SPECIAL TELEVISION NUMBER

HUGO GERNSBACK, Editor

RADIO CRAFT

SEE PAGE 28

JAN 1948

50¢ CANADA 60¢

RADIO-ELECTRONICS IN ALL ITS PHASES

"THE hottest ham performance ever at this price . . ." That's the verdict of amateurs who have had a chance to try Hallicrafters new Model SX-43.

This new member of the Hallicrafters line offers continuous coverage from 540 kilocycles to 55 megacycles and has an additional band from 88 to 108 megacycles. AM reception is provided on all bands, except band 6, CW on the four lower bands and FM on frequencies above 44 megacycles. In the band of 44 to 55 Mc., wide band FM or narrow band AM just right for narrow band FM reception is provided.

One stage of high gain tuned RF and a type 7F8 dual triode converter assure an exceptionally good signal-to-noise ratio. Image ratio on the AM channel on band 5 (44 to 55 Mc.) is excellent as the receiver is used as a double superheterodyne. The new Hallicrafters dual IF transformers provide a 455 kilocycle IF channel for operating frequencies below 44 megacycles and a 10.7 megacycle IF channel for the VHF bands. Two IF stages are used on the four lower bands and a third stage is added above 44 megacycles. Switching of IF frequencies is automatic. The separate electrical bandspread dial is calibrated for the amateur 3.5, 7, 14, and 28 megacycle bands.

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- IN BAND OF 44 TO 55 MC: WIDE BAND FM OR NARROW BAND AM . . . JUST RIGHT FOR NARROW BAND FM RECEPTION
- CRYSTAL FILTER AND EXPANDING IF CHANNEL PROVIDE 4 VARIATIONS OF SELECTIVITY ON LOWER BANDS
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- TEMPERATURE COMPENSATION FOR FREEDOM FROM DRIFT
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- SEPARATE RF AND AF GAIN CONTROLS
- EXCEPTIONALLY GOOD SIGNAL-TO-NOISE RATIO
- SEPARATE ELECTRICAL BANDSPREAD CALIBRATED FOR THE AMATEUR 3.5, 7, 14 AND 28 Mc BANDS

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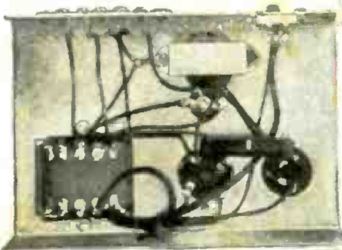

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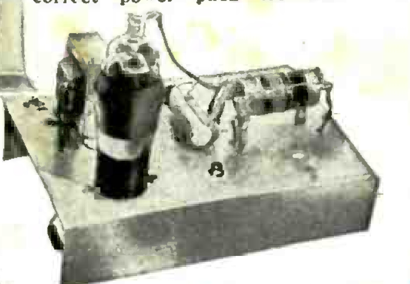

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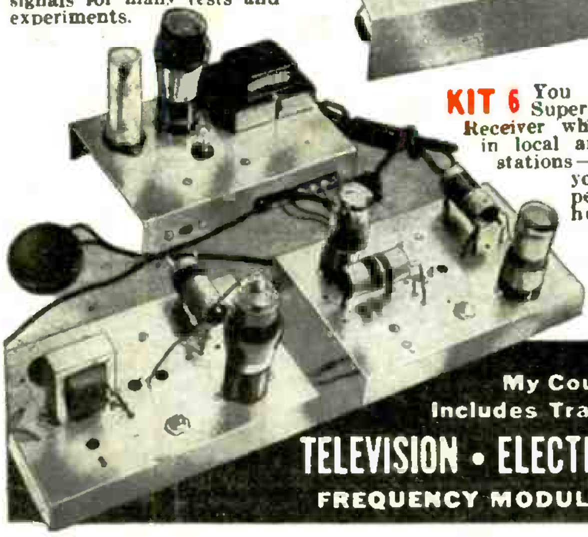

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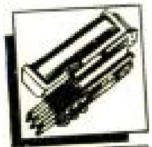

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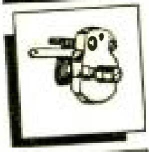

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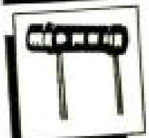

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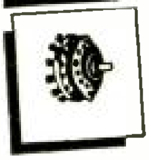

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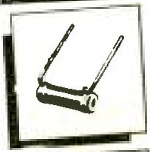

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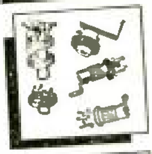

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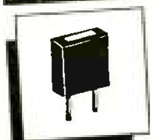

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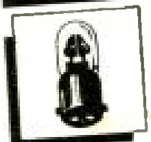

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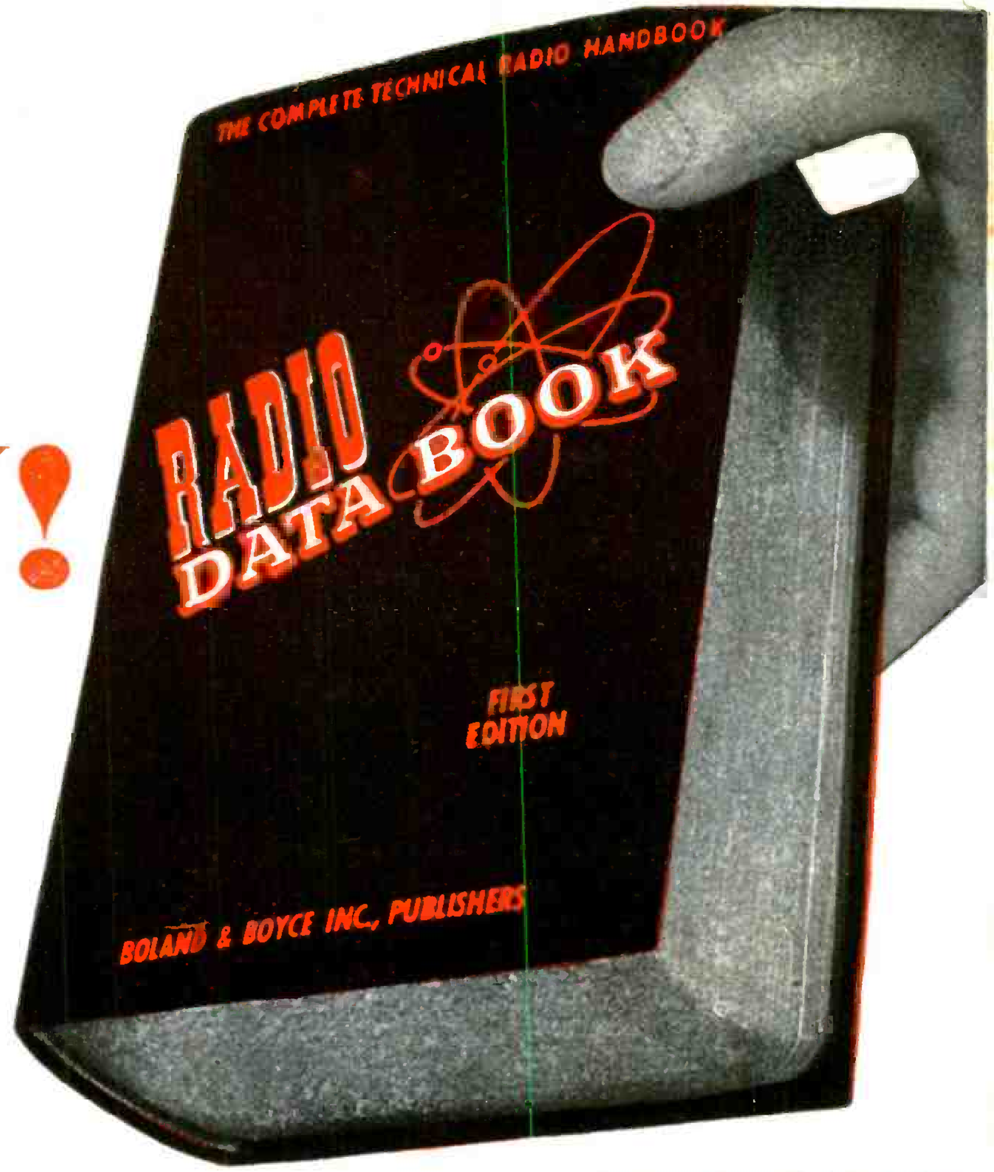

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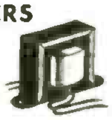

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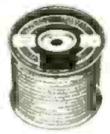

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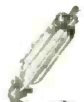

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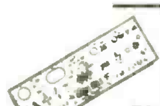

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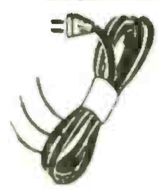

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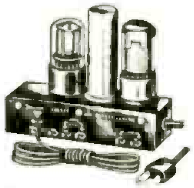

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12" PM dynamic speaker with 6.8 oz. Alnico V permanent magnet; 1" voice coil with 6-8 ohms impedance. Capacity is 14-18 watts. For all general applications.
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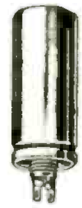

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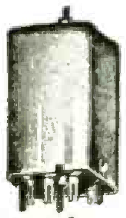

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High gain permeability tuned IF transformer. 375 KC normal peak. Screwdriver adjustments. 5 solder lugs at bottom. 1⅛ x 1⅛ x 2¼". 2 spade mounting. 1⅜ mounting centers.
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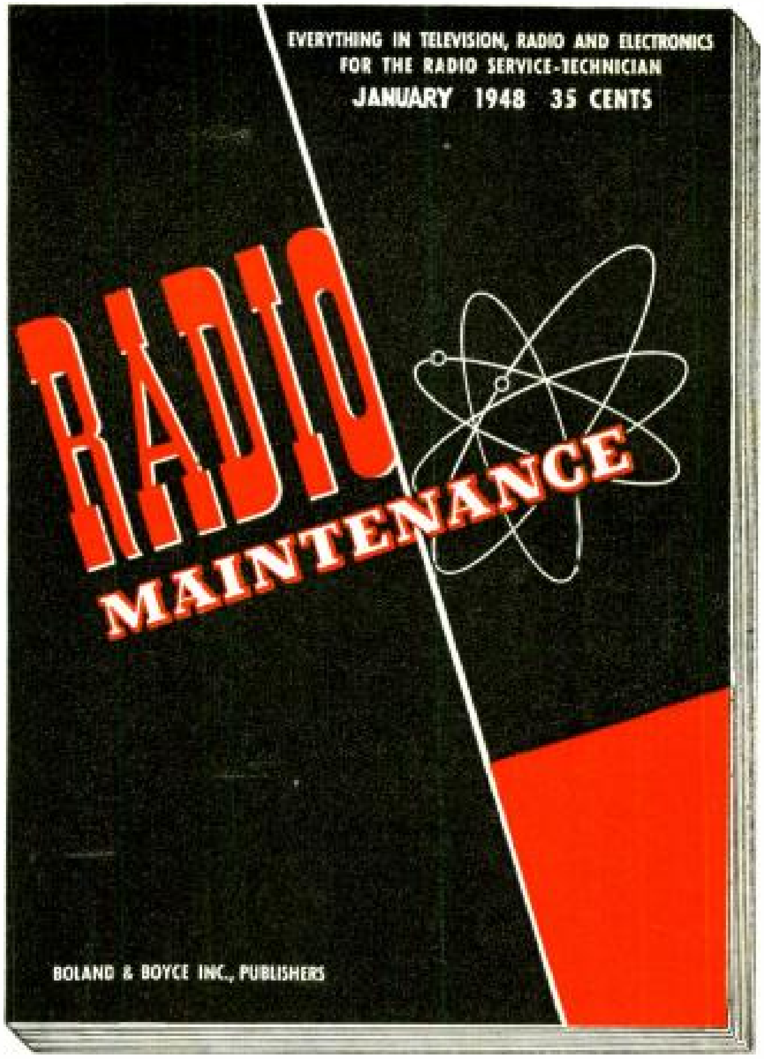

RADIO MAINTENANCE is the magazine of ideas and information for profitable service shops. It helps maintain secure, high quality operation. Where you find RADIO MAINTENANCE, you'll find successful servicing!

Each month RADIO MAINTENANCE brings you the latest developments in television, radio and electronics by top experts in the field. Each article, each department is carefully edited and presented to help you in your daily work. All these articles are invaluable as reference material; and all the articles together will form a complete reference library on everything in the radio servicing business. In the coming year, RADIO MAINTENANCE will bring you a complete series on each of the following: AM—FM—Television—Signal Tracing and All Test Equipment—Low Cost Business Promotion Methods—Sales Techniques for Servicemen—How to Make Huge Profits in the Sound Installation Business. Each article in a series will be a compact unit in itself—combined with the others of its series, they form a complete education—a complete service library—to bring you prestige, profit and security in your own radio servicing establishment. (A subscription to RADIO MAINTENANCE is tax-deductible, too!)

Sales Technique Series

Any service-technician can improve his business by improving his sales technique. *No service technician can afford not to!* Selling power is all important—and can mean the difference between a successful service shop and a complete failure. RADIO MAINTENANCE is, therefore, scheduling a complete coverage of this vital subject in its Sales Techniques Series. These articles will cover personal sales approach to customers . . . basic principles of radio advertising . . . planning local and large scale promotion campaigns . . . how to select proper media for your advertising . . . window and shop decoration for customer appeal . . . how to get bigger jobs and every other detail needed to sell yourself and your business to your community. Sales techniques have been developed to a top-notch degree of efficiency and effect—but many radio service technicians are not using this essential factor. Get the information you need for selling power by subscribing to RADIO MAINTENANCE now!

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FM continues to grow more and more rapidly. RADIO MAINTENANCE is keeping pace with this development in its series on FM. Our readers have enthusiastically received our previous articles on this subject and are asking for more. Every article will give thorough coverage—completely illustrated—of a specific phase of FM. All these articles will form a complete reference library on the subject—a library that will always be up-to-date—always handy—providing easy-to-understand information by top experts. RADIO MAINTENANCE rapid, trouble-free servicing techniques are here applied to FM. The latest type of test equipment is explained and illustrated. All circuit diagrams are clear and easy to follow. With this invaluable reference library you will have the advantage in FM. Get your subscription order to RADIO MAINTENANCE in today and every servicing advantage will be yours!

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This New IRC JUNIOR Control Cabinet Belongs on Your Bench

Here's one selection of 9 "hot-number" controls, switches and shafts you'll use every day! The new IRC Junior Control Cabinet contains 9 of the most-used ½, 1 and 2 meg. type D controls with the added adaptability of the tap-in shaft feature—plus 4 switches and 4 special shafts.

This inexpensive assortment of popular controls will save you time and money, and reduce your need for exact replacements. Factory-packed in a handsome four drawer cabinet of sturdy cardboard. Cabinet attractively finished in blue, yellow and silver with twelve individually identified compartments. Order the new inexpensive JUNIOR Control Cabinet from your IRC Distributor today. International Resistance Company, 401 N. Broad Street, Philadelphia 8, Pennsylvania. In Canada: International Resistance Company, Ltd., Toronto, Licensee.

HERE'S WHAT YOU GET

	IRC Control Type No.	Resistance	Purpose
5	D13-133	500,000 ohms	A
1	D13-133X	500,000 ohms	B
1	D13-137	1.0 meg.	A
1	D13-137X	1.0 meg.	B
1	D13-139	2.0 meg.	A

Purpose: A-Tone or Audio Circuit control; B-Tapped for tone compensation.

SWITCHES

3	#41	S.P.S.T.
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SHAFTS

1 Type "A" double-flatted tap-in shaft is included with each control—plus:

3 Type "E" with universal knurl for special type push on knobs.

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INTERNATIONAL RESISTANCE COMPANY

Wherever the Circuit says -\/\/\/-

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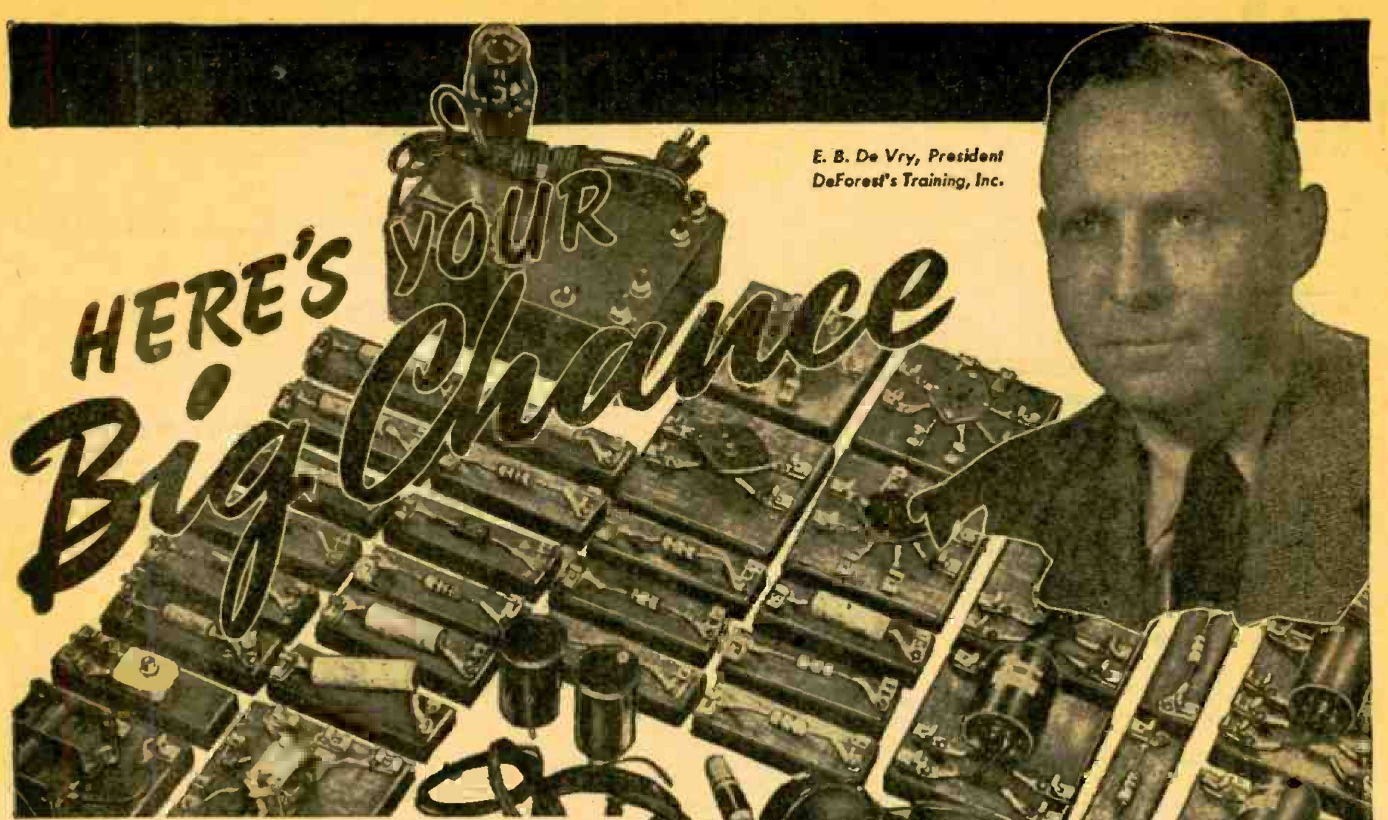

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In An Early Issue

SIMPLE INDUCTION BRIDGE
SUNSPOTS AND RADIO
1-KW DIELECTRIC HEATER

On the Cover:

A novelty motif marks this month's cover. See page 28 for a complete explanation.

