline Drive	2ZA124/1&4
1	Shafting F/MC-124-(300°)	2ZA124/1
5	Nut F/MC-124	2ZA124/2
5	Spline F/MC-124	2ZA124/4
5	Sleeve F/MC-124	2ZA124/5
1	Transformer C289AS-R16-T	



TRANSMITTER & RECEIVER

$14.95

The famous boat anchor, widely used on 144 MC bond. Shipping weight 100 lbs. Your price, less tubes and power transformer.....$14.95

MODULATION TRANSFORMER 1KW $14.95

RCA modulation transformer is conservatively rated at 550 Watt audio to modulate that new KW rig. Really rugged construction with protective flashover gaps, which are adjustable. Terminals and gaps are mounted on a "Mycalex" terminal board. The laminations that make up this transformer are of high audio quality and are extremely thin, making it impossible for the core to "chatter or talk".

Audio Watts—550 Sec. #1-450 Mils Sec. #2-80 Mils Turns Ratio—Pri: Sec. #1-1:1 Pri: Sec. #2-5:1 Pri: Sec. #2 Top-25:1. Impedance Ratio—Pri: #1-1:1 Sec. Pri: Sec. #2-25:1 Pri: Sec. #2 Tap-625:1. DC Resistance—Pri: 135 ohms Sec: #1, 112 ohms; Sec. #2, 99 ohms. Transformers insulation tested: Pri. 8000V.; Sec. #2-2000V. to the rest of the coils and core. Primary center topped for Class "B" modulators. Secondary #2 will carry 80 Mils to modulate screens of beam power or screen grid tubes. Primary will match any Class "B" tubes up to 10,000 ohms plate to plate, such as 810's, 75T's, 800S's, ZB120's, 203's, HY51Z's, 211's, 813's, 828's, 805's, 2037's. Size 9½" wide, 7½" deep, 7¼" high. Heavy channel iron mounting brackets. Weight approx. 40 lbs.

BUTTERFLY CONDENSERS

Type B—frequency range 300 to 1000 megacycles 95c ea
Cat. No. BC-2

Power Transformer

Pri: 115V 60Cy.
Sec. 1—255/255 80MA
Sec. 2—6.3V 3.8A
Sec. 3—.5V 4A

$1.29

BC 191 TRANSMITTER Less tubes and tuning units. $14.95

SCR 625 MINE DETECTOR $49.50

BC 654 TRANS. & REC. Used with tubes $14.95

MICA CAPACITATOR .002 MFD 3000W VDC. Cat. No. RT-101..... 49¢

IF TRANSFORMER Mounted in aluminum shield can 1500 KC, with air trimmer, impedence coupled type. Cat. No. T-19..... 95c

30MC IF TRANSFORMER In square aluminum can, silver slug tuned. Cat. No. T-20..... 29c

TUNING UNIT

Turning Unit BC 375. Approx. 65 M.M.F.D. cond., coils, RF chokes dials, asst'd mica condensers 2500 WVDC, over $50.00 in parts. Cat. No. TU-101..... $3.75

NEW BC 223 AX TRANSMITTER

801 Oscillator and 801 Power Amplifiers, 2-46 Modulators and 1-46 Speech Amplifier 4 Xtal Frequencies and Master Oscillator on selector switch. 10 to 30 watts output, Tone Voice or C.W. Mod. Ideal for 80 meter band. Comes with 3 coils TU 17A 2000-3000 Kc. TU 18 3000-4500 Kc. TU 25 3500-5250 Kc. Black wrinkle cose. Includes 2 separate cases to store extra coils. Frequencies chort and tubes included, packed in original cases, less crystals at this low price. Cat. No. MT-100..... $29.95

BC375E Gen. Elect. Mopa Trans. complete with tubes, 7 tuning units, Dynomotor and Antenna Tuning Unit Brand New in original crates..... $49.95

FILAMENT TRANSFORMERS

Thordarson 6.3 V-4 amps., 6.3 V-4.5 amps., 9.7 V-.5 amp., pri. 110 V AC 25 or 60 cy.—Cat. No. FT-11	1.95
Thordarson pri. 110 V 60 cy.—sec. 6.3 V 6 A, CT—Cat. No. FT-12	1.49
Thordarson 8 HY 150M choke, Cat. No. FC-201	.95
Thordarson 12 HY 25M choke, Cat. No. FC-203	.39

CONDENSERS

Cat. No.	Cap. MFD.	Working Volts		Your Cost
C110	4	5000	Oil	$3.95
C111	3	4000	Oil	4.95
C112	1	1000	Oil	.44
C114	8	600	Oil	.95
C115	2	600	Oil	.49
Westinghouse 1 MFD 6000 volts WVDC				$7.95
Westinghouse 2 MFD 6000 volts WVDC				10.95
Westinghouse 1 MFD 10,000 volts WVDC				12.95

TUBES

813	$ 5.45	829	$ 2.45
814	4.95	872A	1.95
RK60	3.25	211	1.45
VT127	2.95	VR150	.69

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HRC

Hershel RADIO COMPANY

5249 GRAND RIVER • DETROIT 8, MICH.

20% Deposit Required on All C.O.D. Orders. F.O.B. Detroit. $2.00 Minimum. Michigan sales add 3% Sales Tax

TECHNOTES

. . . . PHILCO 37-600

The resistance of the primary of the oscillator coil, normally 2.4 ohms, rises to a very high value—in the order of 50,000 ohms in one case. This coil is difficult to replace or rewind. I was able to obtain an old coil wound with the same size wire on a form that would permit it to slip over the damaged primary winding. Wire was removed from the replacement until its resistance was 2.4 ohms. The old leads were clipped and new ones soldered in place. The set was aligned and worked like new.

LOUIS HOLST,
San Antonio, Texas

. . . . HUM REDUCTION

Experience has taught me never to mount a flat type power transformer directly on a chassis made of magnetic material if any type of high-gain amplifier is mounted on the same chassis. Eddy currents will be set up in the chassis and disturb the grid returns. The transformer should be insulated from the chassis with nonmagnetic spacers or washers. Brass spacers will work well.

ALFRED J. ELBOZ,
Sydney, Australia

. . . . RADIOS WITH LOCTAL TUBES

When working with sets with loctal tubes, you may find that tapping or moving the tubes in their sockets will cause intermittents or noise. In many cases the trouble can be traced to tube pins which have become oxidized or bent. Buff each pin until bright and then bend each one slightly outward. Extreme care should be used in bending the pins to prevent breaking the glass. After you have done this, reinstall the tube and allow it to warm up. Tap it. If the noise is gone the trouble is cured.

JOHN MEDNANSKY,
Belle Fourche, S. D.

. . . . HALLICRAFTERS SX-28A

Complaint: Slight heating of the power transformer, "S" meter hits the pin. Adjusting the meter potentiometer has little effect.

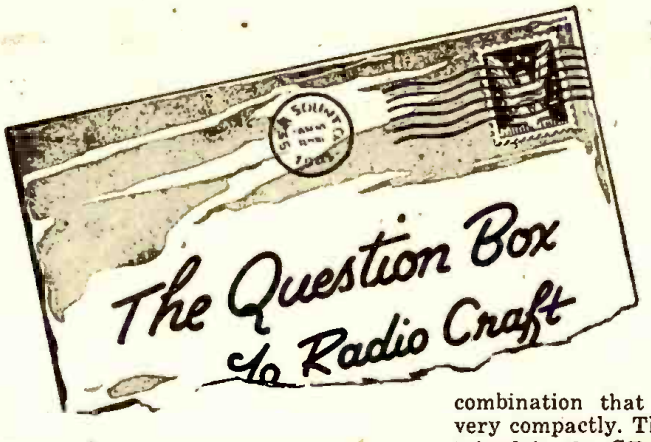
The meter adjustment control is mounted directly on the metal chassis with its center terminal insulated from the metal case. This meter is in the plate circuit and the insulation of the control breaks down, putting an extra load on the power supply and drawing full current through the meter. As a cure, I enlarged the potentiometer mounting hole and reinstalled the control after insulating its shaft with a bakelite insulating washer.

JAMES C. MCGUIRE,
Los Angeles, Calif.

. . . . SILVERTONE 6336

Intermittents in this set are often caused by a defective oscillator grid condenser. This unit changes its value intermittently. Replacing it with a high-quality 50-μμf condenser will clear up the trouble.

MCCLESKY RADIO CO.,
Baton Rouge, La.



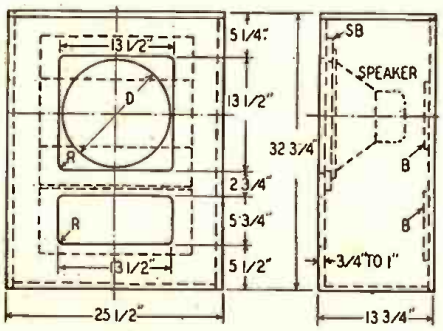
Question Box queries will be answered by mail and those of general interest will be printed in the magazine. A fee of 50c will be charged for simple questions requiring no schematics. Write for estimate on questions that may require diagrams or considerable research.

BASS-REFLEX ENCLOSURE

I would like to have plans for constructing a bass-reflex enclosure for a 15-inch speaker.—C.O.R., Kansas City, Kansas.

A. A bass-reflex enclosure design is shown in the figure.

The hair felt or rock wool pads are placed to absorb the high frequency notes coming from the rear of the



speaker. The exact size and placement of the pads depends upon a number of variables including speaker and wood characteristics. Experimenting with the size and placement of the pads will result in optimum performance.

PHONO-RADIO

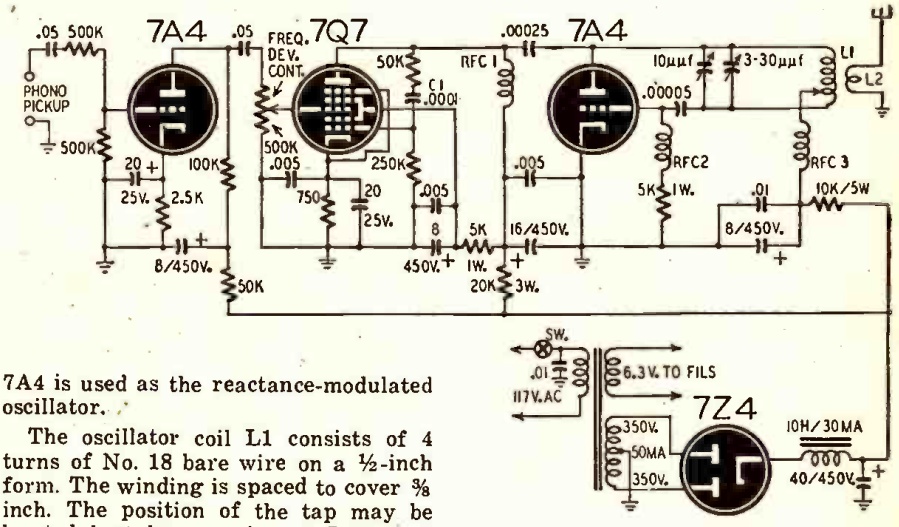
I would like to have a diagram of an a.c.-d.c. phonograph and radio combination. It should be capable of being built very compactly as I want to mount it in a small portable case.—P.S., Chicago, Ill.

A. Here is a circuit for a phono-radio combination that may be constructed very compactly. These tubes may be obtained in the GT/G series. When they are used with midget i.f. transformers, very little space is consumed.

FM RECORD PLAYER

Please print a diagram of a frequency-modulated record player to be used in demonstrating FM receivers on the 88 to 108 mc band.—G.V., Spokane, Wash.

A. Here is the circuit of a four-tube FM record player for use on the new bands. It uses a 7A4 speech amplifier followed by a 7Q7 modulator. Another



7A4 is used as the reactance-modulated oscillator.

The oscillator coil L1 consists of 4 turns of No. 18 bare wire on a ½-inch form. The winding is spaced to cover ⅜ inch. The position of the tap may be located best by experiment. L2 has 2 turns of No. 18 enamelled wire closely coupled to L1.

C1 may be varied to obtain the greatest frequency deviation from the maximum applied audio input.

The r.f. chokes consist of 20 to 25 turns of No. 24 s.c.c. wire wound to an inside diameter of ¼ inch. Slight variations in each choke are recommended to prevent parasitic oscillations.