Chromatone by Alex Schomburg from photo by Warren Z. Z. Illes.

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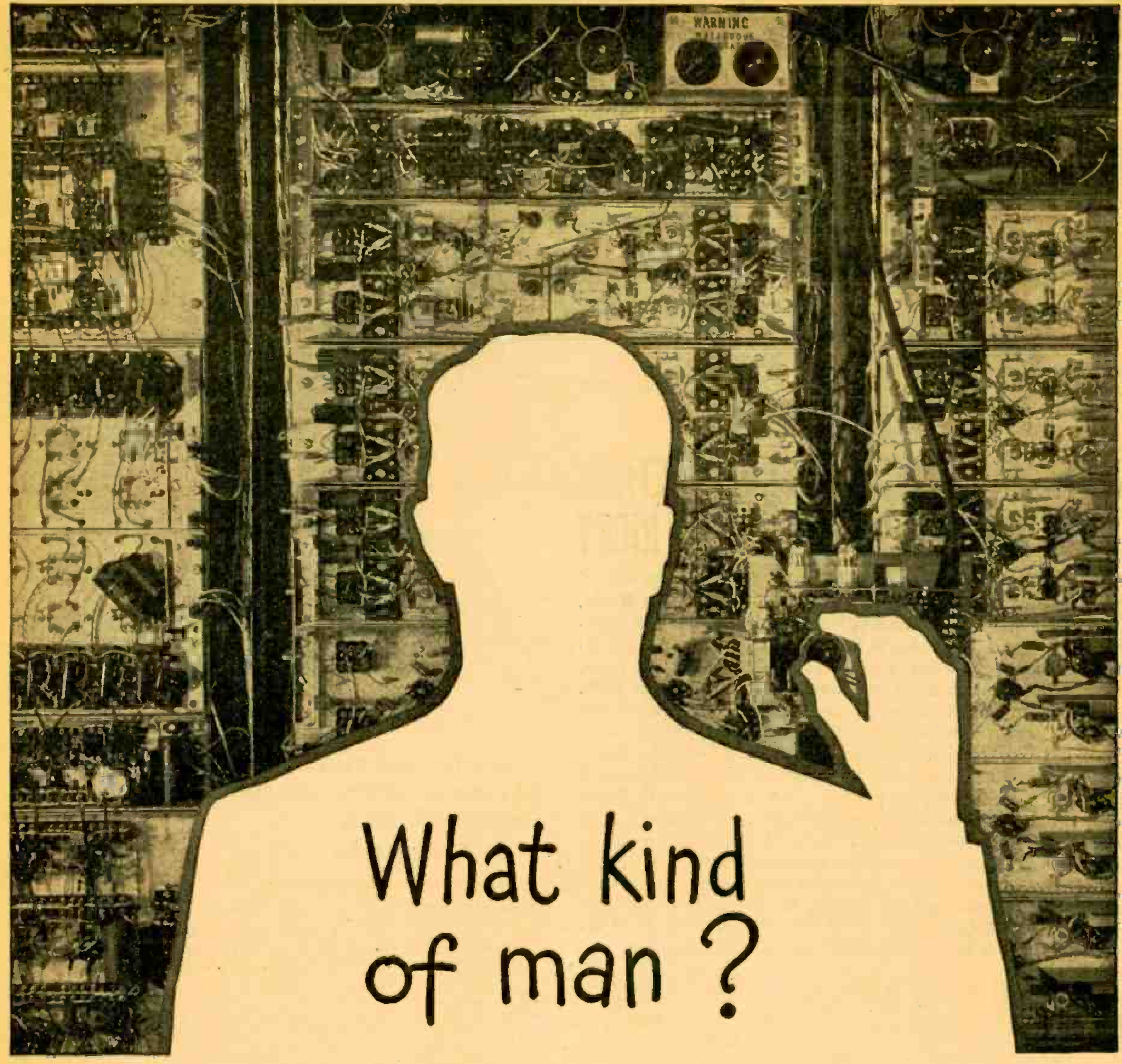


What kind of man?

WHAT KIND of men are the 2,300 scientists and engineers of Bell Telephone Laboratories?

Men of many types, working in different fields of research, may contribute to each development.

But all have certain characteristics in common: Good minds as a foundation, many years of learning in the fundamentals of their science and the methods of research, and a co-operative attitude — for without co-operation of individuals these products of research could never be produced.

Above all else, however, they have "the spirit to adventure, the wit to question, and the wisdom to accept and use."

That kind of men can produce the finest telephone equipment in the world — and have done so.

BELL TELEPHONE LABORATORIES

EXPLORING AND INVENTING, DEVISING AND PERFECTING FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE

TELEVISION IS GROWING!


Dr. Lee de Forest

No longer is Television just a laboratory marvel. It is rapidly spreading over the nation. Practically every radio manufacturer has Television models in production. New stations are being licensed. Television is already *big business.*

Are You Ready?

Who will get those new high paying jobs? Who will step into key positions in a rapidly growing industry? Not inexperienced radio men. Not untrained electricians. But men who know Television and can be relied upon to operate and maintain expensive equipment!

American Television—A Great Training Institution!

American Television has pioneered in Television research. Its directors have made fundamental contributions to the industry. Dr. Lee de Forest, our Director of Research and Training, is known throughout the civilized world as the "Father of Radio" through his invention of the radio tube. U. A. Sanabria, President and founder of American Television, Inc. invented the Interlace Scanning System which is now the standard of all Television. Most recently, a revolutionary new circuit which corrects a common television defect known as "ghost images" has been developed by J. M. Sanabria, head of American Television's Manufacturing Division.

Most Elaborate Training Laboratories

Every modern type of equipment obtainable has been installed for instruction purposes in what we believe to be the most extensive and elaborate Television training facilities in the world. You will find complete operating studios with the new sensitive cameras and their associated equipment. A corps of highly qualified instructors will guide your study.

Start Learning TELEVISION at Home—FREE!

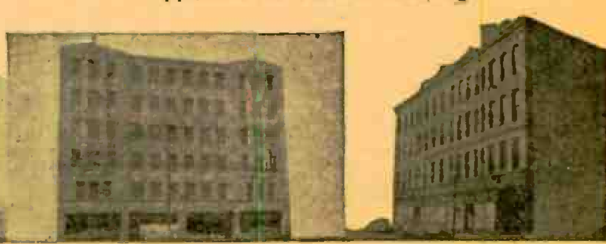
Prepare yourself for the endless opportunities in Television the new "American" way. Now, for the first time, you may discover in advance of entering school, just how your abilities fit into Television. If you qualify under the simple rules, you will be given a complete preliminary home study Television course absolutely free and without obligation.

Your success with the course will not only help you to decide for yourself what phase of Television you like best but will also aid us in qualifying you for residence training.

We prefer that all new resident students take this free course as it provides excellent preparation for residence study. However, there is no obligation on your part to enroll for residence training when you complete the home study course.

We urge you to take advantage of this splendid opportunity at once. Just write your name and address on a penny postcard and say: "I am interested in your free Television Course". Do it today! This offer is necessarily limited.

Approved for Veteran Training

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BRAND-NEW AUTOMATIC DIRECTION FINDER

Radio Compass SCR 269-F

Complete with Component Parts

The Radio Compass SCR 269-F was designed to be the primary radio navigation for the U.S. 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.

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 3 bands. A complete instruction book for operation and maintenance accompanies this equipment........................J254....$75.00

BRAND NEW BC 522 TRANSMITTER AND REC.

Transmitter output 8-9 W., voice amplitude modulated on any one of 4 Xtal controlled frequencies. Receiver is readily switched to either of the 4 present Xtal controlled channels. Tubes used: (2)832, (3)12A6, (1)6G6, (2)6SS7, (1)12J5GT, (1)12C8, (1)9002, (3)9003, (1)12AH7GT, (3)12SG7. Super-Special—complete with tubes..................................J217....$29.95

CONDENSERS

Cap MFD	Working volt		Your cost
1	1000 oil	J220A	44c
8	600 oil	J220B	95c
2	600 oil	J220C	49c

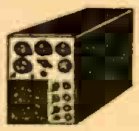
BUTTERFLY CONDENSERS

Oscillator assembly 76-300MC. with acorn tube socket mounted on condenser..........J239A $1.95
Type B- frequency range 300-1000MC......J239B.. 95c
BC4 antenna condenser 105-330MC J239C $1.95
Oscillator 105- 330 MC J2390..$1.95

BC 733-D RADIO RECEIVER

A part of aircraft blind landing equipment manufactured by W. E. Operates on any one of its pre-determined Xtal controlled frequencies in the range of 108-120MC. Contains 10 tubes, 3 of which are W.E. 717A's, and Xtals. Ideal receiver for conversion to 144MC. ham band or mobile telephone bands. For 24 VDC operation. 14½" x 7" x 4⅝". Complete with tubes .... J225....$9.95

BC 923 RECEIVER



This narrow band FM receiver operates from 26-41MC. It has 4 separate RF channels all of the same frequency, and each one individually tuned. These channels, in turn, are connected to a selector switch, which enables choosing desired pre-setting on any of the 4 RF sections. This equipment has a built-in 1000KC. Xtal controlled calibrating oscillator. Complete with 16 tubes, 1000KC. Xtal dynamotor, and speaker J202....$24.95

Dynamotor DA-3A

Input—28 VDC., 10 5 amps. Output—300 VDC., 260 amps. 150 VDC., .010 amps 14.5 VDC., 5 amps. 25 lbs......... .... J210....$1.50

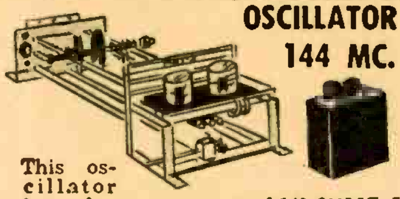
RADIO RECEIVER AND TRANSMITTER BC-620-A

Radio set BC 620-A is a portable low power frequency modulation set, capable of dependable communication. Frequency range 21.-27.9 MC. Either of 2 Xtal controlled pre-set frequencies may be chosen by throwing the channel switch. The change from receiving to transmitting is made by pressing a button on the hand-set microphone. The fact that this equipment incorporates the latest FM. circuit makes it adaptable to uses in locations where noise levels are extremely high.

Power requirements for receiver are as follows: "A" supply—1.5V. at .7 amps. "B" supply—90V. at 25 milliamperes. Transmitter 7.5V. "A" at .3 amps and 150V. "B" at 45 milliamperes.

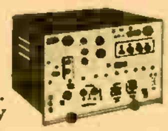
This equipment is used depot stock, is in good condition and comes complete with the following tubes: (1)VT 177 or 1LH4, (1)VT 178 or 1LC6, (4)VT 179 or 1LN5, (2)VT 182 or 3B7/1291, (1)VT 183 or 1R4/1294, (4)VT 185 or 3D6/1299...... .... J200....$9.95

OSCILLATOR 144 MC.



This oscillator has a frequency range of 140-200MC. It incorporates push pull 826 long lines oscillator. It has facilities for varying the sliding bars and also vernier tuning. The unit is silver-plated for efficiency. Comes complete with tubes and filament transformer for same J207 $4.95

BN IFF Transmitter and Receiver



Widely used on 144MC. and now also successfully used as a television receiver. this being made possible by the wide band 30MC. IF. channel and video amplifier. Being sold at this exceptionally low price for the encouragement of television. Original diagram furnished. Less tubes and power transformer. 100 lbs. J227....$9.95

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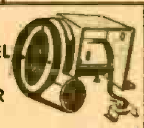
813	$5.95
VR150	.69c
955	.65c
9002	.89c
RK60	.95c
9001	.89c
6J4	$1.50
5FP7	$1.95
7BP7	$2.95
9LP7	$3.95
872A	$1.95
9004	.49c
9006	.59c
50B5	89c
VT127A	$2.95
35W4	.69c
3AP1	$1.95
3BP1	$1.95
6J5	.49c
5BP1	$3.95
6H6	.59c
1T4	.59c
3Q4	.59c
6SN7	.59c
3S4	.44c
5W4—SW4	.44c
6SA7	.44c
1G5	.44c
12H6	.44c
6SH7	.44c

TOGGLE SWITCH

D.P.S.T. 30 amps.
In black bakelite case J223....39c

SQUIRREL CAGE BLOWER



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Thordarsen T48003. 2H-7H 550 MA. swing choke 4½" x 5½" x 5½" square, black, crackle case J228J $5.95
Wafer sockets. 4, 5, 6, 7, and 8 prong J228K per 100 $2.95
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12,000,000 lumens light output. Stops all action. Ignition coil included on back of bulb. 10,000 flashes. Diagrams furnished. J222. ..$8.95.
Complete line of GE photo flash tubes in stock.

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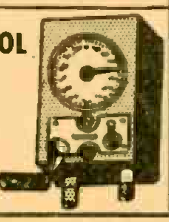

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Duo output Dynamotor. PE-101-C input voltage 12-24V. Output voltage 400V. at 135 MA., 800V. at 20 MA., and 9V at 1.1 amps............J226....$2.95

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Used in conjunction with SCR 269-F. Changeover contains 29V., step relay, 5 deck, 6 position switch. 12V. D.P.S.T. .... J256....$2.95
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6 gang—silver-plated. Sec No. 1 350 MMFD., Sec No. 2, 3, 4, 5, 60 MMFD., Sec No. 6 80 MMFD ..J260... 89c
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5 Gang, approx 50 MMFD. per section with individual air-tuned padders, 18 to 1 vernier drive ....J243....$1.95
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This equipment ideal for amplification of audio frequencies. Comes complete with 3 6V6GT tubes and 28V. dynamotor. Size: 9" x 9" x 5"........J203....$3.95
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110 or 120V.—60 Cy. input; output 500V. ea. side of center. tapped at 400V., 180 MA. Cast iron case ....J206....$4.95
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Complete with tubes and tuning unit covering 80 meter ham band, including frequencies charts, less Xtals ..J255....$12.50
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Kit of 12 switches J242 .... $1.85
LIP MIKE
With head band and cord J230 95c
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Slugged tune....J237....29c
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Containing 110 AC. relay, 3 miniature sockets with tube shields, 5 condensers, and 6 resistors. 3" x 5" x 1" .... J233....$1.95
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Xtal controlled check points. Frequency range 100-120 MC., including 5 tubes and Xtals. Operates from 110V 60 Cy. supply. Ideal precision instrument for high frequency measurement. Used, in good condition ......J268....$24.50
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200 MFD AT 10V.
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ICR TYPE HE
100W. bleeder consisting of 5 sections. 750 ohms, 23 ohms, 23 ohms, 3000 ohms, 7500 ohms, total — 11,269 ohms. J246 49c
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3000 #18 feet J240 ....$2.95
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.05-.05-.05, 300 VDC. In round can approximately 1" x 1" J252..50c Doz.
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10 Hy
At 200MA.—shelled case J238 ....$1.85
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Ideal filament transformer. 110V. 60 Cy. 220V. at 50 MA. 6.3V. at 1 amp. 6.3 at 2 amp. at 6.5 amps. 6" x 4½" x 5". 11 lbs. J271....$1.29
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Coming new television developments...

REVERSIBLE TELEVISION

By HUGO GERNSBACK

IN the December, 1909, issue of my first magazine, *Modern Electrics*, I wrote an article: "Television and the Telephot." This was possibly the first time that the word *television* was used in any technical article.

The article began as follows:

> The principle of television may be briefly stated thus: A simple instrument should be invented which would reproduce objects placed in front of a similar instrument (called Telephot) at the other end of the line. In simple language, it should be possible to connect two mirrors electrically, so that one would show whatever object is placed before the other and vice versa.
>
> As in a mirror, the objects must be reproduced in motion (at the far-off station). The theory further requires that both instruments (one at each end) must be reversible, that is, each instrument must receive as well as transmit.
>
> A good parallel of this requirement is found in the ordinary Bell telephone receiver. As is known, the Bell receiver (without the use of a microphone transmitter) will receive as well as transmit, that is, one can talk in a receiver and also hear the other party, using one and the same instrument.
>
> In the Telephot it should be possible to see the party at the other end while that party should see you—both through the medium of your Telephot.
>
> Unlike the mirror, however, you should not be able to see your own picture in your own Telephot. In this the Telephot differs from the mirror analogy.

The above was written 38 years ago. Since then television has made a great deal of progress, thanks to photoelectric cells and the cathode-ray tube, neither of which were known in 1909.

While television is with us today, much remains to be accomplished technically before it can become as universal an instrument as the present-day radio receiver. That this will be achieved in the foreseeable future, I do not doubt in the least.

As I see it, the obstacles in the way of television today are the following:

One of the major ones is the comparatively high present cost of television receivers. The ideal of a television receiver in every home in the U. S. requires a price range around $75 to $100 for the popular models. With mass production of telesets, this goal will probably be reached in less than 5 years.

Today, television manufacturers will throw up their hands in horror at such a price prediction—yet they know that if the American system of free broadcasting—advertising sponsored—is to prevail in television, as it does in broadcasting, then there must be a television audience in the tens of millions, against less than 150,000—our present audience.

Yet, the future looks exceedingly bright for television. Prices *are* coming down. New inventions, new processes, new ideas are appearing at an astonishing rate. American ingenuity is once again out in full force—soon the results will be apparent.

Take for instance the cathode-ray tube—the heart of the television receiver. A 20-inch tube costs $150.00 today—just the tube alone. No wonder a big set costs over $750. But the tube price will soon go down below $25! The reason? Present-day tubes are made of costly Pyrex glass. The glass "bottle" alone costs $75, F.O.B. the glass factory. But why use fragile glass?

Several laboratories are now hard at work on *metal* cathode-ray tubes, with a glass front for the viewing side. Not much is revealed about this development—it's still under thick wraps. But I do know that this single new improvement may well revolutionize television receivers in the near future.

Believe it or not, a $5 seven-inch cathode-ray tube—now listing at $30 to $50—is on the horizon during the next few years.

So far no television receivers have been mass-produced. Our manufacturers are even now trying to perfect ways and means to streamline production. Remember, telesets are infinitely more difficult to assemble than ordinary radio sets. For one thing, a television set is in reality *2* sets, one for the video (the television part), the other the audio (the sound part).

But the video end—due to the high voltages employed as well as the high-frequency components—is much more difficult to assemble than a radio. Perhaps doing away entirely with present-day wiring assembly methods* will bring mass production and lower price levels.

While television in the home is now assured, let us not overlook other and just as important uses of the new art which are now evolving.

Let us turn back to my 1909 article, part of which was quoted at the beginning of this page. I said, "The theory (television) further requires that both instruments (one at each end) must be reversible, *that is, each must receive as well as transmit.*"

In the 38 years of television progress, this condition has not been attained. *(Continued on page 92)*

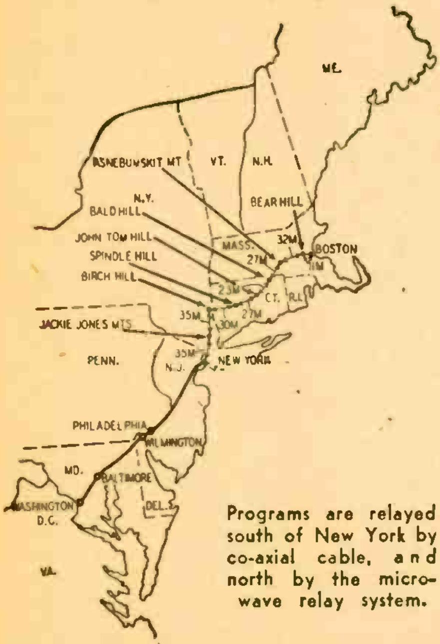
*See RADIO-CRAFT, September, 1947, page 20.

TELEVISION PROGRAMS and telephone conversations are now being beamed from New York to Boston via microwave. The experimental radio relay system was formally opened by the Bell System on November 11.

The two terminal points of the radio relay system are the headquarters building of the American Telephone and Telegraph Company's Long Lines Department at 32 Avenue of the Americas in New York and the Bowdoin Square building of the New England Telephone and Telegraph Company at Boston.

Between terminal points, the microwave beam makes 8 jumps via 7 intermediate radio relay stations spaced about thirty miles apart. To secure the unobstructed view between antennas necessary in microwave transmission, the stations are built on hilltops: Jackie Jones Mountain, 5 miles west of Haverstraw, N. Y.; Birch Hill, about 3 miles south of Pawling, N. Y.; Spindle Hill, 5 miles north of Waterbury, Conn.; John Tom Hill, at Glastonbury, Conn.; Bald Hill, 5 miles east of Stafford Springs, Conn.; Asnebumskit Mountain, 5 miles northwest of Worcester, Mass.; and Bear Hill at Waltham, Mass.

On the roof of each radio relay station are 4 antennas, 2 facing along the route



Programs are relayed south of New York by co-axial cable, and north by the microwave relay system.

toward New York, 2 facing along the route toward Boston. This allows for 2-way operation—with one antenna of each pair for transmitting, the other for receiving. The antennas are ten feet square and incorporate a metal lens capable of focussing the microwave signals into a sharp beam.

The initial equipment comprises a regular and a spare circuit in each direction. For operation of these 2 circuits, frequencies in the range 3700 to 4200 megacycles have been assigned by the Federal Communications Commission. Each circuit carries a signal band width of about 5 megacycles.

Terminal equipment capable of carrying 240 simultaneous telephone conversations will be installed for experiment next spring, and it is expected that more channels will be added later.

RADIO-ELECTRONICS

SEAGOING TELEVISION became a fact last month with the installation of a receiver on the pilot boat New Jersey, which works out of New York Harbor. According to officials of the Radio Corporation of America, which made the installation, this is the first permanent marine installation. A television receiver was installed on the liner President Roosevelt in 1940, but that installation was strictly experimental.

It is expected that the televiser will be a great help to morale aboard the boat, where as many as 35 pilots may be waiting for assignment to incoming or outgoing ships. Good signals from all three New York stations were reported while the *New Jersey* was cruising off Ambrose Light, 20 miles from Manhattan.

TWELVE TELEVISION SETS in Chicago Catholic parishes, and television receivers in the church halls of the People's Church and the Faith Presbyterian Church have been installed, General Electric announced last month.

Primary purpose of the plan, according to Bishop Sheil of Chicago, is to make television reception of football games, hockey matches and similar programs available to young people under church auspices. Later the equipment may be used by adult groups.

TELEVISION EQUIPMENT was used for the first time in testing high-thrust rocket motors on the Pacific Coast, General Electric officials announced last month.

A television camera watched the rocket motor tests and sent its "eyewitness" report to observers comfortably seated in a conference room where they saw the operations on a viewing screen far removed from the test pits.

This is only one of many industrial applications where television should be of tremendous value because it will allow "closeup" study difficult and often impossible to obtain with other methods, stated C. A. Priest, manager of the G-E transmitter division at Electronics Park, pointing out that limitations of present methods of test viewing are manifold. Observation block houses restrict viewing to either the direct method through laminated safety glass which becomes clouded from close-range effects of propellent fumes, or indirect method using mirrors which in addition to becoming clouded limit range of vision and introduce distortion.

The television method has many advantages. Safety is assured by the remoteness of the viewing operation, picture light intensity and definition are far superior to direct viewing through glass, and shock-proofed cameras can be mounted adjacent to the rocket unit for viewing intimate details. Other advantages of the television method are important to the test engineers. The close-up view provided by the television camera allows the engineers to detect in time to stop the test firing any evidence of fuel leaks or malfunctioning of the system which could result in an explosion and major damage to the rocket motor and its entire test setup. Continual observation of the rocket and exhaust flames during the firing period also enables the test engineers to note any irregularities in mixture ratio.

Television camera in place, ready to observe rocket motor in action.

TABLE MODEL TELEVISERS will outsell consoles almost 2 to 1 during the next year, according to 64 New York dealers queried in a survey sponsored by Allen B. DuMont Laboratories.

According to the survey, table-top models are expected to account for 63.3% and consoles for 36.7% of total set sales. In the dealers' opinion, 57.2% of all television receivers sold during the next twelve months will have television only; 20.8% of the units sold will have television in combination with FM and AM; and 22% will have television with AM, FM, and phonograph.

Eighty-eight percent of the dealers in the survey noted that in making purchasing decisions, male customers have the most to say about the brand.

MONTHLY REVIEW

RADAR may set off photo flashbulbs carried in planes, General Electric officials warned last month. G-E factories have accordingly been instructed to ship no more flashbulbs by air.

General Electric said recent experiments have established that the lamps, with the exception of the primer type, can be ignited by high-energy shortwave electro-magnetic radiation such as is encountered from radar transmitters.

John M. Chamberlain, Civil Aeronautics Board safety-bureau director, stated there was no indication as yet that small air-borne radar sets, like those that must be installed by Feb. 15 in all passenger planes, are likely to set off the bulbs. These sets are to be installed to give pilots information about terrain and to warn when planes come too close.

Presumably even large ground radar transmitters would be effective only over a range of a few feet.

RADAR PIONEER Sir Edward Appleton has been awarded the 1947 Nobel Prize in Physics. His researches have been of great direct importance to communications as well as radar.

A pioneer investigator of the ionosphere or "radio roof" surrounding the earth, Sir Edward proved by direct experiment the existence of the layer of ionized atoms 115 miles or so high, present both day and night, which reflects short radio waves at night.

His later work with radio reflections led directly to *radiolocation*, as radar was originally called in England, and his work was one of the underlying factors of Britain's early radar preparedness which was so decisive in the early stages of the last war.

The invisible reflecting layers of the ionosphere have been the subject of intensive research since their existence was proved. Today calculation of their height is important in determining the best frequencies to use for radio communication over great distances.

FM POLICE RADIO installed in 150 patrol cars and other vehicles of the Brooklyn (N.Y.) police department gives that borough one of the largest 2-way police communications systems in the United States. RCA engineers, who made the installation, reported that the system also includes a 250-watt FM station transmitter, powerful enough to reach all parts of the borough.

The system provides for instantaneous 2-way communication between one or more cars and the despatcher's office. Using the call letters WRQP, the station transmitter operates on a frequency of 39.58 megacycles, while the mobile transmitters operate on two different frequencies: 37.22 megacycles for the eastern, and 39.38 megacycles for the western part of the borough.

RADIO TRADE-IN allowances may be merely a cover for unethical trade practises, the Better Business Bureau warned last month. Dealers or even manufacturers may inflate list prices, then offer a trade-in allowance inflated to the same extent as the list price of the new equipment, thus falsely leading the buyer to believe he is receiving an exceptional bargain.

Kenneth B. Wilson, operating manager of the Bureau, pointed out as one of a number of examples, a case in which dealers in one large city offered a $30 trade-in allowance on old radios to purchasers of a certain FM-AM radio-phono combination. The advertisement stated that there would be "no quibbling over age, make or condition" of the old radio. Just prior to that, the manufacturer of the FM-AM combination had advertised his set at a price $30 over its former regular list price.

RADAR NAVIGATION may be hampered by archaic laws under which a radar-equipped vessel involved in a collision may be held liable for damages, Vincent A. Catoggio, New York marine lawyer, warned last month. The inland and international navigation rules, which were adopted in 1897, provide that a vessel shall slow down to "moderate speed" in a fog. "Moderate speed" has been interpreted by the courts to mean a speed that will permit a vessel to stop "within the limits of visibility."

Since one of the most important features of radar is that it permits greater speed in fog, this ruling would negate much of its value, unless courts would decide that the visibility of radar could be considered a substitute for the traditional "rule of sight."

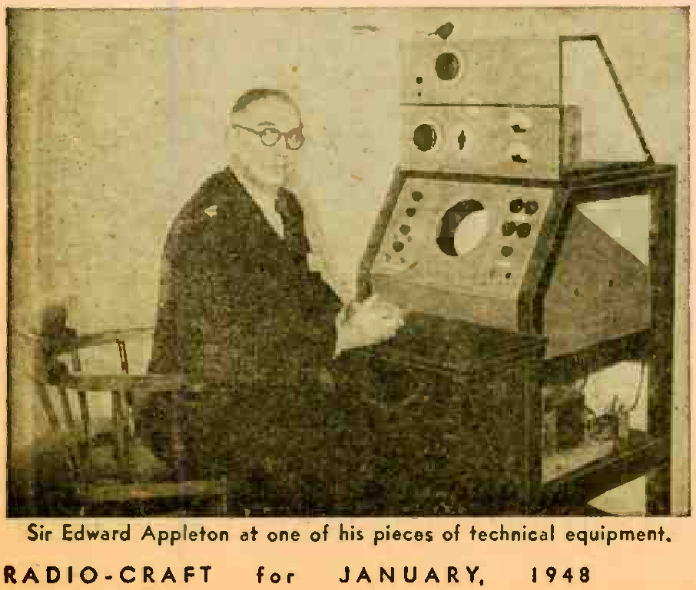
CITIZENS RADIO will soon become an actuality with the help of printed circuits and new high-frequency tubes. A transceiver already tested and about to be put in production by Gross Electronics Co. operates on the 460-470 mc band. It was exhibited by its developer Al Gross, president of the company, at the recent printed-circuit symposium in Washington.

The radios will be sold in pairs tuned to their own private frequency within the 460-470 megacycle range, the Citizens Radio Band, thus reducing eavesdropping. Each set is a self-contained transmitter and receiver.

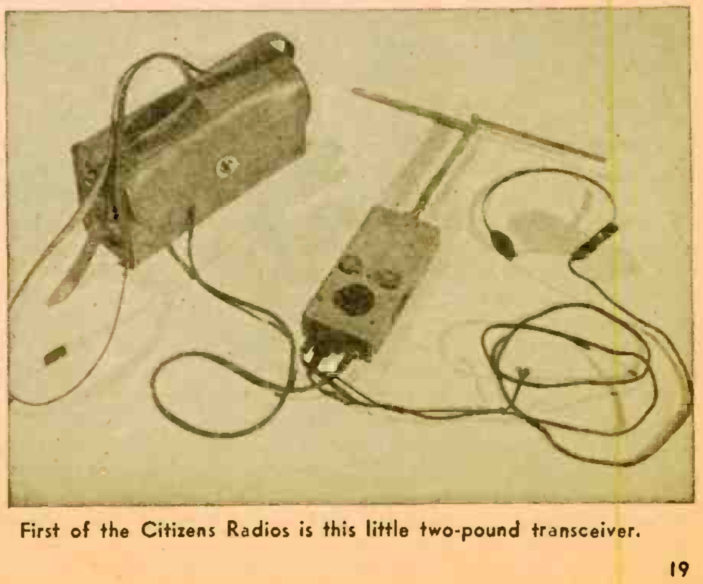
They will sell at less than $200 a pair. Volume production eventually should bring the price down to about $100.

Performance varies under different conditions. On ground level in the city, the equipment has operated satisfactorily for distances up to four miles. Tests made in various cities resulted in perfect reception over varied distances among city blocks. In a ground to plane test, it made good contact between Cleveland Airport and Sandusky, 60 miles away.

The transmitter and receiver of the civilian walkie-talkie weighs 11 ounces with antenna, is 6 inches long by about 3 inches wide by 1¼ inch thick. With batteries and leather case, the overall weight of each set is little more than two pounds.



Sir Edward Appleton at one of his pieces of technical equipment.



First of the Citizens Radios is this little two-pound transceiver.

Progress In Television

Dr. Zworykin, shown holding the image orthicon, is one of the engineers whose work created the science of television. He is still pioneering in the television art, as well as in other advanced fields of radio and electronics.

America's foremost television-inventor, pioneer and engineer reviews recent developments

By DR. VLADIMIR K. ZWORYKIN

THE end of the war emergency has seen the beginning of two developments in the television field in America. The first is utilization of the accumulated experience of the war and prewar years to create an extensive, high-quality television broadcasting service. The second is the application of television techniques to an ever-increasing number of peacetime industrial uses, a process which is bound to result eventually in further advances in broadcasting technique.

The first development is reflected in the increasing numbers of station-operating licenses issued by the Federal Communications Commission, the opening of new concentric cable and radio relay links between stations, heavy receiver production schedules, and the blossoming of the characteristic television dipole antennas over the landscape.

By midsummer of 1947 there were 12 television broadcasting stations in operation and a larger number under construction. Some 70,000 receivers had been installed. The tools of this television system are tried and tested. Following the same pattern of private sponsorship as American radio broadcasting, television programs provide black-and-white transmissions with a 525-line, interlaced scanning pattern. Electronic storage pickup tubes—in particular the *iconoscope* and the *image orthicon*—are employed both in the studio and for spot pickup. In the receivers, *kinescopes* serve to reproduce the image both for direct viewing and for screen projection. These elements play a central role in most of the television equipment to be considered.

The most important common feature of the pickup tube under consideration, the storage principle, is illustrated in Fig. 1. The light image of the scene to be transmitted is projected on a photosensitive, insulating surface—the *target* or *mosaic*. This surface is capacitively coupled to a metal backing, the signal plate. The light image builds up, by photoemission, a charge image on the insulating surface. This charge image is scanned by an electron beam. As a particular picture element is scanned, the charge stored in the element by photoemission during the preceding picture period is released and provides the picture signal current from the signal plate behind the mosaic to the video amplifier input.

In the iconoscope the scanning beam has a velocity corresponding to an accelerating voltage of about 1,000. For this velocity the secondary-emission ratio of the photosensitive surface is much larger than unity. Accordingly the beam brings a scanned element to an equilibrium potential which is sufficiently positive with respect to neighboring collecting electrodes so that all secondary electrons but one per primary electron are forced to return to the element. Under such circumstances only a small fraction of the secondary electrons and photoelectrons emitted by the element reach the collecting (anode) coatings on the tube walls. A majority of those which are not returned to the element of origin are redistributed over the remainder of the mosaic surface. This both reduces the efficiency of operation, and hence the sensitivity, of the pickup tube and distorts the charge image formed on the mosaic by photoemission. In practice, this distortion is rectified by the monitoring engineer by adding appropriate "shading signals" to the picture signal.

The orthicon—short for orthiconoscope or "true iconoscope"—remedies these drawbacks by reducing the velocity of the scanning beam on its approach to the target to such an extent that the secondary emission ratio of the latter falls below unity; the equilibrium potential of the target is now slightly below the potential of the cathode of the electron gun, and the beam deposits just enough electrons on the target to neutralize the positive charge stored by photoemission. The returning beam electrons, just like all the photoelectrons and secondary electrons emitted by the target surface, are collected by the anode.

Although the orthicon is, consequently, considerably more sensitive than the iconoscope, perfectly linear in its response to illumination, and free from spurious signals, it falls short of an ideal storage tube in two respects: (1) at very high light levels the tube operation becomes unstable, since the target may become sufficiently positive to pass over to its high-voltage equilibrium point under the scanning beam; (2) the signal level is still sufficiently low so that noise introduced by the first stage of the amplifier may impair the quality of the transmitted image.