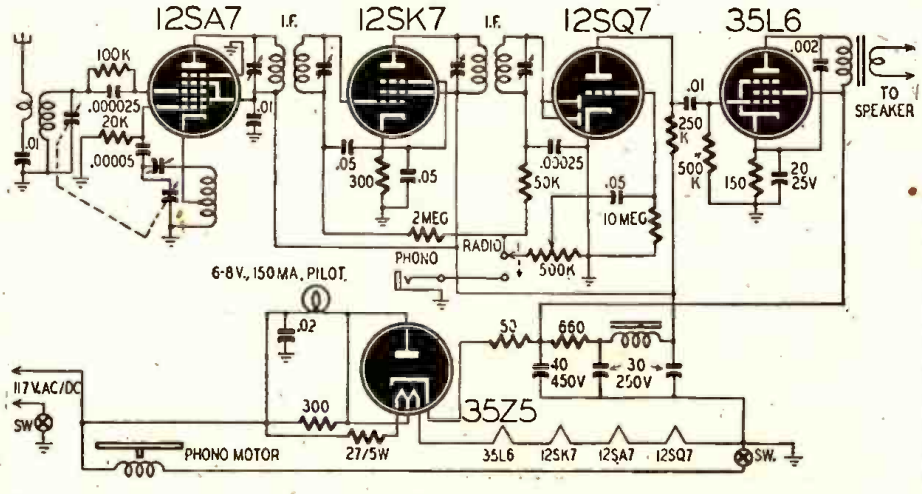
COIL DATA

I am building a superhet. receiver to cover from 550 kc to 25 mc when using 365-μμf condensers and an intermediate frequency of 465 kc. Please supply me with winding data for antenna, oscillator, and r.f. coils. What size padding condenser should I use?—C.W.W., St. Paul, Minn.

A. Here are the coil specifications. All coils are close-wound with enamel wire on 1-inch forms.

Band (Mc)	R.F. Coil Turns	R.F. Wire Size	Osc Grid Coil Turns	Osc Grid Wire Size	Osc Plate Coil Turns	Osc Plate Wire Size
0.55— 1.5	146	32	92	32	20	32
1.50— 4.0	36.2	30	30.9	30	12	30
4.0 —10.0	10.1	30	9.7	30	12	36
10.0 —25.0	4.4	20	4.3	20	6	36

The oscillator coils for the 0.55—1.5— and 1.5—4.0-mc bands are wound with the plate coil over the primary, the B-plus end being toward the primary's grid end. For other bands, the coils are wound side by side with 1/32 inch between them. The grid and plate connections are then made to the ends of the coils with the B-plus and cathode connections at the center. Padding condensers are 400 μμf, 1,070 μμf, 2,900 μμf, and 7,300 μμf, respectively, beginning at the broadcast band.



V.F.O. EXCITER OR TRANSMITTER

(Continued from page 30)

ed excellent. Not until a 0.5-μf fixed condenser was added across one side of the power line and ground were we able to clear up the signal of the v.f.o. Evidently radiation had been picked up by house wiring and had modulated the oscillator supply.

The frequency of every oscillator depends to some extent upon plate and screen potentials. Turning on a light or electric iron will cause a variation in voltage which in turn will change the oscillator frequency. Even the transmitter itself constitutes a variable load as it is keyed. These voltage changes are made negligible by using the common voltage-regulator tubes. These are widely available as surplus items and are easy to connect into regulating circuits. It is advisable to regulate not only the oscillator potentials but the following buffer as well.

Drift is due to heating of tube elements, components, and wiring. Mica and paper condensers cannot be used in critical circuits. The more expensive ceramic type of condenser has a low temperature coefficient so its capacitance remains constant. In any case the transmitter should be left on for several minutes before calling since there is always an initial drift.

Chirp is the result of a change in frequency while a rig is being keyed. This may be due to a changing load, oscillator blocking, or an unstable oscillator. It is often claimed that the oscillator should be left running at all times for best results. On the other hand, keying the oscillator permits break-in as soon as the key is up. In addition, intermittent oscillation prevents too great a change in temperature between intervals of transmission and reception. With a well-designed high-C oscillator there should be no chirp during keying. On the other hand, it is quite possible that keying the final or a buffer may introduce serious chirp. Unless isolation is complete, keying *any stage* will vary oscillator loading and frequency. To check for this condition tune the stage through resonance. If there is no noticable change in frequency, that stage may be keyed.

In checking for chirp, drift or unsteady signals, it is most effective to listen in at some high harmonic of the signal. As mentioned before, any change in frequency is multiplied by the order of harmonic.

In addition to technical problems which accompany a v.f.o., there also seems to be a psychological handicap. Some hams feel that all such rigs are inherently unstable. While an easy-to-read and stable signal always gets a T9X report and little additional comment, it is sometimes true that far more critical listening follows if the signal is known to come from a v.f.o. Actually, of course, even a crystal oscillator is subject to many of the ills of the variable oscillator unless it is correctly designed.

NEW RADIO-ELECTRONIC DEVICES

INTERCOMMUNICATOR

Rauland Corporation of Chicago
Chicago, Ill.

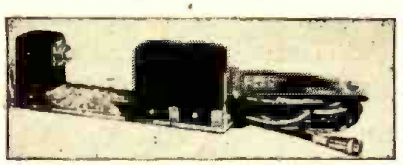
The Amplicall master station unit is available with or without handset (for completely private conversation). Distinctive features include visual busy signal, individual locking-type push buttons for station selection, illuminated

ON-OFF volume control, plug-in cable connections, and a balanced line wiring system which prevents cross-talk. Systems are available with facilities for the use of up to 24 master stations, permitting as many as 12 conversations to be carried on simultaneously. — RADIO-CRAFT

PHOTOELECTRIC ACTUATOR

Potter Instrument Company
Flushing, N. Y.

The Model 600 photoelectric actuator is a high-resolution instrument for counting pills, buttons, watch screws, bottle caps, hardware, and other such items. The unit has a beam approximately 1/16 inch wide and will respond to changes in light level as small as 20 percent. Since complete interruption



of the light beam is not required for normal operation, objects as small as 10/1000ths of an inch have been counted with absolute accuracy. This feature also permits the counting of objects which do not have a distinct separation.

The actuator provides the negative pulses for operation of electronic counters, and is designed to detect objects at rates up to 30,000 per minute. The unit contains a capacitor discharge output circuit for the high-speed operation of control solenoids such as are required for deflector gates and packaging equipment.

Electronic counters of various capacities, predetermining features, and output circuits also are available for operation with the Model 600.—RADIO-CRAFT

FREQUENCY STANDARD

Hammarlund Mfg. Co.
New York, N. Y.

The type FS-135-C frequency-standard unit consists of a precision 100-kc quartz crystal in an aperiodic oscillator circuit. Provision is made for slight frequency correction to enable the operator to adjust the crystal frequency to exactly 100 kc by zero-beating a harmonic with the standard frequency transmission of the U. S. Bureau of Standards transmitter WWV.

It is completely self-contained except for power supply. Leads are brought out for easy connection to the receiver's power supply. The power required is negligible: 6.3 volts at 0.3 ampere for the tube cathode heater, and approximately 2 milliamperes at 200 volts for the plate and screen-grid supply. The plate and screen potential is not critical and may be anywhere from 100 to 300

volts; recommended voltage is 200 to 250.

The frequency standard is mounted in a drawn aluminum case 2 by 2 inches square, and 1½ inches high, and is equipped with 2 convenient mounting brackets. The tube and crystal are plugged into the top of the unit. With the tube and crystal in place, the total height is approximately 3⅜ inches. —RADIO-CRAFT

POCKET-SIZE OHMMETER

Sylvania Electric Products, Inc.
New York, N. Y.

A miniature ohmmeter has been designed particularly for use by servicemen as a pocket indicator for preliminary isolation of electric faults. In radio set servicing the ohmmeter will indicate transient or other faults in difficult replacements including i.f. transformers,

tuning units, and audio sections; approximate values of individual resistors; and open or shorted conditions in other circuit components. It also provides a direct-reading means for spot-checking automotive electrical equipment, industrial electronic apparatus, home appliances, and experimental or development electrical circuits.

Direct readings between 0 and 10,000 ohms are given on a 1.5-milliampere, full-scale sensitivity Weston meter in series with a 1,000-ohm molded carbon resistor and a penlight dry cell.

The ohmmeter is enclosed in an attractive tubular plastic case ⅞ inch in diameter and 5¾ inches over all. The prod tip base and top cap, constructed of green molded bakelite, are mounted in a transparent cellulose acetate tube housing the meter.—RADIO-CRAFT

PIONEER ATOM SPLITTER

(Continued from page 23)

the passage of *a single electron* through its gas chamber. Where the number of counts per second is too great for the mechanical relay in the plate circuit of the final amplifier to handle, other circuits have been constructed which supply one impulse to the relay for every two (or higher multiple) counts. These *scaling circuits* may have a factor of 4, 8 or higher numbers, or may be based on the decimal system, giving an indication for every 5 or 10 counts.

Vacuum-tube *quenching circuits* further speed up Geiger tube action, by causing the tube to de-ionize more rapidly after each pulse, so that it can count faster and register heavier showers of particles.

The voltage-regulated power supply is by no means to be neglected as a factor in atomic research. Maintenance of voltage within very narrow limits is very important when counters or other instruments are operating over critical portions of their characteristics, as is necessary in some very important types of study.

Regulated voltage supplies, vacuum-tube amplifiers and electronic switching circuits have so extended the capabilities of older research devices as to make them practically new instruments, of which the electronic circuits are fundamental parts. Thus it is not surprising that an important piece of equipment for atomic study and research should resemble a radio transmitter rack.

DEMONSTRATION TRANSMITTERS

(Continued from page 35)

the same time taking advantage of the same audio amplifier and loud speaker for both units and thereby eliminating any change in fidelity from that source.

For the interference source an old model "T" Ford spark coil was wired through a push button to four dry cells and a short length of wire connected to the high tension terminal. This created no small amount of racket in the AM receiver yet was thoroughly eliminated when switching to FM.

New Radio-Electronic Patents

By I. QUEEN

TELEVISION SWEEP CIRCUIT

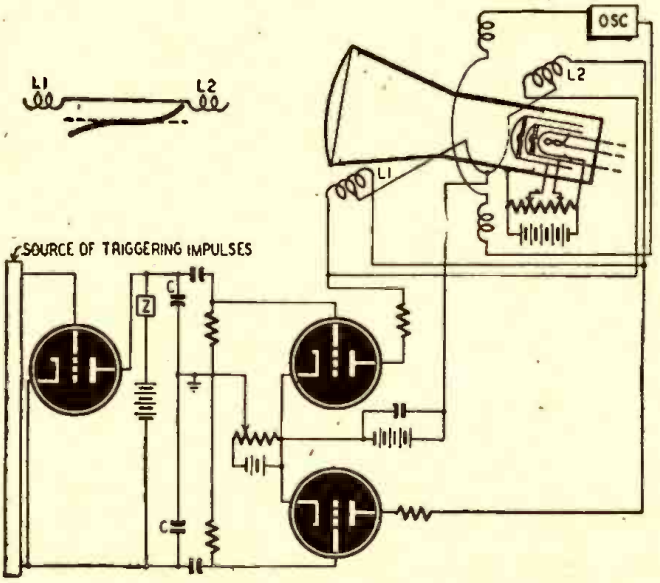
Patent No. 2,393,601

Millard W. Baldwin, Jr., Glen Ridge, N. J.

This invention is an improvement over existing circuits which govern the deflection of an electron beam by electromagnetism. The magnetic type of cathode-ray tube is advantageous where the necessary deflection power is available, as in television reception, since the tube can be smaller and simpler. Since the special features are associated with the vertical sweep circuit, it need only be mentioned that the horizontal sweep is controlled by a suitable oscillator and deflection coils according to present-day procedure.

The vertical sweep circuit uses three tubes, the last two in push-pull for second-harmonic reduction. The input triode is triggered by periodic pulses which cause the tube to conduct and therefore discharge the condensers C. These charge again from the battery through any well-known constant current device and the cycle repeats.

The output of the push-pull stage flows through the coils L1 and L2 and it consists in general of a residual d.c. component and the signal a.c. component. For convenience consider the first portion alone, that is, in the absence of a signal. During these intervals there should be no vertical deflection of the beam. The deflection coils ordinarily carry the current of only one of the push-pull plate currents, and as a result the two equal and opposite currents balance out only near the center of the scope tube. This means that when an electron is near the end of its travel (along a horizontal line), one or the other of the magnetic fields will predominate and cause the beam to be deflected even though no signal is coming through. Therefore the television picture will be distorted along the two sides. In this circuit, each deflection coil is *center-tapped* and each half carries the current from one tube. As a result, the two opposite and equal fields cancel out in each coil. Under this condition there is practically no magnetic field due to the d.c. component of the push-pull tubes and therefore no vertical deflection without signal input.



MAGNETIC MEASUREMENT

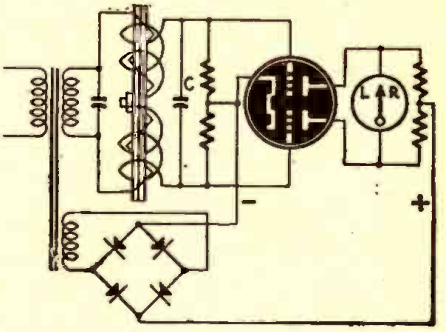
Patent No. 2,410,039

Lennox F. Beach

(assigned to The Purves Corporation, Springfield, Mass.)