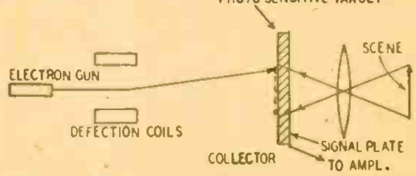


Fig. 1—The storage action of a pickup tube.

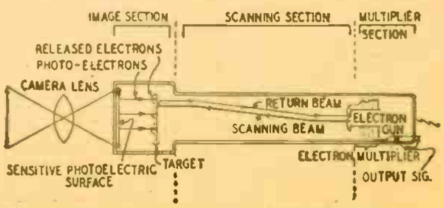


Fig. 2—How the image orthicon tube operates.

The image orthicon

In the image orthicon[1] (Fig. 2), the instability at high levels is removed by providing a target screen at a voltage only slightly above the equilibrium potential of the target to collect the electrons emitted by the latter. This makes it impossible for any portion of the target to become sufficiently positive to result in unstable operation. Furthermore, the signal level of the output is raised both by inserting an image tube section ahead of the target and employing a secondary-emission multiplier for the noise-free amplification of the signal current. The methods of beam focusing (by a longitudinal magnetic field) and of beam deflection (by superimposed transverse fields) are similar to those employed in the orthicon. They are designed to produce a low-velocity spot

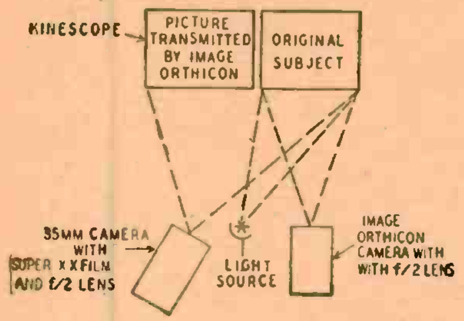


Fig. 4—Experiment on orthicon sensitivity.

which is sharply focused at all points of the target. Magnetic deflecting fields are employed throughout in the image orthicon, so that the beam electrons which fail to be deposited on positively charged portions of the target return along paths close to the incident beam to the area of the anode disk surrounding the beam-defining aperture. Here they eject secondary electrons. The electrostatic fields surrounding the anode disk are such that these secondary electrons are drawn over into the first stage of a "pinwheel" secondary-emission multiplier which surrounds the gun structure. Repeated secondary-emission multiplication at the vanes of 5 successive pinwheels results in a total gain from 200 to 500. The amplified return-beam current, representing the difference of the constant scanning-beam current and the variable picture-signal current, provides a high-level input for the succeeding video amplifier.

1. A. Rose, P. K. Weimer, and H. B. Law, "The Image Orthicon—A Sensitive Television Pickup Tube," *Proc. Inst. Radio Engrs.*, Vol. 34, pp. 424-432, 1947.

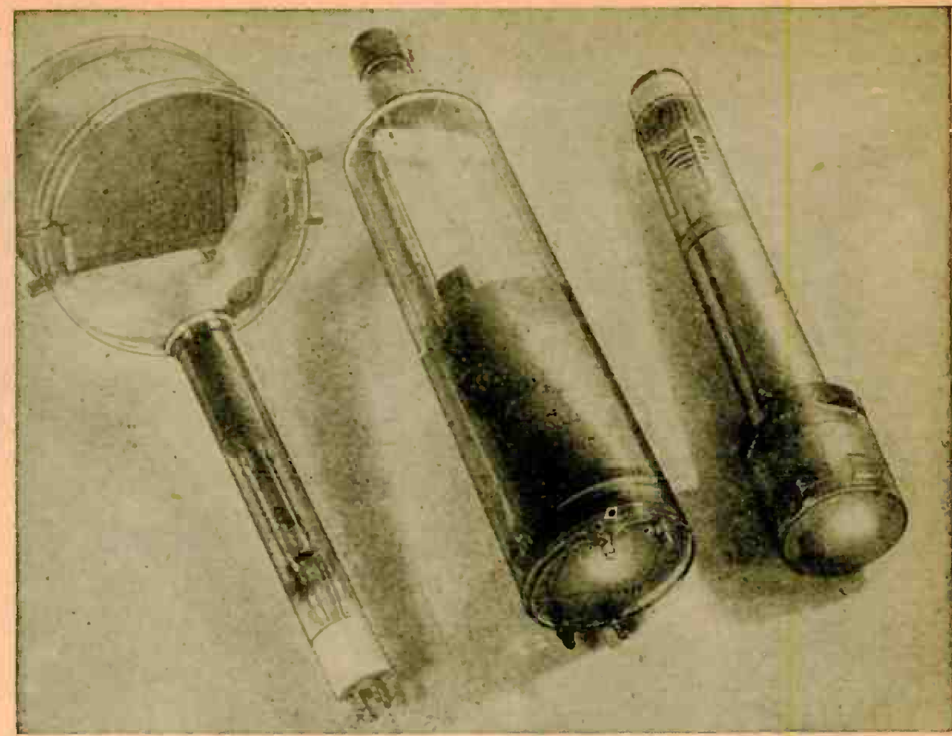


Fig. 3—Iconoscope, orthicon and image orthicon. Size decreases as sensitivity increases.

The formation of the charge image on the target presents some new features. The light image of the scene is projected on a transparent photocathode, which is maintained approximately 300 volts negative with respect to the target. The photoelectrons emitted as a result are accelerated and focused by the longitudinal magnetic field on the target, ejecting a multiplicity of secondary electrons. Picture elements of the target which correspond to bright portions of the image assume consequently a positive charge; the secondary electrons are drawn to a high-transmission, 20-40-mesh-per-millimeter, metal screen placed just in front of the target.

The target itself is a very thin, high-conductivity glass film, stretched on a metal frame. Although potential differences between its faces are substantially neutralized by conduction in the course of a frame time, leakage from picture element to picture element is too slight to result in an appreciable reduction in the contrast and resolution of the picture.

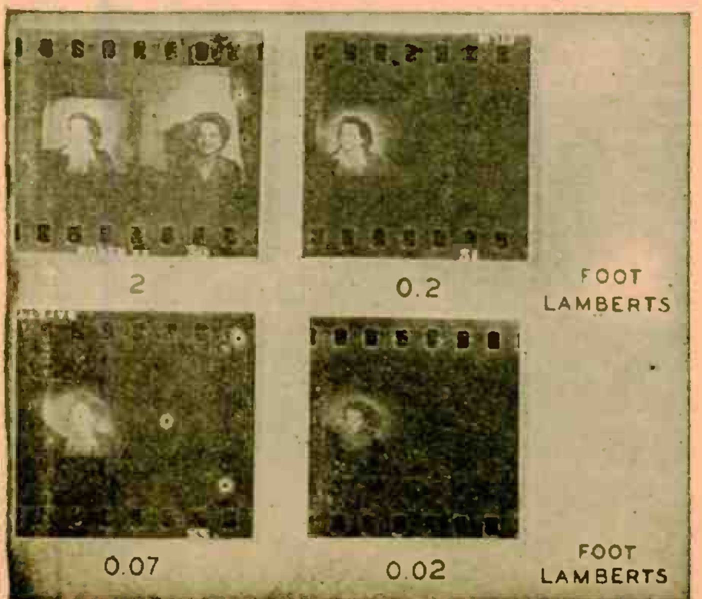


Fig. 5—Results of the experiment of Fig. 4.

The relative dimensions and general structure of the 3 pickup tubes discussed are well brought out by Fig. 3. Increasing complexity of construction has not brought increase in bulk.

The extraordinary sensitivity of the image orthicon is illustrated by the experiment shown in Fig. 4. An image orthicon camera and a photographic camera employing high-sensitivity (Eastman Super-XX), 35-mm film were both trained on the same subject. A television

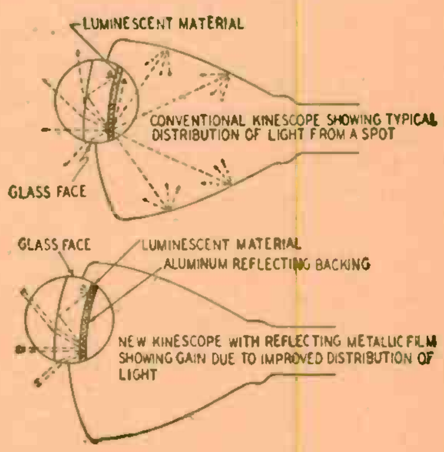


Fig. 6—Effect of aluminizing screen surface.

receiver connected to the image orthicon camera was placed next to the subject. Both cameras were provided with f/2 lenses and exposed for 1/30 second (corresponding to the standard television frame time). The result of attenuating the illumination provided by a 40-watt incandescent lamp with neutral filters is shown in Fig. 5. It is seen that the subject is recorded by both cameras only at the maximum subject brightness of 2 foot-lamberts or, approximately, 2 millilamberts. At the lower intensities only the television image remains, which is still readily recognizable when the il-

(Continued on following page)

lumination has been reduced to a hundredth of its original value.

The viewing tube, or kinescope, has undergone only minor changes in recent years. The most important of these have increased the image brightness of projected television pictures. Considerable gains have been recorded both in the light emission of the projection kinescopes themselves and in the efficiency of the optics employed to project the pictures.

Enhancement in the emission of the projection tubes has been achieved by depositing a thin metal film—transparent to the beam electrons but reflecting for light—over the surface of the luminescent screen. The optical effect of such a film on light emitted backward by the luminescent screen is indicated in Fig. 6. In a tube with an untreated screen this light, which is lost for the formation of the image, may in part reach other portions of the screen, reducing contrast. The metal film[2] both adds this light to that emitted in a forward direction and prevents this contrast reduction. An even more important factor with high-voltage operation is that the metal film, maintained at anode potential, prevents the screen from charging negatively.

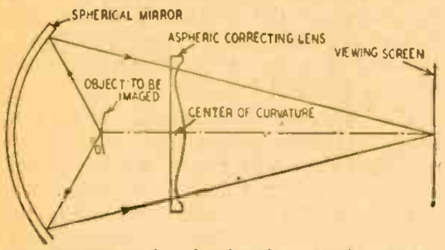


Fig. 7—Principle of Schmidt optical system.

Without such a film this charging process may reduce by a large factor the kinetic energy with which the electrons impinge on the screen so that the energy available for conversion into light is greatly decreased. A final advantage of the metal film is that it absorbs nega-

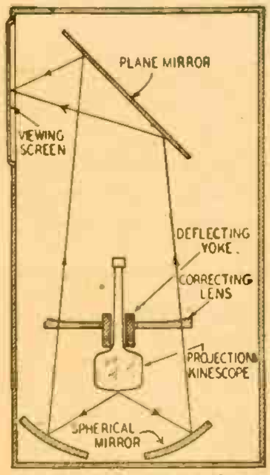


Fig. 8—Schmidt-type television projection set.

tive ions originating in the cathode region of the gun, preventing the appearance of "ion spot" without requiring special ion-trapping arrangements.

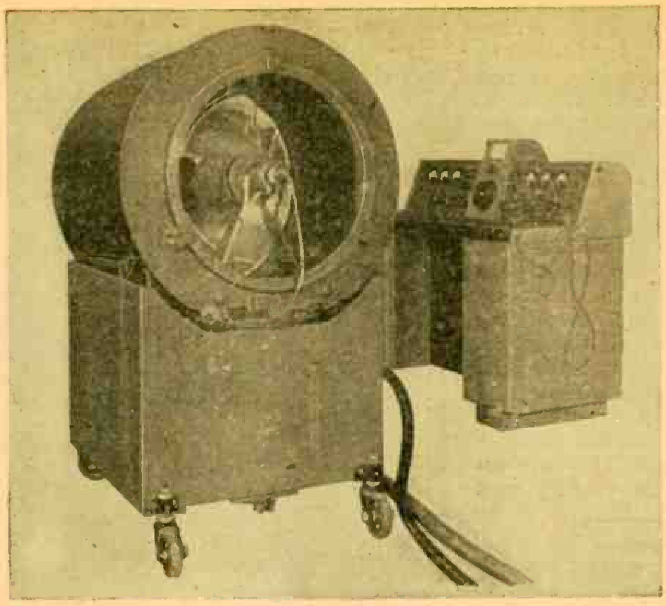


Fig. 9—Large projection televiser designed for 5 x 7-meter screen.

Reflective systems

The substitution of reflective projection systems with aspheric correction for the conventional projection lenses has led to gains by a factor from 5 to 7 in the optical efficiency of projection systems.[3] The principle of the new optical system is shown in Fig. 7. The television image formed on a curved kinescope face is projected by a concentric spherical mirror on the viewing screen. Such a system is spherically symmetrical about the common center of curvature of mirror and tube face, and hence provides an image field free from optical defects apart from spherical aberration. If the latter is corrected by placing a weak aspheric lens at the center of curvature, there results a wide-angle, large-aperture system free from all lower-order optical defects. The preparation of the aspheric lens, it is true, presents a difficult mechanical problem. However, a plastic molding technique makes it possible to prepare large numbers of such lenses from a single steel master. This procedure has rendered it economically feasible to employ reflective projection systems in home receivers, arranged as shown in Fig. 8. The image on the tube is projected upward and deflected by a 45° mirror onto a vertical directional viewing screen. The optical efficiencies of such systems have been found to range from 18 to 35%, as compared to 4-5% for an f-2 projection lens. Fig. 9 shows an earlier television projector operating on the same principle, but designed to cover a motion picture theater screen 5×7 meters in dimension.

The equipment described so far primarily finds application in current television broadcasting and reception. However, its utility is by no means limited to broadcast television. Numerous other uses may be conveniently grouped under the heading "industrial television."

Many other uses for television

An application of obvious importance is the employment of television equipment to observe industrial processes which are either inaccessible or dangerous to human beings; the Bikini atomic bomb observations are a relevant example. Other uses are deep-sea observations and the surveillance of boilers in power plants. A similar type of application is the watching of a series of widely separated, automatic substations from a conveniently located central point. Here television enables one individual to observe simultaneously events taking place at widely separated points. The converse problem, of permitting a group of individuals, too large for direct viewing, to observe the same point is met not only in broadcast television, but also in department stores, to let customers view fashion exhibits at widely separated sections of the store; at conventions, to permit an overflow audience to watch the proceedings; and, perhaps most significantly, in medicine, to give consulting and visiting physicians an

Fig. 10—Television camera at Johns Hopkins.

intimate view of an operation without interfering with its progress. Fig. 10 shows a television camera suspended for this purpose directly above the operating table in an operating room of the Johns Hopkins University Hospital.

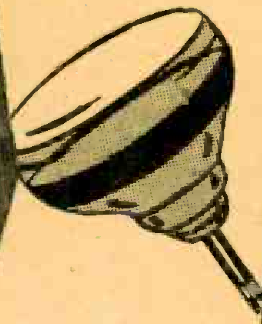
Television techniques also find valuable application in fields which, at first sight, seem only very remotely related. One of these is projection microscopy. Many years ago the ultra-violet and infra-red sensitivities of the iconoscope and the image tube were utilized to per-

(Continued on page 127)

2. D. W. Epstein and L. Pensak, "Improved Cathode-Ray Tubes with Metal-Backed Luminescent Screens," *RCA Review*, Vol. 7, pp. 5-10, 1946.

3. D. W. Epstein and I. G. Maloff, "Projection Television," *J. Soc. Motion Picture Engrs.*, Vol. 44, pp. 443-455, 1945.

1948 Televiser Parade



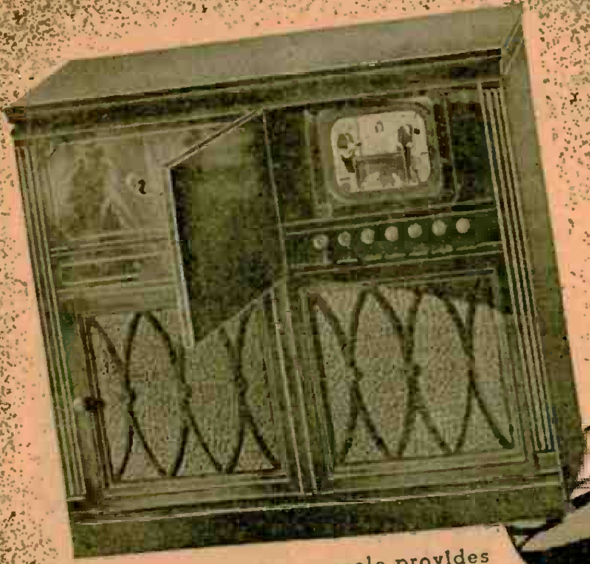
Emerson table model teleset has 52 sq. in. image. Tunes in all TV channels.

RCA television FM-AM-phonograph console; 52 square inch image; automatic record changer.

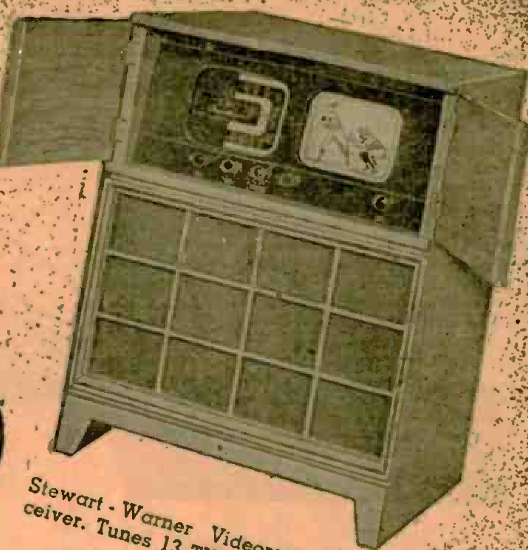
Philco table model television receiver with 10-inch tube, has 54 square inch image.

Garod receiver with 10-inch tube. Provides AM and FM reception; has automatic record changer.

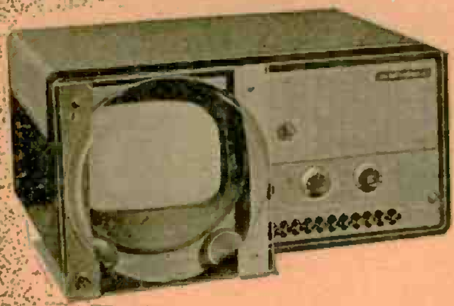
DuMont Sherwood model teleset; direct-view image 9½ by 12¾ in. AM, SW and FM; record changer.



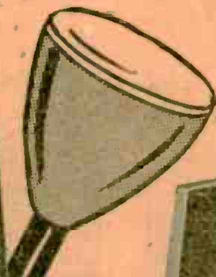
Bendix television console provides AM-FM reception and phonograph.



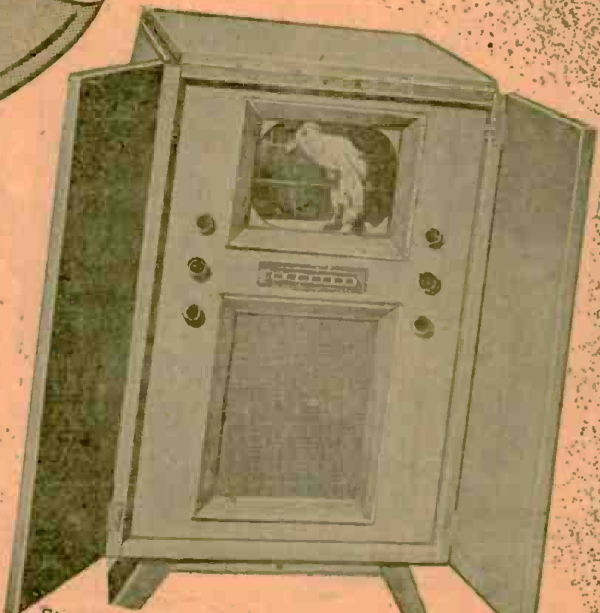
Stewart-Warner Videorama TV receiver. Tunes 13 TV and BC channels.



Left — Hallicrafters table model TV set has 7-inch image. 13-channel push-button tuning. Has gray and silver metal cabinet. Right—Espey TV3K television table receiver presents an extremely neat appearance.



General Electric model 802 TV set is a direct-view AM-FM and phono console. Image 48 sq. in.

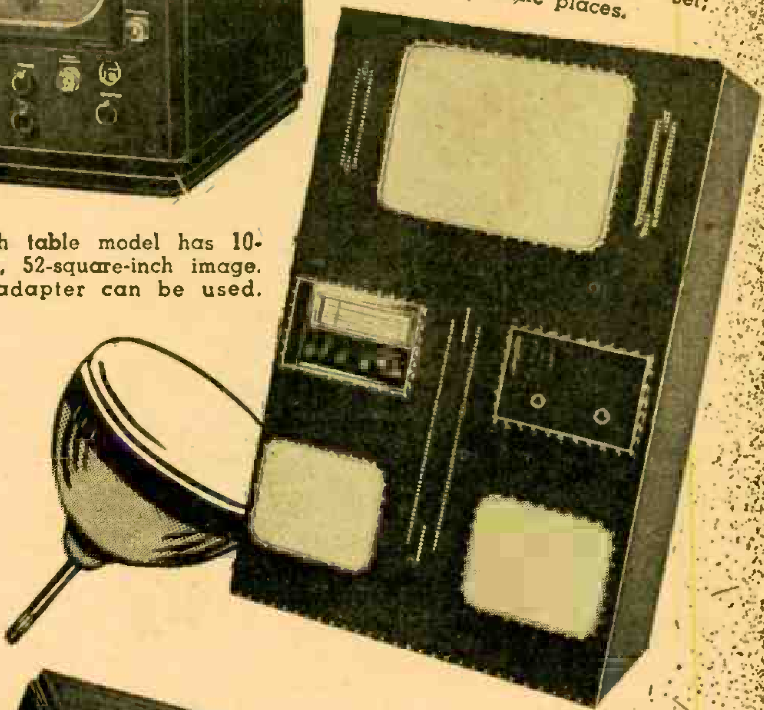


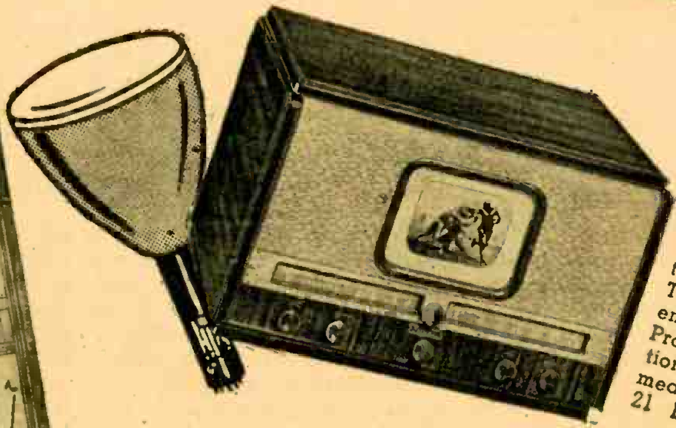
Stromberg-Carlson model TV10L set has 10-inch direct view image. Seven channel, motor tuning.

Remington 12-inch tube television receiver, covers all FM channels. Another model has 15-inch tube.

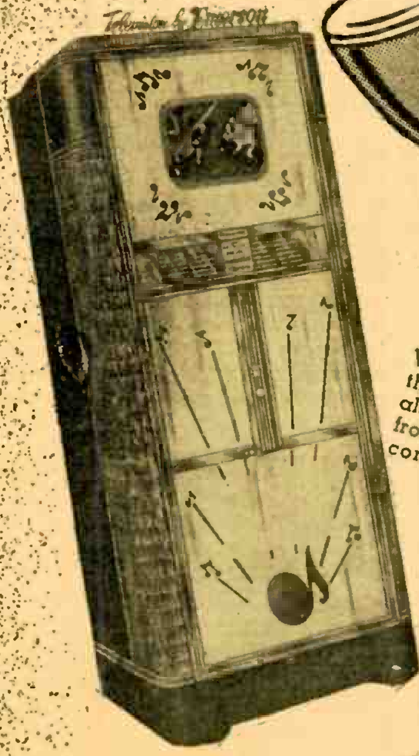
Farnsworth table model has 10-inch tube, 52-square-inch image. An AM adapter can be used.

United States Television large screen (19 by 25 inches) TV set; intended for public places.





Belmont table set with 7-inch picture tube. Covers all 13 TV channels and employs 21 tubes. Provides FM reception. The cabinet measures 14½ by 21 by 16 inches.



Videograph-Emerson coin-in-the-slot television receiver—also supplies music and song from phonograph records. Table control is also available.

Transvision 12-inch tube television "Kit" set. Picture size 75 sq. in. Factory-tuned R.F. unit. All TV channels covered. 22 tubes. Home assembly.

Nation-Wide Television

is now

in the Making

By DR. ALLEN B. DU MONT

Allen B. Du Mont is a television pioneer largely responsible for the commercialization of the cathode-ray tube and oscilloscope and president of the Allen B. Du Mont Labs., Inc., manufacturers of television receivers and transmitters, cathode-ray tubes, and oscilloscopes; owners of Du Mont network with Du Mont-John Wanamaker studios and Stations WABD (New York) and WTTG (Washington).

SOONER or later, and probably sooner than generally expected, it will be immaterial whether you live in New York or Pumpkin Center so far as satisfactory television entertainment is concerned. For in due course television will become nation-wide. Smaller cities and rural areas will have their local telecasting services. Topflight television programs originating in leading centers will be piped to dozens and later hundreds of telecasting stations dotting this nation from coast to coast, following in the footsteps of the great broadcasting networks. Nation-wide telecasting will spell nation-wide sale of television receivers. Realization of that dream is already in the making.

That the commercialization of television has been slow, no one can deny. The end of 1947 still saw telecasting services concentrated in a mere handful of leading centers—New York, Philadelphia, Washington, Schenectady-Albany, Chicago, St. Louis, Los Angeles, Detroit, and Cleveland. Fifteen stations were operating in those metropolitan areas. However, 56 more telecasting stations were authorized and under construction, so that a total of 41 cities and areas should shortly be enjoying visual programs.

Meanwhile, at the receiving end, there were less than 10,000 television sets in use at the start of 1947. The majority were rendering yeoman service in bars and grills, restaurants and clubs, and in other public places, while the homes boasting television entertainment were to all intents and purposes public places too, so far as immediate neighbors and friends were concerned. But during the year the leading manufacturers got their production lines rolling. Deft-fingered girls took the place of clumsier males in wielding screw drivers and wrenches, pliers and wire strippers, soldering irons and delicate connections. Between 125,000 and 150,000 sets were built and delivered last year, plus an unknown number of miscellaneous kit-assembled receivers as well as receivers put together by local custom-set builders. Therefore we can accept the fact that 1947 definitely dates the birth of *commercialized* as distinguished from *experimental* television. From here on we can expect rapid expansion and extension. Television is at last on its way!

So far, television has been concentrated in the 6 metropolitan areas chosen by the pioneer telecasters—New York, Philadelphia, Washington, Schenectady-Albany, Chicago, and Los Angeles—plus the newcomers in Detroit, St. Louis, and Cleveland just starting on their telecasting career. It is particularly significant that 79% of television set production in 1947 went into the New York metropolitan area, leaving only minor allotments to other areas already enjoying telecasting service. This means that even the enormous increase in production anticipated for 1948—perhaps topping a million units if general business conditions remain good—will still fall far short of meeting the demands of the old and new telecasting areas.

The telecasting range

That leading metropolitan areas will continue to forge ahead with their telecasting stations goes without saying. Broadcasters, newspapers, department stores, theatrical interests, and others are willing and ready to step in with telecasting services as and when the proposition looks like a money-maker.

Until recently, however, limited service range was taken for granted. The would-be telecaster figured on a reliable coverage of 25 miles radius, and perhaps another 25 miles thrown in for good measure. Potential audiences were figured within such concentric circles. The economics of station investment, operation, and anticipated returns were worked out on that basis. Television engineers themselves were insistent that, given an elevation of around 500 feet for the transmitting antenna to dominate the surrounding terrain, 25 to 50 miles was good coverage. The city folks and those in the suburbs could take satisfactory television service for granted. But rural areas were quite apt to be out of luck. Perhaps television was not for them.

Fortunately, more recent telecast experiences have broadened the horizons. The 3 telecasting stations in New York City—WNBT (National Broadcasting) atop the Empire State Tower, with about a 1,300-foot elevation; WCBW (Columbia Broadcasting) atop the Chrysler Building, 950-foot elevation; and WABD (Du Mont) atop 515 Madison Avenue, 700-foot elevation—are being received as a regular thing at distances up to 75 miles and beyond. Thus an enormous rural area about this great city is covered by television programs.

Two-deck television antenna with reflector, commonly used in remote receiving locations.

Better aerials, as well as television receivers of higher sensitivity, have increased telecast coverage. At the transmitting end, improved antennas such as the bat-wing turnstile have been introduced, beaming the radiated signal in the horizontal plane instead of dissipating it into the sky where it can do little or no good so far as the remote television receiver is concerned.

By such concentration, the new transmitting aerials are now stepping up radiated power gain from 3 to over 9 times by actual measurement. In other words, a 5-kw transmitter now has the effective signal strength of an earlier 15- to 45-kw transmitter. Such tremendous gain is reflected in higher signal strength at the receiving aerial, which in turn provides brighter, better contrasted images, and good sound reproduction, especially at remote points.

Meanwhile, considerable progress is being made with receiving aerials. The earlier simple dipole with or without reflector is making way for stacked dipoles and even an impressive array of dipoles of different sizes to cover television and FM bands from the lowest to the highest frequencies—44 to 216 megacycles. Some aerials are masterpieces of pipe-fitting, far more conspicuous than the conventional dwelling that supports them.

More care is being taken with transmission lines, especially the matching of impedances of line and set input, for minimized losses. In Du Mont receiver installations, the Cosgrove folded dipole with supplementary members or "horns" has proven satisfactory in covering all television and FM bands in most localities, although some of the more elaborate stacked dipoles and reflectors of assorted sizes will doubtless be required in stretching telecasting coverage beyond our customary service ranges.

Dr. Thomas T. Goldsmith, Director of Research for the Du Mont Laboratories, and the writer, occasionally accompanied by others interested in such studies, have done considerable work in long-distance television reception. The author's Chrysler sedan has been equipped with a gasoline-driven a.c. generator, collapsible pipe mast, and various aerial rigs, as well as a standard television receiver, to make receiving tests at remote points. The New York television stations have been received in the Catskills and the Poconos, at Montauk Point on the end of Long Island, and at Atlantic City, or over distances considerably beyond 75 miles. Various types of dipoles have been tried, as well as rhombic antennas which, while requiring more space than can be provided in crowded localities, compensate for such handicaps by requiring relatively little elevation. Some of the results of these long-distance television reception experiments will soon be released.


All New York City's television stations were picked up in the Catskills with this antenna.

Some distance from the nearest movie theater, away from the numerous distractions of the city, with plenty of evening time to spare, certainly the rural family is the ideal television audience. And television engineers intend to include that group in the metropolitan area of television.

The remoter areas

But what of the small town—the secondary city—the trading center which means so much to the surrounding rural area but does not rate among the so-called metropolitan centers? Will television come to these spots, too?

Until this past year, the telecasting investment was considered well up in the six figures—and we mean all dollars and no cents. We talked glibly of a quarter to half a million dollars for a telecast transmitter and associated equipment. That's a lot of money. So much that only monied individuals or organizations could even think of going into the telecasting business, and then only in leading metropolitan areas with large populations to justify the program sponsor's money.

Yet there are a dozen or more small towns and secondary areas for every leading city and primary metropolitan area. The writer's organization soon sensed this situation when approached by individuals and organizations from small centers who had some money to invest but not the sums being talked about for large cities. Quite evidently this telecasting proposition had to be cut down to the right size for the smaller telecasters. So the engineers got to work boiling down telecasting equipment until the irreducible minimum was attained for satisfactory telecasting service over a range of 15 to perhaps 50 miles, depending on transmitting antenna height and the nature of the surrounding terrain.

Such a boiled-down telecasting setup has been developed by the writer's organization. At a total investment well under $100,000, including all essential camera, movie pickup, control, audio, lighting, transmitting, high-efficiency antenna and tower, and even test equipment, the telecaster is soon ready for business. The 2 image orthicon cameras are used for studio live-talent pickups, movie pickups, and outside work. The 500-watt video and 250-watt audio transmitters provide adequate coverage at the start, and can be added to later by way of r.f. amplifiers, ultimately attaining a dual transmitter of 5-kw video and 2.5-kw audio rating, or even higher.

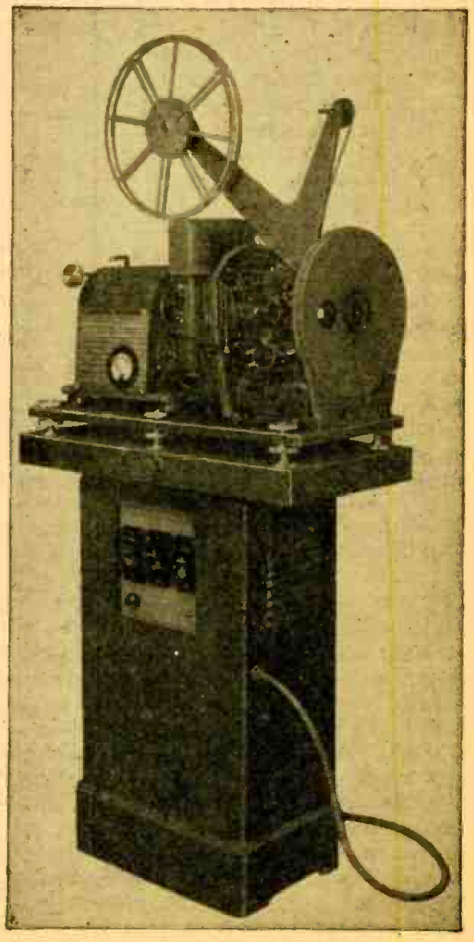
Here at last is basic gear. The small telecaster can get on the air. The investment is kept at a minimum while the commercial angle is being worked out over the first year or two. Video programs can be placed on the air while local folks install their television receivers. As the audience grows, the telecaster can step up his transmitting and studio facilities with a minimum of obsolescence. The whole scheme makes for a sound economic balance. Certainly the basic television gear, as exemplified by this Du Mont television package and corresponding offerings of RCA, G-E, and other builders of equipment, is attracting widespread attention and will soon be opening up many areas that otherwise would be passed over by telecasters.

The program problem

So far, we have discussed getting satisfactory television signals to large and small cities, urban and rural areas, near and remote locations, alike. But what about the programs such signals will carry? *After all, it's the show that counts.*

Television productions *are* relatively costly. Live-talent studio presentations, to be worthy of a real audience, call for skilled performers, writers, directors and scenery artists in front of the camera, and for cameramen, control-room operators, microphone-boom, dolly and lighting attendants, and others behind it. Television shows call for actors who can memorize their lines. Obviously,

(Continued on page 136)


A movie machine designed to project images which are picked up by a television camera.

COVER FEATURE:

Filters Aid Television

Transparent films improve contrast of television images in lighted rooms

By Dr. THOMAS T. GOLDSMITH, Jr.*

A SHEET of semitransparent material placed in front of a television cathode-ray tube improves the viewing conditions for the picture under many circumstances. Such a sheet of material is frequently called a *neutral-density filter*. This filter may take, for example, the form of a thin sheet of plastic in which a pigment material has been added to give the effect of smoked glass. The amount of pigment determines the density of such a screen and thus controls the amount of light which can be transmitted through it.

If the receiver is in a well-lighted room, the presence of the filter may definitely enhance the contrast range of the picture. In other words, the dark portions of the picture appear darker when the filter is used than they would if the filter were removed and the room illumination were allowed to fall directly on the screen. The filter absorbs much of this room light and prevents its striking the screen with full intensity. Accordingly, the light coming from the cathode-ray tube reaches the eye of the observer under more nearly the conditions which would occur in a darkened room.

Let us now define that light which comes from the cathode-ray tube fluorescence as the *television* light. Then we can define the surrounding room illumination as *ambient* light. Thus we have *television* light and *ambient* light to consider. In a completely darkened room, only the television light is of consequence and a picture will appear to have good contrast range. However, it is not desirable to use a television receiver in a fully darkened room because under dark-room conditions the human eye tends to change its iris opening quickly in accordance with the light changes in the television picture. This causes considerable eye fatigue. In a reasonably lighted room the eye remains partially stopped-down because of the presence of ambient light, and the picture can still be seen to good advantage with the brightness available from modern cathode-ray tubes.