Measurements of magnetism are inherently indirect and often difficult to make. This electronic method simplifies the process and is capable of high sensitivity and accuracy. It operates on the principle of hysteresis—often known as magnetic inertia because it imposes a lag between an exciting current and the electromagnetism which results.

Two windings are placed over a suitable iron core. An a.c. source excites the primary, one half of which is wound in opposition and in series with the other half. The entire secondary is wound in one direction. If the core is in field-free



space, it may be considered as composed of two equal and opposing electromagnets, end to end. Since hysteresis lag depends upon peak magnetism, it is equal for each half of the core in this case and there can be no induced secondary voltage.

If the core is surrounded by a magnetic field (for example that of the earth) the two halves of the core no longer have the same peak magnetism since one is strengthened and the other weakened during any given half-cycle of exciting current. As a result, the hysteresis lag is increased in one of the core "magnets" and is decreased in the other; so there is a distortion of the previously symmetrical field variation.

The effective electromagnetic field now has a component which varies at a frequency twice as great as that of the exciting current. Condenser C tunes the secondary winding to this frequency and the induced voltage is amplified and detected by a meter. The deflection may be either to the right or left depending upon the direction of the magnetic field being measured. The field intensity is shown by the output current magnitude. Note that the plate potential for the tubes may be obtained from the same a.c. source that supplies the electromagnetic primary.

This device may be used as a magnetic compass. The meter will indicate a peak reading when the core is pointed toward magnetic north and south.

UNDERWATER DETECTION

Patent No. 2,410,065

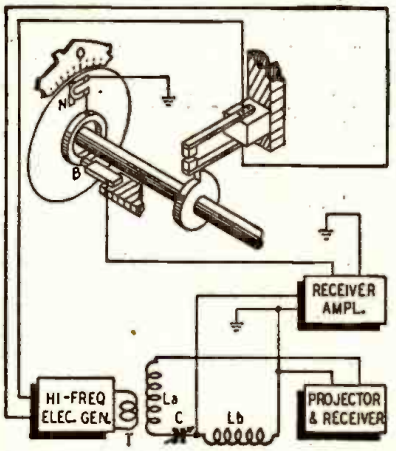
Bertram M. Harrison

(assigned to Submarine Signal Co., Boston)

Power at superaudible frequencies is generally used in devices for underwater detection of objects. A sharp pulse is transmitted (periodically) and is subsequently received as an echo. The time interval between the two instants measures the distance of a target. Because of the very short time between transmission and reception of a pulse, it is difficult to prevent blocking of the receiver. An effective method has been devised in this invention.

The figure shows the new method as applied to one type of detector. A shaft rotates at constant speed and carries with it a disc and a cam arrangement. The disc is equipped with a thin vertical slot behind which is fixed a neon tube N. One terminal of the discharge tube is fed through a brush and commutator B and the other is grounded.

The cam is first adjusted so that it closes the contacts and actuates the transmitter at the



instant that the slot corresponds to zero on the scale. Received pulse echoes are applied across the neon tube which is caused to glow during such instants. Since transmission of a pulse takes place while the slot is at zero, the echo will arrive after the slot has moved to some other position. If the scale calibration is marked off in suitable units of distance, the range of an object is indicated directly by noting the point at which the neon tube flashes.

Receiver blocking is accomplished by the network La, Lb and C. The reactance of La is designed to be equal and opposite to that of C. The reactance of Lb and that of the projector are such that only a fraction of the total circuit voltage appears across the inductance. During transmission of a pulse, therefore, only a fraction of the total voltage is present across the receiving amplifier. The amplifier input and Lb are designed to be parallel-resonant at the superaudible frequency being used. Therefore the entire received voltage is effective across the amplifier.

MULTI-CHANNEL U.H.F. RECEPTION

Patent No. 2,394,917
Heinz E. Kallmann

High-frequency broadcasting (including FM, television, facsimile) has created special problems which differ greatly in several ways from those of AM broadcasting. For example, the line-of-sight limit makes it desirable to use directional antenna systems, Also an accurate impedance match should be made throughout, since wave reflections often seriously distort a received picture. The wide modulation bands require special design in the antenna and receiving units, and limit the number of available channels.

This patent proposes to use separate antenna systems for each station within range, thus making it possible to tune, orient, and match each for optimum picture or sound reception. The various outputs feed a single transmission line designed for low loss at ultra-high frequencies. Fixed-tuned receivers then may be connected across the line where desired. In some cases, it may be desirable to convert the original high frequency to a lower carrier frequency or even to demodulate before feeding the line, thus simplifying the apparatus necessary to reproduce the signal from the line.

This invention should be especially applicable to large apartment buildings and hotels.

COLOR TELEVISION

(Continued from page 40)

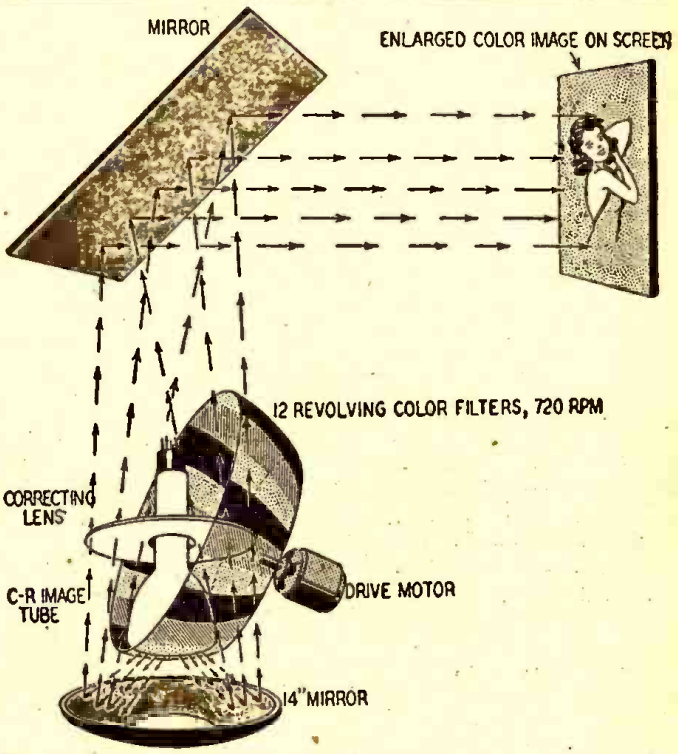


Fig. 5—Sequential color receiver, showing how color is restored.

of each tube, as Fig. 1-b and Photo E show. The 3 color beams are flashed onto a mirror, which reflects and blends them on a translucent screen. The observer sees a single composite color image or picture on the screen, the size of the image being 15 x 20 inches. The receiver is of the *projection* type and is not adapted to direct viewing, at least in its present design. About 45 tubes are used in the receiver; this includes sound.

In the tests conducted at Princeton, N. J., for the FCC, color images were transmitted by *radio* for a distance of about ½ mile, using a frequency of 520 mc.

For comparison it is interesting to note that the RCA console receiver for B & W reception, with a 10-inch tube for direct viewing, has 30 tubes. The B & W *projection* receiver for an image 15 x 20 inches has 45 tubes.

One of the advantages of the simultaneous color system is that a standard *black and white* receiver can be fitted with a nominally priced frequency converter so that B & W images may be picked up from a color broadcast. The converter permits the receiver to pick up the *green* carrier, and as this contains all the essential picture characteristics and the synchronizing signals, a satisfactory B & W picture can be reproduced on the receiver. This prevents obsolescence of B & W television receivers purchased in the past few years. The B & W receiver cannot pick up its images in color, of course. To do that a color receiver must be used. A sequential receiver must be of the *dual* type, fitted with changeover switches, to pick up

(Continued on page 59)

causes this separation of ions and electrons is obtained from a small coil placed on the outside of the neck of the tube, above the cathode. The 10AP4 tube is a commercial tube which employs this type of ion trap.

Yet another method of practically eliminating the ions is the type of electron gun shown in Fig. 9. The electrons and ions, when emitted from the cathode, tend to spread out. If a strong magnetic field is applied at this point, the electrons can be made to converge and pass through an extremely small aperture and into the main focusing and deflection fields. Again, the heavier ions

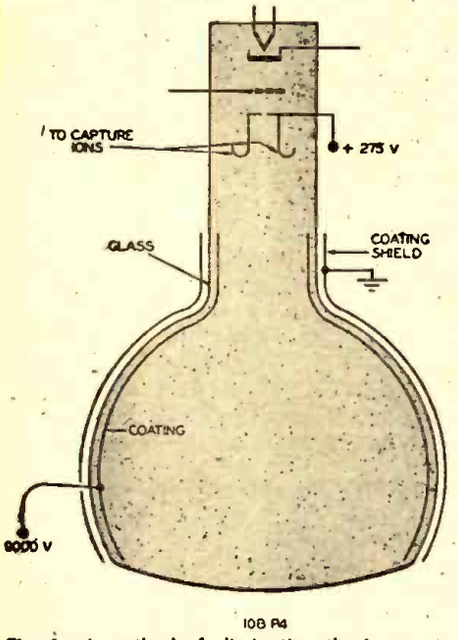


Fig. 9—A method of eliminating the ion spot.

do not react to the magnetic concentrating field but continue to diverge until they reach a positively charged electrode and are conducted back to the cathode. Those ions which leave the cathode in a straight line do pass through the small aperture and into the electron beam. However, the percentage of them is extremely small and no visible damage is caused. A tube with this type of gun is used in the latest RCA television receivers.

The proper position of the bending coils for the ion trap is at the end of the tube neck close to the tube base. In adjusting the set, the coils are moved until the scanning raster or image is brightest. The coil clamps are then tightened securely.

A third method of preventing ions from reaching the screen is accomplished by the aluminum layer mentioned previously. The ion, with its greater mass, does not penetrate as deeply into the aluminum screen as does the electron. By properly determining the thickness of the metal screen, ions are excluded, while the electrons in the beam are able to pass through.

This article closes the series. Comment from readers, or suggestions as to other subjects for similar treatment, is invited.

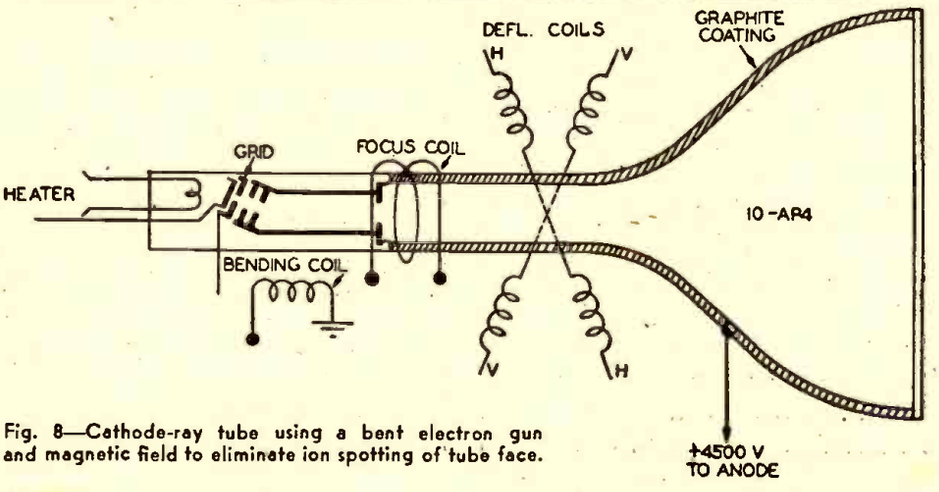


Fig. 8—Cathode-ray tube using a bent electron gun and magnetic field to eliminate ion spotting of tube face.

CAN YOU ANSWER THESE?

Employees of Collins Radio Co., Cedar Rapids, Iowa, are expected to pass a technical examination to show their knowledge of the work they are to perform. A passing grade entitles the applicant to a trial period on the job which, if successfully completed, leads to a permanent assignment.

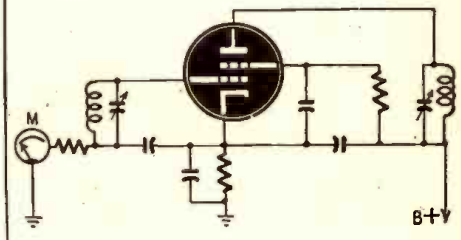
The following are sample questions taken from an examination for a "Test Technician B" position.

1. In a radio frequency amplifier stage having a plate voltage of 1,250 volts, a plate current of 150 milliamperes, a grid current of 15 milliamperes, and a grid leak resistance of 4,000 ohms, what is the exact operating grid bias value?

2. Sketch a block diagram of a crystal-controlled transmitter, using a buffer stage and high-level modulation.

3. Why is the distributed capacity of a coil always increased by the wax or other coating used for protection against moisture?

4. How is the vacuum-tube plate current of an r.f. amplifier affected as the plate-circuit resonant frequency is varied?



5. The above is a circuit of an r.f. amplifier. What is the fundamental difference between the action of the meter if the tube is operating Class C from what it would be if the tube was operating Class A?

6. What are the principal output voltage ripple frequencies in a full-wave rectifier?

7. What is the relation between the direct-current power input of the plate circuit of the stage being modulated, and the output audio power of the modulator for 100 percent sinusoidal modulation?

8. Sketch a block diagram of a superheterodyne receiver showing an audio frequency stage, radio frequency stage, audio power amplifier stage, speaker, mixer, second detector, and intermediate frequency stage.

9. What is the sum of 25 cycles, 25 kilocycles, and 25 megacycles?

10. What is a "parasitic oscillation"?
—*The Collins Signal*, Jan., 1947

(Answers for these questions next month, if you need 'em! Write in and ask.)

COLOR TELEVISION

(Continued from page 56)

black and white images as well as color pictures.

Simultaneous-type color receivers can pick up and reproduce images broadcast by B & W stations, with the aid of an adapter. The adapter is needed only because the color band is at a higher frequency than is covered by B & W receivers, and would be needed to receive B & W transmissions on those frequencies. At the present development stage, a mechanical or sequential color receiver cannot pick up a simultaneous image, either in color or as a black and white monochrome.

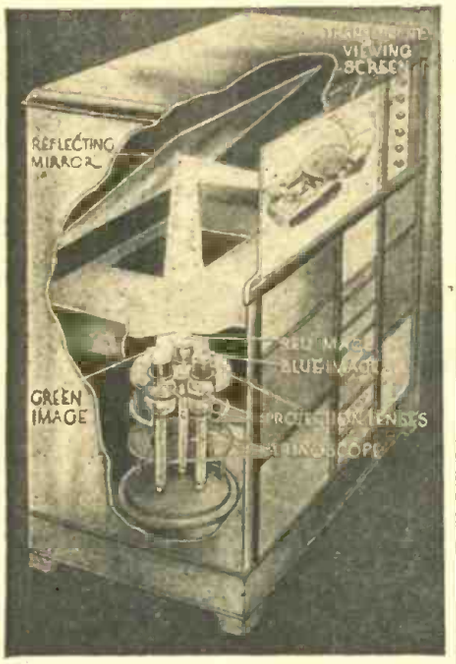


Photo E—A simultaneous television receiver.

Among some of the advantages claimed for the *simultaneous* color system are: narrower band width than that required for sequential transmission; greater freedom from flicker; no color fringing and no color breakup; greater fidelity in picture detail and superior picture brightness for comparable size of images; superior flexibility for network broadcasts.

The second part of Mr. Secor's article—to appear in an early issue—will describe three other proposed methods of color television.

COMMERCIAL PARADISE

Commercial announcements on the Brazilian ether are so frequent and lengthy as to cause one American broadcasting magazine editor to evolve a theory that the Brazilians must like 'em. As many as 20 spot commercials may be broadcast successively, with no program material.

Proof that the people like this type of fare is entirely lacking, and the fact that there is only one radio for every 50 inhabitants of the country might be adduced as evidence to the contrary.

WORLD-WIDE STATION LIST

Edited by ELMER R. FULLER

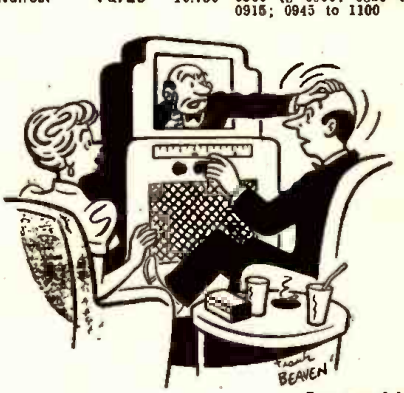
CONDITIONS here have not been very good. The same seems to be true all over, as very few stations of note were reported by our observers this past month. This year marks the beginning of the twenty-first year of broadcasting of the "Happy Station" known to many listeners as PCJ. It is located in Hilversum, Netherlands, with the programs under the direction of Edward Startz who is well known to many of you. Transmissions are directed toward the United States and Canada on Sundays and Wednesdays from 2130 to 2300 hours EST. Frequencies used are 11.730 mcs, 9.59 mcs, and 6.02 mcs. Other transmissions are heard on Sundays at 1030 to 1200 hours on 17.77 mcs, 15.22 mcs, and 6.02 mcs; and from 1600 to 1730 hours on 11.73 mcs, 9.59 mcs, and 6.02 mcs. Transmissions on Tuesdays are from 0300 to 0430 hours on 17.77 mcs, 15.22 mcs, and 6.02 mcs; and on Wednesdays from 1030 to 1200 hours on 17.77 mcs, 15.22 mcs, and 6.02 mcs; from 1600 to 1730 hours on 11.73 mcs, 9.59 mcs, and 6.02 mcs.

Many changes have been made recently in the U. S. stations' frequencies and schedules. These will be available to you in the next issue. Our new 24-hour clock system seems to have been well received by our readers according to the letters received recently. We are glad that you like it and hope to see it used throughout the shortwave spectrum in the near future. It certainly saves a lot of confusion.

Some new equipment has been put into service here and we have a report ready for you in an early issue. A Panadaptor (manufactured by Panoramic Radio Corp.) is being used for visual reception, and our report on it will give you full dope on its operation and usefulness to the shortwave listener. Your shortwave editor would like to correspond with anyone using a Panadaptor in conjunction with their receiver. To those of you who have written about the shortwave dope card, we will have more on this matter in a few weeks, possibly by the time that you read this. Information will be sent to you soon.

(All schedules are on Eastern Standard Time)

Location	Station	Freq.	Schedule
FINLAND			
Lahiti	OIX2	9.500	1100 to 1600
Lahiti	OIX5	17.800	0130 to 0200; 0500 to 0545; 0800 to 1700
FRANCE		11.840	0000 to 0045; 0100 to 0145; 0545 to 0615; 1045 to 1130; 1315 to 1730; 1830 to 2345
Paris		15.350	0700 to 0900
Paris		17.760	0700 to 0900; 1100 to 1230
FRENCH EQUATORIAL AFRICA			
Brazzaville	FZI	6.020	1600 to 1845; 0000 to 0130
Brazzaville	FZI	9.440	0000 to 0130; 1100 to 2020
Brazzaville	FZI	11.970	0445 to 0800; 0930 to 1030; 1100 to 2020; 0000 to 0230
Brazzaville	FZI	15.590	0445 to 0800; 0930 to 1030
Brazzaville	FZI	17.530	0000 to 0130; 0445 to 0745; 1100 to 1700
FRENCH WEST AFRICA			
Dakar	FGY	7.210	
GERMANY			
Berlin		6.070	0000 to 0345
Munich	DTYC	5.300	0000 to 0930
Munich	AFN	8.560	0400 to 1200
GOLD COAST			
Accra	ZOY	7.290	1045 to 1300
GREECE			
Athens		7.290	1400 to 1530
Athens	SVM	9.930	1300 to 1800
GUADALOUPE			
Point-a-Pitre	FG8AH	5.990	1700 to 1900
GUAM	KU5Q	7.640	0400 to 1200
GUAM	KU5Q	9.330	2300 to 0100; 0530 to 0700; 1100 to 1330; 1400 to 1545
GUATEMALA			
Guatemala City	TGWB	6.530	0800 to 1200; 1830 to 0100
Guatemala City	TG2	6.620	1800 to 2300
Guatemala City	TGWA	15.170	1200 to 2000
HAITI			
Port-au-Prince	HH2S	5.950	0600 to 0815; 1100 to 1300; 1730 to 2130
Port-au-Prince	HHCM	6.160	0500 to 0830; 1100 to 1400; 1700 to 2145
HAWAII			
Honolulu	KRHO	9.650	0400 to 1100
Honolulu	KRHO	17.800	Philippine beam. 0400 to 1130
HONDURAS			
La Ceiba	HRD2	6.230	1200 to 1400; 1900 to 2300
San Pedro		6.360	1100 to 1415; 1800 to 2255
Sula	HRPI		
Tagucigalpa	HRN	5.870	0800 to 1000; 1300 to 1500; 1800 to 2300
ICELAND			
Reykjavik	TFJ	12.260	Sundays. 0900 to 0930
INDIA			
Delhi	VUD3	3.340	1200 to 1245
Delhi	VUD7	6.100	0830 to 0915
Delhi	VUD8	7.270	0600 to 0700; 1115 to 1315; 1830 to 1915; 2100 to 2200
Delhi	VUD3	7.290	2040 to 2245
Delhi	VUD4	9.590	0030 to 0100; 0200 to 0400; 0430 to 0515; 0900 to 1220
Delhi	VUD4	9.670	0000 to 0130; 0200 to 0400; 0430 to 0515; 0730 to 0745; 0800 to 0830; 0845 to 1230
Delhi	VUD3	15.290	0130 to 0145; 0200 to 0400; 0445 to 0815; 2245 to 0030
Delhi	VUD10	17.830	0400 to 0430; 0445 to 0700
IRAN			
Teheran	EQB	6.150	1000 to 1415; 2230 to 2400
Teheran	EQC	9.680	1200 to 1430
JAMAICA			
Kingston	ZQ1	4.790	1630 to 1830
JAPAN			
Tokyo		3.075	0400 to 0900.
Tokyo	JVT	6.750	
Tokyo	JVW	7.200	Home Service. 8 pm to 8:30 am
Tokyo	JLG	7.280	Home Service. 0200 to 0800
Tokyo	JLG2	9.510	0300 to 0830
Tokyo	JLU2	9.520	0600 to 1200
Tokyo	JZK	15.160	1730 to 1815
Tokyo	JTL3	15.220	1800 to 0230
KENYA			
Nairobi	VQ7LO	4.950	1100 to 1400
Nairobi	VQ7LO	10.730	0500 to 0600; 0830 to 0915; 0945 to 1100



Suggested by Frank Beaven

"Ah, Ah, Don't Touch That Dial!"

Location	Station	Freq.	Schedule
LEBANON			
Beirut	FXE	8.030	0015 to 0115; 0525 to 0630; 1000 to 1600
LUXEMBOURG		6.090	1430 to 1700
MALAYA			
Singapore		4.780	1730 to 2230; 2330 to 0120
Singapore		6.770	0345 to 0935
Singapore		7.220	2330 to 0130
Singapore		9.550	0315 to 0515; 0530 to 1100
MARTINIQUE			
Ft de France		9.700	0900 to 1245; 1600 to 1610; 1730 to 2030
MEXICO			
Guadalajara	XEJG	4.820	2200 to 2400
Mexico City	XEUW	6.020	0700 to 0100
Mexico City	XEUZ	6.130	1500 to 0030
Mexico City	XEWW	9.500	0800 to 0200
Mexico City	XETT	9.550	0700 to 0100
Mexico City	XEYU	9.600	Sked unknown
Mexico City	XEQQ	9.680	0700 to 0045
Mexico City	XETW	6.040	0745 to 0045
MOROCCO			
Rabat	CNR3	9.080	0100 to 0330; 1300 to 1700
MOZAMBIQUE			
Lourenco Marques	CR7BO	4.920	Daily, 1330 to 1600; Sundays, 1000 to 1400
NETHERLANDS			
Hilversum	PCJ	6.020	0300 to 0430; 1030 to 1200; 1600 to 1730; 2130 to 2300
Hilversum		9.59	2130 to 2300; 1600 to 1730;
Hilversum		11.73	1600 to 1730; 2130 to 2300;
Hilversum		15.22	0300 to 0430; 1030 to 1200;
Hilversum		17.77	0300 to 0430; 1030 to 1200; 2130 to 2300
NETHERLAND INDIES			
Bandoeng		4.790	0730 to 0800
Bandoeng	PMA	6.780	sked unknown
Batavia	PMC	18.135	2330 to 0930
NEW CALEDONIA			
Noumea	FK8AA	6.200	0200 to 0400; 1900 to 2000
NEWFOUNDLAND			
St. Johns	VONH	5.970	0900 to 1400; 1500 to 2200
NEW ZEALAND			
Wellington	ZLT7	6.710	0415 to 0450
NICARAGUA			
Managua	YNDS	6.760	0800 to 1000; 1700 to 2330
Managua	YNOW	6.850	0800 to 2400
Managua	YNQW	6.910	schedule unknown
NOVA SCOTIA			
Halifax	CHNX	6.130	0700 to 2300
Sydney	CJCX	6.010	0530 to 2200
PALESTINE			
Jerusalem	JCKW	7.220	2330 to 0130
PANAMA			
Colon	HP5K	6.000	0700 to 1300; 1900 to 2300
Panama City	HP5B	6.030	1800 to 2300
Panama City	HP5H	6.120	0700 to 2300
Panama City	HP5A	11.700	0700 to 2300
Panama City	HP5G	11.780	0745 to 1000; 1200 to 2230
PERU			
Lima	OAX4Z	5.890	1630 to 2330
Lima	OAX4V	5.910	1800 to 2400
Lima	OAX1B	5.530	1800 to 2330
POLAND			
Warsaw		6.100	1330 to 2100
PORTUGAL			
Lisbon	CS2WD	6.150	1430 to 1900
Lisbon	CSX	6.370	1330 to 1900
Lisbon	CSW7	9.730	1900 to 2000
Lisbon	CSW6	11.040	0900 to 1130; 1230 to 1500; 1600 to 1800
Lisbon	CSX	11.990	0800 to 1000
PORTUGUESE GUINEA			
Bissau		7.100	1600 to 1730
SALVADOR			
San Salvador	YSN	7.310	1300 to 1500; 1900 to 2300
SOUTH AFRICA			
Capetown	ZRK	5.880	2345 to 0130; 1000 to 1600
Capetown	ZRL	9.610	0300 to 0700; 0900 to 1030
Johannesburg	ZRH	6.010	2345 to 0130; 0900 to 1100
Johannesburg	ZRG	9.520	0300 to 0700
Johannesburg	ZTJ	9.900	0315 to 0715
SOUTHERN RHODESIA			
Lusaka	ZQP	8.910	2230 to 1300
SPAIN			
Alicante		7.950	0730 to 0930; 1530 to 1800
Madrid	EAQ	9.370	1500 to 1700; 1830 to 2100
SPANISH MOROCCO			
Tetuan		6.060	0230 to 0300; 1330 to 1830
SURINAME			
Paramaribo	PZH5	5.840	1800 to 2045
SWEDEN			
Stockholm	SBU	9.530	0130 to 0145; 1330 to 1700; 2000 to 2100
Stockholm	SDB2	10.780	1100 to 1720
Stockholm	SBP	11.700	2000 to 2100
Stockholm	SBT	15.150	0130 to 0215; 0600 to 0700; 1000 to 1315
SWITZERLAND			
Berne	HER3	6.160	0020 to 0120; 0245 to 0700; 1200 to 1700
Berne	HEI2	6.340	
Berne	HEK3	7.380	1000 to 1045; 1510 to 1530
Berne	HEF4	9.180	
Berne	HEI5	11.710	Tuesdays and Fridays, 1000 to 1130; Saturdays, 1550 to 1625
Berne	HEK4	11.960	1645 to 1715 except Saturdays
Berne	HER6	15.310	Saturdays, 1000 to 1200
Geneva	HBL	9.340	1300 to 1500
TAHITI			
Papeete	FO8AA	6.980	Tuesdays and Fridays, 2200 to 2400
TURKEY			
Ankara	TAP	9.460	1000 to 1615
Ankara	TAQ	15.190	0000 to 0200; 0415 to 0730