A picture from a direct-viewing television receiver is quite acceptable in a reasonably lighted room even without a neutral filter. However, in some cases, the location of lamps in a room causes light to fall directly on the face of the cathode-ray tube from the lamps or by reflection from walls or furniture. Under these conditions, the neutral filter improves the appearance of the picture. The ambient light passes through the filter and strikes the fluorescent surface of the cathode-ray tube. The light is then scattered from the white fluorescent screen and returns through the neutral filter to the eye of the observer. Thus the ambient light has passed twice through the neutral filter and is considerably weakened. On the other hand, the television light starts at the fluorescent screen and passes *only once* through the neutral filter. In this way the picture appears crisper and with more contrast between blacks and whites than would be the case without the filter.

The absolute brightness of the television picture is reduced by the presence of the filter, but improved contrast obtained by partial exclusion of ambient light more than offsets this loss of brightness.

A filter having the characteristic of transmitting approximately 10% of the light which falls on it is quite suitable for television performance. Under some conditions, a less dense filter which (for example) passes 30% of the light may be used. Usually it is preferable to employ in a neutral filter a pigment which has a colorless grey appearance and which uniformly attenuates light of all colors. In this way the actual color of the fluorescent screen is not materially changed. Some people prefer a slight tint for the filter, to give the picture a soft green, soft blue, or soft rose effect. We might say that the viewer is looking at television through "rose-colored glasses."

Neutral filters have been used widely in the optical industry for many years. They were discussed very intensively in connection with color television, and have been used quite successfully for enhancement of black-and-white television outdoor installations. The pictures have considerably improved contrast when viewed in sunlight. It is desirable for the filter to have sufficient mechanical strength to withstand wind and weather. It may be incorporated directly in the glass as a pigment or may be attached permanently to the glass surface either inside of the tube or on its outside surface. However, under some conditions it is desirable to make such a filter optional, and then a detachable separate sheet of filter material is found to be more desirable.

A cathode-ray television tube generally appears white in the presence of room illumination even before the video signal produces further light. The neutral filter in effect allows the screen to appear more nearly black. The fluorescent light increases the whiteness to produce highly contrasting pictures. Thus we can say that a black-face cathode-ray tube would be the most ideal reproducer. The neutral filter approaches this condition and is thus a useful aid for television reception which may well come into general use.

THIS MONTH'S COVER

This month's cover was one of the most difficult subjects we have tackled in many years. It is of the type called an INFINITE picture, one picture within another AD INFINITUM.

Here we see Powers' model Dorothy Sparkman, holding the largest commercially made television tube, which measures 20 inches in diameter. Her right hand holds the smallest practical television tube, which measures 3 inches in diameter. The identical picture appears on both the small and the large tubes.

To show the visual effect of the various colored filters, as explained in Dr. Goldsmith's adjoining article, a hand was posed in front of the large television tube with 4 different colored filters. The colors used would depend to some extent on the tastes of the viewer and the predominant tone of room decorations.

It should be understood distinctly that no attempt is made here to show color television, which so far has not been achieved commercially. To understand better how the colored filters work, the adjoining article should be read.

How was this cover made? Perhaps you can puzzle it out for yourself. It is believed that this is the first time a cover of this type was made for a technical publication.

—H. GERNSBACK

*Director of Research, Allen B. Du Mont Laboratories, Inc.

TELEVISION EQUIPMENT

Fig. 1 (left) — Du Mont Image Orthicon Control and Monitor used to compensate for differences in scene brightness. Fig. 2 (below) — RCA Visual Monitor Converter.

Fig. 3 — "Big Dishes" for microwave television relay. Devised by General Electric Co. engineers for reflecting television signals between relay stations.

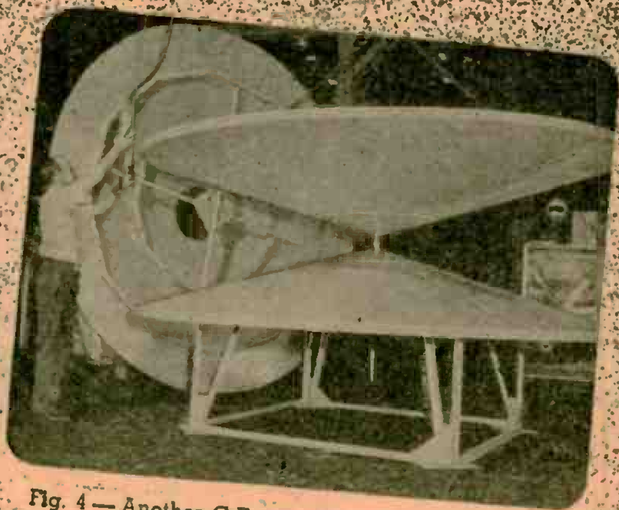


Fig. 4 — Another G.E. television idea — the "chicken brooder" antenna for picking up programs from mobile units. 16 times better than simple dipole.

Fig. 5 — A streamlined 56 lb. television camera devised by General Electric suitable for studio or outdoor pickup. Has 3 lenses and mobile dolly.

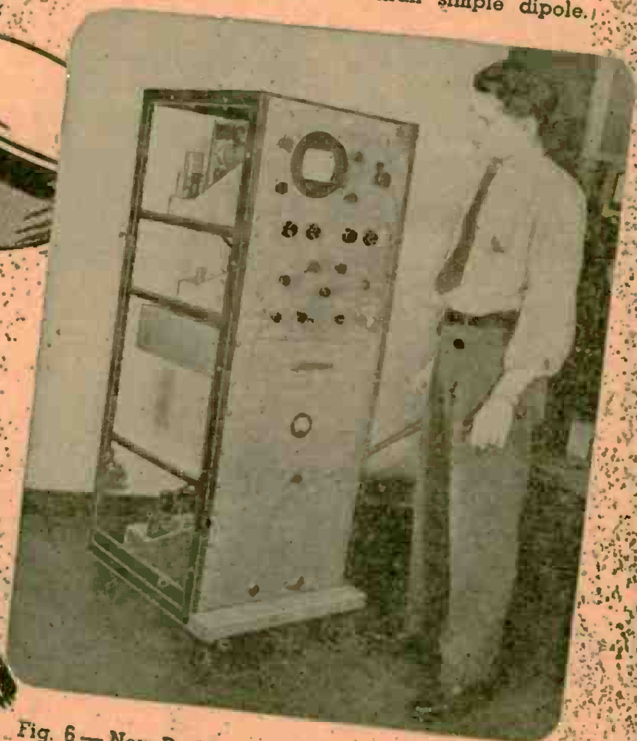


Fig. 6 — New Du Mont oscillograph facilitates television wave form studies. Analyzes image down to a line and shows duration and wave shape.

TELEVISION EQUIPMENT

(continued)

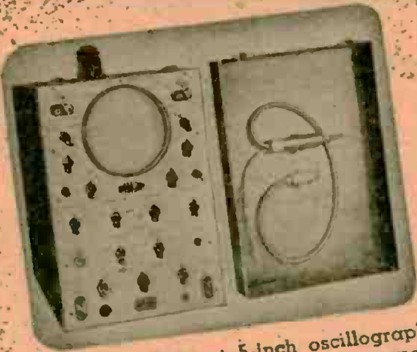


Fig. 7—DuMont 5-inch oscillograph for observing audio and video frequency signals, including pulses and square waves.

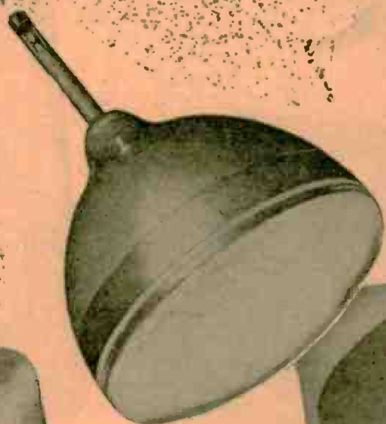


Fig. 10—Large 20-inch DuMont television tube with magnetic deflection and focus. Face curvature radius 30 inches. Picture area 12⅞ by 17¼ inches. For large screen, direct-viewing telesets.

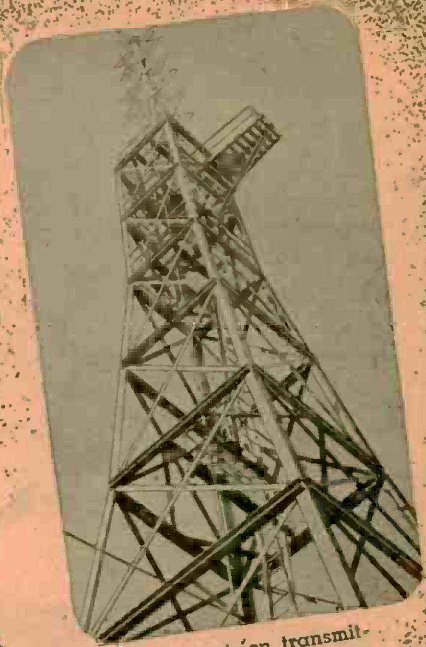


Fig. 11—Television transmitting antenna of DuMont station WABD, in New York City.

Fig. 8—Studio control console at DuMont television station WABD in New York Wanamaker store.

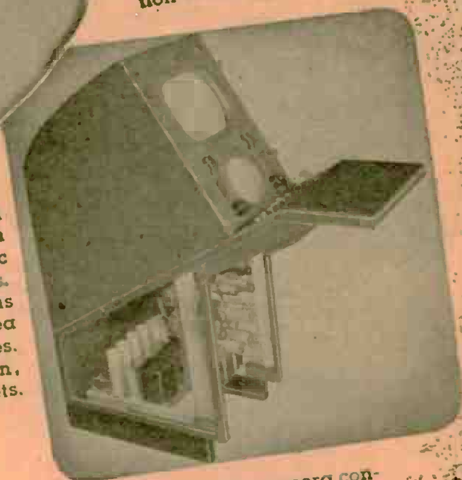


Fig. 12—RCA studio camera control—permits operator to monitor quality of picture signal.

Fig. 9—RCA mobile television truck, equipped with reflector for relaying signals to pickup station.

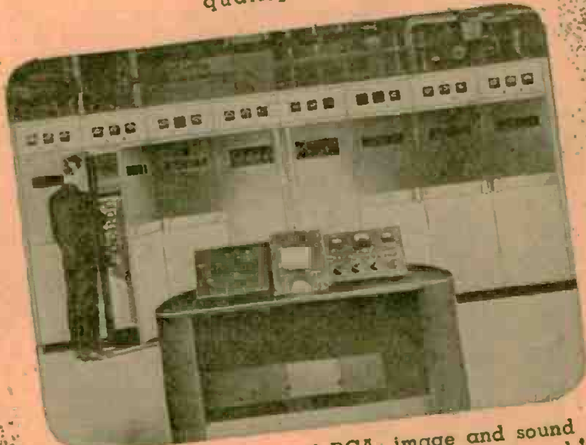


Fig. 13—5 kw 12-channel RCA image and sound television transmitter. Control desk in foreground.

TELEVISION IS HERE— WHAT NOW?

By LOUIS GERARD PACENT

IN MARCH, 1931, I wrote in an article for Hugo Gernsback's *Television News*, Volume 1, Number 1, that television was *not* just around the corner, in contradiction to the opinion of many in the industry, and the then enthusiastic publicity. History speaks for itself; there is no need to comment further on that article.

Now 16 years later, thanks to accelerated war radar research, television is really here, but *what now?*

While it is true that many are buying television sets, and most restaurants and bars in television centers like New York and Philadelphia provide television for their patrons, something must be done to put television on a proper foundation before the general public will buy for home use.

The chief difficulty in the way of making television a mass means of entertainment is the *cost* of television receivers. When a televiser made to sell at $400 or so is called a "cheap" model, and average receivers sell at $1,000 to $2,500, there is no reasonable hope that a majority of medium-income families will install one in the near future. The price of receivers *must come down* if the number of television homes is to go up at the tempo it should.

The cost of cathode-ray tubes for replacement should be considered, too. When the owner of a televiser finds he has to pay from $50 to $150 or more for a new viewing tube, his enthusiasm for television may get a bad blow.

The present small-screen models cannot fill the need for low-priced television entertainment. The more television I see, the more I am convinced that *entertainment begins with the large screen.* Despite the improvements in brightness achieved on small-screen sets, a greater amount of concentration is necessary to view a program than on large-screen receivers. Entertainment requires relaxation—a chance to lean back and watch the show, not lean forward and concentrate on the screen. (With the present size of television audiences, there is a second point in favor of the large screen. It relieves the spectator of the necessity of craning his neck to watch the program over the shoulder of some other member of the group.) *The future of television is tied up with the large-screen receiver.*

A program for television

Unless the following is done without delay, television will not be, in my judgment, on an equal footing with sound broadcasting:

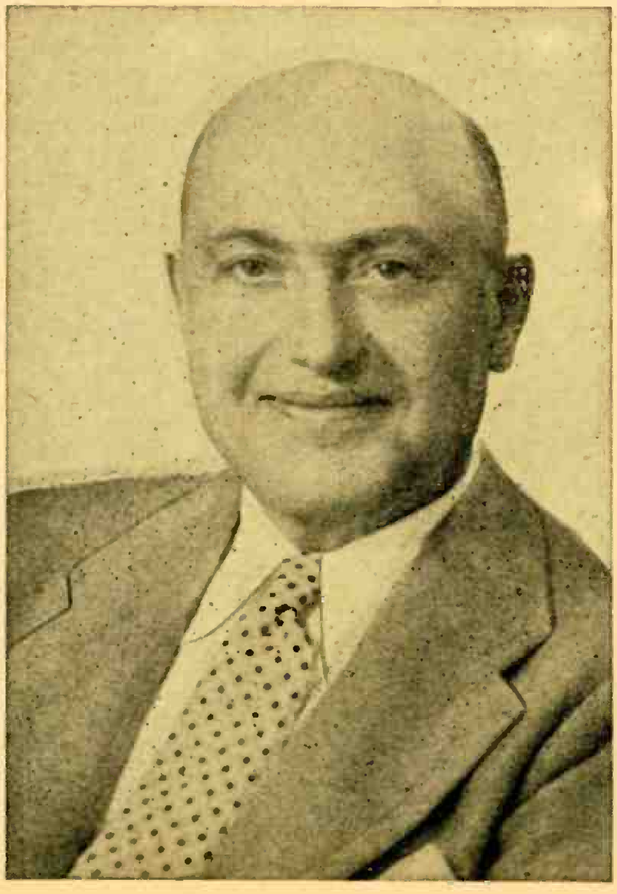
1. Group all the television transmitters of a given locality on *one tower* high enough to serve an area 90 miles in radius.
2. *Increase the output power* to 50 or 100 kilowatts.
3. Design a *master television receiving set antenna* for apartment-house installations.
4. *Lower the cost* of television receivers.
5. *Increase the size* of the television screen to 18 x 24 inches at reasonable prices.
6. Design *compact projection-type receivers* with simple inexpensive television tubes and optical systems.
7. *Lower the replacement cost* of television tubes.
8. *Improve programs.*

To some, these suggestions may sound impossible of realization for many years, but they are in the cards. With concerted action by the industry they can be made a reality in time to save this gigantic business, destined to grow into one of the biggest of the new postwar industries, from a serious temporary downfall toward which it will surely head otherwise. Engineering thinking, without too much promotion, will be needed before we have the service and the product at a price the public expects and demands.

The great number of engineers, scientists, and technicians who are out of the government services, and who are now devoting their knowledge to electronics and particularly to radar and television problems, can and will help greatly to solve the problems facing the television industry.

LOUIS GERARD PACENT

Mr. Pacent is one of the earliest pioneers of electrical and radio communication. Since 1910 he has been actively engaged in the radio and electronic engineering fields and was one of the pioneer radio manufacturers, a designer of the all-powered sound motion picture equipment and the holder of many patents on electronic devices.



Mr. Pacent is a Fellow of the American Institute of Electrical Engineers; Fellow of the Institute of Radio Engineers; Fellow of the Society of Motion Picture Engineers; Fellow and Past President of the Radio Club of America; Member of the Acoustical Club of America; Member of the Board of Examiners and Committee on Communication of the A.I.E.E. and the recipient of the I.R.E. Engineering Key. He was also awarded the War Department Certificate of Appreciation in recognition of his engineering services to the United States Signal Corps.

Portrait of Jenkins during his active period.

C. Francis Jenkins--Television Adventurer

By GEORGE H. CLARK
Radio Historian

CHARLES FRANCIS JENKINS (1867-1934) of Washington, D. C., was one of radio's most colorful personages, and in his chosen realm of "seeing via the ether" America's best known, most loved pioneer. He was indefatigable in his efforts to create a new art and novel means of serving it, and his personal interest in those with whom he worked, whether in the laboratory or via the web of wireless, was so vital that he made friends everywhere, from the amateurs who listened and looked in to the higher officers of Washington's officialdom.

When Bell brought out the telephone in 1876, the idea of voice-over-wires was followed up by a flood of ideas for sight-over-wires. Strangely enough, these were in general very similar to some of the earlier television principles that followed later. Jenkins was an avid reader of books and magazines of a technical nature, even as a lad, and perhaps some of these primitive plans were noted by him and stored away in his mind.

He came to Washington as a Civil Service employee, and was appointed clerk to the head of the U. S. Life Saving Service, now the U. S. Coast Guard. Passing over the "Government slave" phase of his life, his entry into the world of engineering and of invention was by way of the motion picture field. In 1895 he created and built a moving picture machine, and exhibited it that same year before the Franklin Institute. They thought so highly of it that three years later he was awarded the Elliott Cresson Gold Medal of the Institute, the citation terming this "Phantoscope" "the first successful form of projecting machine for the production of life-size moving pictures from a narrow strip of film containing successive phases of motion." The original device is now in the National Museum, Washington. His interest in the flickering images was so great that he founded the Society of Motion Picture Engineers in 1916 and was its first president. The Society is now international in scope.