$3.00 FOR CARTOON IDEAS

RADIO-CRAFT prints several radio cartoons every month. Readers are invited to contribute humorous radio ideas which can be used in cartoon form. It is not necessary that you draw a sketch, unless you wish.

IDEAS NOT WANTED:

No electrical or radio definitions wanted. Some of these were published in the past, but the subject is about exhausted.

Payment is made on publication.

Address RADIO CARTOONS, RADIO-CRAFT, 25 West Broadway, New York 7, N. Y.

Radio production for the first quarter of 1947 totalled 4,231, 415 receivers.

NOISE ELIMINATION

(Continued from page 29)

provided he is tactfully assured that his sign will work as it did before.

Household equipment interference

If a refrigerator is causing the noise, putting the radio on a different outlet may help, but more often the refrigerator is in need of repair. The brushes in the motor may spark excessively and require replacement; the commutator may need cleaning or turning down. The belt may need replacing. If in doubt, try to have a refrigerator expert look it over and make any necessary repairs. If it still interferes, the noise can be further cut down by putting a filter similar to that in Fig. 1 on the refrigerator. However, in many cases an ordinary line noise filter can be used without difficulty and with completely satisfactory results.

If the noise is being produced by an electric razor, putting a filter at the razor outlet, as shown in Fig. 2, may prove helpful. The setscrew which holds the wall plate of the regular outlet to the box may be loosened slightly. Then the wire from the ground post of the

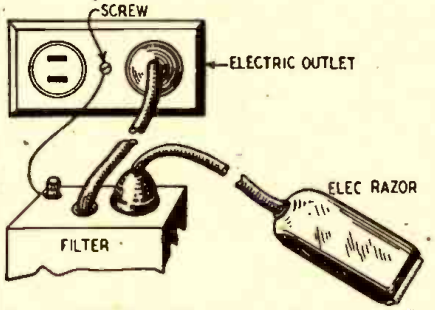


Fig. 2—Put line filters near the receptacle.

filter is twisted under the head of the screw, in a clockwise direction, so that tightening the screw will make the wire fit tight. The razor itself is plugged into the filter box which may contain a couple of by-pass condensers and, in some cases, series chokes, depending on the filter purchased.

A listening test should be made. If the filter does not cut out the noise, try using it at the radio instead of at the razor outlet. Be sure wherever possible to use different outlets for the razor and radio.

Razor interference is often terrific. In some cases there will be nothing to do but buy a frequency-modulation radio or turn the regular radio off while the razor is being used.

Keeping the antenna of the set away from power wiring and using a doublet lead-in will help in minimizing interference.

Work at the radio

Realigning the radio and making every effort to get it selective will help in cutting down noise. With sharp selectivity, a certain amount of side-band cutting will be noticed, reducing the total amount of noise output of the detector, since smaller side bands mean

less audio output. There may be some sacrifice of fidelity, especially in heavily built-up sections of cities, but often the listener is willing to hear fewer high notes if only the main portion of the audio spectrum is not too noisy.

Usually, sets with a stage of r.f. before the first detector will outperform sets without the r.f. stage. In some cases it may be wise to recommend to the customer that the set be traded in for a larger one which does have r.f. This has been found excellent "repair" practice in many stubborn cases of noise.

A good antenna is important but not the whole story by any means. In the shadow of Brooklyn Bridge or any of the other big steel bridges reception may be very poor. On one side of the Manhattan skyline, running north and south, reception from certain stations may be good, but on the other side reception from the same stations may be too weak. If the local noise level is high, the weak signal cannot be separated easily from the noise, and whatever separation is gained is due to the selectivity of the receiver and to such other things as inherent low noise in the set itself.

Line noise filters at the radio will often eliminate noise due to elevators. It is usually impractical to filter the elevator itself.

A simple filter the radioman can make and use is shown in Fig. 3. The 2 coils

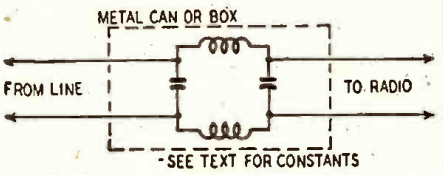


Fig. 3—A more effective type of line filter.

are ordinary rolls of bell wire, used just as purchased. The condensers should be of the metal-cased type and may range from 0.5 to 2 μf. It is a good idea for the serviceman to construct 3 filters (one with 0.5-μf condensers, one with 0.1-μf condensers, and the third with 1.0 μf condensers) and to use the one which is best for the given job. To provide shielding the coils should be put in a metal can about the size of a coffee can or slightly smaller. They can be inserted between the line and either the radio or the interfering device.

In some cases, where the radio is several floors above the street level, it may be found that less noise will be picked up if the ground wire is left off the set than if it is attached. The reason for this is that the impedance between the ground terminal and the actual earth ground may be appreciable for a long stretch of pipe; noise currents flowing in that impedance set up a noise voltage which acts in series with the input circuit of the radio

Keeping the antenna of the set away from overhead power wiring is important from the standpoint of minimizing noise. *The higher the antenna, the better!* Distance from surface or elevated electric railway lines is also important. Very often it will pay to use a longer doublet lead-in and to keep the flat top farther away from the elevated line or overhead power wires, and particularly from other antennas on the same roof. In apartment buildings, this is often difficult, but all possible efforts should be made. Keeping the flat top away from the elevator housing on the roof is desirable also, since the elevator and everything connected with it is noisy.

The importance of a good antenna job cannot be stressed too much. In some respects, this work is pure labor and not very technical, but it's a very important part of servicing and not to be shirked. At least half the noise jobs can be solved simply by installing a good outside aerial. The change in signal-to-noise ratio is usually such that the offending interference hardly can be heard at the new and lower volume control setting required to bring in programs at a satisfactory level. This is true even in the case of FM radios which are not as susceptible to noise as AM sets, but require outside antennas for best reception.

A SMALL RECORDING STUDIO

(Continued from page 32)

sirable to cut a groove which matches this radius as nearly as possible. It is advisable not to cut too deep a groove, which would result in distortion and a loss in high-frequency response. It is wise also to determine the maximum level of signal which can be fed to the head with a given depth of cut. Otherwise, over-cutting, which will result in the grooves running into each other, will take place. This can be seen with a magnifying glass. If the grooves come too close together when cutting, an echo will be noticed when the disc is played back.

There will be a difference in depth of cut, with a particular adjustment of the cutting head, when changing from 78 r.p.m. to 33 1/3 r.p.m. A satisfactory compromise adjustment can be made if it is necessary to change speed frequently. The highest quality recording, however, necessitates individual depth-of-cut adjustment for each speed.

It is wise to check the depth of cut frequently, as even the best needle wears. As the point becomes dull it requires more pressure to cut properly. The frequency response of a recorder is a function of needle sharpness. This is particularly true when recording the higher frequencies at 33 1/3 r.p.m. For best results, the over-all response of the system should be checked frequently by cutting a variable-frequency test record (introducing sufficient compensation electrically to offset the effects of recording-blank hardness, needle sharpness, depth of cut, etc.) and observing the light pattern. All the items above can cause a high-frequency loss.

Speed considerations

When recording at 33 1/3 r.p.m., it is conventional to record at a slightly lower level, particularly near the center of the disc. It is not considered good practice to record any closer than 4 inches to the center of a record at this speed. Below a 6-inch radius there will be a noticeable reduction in the higher frequencies. This can be offset in part by boosting the higher frequencies smoothly as the diameter of the uncut portion of the disc increases. On some recorders this is done automatically as the carriage travels across the disc.

It is not considered good practice to record at 78 r.p.m. on the rim of a 16-inch disc, as the speed of the disc past the cutting stylus is too high for reasonable stylus life. To obtain a maximum of fidelity with good economy when using 16-inch discs, a musical selection can be recorded at 33 1/3 r.p.m. starting at the outside of the disc. A second selection then may be recorded at 78 r.p.m. This will yield a recording time of approximately 6 minutes without serious reduction in the high-frequency response of the resultant recordings.

It is poor economy to use inferior discs. One ruined sapphire will more than offset the saving effected by many "inexpensive" discs, which are not coated as evenly nor as thickly as a first-quality disc, and once the sapphire point hits the base material it is ruined. The material on the disc also may contain grit or have hard spots, which result in a high noise level. Old dry blanks have a high inherent noise level, and cause the cutting stylus to wear rapidly. The blanks should not be stored in a too-dry place.

The recordist will encounter a multitude of special problems. These will be presented in itemized form, with their causes and remedies, in the next and concluding article of this series.

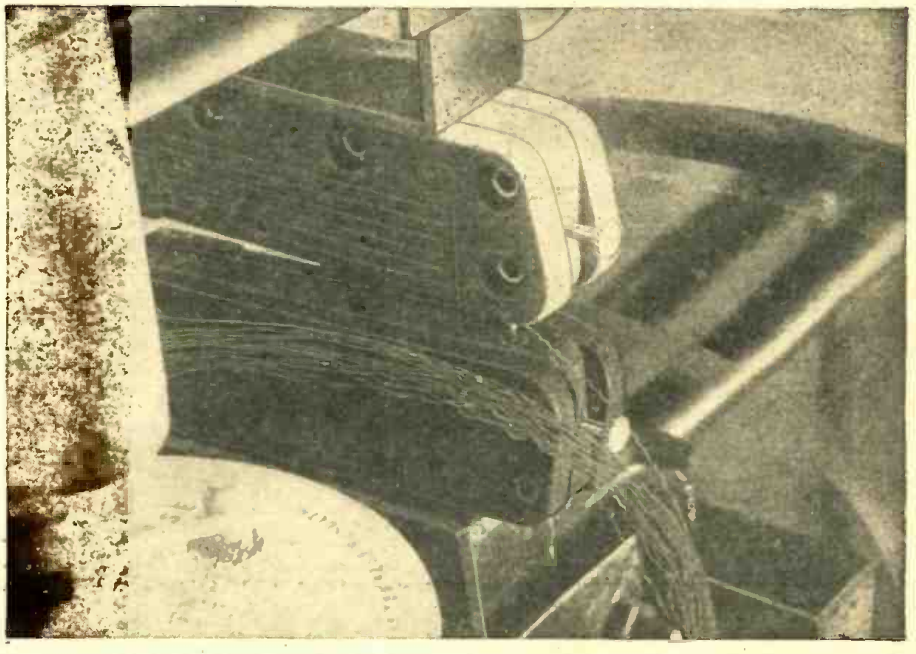


Photo D—How the chip is thrown when recorder is working properly.

NEW SUBMINIATURE PRINTED CIRCUITS

(Continued from page 25)

effective resistive and conductive paints are used on the steatite plates, inasmuch as they can be fired on at temperatures ranging from 150 to 800 degrees Centigrade.

Absolute cleanliness is necessary if the paints are to adhere. The third unit of Photo B was made by first wrapping a stencil of the coil pattern around the tube, using masking tape. The glass envelope was then etched in fumes of hydrofluoric acid (sandblasting could have been employed) which roughens the surface and allows excellent adhesion of the paint to the envelope. After etching, the hydrofluoric acid was neutralized with strong caustic soda solution, and the envelope washed thoroughly with soap and water and rinsed in distilled water. The conducting paint was applied to the etched surface and allowed to dry in air.

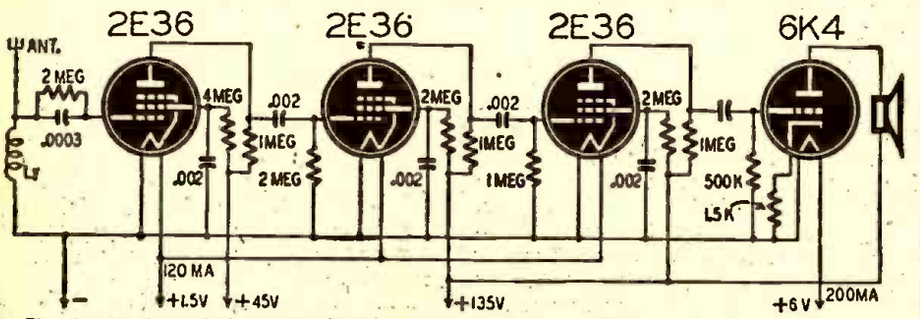


Fig. 3—Hookup of the 4-tube printed receiver does not differ from standard circuits.

Range and operation

Subminiature tubes will deliver 50 milliwatts of power or more to an antenna. Although receivers are available that provide satisfactory reception on field strengths of 1 microvolt per meter, it is more practical to assume that miniature receivers will require field strengths of the order of 100 microvolts per meter for satisfactory reception. For a transmitter power of 50 milliwatts and a 100-microvolt receiver theoretical calculations yield a distance of transmission of 9.8 miles.

The ideal assumptions made in deriving formulas for distance are hardly realized in practice, particularly if one uses an antenna of convenient size and shape. For a personal radiotelephone (or transceiver) a single short telescoping antenna is preferred if any is used at all. Coupling to and radiation from the antenna unavoidably will be far from optimum. If used in a building or on a street, absorption and reflection from the walls of the buildings takes place. These and other factors make the distance of operation a matter which must be determined experimentally.

The personal radiotelephones shown in Photo B have been used successfully in various tests at the Bureau of Standards. Excellent communication was obtained with a standard transceiver located in one of the rooms of a modern four-story laboratory and a subminiature transmitter operated from all other parts of the laboratory as well as from the grounds a half a mile away. Clear reception was also possible with the transmitter located in a modern metal-roofed automobile (door closed) six blocks from the transceiver, even though many buildings prevented a clear line-of-sight transmission. A light antenna consisting of a thin rigid wire 18 inches long was employed in these tests.

While miniaturization is a feature which has attracted the greatest attention in the printing of electronic circuits, there is another feature of equal or greater importance. The process makes it possible to effect economies in production not possible in present assembly-line methods. A single operator can turn out thousands of printed electronic plates

(Continued on page 70)

TRANSATLANTIC NEWS

(Continued from page 33)

tion. Many attempts have been made to reduce it by the use of special needles, of filter circuits and of different materials for the record blanks. Some needles are a little better than others, but none effects a cure. Filters are almost useless, since surface noise is random, occurring not on one frequency or narrow band of frequencies, but on all frequencies from about 1,500 cycles upward. Discs of soft plastic material, such as the vinyl compounds, may lessen the noise a little, but they also cut down the high-frequency response of the pickup. The reason? Well, it is just that with these softer materials what is known as "cold flow" is apt to take place when the needle is traversing the tiny, sharply bent curves of the grooves corresponding to the upper audio frequencies. The material has not sufficient rigidity to force the needle point to follow the grooves. Instead, the needle deforms—bends—the grooves as it traverses them and they spring back into their original shapes after it has passed. The microscope will show that the upper audio frequencies are on such a record, but when it is played cold flow prevents them from being reproduced.

Decca's first line of attack was to produce a pickup with no resonance within the audio range. Figs. 1, 2 and 3 illustrate its make-up. The body of the pickup is 1⅜ inch in length, 1⅛ inch in diameter and ⅝ inch in depth. When balanced on the tone arm its weight is six-tenths of an ounce. As will be seen, it is of the moving iron type and contains many interesting features. The rubber mount of the armature allows free lateral movement but enforces complete rigidity fore and aft. The magnets are so situated that when a record is being played they are little more than one sixteenth of an inch above its surface. The maximum flux change through the armature is thus obtained. The pivot of the armature, being near the top of the pickup, is well away from the area of flux change. The playing tip of the armature is of sapphire; after 1,000 records the pickup is opened by undoing the milled screw, the armature and its mount are removed and thrown away and replaced with a new armature complete with mount.

This pickup has no resonances below 14,000 cycles and surface noise is very slight when it is in use. Shellac is used for the record blanks, the particles of the filler being ground very fine and passed through a sieve with a mesh of 300 to the inch; they are thus too small to give rise to waves of audible frequency.

The recording head is of the moving coil type with very low mechanical inertia. The range of frequencies actually cut on the master record is from 30 to 14,000 cycles. *No monitoring or contrast compression* whatever takes place during recording. The gain control is set before recording begins to prevent

an overload occurring on the loudest passages. It is not touched again. When a very soft passage occurs the level of the music is actually allowed to fall, if need be, below the noise level. This may sound surprising, but it is amply justified by the results. During the playing of an orchestral record one is so entranced by hearing the music played as the conductor's baton (and not the monitor's knob!) directs that the hiss, which is noticeable only on passages that are exceptionally *pianissimo*, is not annoying.

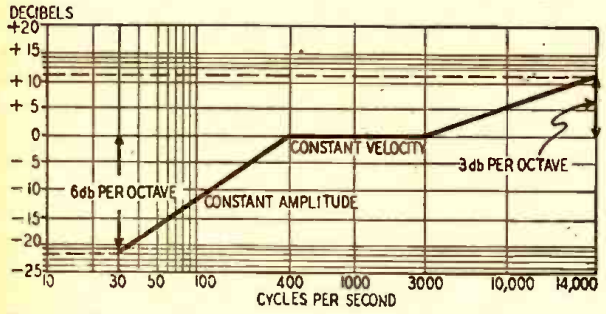


Fig. 4—The recording characteristic curve for ffrr recordings.

The recording characteristic is shown in Fig. 4. It will be seen that from 400 to 30 cycles at constant amplitude there is a fall of 6 db per octave. After the change-over at 400 cycles the characteristic (constant velocity) is level to 3,000 cycles. From that point upwards the rise is 3 db per octave. This rise is deliberately made to begin at 3,000 cycles because it is realized that the records will often be played on ordinary radio-phonographs, almost all of which have loudspeakers peaking at or about this point and then showing a falling characteristic. It is found in practice that a rise of 3 db per octave is the most that can be used profitably: if the rise is steeper the pick-up needle is liable not to track properly at high frequencies owing to the sharpness of the curves of the grooves.

Though these records can be used with very good results on ordinary radio-phonographs, only a specially designed reproducing instrument can bring out their full beauty. Radio and radio-phonograph designers are usually well satisfied if the harmonic distortion of the reproduction does not exceed 5 percent. This undoubtedly fulfills most requirements, so long as the a.f. response does not extend much beyond 5,000 cycles. But when an amplifier is capable of a response up to 14,000 cycles such a percentage of harmonic distortion would cause unpleasant effects owing to the production of parasitic *difference* and *summation* notes, whose number increases as the frequency range is widened.[1]

Many textbooks state that phase dis-

[1]These records, imported from England, are being sold to a very limited market in the United States, the supply being very short.

(*Continued on page* 68)

TRANSATLANTIC NEWS

(Continued from page 67)

tortion is of small account in radios and phonographs. This may be true enough where the cut-off is in the region of 4,500-5,000 cycles; but it does not hold good for wide frequency range audio amplifiers. Fig. 5, by illustrating a very

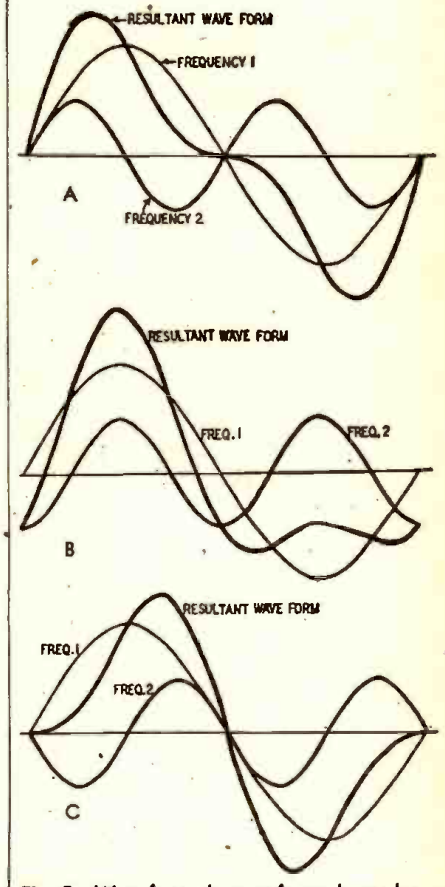


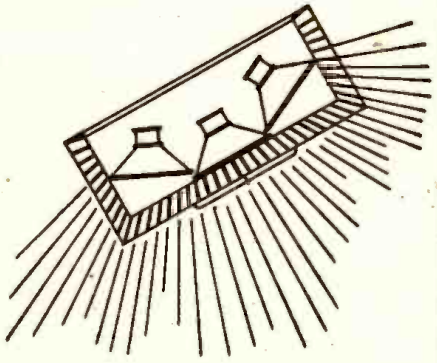
Fig. 5—Waveform changes from phase change.

simple example, will serve to show what effects phase distortion may have. Suppose that a sound made in the studio consists of two frequencies with the phase relationship seen at A; if the phase of the higher frequency is shifted 90 degrees, as at B, during recording or reproduction the resultant waveform has a totally different shape. The shape is again entirely altered if the phase-shift is 180 degrees, as seen at C. B and C represent very simple forms of phase distortion. Imagine what would happen to the complex sounds made by a full orchestra if they were reproduced by a phonograph with a wide frequency range in which phase distortion took place on the grand scale! Phase distortion is then of great importance in an amplifier with a range of 30-14,000 cycles and steps have been taken to reduce it to negligible proportions.

The Deccola, as the reproducer is called, contains four stages of triode Class-A amplification. Careful design has reduced the harmonic content to 0.5 percent. Three 12-inch loudspeakers are used, arranged on the convex arc of a circle so that the sound is evenly

distributed and there is no beaming of the high audio frequencies. One can walk about the room without finding the high notes stronger in some places than in others.

The Deccola is an electric phonograph only; the present models have no radio equipment. You might think that no one now would buy a high-priced phonograph (the Deccola costs the equivalent of over 800 dollars[2]) no matter how good its performance might be.



Three speakers provide wide-angle coverage.

Well, it has been on the market only a short time and most of our English factories were closed down for several weeks at the beginning of this year through lack of coal; but over 2,000 have been sold so far in this country and the demand is steadily increasing.

[2]The phonograph is being sold in the United States by an American agent for $1400.

NEW SUBMINIATURE PRINTED CIRCUITS

(Continued from page 65)

per day at the cost of a few cents per plate. It is not necessary to cut wires to length, bend them into shape, and individually solder or connect them to a chassis. With the printed technique, each unit is a reproduction of the master patterns, which reduces line rejects to a minimum. Substantial savings in wiring and inspection and reduction of rejects makes the process economically attractive.

Work on the miniature transmitter and receiver units was to a great extent carried out by the members of the staff of the Ordnance Development Division, National Bureau of Standards, voluntarily devoting their after hours to the program. Space does not permit naming all who showed extreme interest and assisted in producing the units. Specific acknowledgment is made by Messrs. Brunetti and Cronin to J. J. Gurtowski, Robert L. Henry, and Miss C. G. Moon, who made important contributions to the methods and carried out the printing of the units. The electronic phases were executed by Max Shufer, G. J. Tedore, P. E. Landis, L. A. Riley, and E. A. Vogelsang. Additional work on the development and perfection of new methods of printing electronic circuits and studies of their performance is being carried on in the Division by a group under the supervision of P. J. Franklin and Dr. R. W. Curtis.