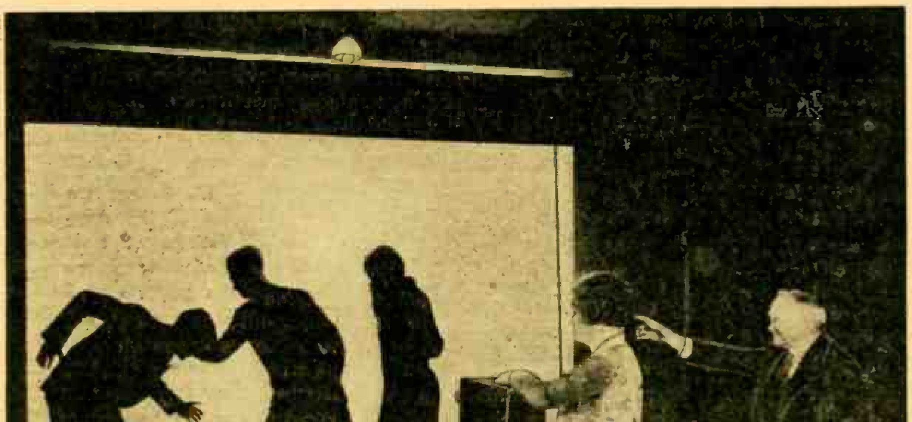
Yet even while he was polishing up his projector for its display in Philadelphia, its use in wireless communication was already in his mind. In 1894 he wrote an article for the July 25th issue of *Electrical Engineer* on the subject of transmitting pictures by wire. The later transfer to the field of radio was inevitable, by the law of genetic descent.

In 1921 he set up a small research laboratory in Washington, surrounded himself by a picked force of young and extremely enthusiastic helpers, and plunged with his characteristic dynamic energy into the investigation and practical construction of transmitting and receiving apparatus.

At that time, Nipkow's disc scanner was universally used for picking out one element of a picture at a time at the sending end and for synchronous reconversion at the receiving end. That device Jenkins adopted. His first task was to teach himself the simple mysteries of scanning, and then the more difficult techniques of making a record. But his mind was far ahead of this work, and even in those elementary days he predicted home movies by radio, prophesying that an "entire opera may some day be shown in the house without hindrance of muddy roads." (Apparently he did not believe that the art of road-building would go ahead as fast as radio and television!)

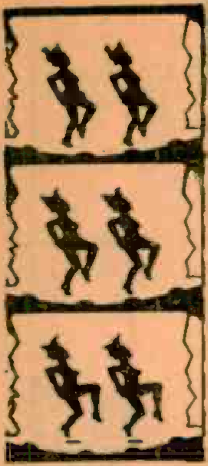
He then began specific invention, his first venture being the transmission of still pictures by wireless and their reproduction in recognizable form on paper or other medium at a distant point. This, of course, was facsimile radio, or photoradio. His first demonstration on December 12, 1922, was before officials of the U. S. Navy, including Admirals S. S. Robison and H. J. Ziegemeier, Captain J. T. Tompkins, Commander S. C. Hooper, and Lieut. Commanders E. H. Loftin and H. P. LeClair. A report of this demonstration was printed in the *Washington Star* of January 14, 1923.

By 1924 Jenkins had greatly improved his technique, particularly by means of his prismatic ring scanner, which, unlike the scanning disc, provided a receiver picture without lines or dots appearing in it, i.e., of photographic



Underwood & Underwood, Washington, D. C.

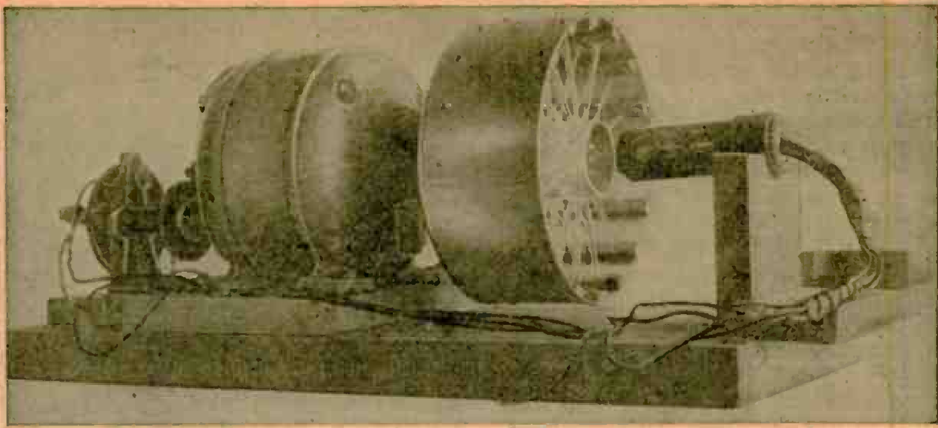
Jenkins invented a new method of photographing silhouettes for early television broadcasts.



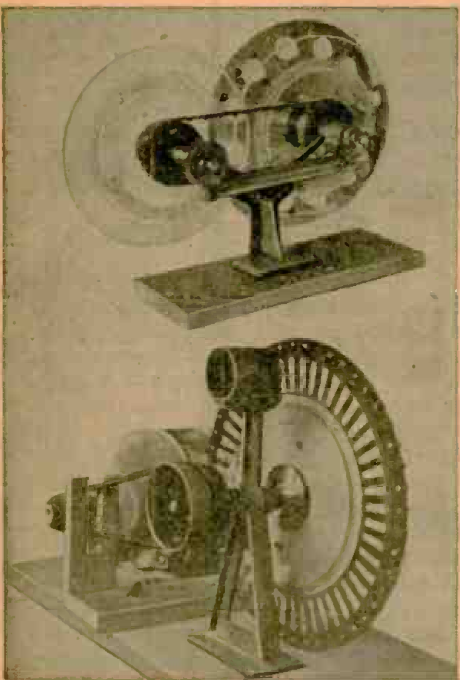
Movie film used in Jenkins' broadcasts.

value. On June 15, 1924, Jenkins made his first 100-line radio photograph, one of the first subjects being a photograph of Président Coolidge.

1924 was a telephoto year, for not only was the work described above going on, but the A. T. & T. Co. had stepped into the picture, sending electrical pictures via wire from Cleveland to New York on May 20.



The Jenkins-de Forest drum scanner was the most highly refined television receiver to use mechanical scanning principles. It had four spirals of holes and a multiple neon lamp, light from which was "piped" to the holes in the drum through quartz rods to avoid loss.



The upper scanner employs the prismatic ring.

Radio movies at last!

In the following year, Jenkins graduated to radio-movies, even if they were only silhouettes. His first laboratory demonstration of *radio-vision*, a term which he had coined for "the transfer of pictures via the ether," had been on June 14, 1923. Now, in 1925, he was ready to proceed on a broader scale. On March 31, movies by radio were sent from a standard moving picture machine to a small screen on a distant radio receiver. This was a room-to-room experiment; but early in the week of June 3, 1925, he decided that a public demonstration was in order. The transmitting on this occasion was done by courtesy of the U. S. Navy from its Naval Laboratory station NOF, at Anacostia, with the receiver in the Jenkins Laboratories.

Present were George M. Burgess, director of the Bureau of Standards; Secretary of the Navy Curtis D. Wilbur; Admiral S. S. Robison; Captain S. C. Hooper, U.S.N.; Judge S. B. Davis, Department of Commerce; and W. D. Terrill, Radio Division, Department of Commerce. Incidentally, although it does not appear in the records of the day, the fine Italian hand of Captain Hooper (now Rear Admiral, U.S.N., Ret.) functioned invisibly in all these tests, for it was he, as the Navy's chief protagonist of matters radio, who organized and approved this test.

What did they see? Not much. A small rotating fan, imitating a Dutch windmill, started, stopped, reversed, as air was blown on it from an unseen source. Finally, a chief petty officer at NOF, by direction of Admiral Robison, stood before the television transmitter and wigwagged a message to his superiors standing before the radiovisor in the Jenkins' laboratory. (Captain Hooper, at least, was able to read the message!) Said Mr. Jenkins of this demonstration, "Congratulations were in order, but they seemed to be given in a rather awed manner, as the unfathomable possibilities of this new extension of human vision came to be more and more realized."

Mr. Jenkins further commented, "This first public demonstration of June, 1925, was duly heralded in the press. But there was no spontaneous response from the public until the A. T. & T. sent pictures of living persons from Washington to New York over their wires. No wires were available to me, so I have used wireless." (As if he hadn't intended to use wireless from the very beginning!)

An amateur scans amateurs

As yet, Jenkins had made no effort to interest the public, or at least the amateurs (who were the radio public of that day), in "home reception." That was probably because there was no appreciation of the possible monetary benefit that might ensue; sales of sets to the Navy had a much more immediate enticement.

But Jenkins was a youngster at heart, and still younger youngsters worked under him, so in time he decided to install a broadcast transmitter for radio-movies (plus announcements) on the amateur band. Station 3XK (later W3XK) was approved by the FRC, and four channels were assigned—to over-

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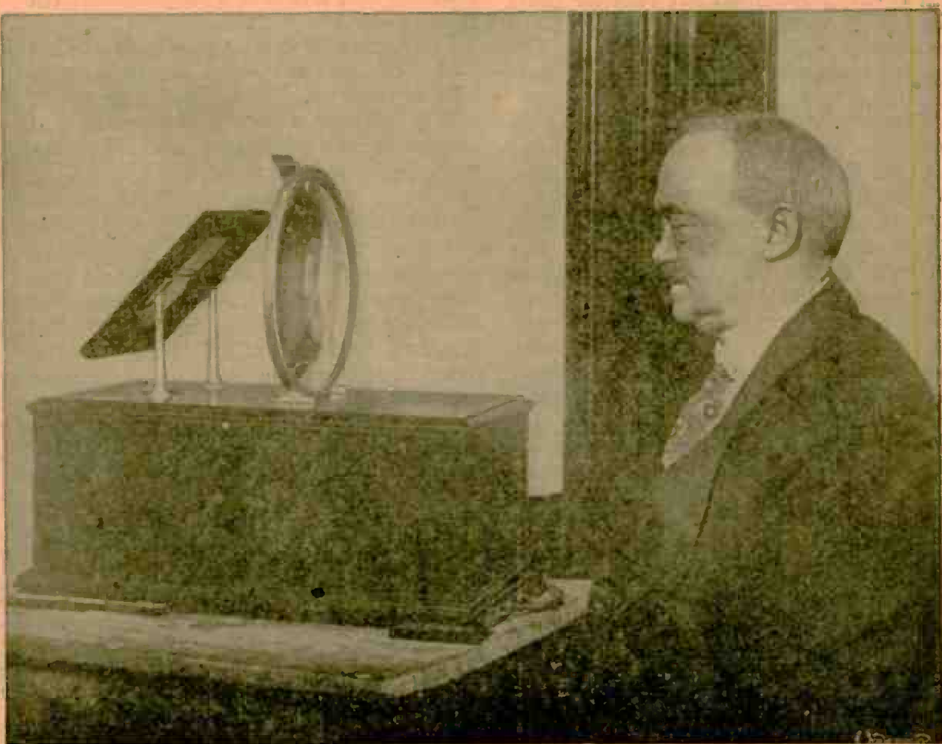


The drum receiver was considered at the time to be a great advance in the art of television.

come skip distance on the short waves used. The first Jenkins radio movie, or radio silhouette, was broadcast on July 2, 1928. During the "talk" part, amateurs were asked to write and give their opinion of the broadcast and tell how it was received, and those who "heard" only were urged to equip their short-wave code receivers with Jenkins picture attachments (discs, motor, light, etc.). Many of them did so, but it was rather difficult for them to lay out, and construct their own spiral discs, although Jenkins gave them full instructions both via broadcasts and by mail on request. So after a short time he manufactured an inexpensive picture attachment and sold it at less than cost. This consisted of a neon lamp, disc, and synchronizer, to be mounted on a synchronous motor.

At first, and for a long time, only silhouettes were broadcast. These seemed perfectly acceptable to the amateurs, most of whom were "kids" either actually or at heart. To produce these silhouettes, Jenkins set up a studio of his own, unique in the movie art, where silhouette movie films could be made as cheaply as ordinary movie films. The stars were recruited from his laboratory staff, except those parts taken by children. Among the latter was little Jane Marie, who came to be known all over the continent as "the little girl bouncing the ball." The studio director was Miss Florence Anthony, (later married to the late George Clark, then a prominent business man of Washington).

Another silhouette well received by the "lookers-in" was "The Old Dutch Girl" of the cleanser ad. A large picture of the Dutch Cleanser can was also televised, showing an early appreciation of commercials. "Possibly," wrote Jenkins in a memo, "we can put in silhouette the little fat boys of Campbell's Soup." Other silhouettes were "The Washwoman," "The Crook," the little girl skipping a rope and then putting it away and turning somersaults, another little girl, Miss Constance, who must have been very clean for every night she washed her doll's clothes and hung them on a line to dry "in a drying breeze," as Jenkins termed it. Then, last but by no means least, was Jacqueline, who did athletic dances with Master Fremont. (I wonder who's tripping her now?)

"Our audience," said Jenkins later, "in those primitive days of 1928 was between 18,000 and 20,000." Letters ranging from Malden, Mass., ("got your picture through the entire transmission despite local severe lightning") to Cedar Rapids, Ia. ("have received every one of your broadcasts"), and even further, south and west, told the story of Jenkins and his unpaid amateur laboratorians. These young home-scientists cared most for the technical pleasure of looking and recognizing, just as later in voice-broadcast days they cared only to receive and log the voice reception, however inane the content. (QST, please note!)

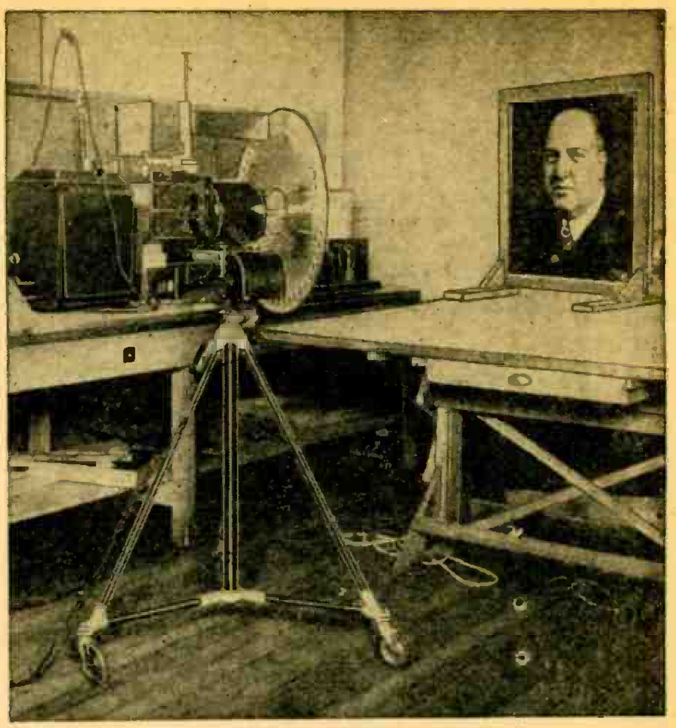
All these transmissions of line pictures were on the amateur wave of 46 meters. "Silhouettes only were sent," said Jenkins, "so that the picture frequency band could be kept within the legal limit, 10 kc. Later, a band 100 kc wide—4,900 to 5,000 kc—was assigned to us by the FRC so that we could broadcast half-tone movies."

Crude though this early television was, it made its impression as a possible growing art. For example, the *New York Tribune* of June 16, 1925, viewed with alarm as follows:

> Before lending any further aid to Jenkins, the Government should consider its (television's—*G.H.C.)* effect on posterity. It means stagnation to transportation industries when it becomes unnecessary to go anywhere to see anything. In fact, it is in a way a scientific accomplishment of the notion of Mahomet that the mountain should come to him . . .

Opinions differed, as note this quote from *The Grid* de Forest house organ, 1929:

> The success of the Jenkins Washington station for television attracted the attention of financiers, and a financier of New York and Palm Beach undertook the merchandising, under the corporate title of the "Jenkins Television Corporation" of the devices developed by the Jenkins Laboratories.



Jenkins' improved lens-type Nipkow scanner, set up to scan photo of W. T. Barkley, who was then vice-president of the de Forest Radio Co.

The new control was in the hands of the de Forest Company, of which the Jenkins Television Corporation (of New Jersey) was a subsidiary. On September 27, 1929, the de Forest directors had authorized the purchase of the television company's stock, at the rate of 1 share de Forest common for 1¾ shares of Jenkins. Mr. Jenkins retained his control of the Jenkins Laboratories in Washington, and was vice-president till 1930, when he resigned.

The resignation was partly due to his poor health at the time, partly because he was not "in the saddle" any more, partly because those in the saddle did not cooperate with him and felt they were possessors of a white elephant.

Drum replaces scanner

Before describing the career of the new company in New Jersey, let us consider some of the major developments made by Mr. Jenkins while he was still his own boss. Chief of these are the drum receiver, the plate transmitter and receiver, and the prismatic ring.

The drum receiver was a refinement of the disc scanner, and removed many defects inherent in the latter. In the place of a huge rotating disc with helical holes, he substituted a drum, 6 inches in diameter, the circumferential band of which was pierced with 4 rows of holes, each row being arranged helically. All in all, there were 48 scanning apertures. Inside the drum was a neon light system, not with 1 glow-plate, but with 4 arranged end to end and connected to a commutator so that each plate or "target" was lighted in unison with the rotation of one row of holes on the drum. This complicated structure made it possible to have each target much more brightly illuminated—since lighted only for a short time—than if a single target were lighted continuously.

To conserve the light—which was placed some distance from the periphery of the drum, and not directly adjacent to the rotating element as in the case of the disc—quartz rods acted as "pipes" to carry the light directly outward without scattering. A drum 7 inches in diameter with 6 helical turns gave a 3-inch picture, twice the area of any picture available with a 36-inch disc, and much brighter. "The drum receiver with quartz rods," said Jenkins in the *Journal of the Society of Motion Picture Engineers* in 1930, "is the best television receiver known. It makes bigger and brighter pictures with simpler mechanism and less amplification than any other form. How long it will remain the best form of receiver no one knows, for thousands of engineers, my own included, are feverishly at work on the problem." Those were prophetic words! "His own engineers" did not succeed, nor did the much better trained de Forest engineers, in making a receiver that would be acceptable in commercial television. It remained for the electron to solve the problem, much as perhaps in the near future the atom may dissolve it!