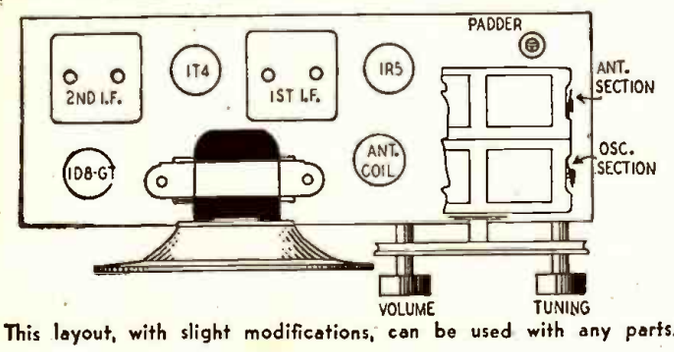
BATTERY SUPERHET USES THREE TUBES

(Continued from page 31)

After the wiring has been completed and everything seems in order, insert the tubes in their respective sockets. Be careful not to damage the tiny prongs of the small tubes. Plug in the A- and B-batteries and turn on the set. Now you are ready to line up the set. It may be better to have it lined up by a serviceman, who has all the necessary equipment, but if this is not possible, the procedure is as follows:

First connect the set to a good aerial and ground, and open the gang condenser to about 1,600 kc. You may hear a station, but it will be weak. With an insulated screwdriver, set all four trimmers on top of the i.f. transformers to the point giving maximum signal strength. The i.f. is 456 kc. Next fully close the gang condenser to about 600 kc and adjust the padding condenser for resonance. It may be necessary to go back and touch up the i.f. trimmers slightly to secure maximum signal strength. Most i.f. transformers are aligned at the factory, so little adjustment should be necessary. A constructor who lacks a signal generator to accept the factory adjustment as approximately correct, and confine his alignment to the oscillator and r.f. trimmers and the padder.—*Editor*

The completed receiver.



This layout, with slight modifications, can be used with any parts.

"SHOOTING STARS" TRACKED BY RADIO

(Continued from page 26)

exercise a profound influence over the frequencies used for FM broadcasting as well as for long-range radio communication and navigation.

One way, points out the Bureau of Standards, in which meteors may affect radio waves is to cause "bursts" on FM channels. Some scientists, notably Dr. J. A. Pierce of Cruft Laboratory, Harvard University, contend that a major share of the ionization of the E layer of the ionosphere may be caused by meteors. Up-to-the-minute information on the behavior of the E layer is of basic importance because it governs radio frequencies employed for radio communication and radio navigation. The heat set up by friction as the meteors travel at a great velocity through the atmosphere is sufficient to vaporize the solid matter and create a trail of hot ionized gas in the vicinity of the shooting star. This blaze of hot gases gives off a visible glow. These gases and the near-by atmosphere are seemingly highly ionized.

"Ionospheric investigations," we are told by the Bureau of Standards, "have shown that ionized gases will reflect radio waves below a given frequency, allowing higher-frequency waves to pass through. The frequency that will just be reflected by a region of ionized gases is proportional to the square of the density of ions. Because the amount of frictional energy dissipated by a meteor, the hot gases in its trail should be ionized for a brief instant to a much greater extent than is the ionosphere. It is known that the 100-megacycle radar waves penetrate the ionosphere. However, the ionization in the trails of the meteors should be sufficiently intense to reflect radio waves at least in the region of 100 megacycles, a frequency relatively low in terms of modern radar, but much higher than the frequencies used for long-distance sky-wave radio.

"Supporting evidence for these contentions was the fact that interference encountered on the old frequency-modulation broadcasting frequencies in the form of 'bursts' (parts of programs from long-distance stations interfering with local station performance) had been found to coincide with the appearance of meteors. Further, it had been reported that during the war radar operators tracking V2 rockets had been confused by reflections from meteors. Other radar observers, such as O. P. Ferrell, working in an unofficial capacity, in India, had actually made observations which coincided with the visual observations of meteors.

"Out of the research on the effect of such phenomena will come decisions as to which frequencies are the best for the various types of radio services. These recent tests, together with the observations with the moon as subject, indicate that radar, besides being a plane locator and navigation device, is a valuable tool for the study of radio-wave propagation and is finding also a place as an instrument in the field of astronomy."

INTERMITTENT ALARM

(Continued from page 34)

3. Adjust volume control of radio to normal audio output level.

4. Connect the Signalometer clips across primary of output transformer of radio under test. The output should drop to below audibility. If necessary, reduce the input from the signal generator.

5. Turn on the Signalometer line switch and set the potentiometer arm for greatest resistance. After heating, the warning tone should be heard.

6. Gradually rotate the Signalometer potentiometer arm, decreasing the resistance until the warning tone stops. The position of desired sensitivity will be located close to or slightly beyond this point.

How the circuit works

Operation of the Signalometer is simple. The small audio voltage which appears across the secondary of the input transformer is amplified by the 6J5. The rectifier half of the 6SL7 then delivers a positive voltage to the grid of the other half, which is triode-connected. This causes a heavy plate current to flow, resulting in a large voltage drop across the 250,000-ohm potentiometer in the plate circuit. When the set fades, no voltage is delivered to the 6J5 for amplification, and the triode half of the 6SL7 is cut off, due to its large cathode resistor (22,000 ohms). The voltage at point P, the potentiometer's center arm, rises, and the neon tube goes into oscillation.

The voltage across the potentiometer will be high when the plate current in the second half of the 6SL7 is low and vice versa. Therefore it can readily be seen that loss of gain or fading in the radio under test produces a higher voltage across the potentiometer which in turn causes the neon tube to operate as an audio relaxation oscillator in conjunction with the 32L7 grid circuit. The potentiometer arm can be adjusted for various degrees of fading. The arm is advanced to the point of oscillation and then reduced slightly below this point. Of course, too critical an adjustment might cause the Signalometer to go into oscillation because of slight line voltage variations or normal signal generator drift. The signal generator should be fairly stable and capable of producing a constant non-varying voltage output.

The signal generator voltage should be sufficient to allow the neon to start or stop by adjusting the potentiometer arm. Too low a voltage from the signal generator will result in a constant tone, regardless of the position of the arm.

Applications of the instrument

The device has many uses. Radios can be given a routine fading intermittent and noise test before being returned to the customer, with the full assurance that any fading complaints

(Continued on page 74)

Ultrasonic laundries are forecast by the British radar authority, Sir Edward Appleton, who told the Launderers Research Association that dirt is often held in fabrics by electrical forces.

INTERMITTENT ALARM

(Continued from page 73)

are due to receiving conditions or location. Many chronic complaints can be stopped in this way by a demonstration to the customer in the shop.

Audio amplifiers may be tested for stability over long intervals, without having to stand by and observe them audibly. FM or television sets also may be checked by simply injecting the proper type of voltage from a generating device, and connecting the Signalometer across the audio output.

Fading troubles may be isolated also in the stages where the defect occurs unless the defect reflects back into the last audio, such as power supply breakdown. However, for isolating components such as intermittent grid resistors, coupling condensers that open, or catching a thermostatic filament, it is ideal. When isolating intermittent troubles in separate stages, the signal generator should be applied to the individual stages separately. Much valuable time may be saved in this way. Simply hook up the Signalometer, let it play *silently*, and attend to something else! The small investment in material will be repaid many times, plus the satisfaction of knowing that the job left the shop in a healthy condition.

FM AND ALTITUDE

(Continued from page 17)

There seems to be another much cheaper way of gaining high altitude for FM transmitters—and that is captive balloons of the type which were used in England and elsewhere to snag enemy bombers during World War II. The transmitters would be attached directly underneath the balloon in a sort of gondola, thus doing away with excessively long r.f. transmission lines.

Such captive balloons are comparatively cheap, if compared to expensive towers. They are fairly steady and do not sway too much, even under high winds. If these balloons are filled with nonexplosive helium, they do not become dangerous because this gas cannot burn. A pair of captive balloons can be used for transmitters which are on the air 24 hours daily, so that while one is aloft, the other is on the ground for repairs, reconditioning, etc. The upkeep should not be overexpensive, and by having spare balloons on hand, continuous operation of FM stations would be assured. Naturally, such balloons would not be used everywhere in the country, but only in certain localities and only under those conditions where their use might be warranted.

Semi-public television is so popular that one manufacturer (United States Television Corp.) is channelling the larger part of its production into models especially intended for use in taverns, hotels and clubs.

Radio Thirty-Five Years Ago

In Gernsback Publications

HUGO GERNSBACK

Founder

Modern Electrics	1908
Electrical Experimenter	1913
Radio News	1919
Science & Invention	1920
Radio-Craft	1929
Short-Wave Craft	1930
Wireless Association of America	1908

Some of the larger libraries in the country still have copies of ELECTRICAL EXPERIMENTER on file for interested readers.

From June, 1913 ELECTRICAL EXPERIMENTER

Treatise on Wireless Telegraphy by *Hugo Gernsback*

Curious Electrical Rocker

How to Construct a One-Quarter KW Wireless Transformer

Recent Developments by the Federal Telegraph Company by *Lee de Forest, Ph.D.*

How to Construct an Oscillation Transformer by *S. W. Hector*

3407 Wireless Licenses

Control by Wireless

Quench Spark Gaps

Aerial Problem

SOCKET SUBSTITUTE

While constructing a signal tracer probe around a 9006 u.h.f. diode, I found that the available sockets for the tube were much too large to fit into the probe that I had in mind. I learned—the hard way—that it does *not* pay to solder directly to the tube pins.

An excellent connection that takes up very little space can be made by wrapping about six turns of No. 24 bare wire around a straight piece of No. 18 wire. This will form a small coil with an inside diameter slightly smaller than the diameter of a miniature tube pin.

When the coil is placed over the pin of a tube, it makes a firm connection without damaging the tubes. Soldered connections are made to one end of the coil.

CHARLES J. APPLEGATE,
Champaign, Ill.

Sweden, with 1,840,000 radios, has the highest rate of radio ownership in Europe.

Output of FM receivers in 1947 will be close to 2,000,000 sets, say manufacturers. By the end of December, however, it is expected that FM receivers will be in production at the rate of 5,000,000 annually.

Communications

RADIO-CRAFT EQUIPMENT IN THE ANTIPODES

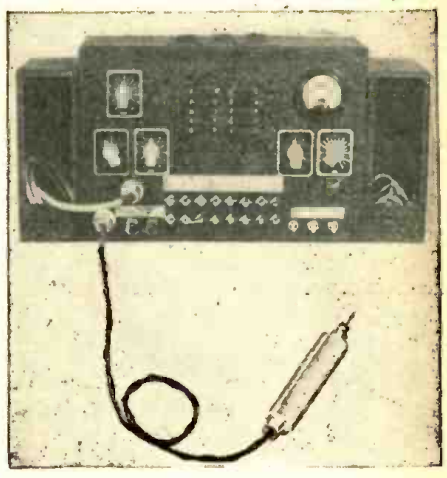
Dear Editor:

I have enclosed a photo of a signal tracer that I constructed from the article in the August, 1946, issue of RADIO-CRAFT. Although I made several structural alterations to accommodate the material I had on hand, the instrument worked perfectly from the first.

As you will see from the photo, I added pockets at each end to dispose of the spare leads that are a necessary adjunct to the tracer. Also, instead of having a speaker hole cut, I placed louvres in the front of the cabinet, this to my mind improving the appearance of the article. Also, the pockets on the ends took the high look off the tracer.

I have been a subscriber to your publication for years now, enrolling through a local agent for three years at a time, and always look forward to the arrival of the book with impatience. My father and myself are in partnership in a radio service business, and have made all our test equipment, including an all-wave signal generator, grid-dip meter, and 1,000-volt vacuum-tube voltmeter. The latter is a very elaborate instrument, using a 100-microampere meter. The data on it came from an Australian technical monthly.

Way down here the cost of test equipment is all haywire. When I see the cost of things like 'scopes in America and compare them with the price we



have to pay, I wonder where the difference comes in.

In conclusion, I would like you to congratulate the author of the article referred to, Mr. W. H. Watkins, and show him the photo of my version of his tracer.

K. WOSKETT,
Palmerston, New Zealand

TWO REACTIONS TO THE CRYSTRON CIRCUIT

Dear Editor:

I enjoyed the mendacious adventures of Mohammed Ulysses Fips in your April issue. Maybe he's "got something there."

Hearing aids need a *perpetual* source of "high" voltage for the voltage-amplifier tubes; and an output tube operating on the voltage of the *filament-supply battery!* That means a *very* gassy tube without too much distortion of output current, conditions not easy of attainment.

Put Fips to work on that problem, and a million hard-of-hearers will forever bless him.

Maybe he can combine the Electret and crystal earfone with the output tube; requiring an extremely small, periodic *recharge* of the Electret, to supply the energy lost in sound-waves from the crystal.

No charge is made for this invaluable suggestion!

LEE DE FOREST,
Guadalajara, Mexico

Dear Editor:

Every year about April first, you editors go off on a binge and come up with some silly monstrosity of an article such as the "New Crystron Lapel Radio" which appeared in the last issue.

Just why the editors of R-C indulge in such childish horseplay is just too much for me, and must be for many of your other readers. I wish the editors of RADIO-CRAFT would grow up!

Why not devote that time, energy and space to a decent article—an extra article of real consequence—an article on some TRUE unusual subject.

Please editors, do be your age. It was one of you editors who remarked in a previous issue that all radiomen are strangely "suspect." I don't argue the point. But do not let us ADVERTISE the fact. And that's exactly what your "FIPS" articles are doing.

P.S.—(But I like you and your mag. anyway.)

E. E. JONES,
Richmond, Va.

WOULD YOU LIKE A QUIZ?

Dear Editor:

I read with much interest your editorial on generalization before specialization, with its accompanying quiz.

As one of the many individuals who find pleasure experimenting in all branches of science, I observed at once the educational benefits we could obtain from a monthly students' radio quiz. I ask not only for myself, but for all those who wish to acquire a more general knowledge of science, that you include in each issue of RADIO-CRAFT a quiz parallel to that of the March issue.

J. B. GREABLE, JR.
Fredericksburg, Texas

(Possibly some of our regular authors would like to try their hands at a quiz or two?—*Editor)*

AVOIDS FILING SYSTEMS

Dear Editor:

From time to time I read in RADIO-CRAFT about filing systems, keeping articles separate from advertising, backing up all articles by advertising, etc. I solve my filing problem quite simply.

I cut out the contents page of every issue and keep them all in a loose-leaf book. When I want a particular article, all I have to do is refer to the book with the contents pages, which gives me the date and page number of the article.

H. SILK,
London, England

Facsimile took another step ahead at the recent national convention of publishers. Some 14 newspaper owners placed orders for equipment after seeing it demonstrated, according to reports from Radio Inventions, Inc., which exhibited at the meeting.

INDEX TO ADVERTISERS

RADIO SCHOOL DIRECTORY
(See Page 80)

A MINORITY REPORT?

Dear Editor:

I am and have been for some considerable time a regular reader of your magazine RADIO-CRAFT.

My reason for writing to you is my amazement at the article "Transatlantic News" by Major Hallows, in the issue of January of this year.

My job is that of managing a radio business in the heart of London, in Fleet Street. I have been selling, installing, and servicing television receivers since June of last year when the BBC recommenced its transmissions after the wartime break.

Business is of such a magnitude that I am now booking orders for television receivers 18 months ahead. The demand is terrific for receivers of all sizes, from the standard 8- x 6-inch picture to the large 12- x 10-inch type. Prices range from £35 plus tax to £150 plus tax, and the demand is just as great for the smaller-tube type as for the other.

Definition is excellent and in my opinion is quite good enough for this size of screen, and no appreciable benefit would result from the use of 1,000-line transmissions.

Even with the 8- x 6-inch type the viewing distance (optimum) is found to be about 5 feet, so that in the small flats which abound in this town anything much larger is not required and neither could it be used in comfort in most cases.

From the transmitting end the art of the cameraman can be seen to improve daily as they get more practice at this new and very difficult art.

In conclusion, I would like to point out that mine is not at all an unusual case and that if Major Hallows would like to come and see me, or for that matter any other television dealer in London, we should be only too pleased to give him plenty of evidence as to the unmeetable demand for television receivers of all descriptions.

I am

Yours sincerely,
L. A. LEE,
London, England

UNWANTED INVENTION

Dear Editor:

In the "Why Not" item by Elizabeth Rehm in the February issue of RADIO-CRAFT, Miss Rehm says that a telephone which could be used without being held in the hand "would enable a woman to chat and do some mending at the same time." That is probably precisely the reason the telephone companies have not dared touch the idea with a ten-foot pole. Why, that's dynamite to play with! Women do enough "visiting" on the telephone under present conditions. Imagine the confused state of affairs that would exist if they could sit and mend while gossiping on the phone. We men would never get the chance to use it. So please, Bell System, don't toy with the idea!

LONG-SUFFERING MALE,
(Name withheld at writer's request)
Cabin John, Md.

RADIO SCHOOL DIRECTORY

PREPARE NOW FOR SKILLED JOBS IN RADIO AND ELECTRONICS

BOOK REVIEWS

DIRECTIONAL ANTENNAS, by Carl E. Smith, E.E. Published by Cleveland Institute of Radio Electronics, Cleveland, Ohio. Loose-leaf style, flexible leatherette covers, 8½ x 11 inches, over 300 pages. Price $15.00 (2 copies $25.00).

This book is complete with charts, illustrative patterns, definitions, and equations.

Part I derives the characteristics of reference antennas (spherical, half-wave, quarter-wave, 0.311 vertical, and others) from those of an "infinitesimal" radiator. Design equations for field shape and strength of the several types are developed from basic considerations. The method is clear and concise, and not too demanding, so it is suitable for technical student as well as engineer.

Part II contains over 500 actual field patterns obtained from two towers spaced up to 4 wave lengths and phased up to 180 degrees (in steps of 15 degrees). Almost 15,000 actual patterns obtained from 3-element arrays are shown in Part III. Each page contains 64 patterns associated with a given placement of the radiators, the 8 rows and 8 columns corresponding to the phasing (up to 360 degrees in steps of 45 degrees) of two of the towers relative to the third. A special feature of these sections is the method used to designate each pattern by a definite number to indicate directly the phase, orientation, and distance of the towers. These patterns were originally drawn by an electro-mechanical calculator which was designed, built, and patented by the author and his associates.—*I. Q.*

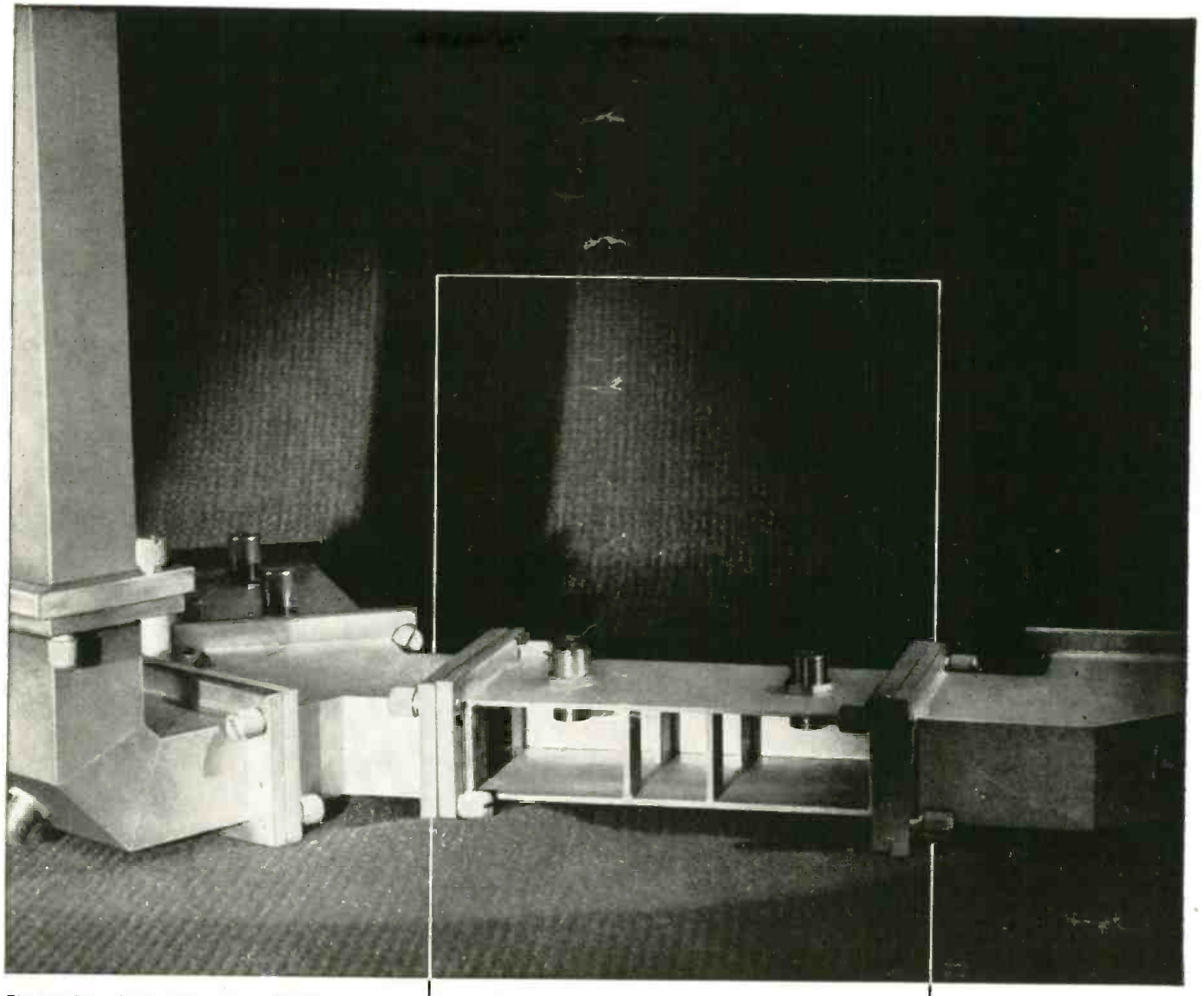
MORE COLOR TELEVISION

A new television invention reported last month from the West Coast may make possible 3-color television with a single electronic image tube.

The system is the invention of George E. Sleeper, chief engineer of Color Television, Inc.

It employs a scanning device which converts filtered colors into a single picture at the transmitter, using a single electronic picture tube. The images are reproduced in a group in black and white on the receiving picture tube and then projected through filters and combined optically and projected to a screen as a color picture.

A feature of the system, it is pointed out, is that it is receivable on both sets equipped for color and those producing only monochrome images.



The two filters in the picture (one with side cut away) are used to separate two radio channels coming in on the same antenna but on different frequencies. At the end of the connecting waveguide, the channels are made to part company, each going to a different circuit through its assigned filter.

SEPARATION CENTER

FOR RADIO WAVES

Thirty years ago, when all telephone service went by wire, Bell scientists developed means of sending dozens of conversations over the same line.

This they did by giving to each conversation a different carrier frequency; then to separate it from the others, they used a device which they had invented and named—the *electric wave filter*.

Today, in microwave telephone systems, the message-bearing waves pass to and from the antenna in pipes called waveguides. So scientists in Bell Laboratories devised a different kind of filter—a filter in a waveguide. This filter is a system of electrically resonant cavities formed by walls and partitions. Waves that set up sympathetic vibrations in the cavities pass through; others are reflected.

In the Bell System, now, single circuits are carrying many conversations at the same time through precision wave-filtering.

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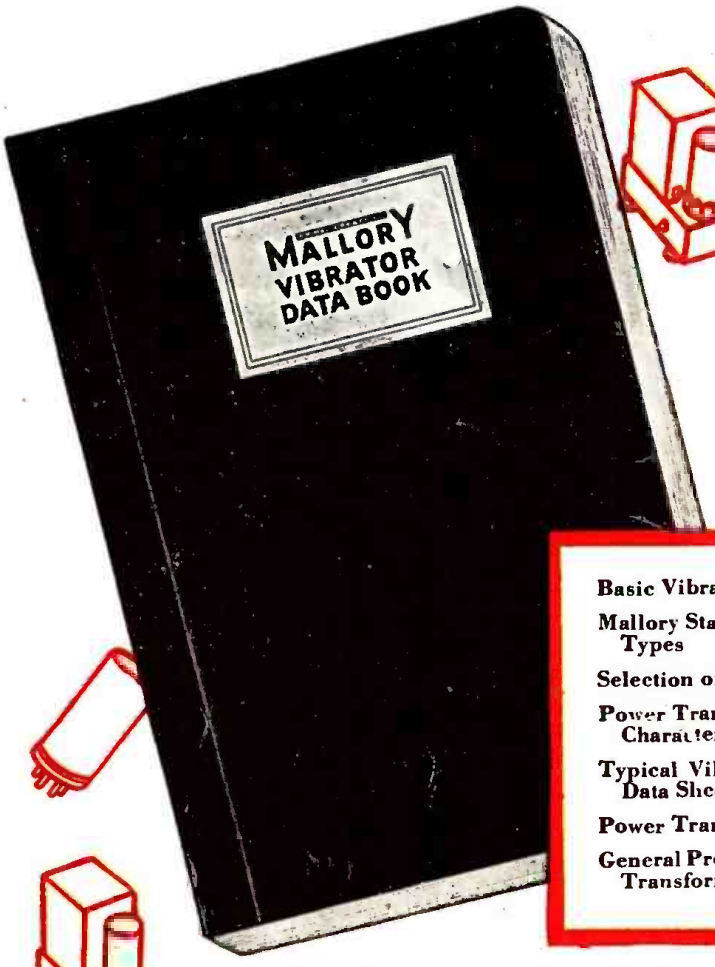

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