There is this to be said: that the drum receiver was a product of elegance and—within its limitations—of efficiency. That it was not commercially practical can be ascribed partly to the fact that its inventor was not a particularly commercial-minded person.

Beginning of the end

One of the engineers working "feverishly" on the problem was C. E. Huff-

(Continued on page 120)

Television Steps Out!

The new art is repeating the history of broadcasting on a grander scale

By WILL BALTIN*

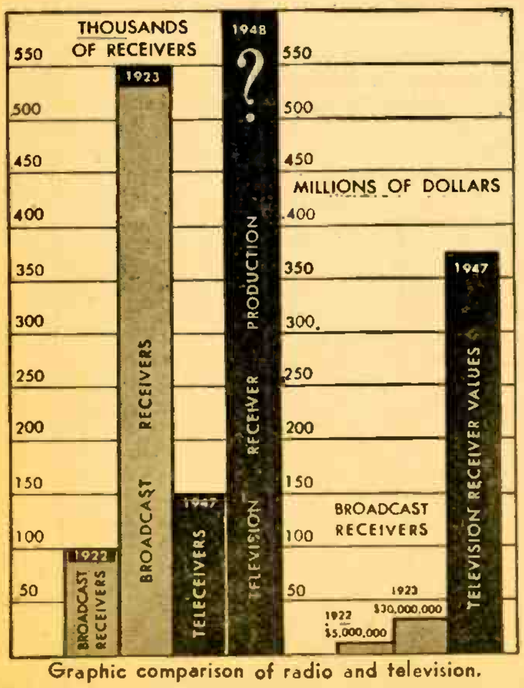
TELEVISION'S tremendous potential, which has been pent up for so many years, will burst forth across the United States this year with force that will rock the inertia and indifference out of a lot of people. Television talk has been bantered about for so long that it is little wonder that millions of Americans living in the vast hinterlands, who have yet to see a television image sweep across the face of a cathode-ray tube, still accept this new art with the proverbial grain of salt.

Twenty-six years ago when radio broadcasting began to enlist adherents through the magic of a cat's whisker, a crystal, and a pair of headphones, a skeptical public was equally disbelieving. Only after the doubter got a "dose of listening" did he fully realize that a new wonder had been achieved for him to own and enjoy.

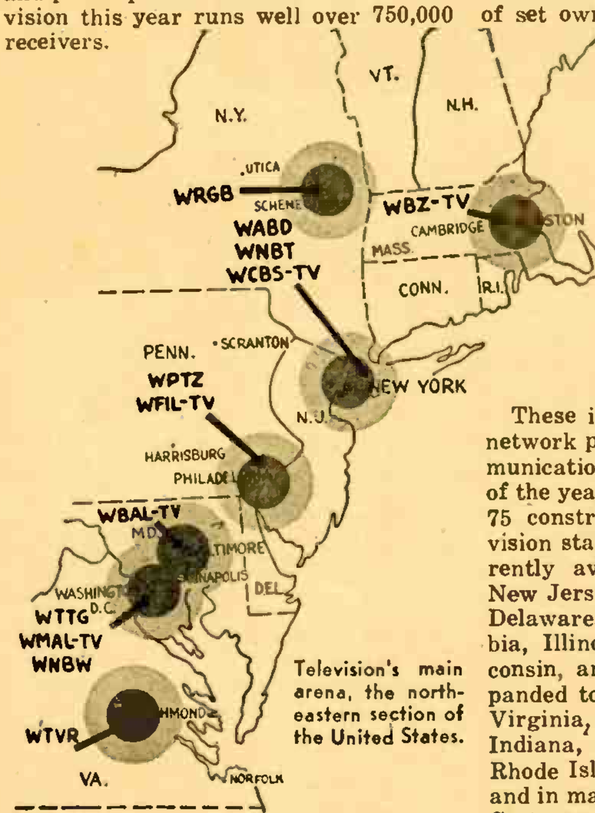
Television is finally breaking out of its shell and is now on its way to becoming a principal service. With nearly 150,000 television receivers in the hands of the public as 1947 faded into oblivion, television had at long last ceased to be an experimenter's delight. It is now a commercial product with enormous untapped possibilities.

A recent survey made by the Television Broadcasters Association, Inc., indicated that in 1922, radio's first big year, there were 100,000 radio receivers in use in the United States. In 1947, a comparable year for television, 150,000 television sets were in use. In 1923 there were about 550,000 radio sets in homes and public places. The estimate for television this year runs well over 750,000 receivers.

*Executive Secretary-Treasurer, Television Broadcasters Association, Inc.



Graphic comparison of radio and television.



Television's main arena, the northeastern section of the United States.

In dollar volume, the comparison between radio yesteryear and television today lifts the eyebrow high on the dome. For example: the dollar volume in radio receivers at retail levels in 1922 approximated $5,000,000. The dollar volume in television at the same levels last year amounted to a staggering $74,000,000! In 1923 radio's dollar volume totaled $30,000,000. In television, the estimate for this year exceeds $387,000,000!

Hence, the strides made by television to date are already far ahead, comparatively, of radio, presaging a popular future for this newest of twentieth-century miracles.

Television brings into the home a veritable potpourri of entertainment, information, culture, and education. Ask any man who owns a television set. The effect of televiewing on the present army of set owners parallels—and surpasses—the enthusiasm of the early radiophone dxers.

The mere fact that television receivers will be abundantly available this year does not tell the whole story of the impending expansion. Unless television stations are operating, the market for receivers is negligible. No one knows this better than television industry leaders—and there are several factors at work to ensure their operation.

These include new station operators, network planners, and the Federal Communications Commission. At the close of the year, the FCC had granted nearly 75 construction permits for new television stations in 25 states. Service currently available in New York State, New Jersey, Connecticut, Pennsylvania, Delaware, Maryland, District of Columbia, Illinois, Michigan, Missouri, Wisconsin, and California soon will be expanded to include Massachusetts, Ohio, Virginia, Florida, Texas, Louisiana, Indiana, New Mexico, Oregon, Utah, Rhode Island, the State of Washington, and in many other sections of the United States.

It is estimated that between 35 and 40 television stations will be operating in at least 18 states by the end of 1948 and that an additional 35 will be in full operation within the following year. Not

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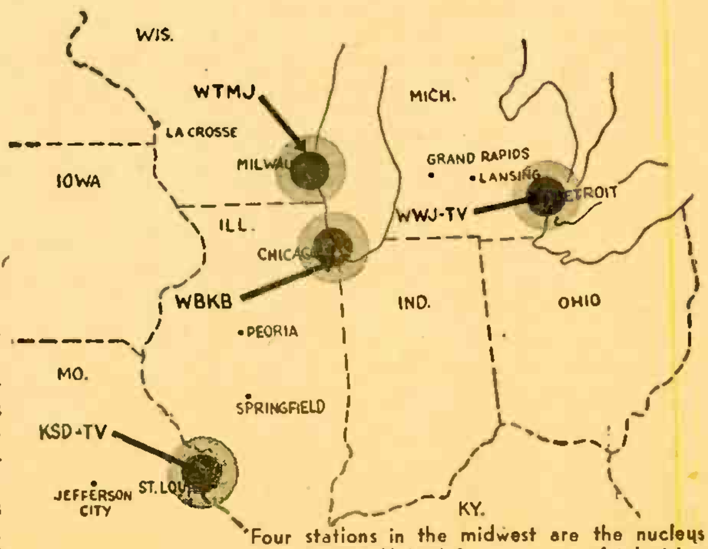
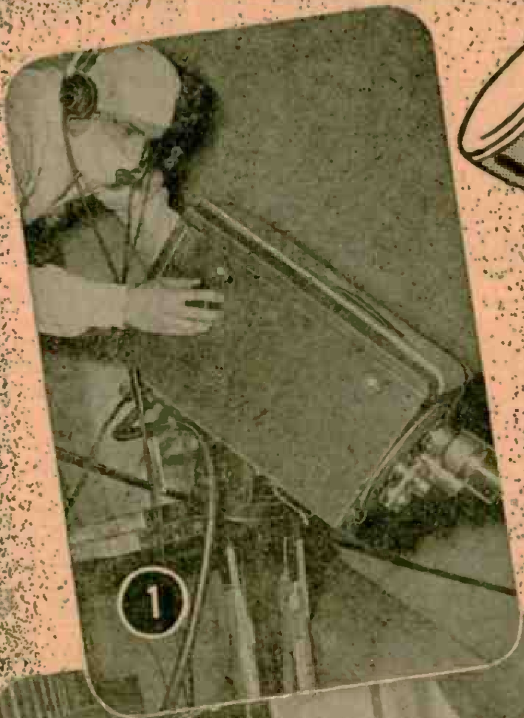
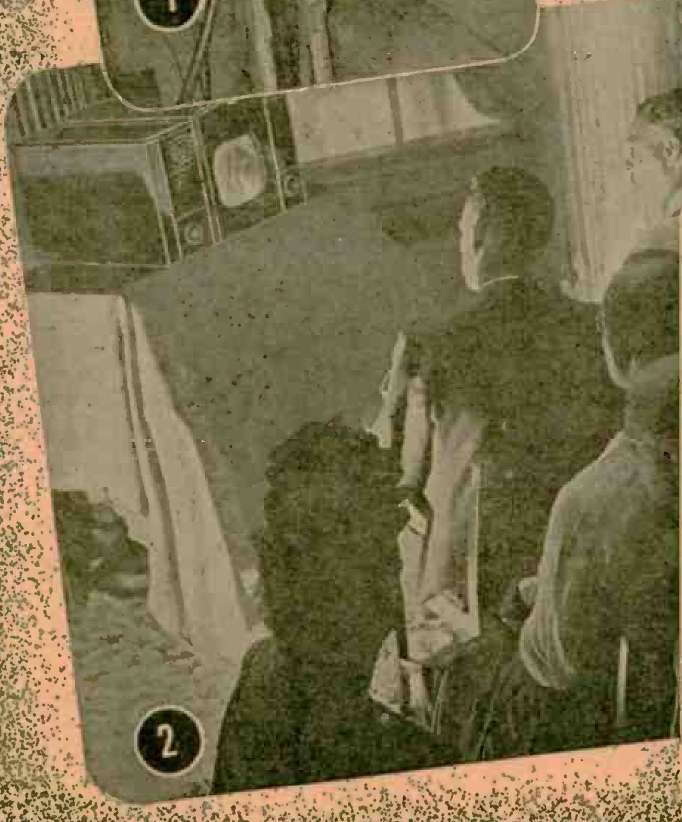


Four stations in the midwest are the nucleus of a Central United States group of television stations which will be increased very soon.

TELEVISION *as a* USEFUL ART





Television may become more important in our daily life than as an entertainment medium. In education, medicine, business and heavy industry experiments already made point the way to important advances in the near future. Hundreds of students can view an operation, goods can be shown to housewives in a dozen cities, dangerous industrial processes be viewed safely on the television tube's screen.

Fig. 1 shows an RCA Image Orthicon camera set up in the balcony of Johns Hopkins hospital to televise a "blue baby" operation. The camera is equipped with 4 turret-mounted lenses. Images from this camera, and one mounted directly above the operating table, were relayed by co-axial cable to 10 RCA-Victor television receivers distributed on 3 floors of the hospital, to permit over 300 surgeons to view the operation clearly. Fig. 3 shows the Orthicon camera mounted over operating table. Fig. 2 shows surgeons watching an operation televised in New York City; the receivers were located several blocks from the hospital.

Fig. 4—WABD's (New York) cameras give students in New York and Washington (WTTG) a close-up of a radioactive specimen in the hands of Dr. Clark. The Telecast was carried to Washington by coaxial cable.

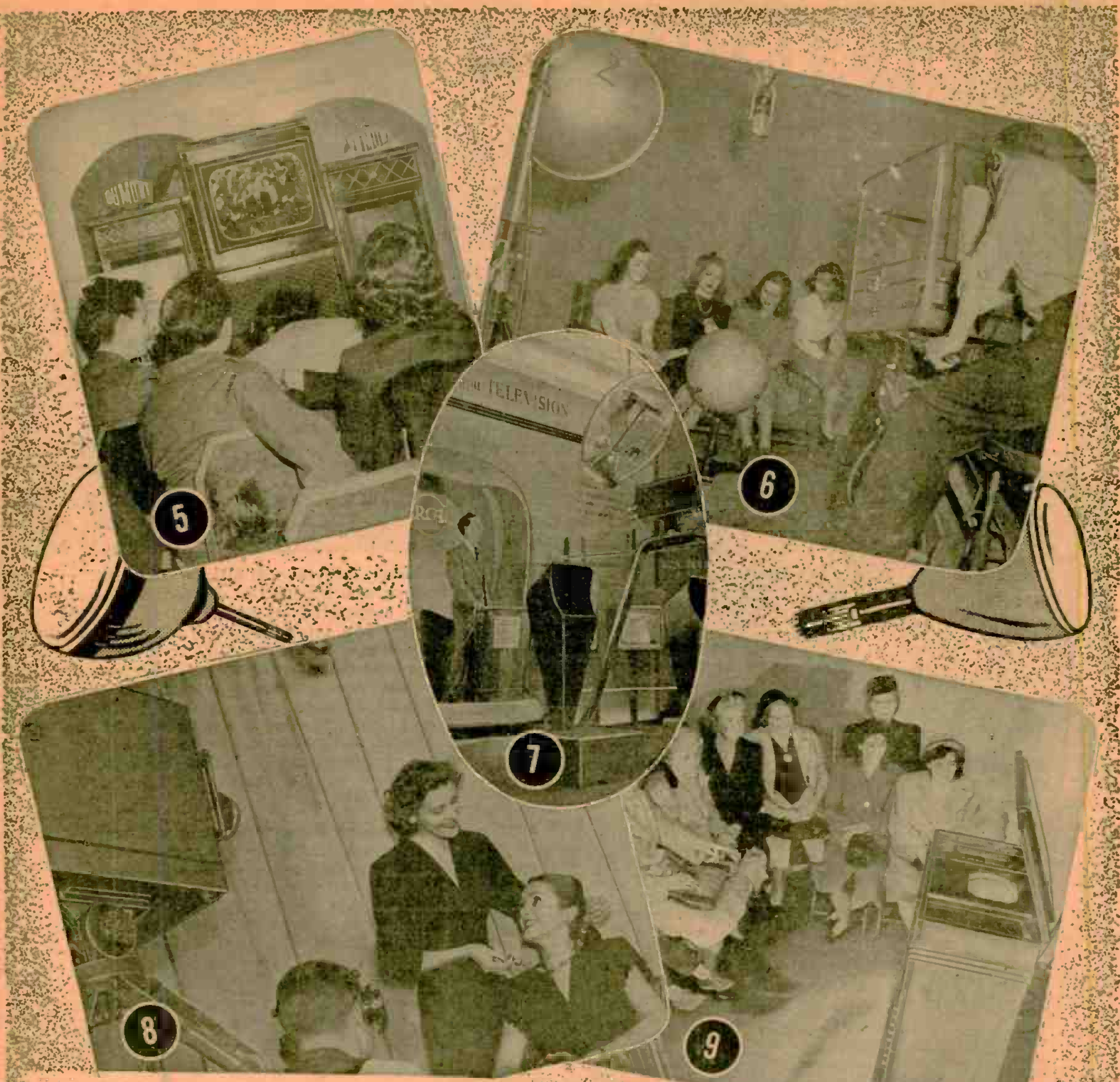


Fig. 5 shows a group of students attending the remote radioactivity lecture by television receiver, using the Du Mont system. The future possibilities in the telecasting of lectures and demonstrations are limitless, and students all over the country will be able to hear and see scientific lectures and demonstrations by famous people. Fig. 6 shows a class in geography being telecast in the studios of WRGB (General Electric Co.) Schenectady.

Fig. 7 illustrates television exhibit at the RCA Building in New York City, where the latest cameras and receivers are shown to the public.

Figs. 8 and 9 show the application of television to large stores (Gimbels store in Philadelphia), using RCA equipment. Sales possibilities with television are legion ... merchandise of various kinds can be displayed in every department of a large store, and the power of the television screen to eventually introduce new products right into the home is almost unimaginable.

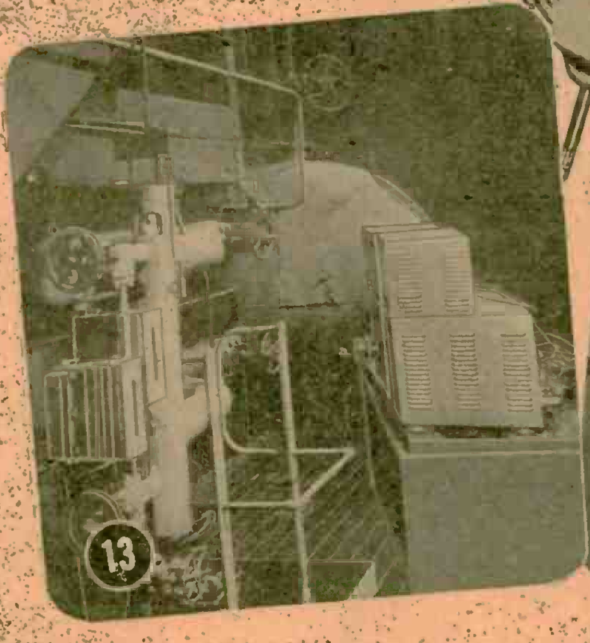
Fig. 10 shows another new use for television — identifying signatures on checks. The teller can flash a check on the screen in the bookkeepers' department for verification — a system actually in use in the Franklin Square National Bank, Long Island, N. Y.

TELEVISION *as a* USEFUL ART

(continued)

Undersea Television at Bikini—The television camera was mounted in a water-proof steel shell suspended on cables as shown (12) above. The television equipment was installed aboard the U.S.S. Coucal, during a scientific resurvey of the area where two atomic bombs were exploded last year. Photo (11) at left shows Richard E. Frazier and John P. Gould, engineers who installed and operated the equipment. The camera viewed the scene through the window in the shell cover. *Official U. S. Navy Photo.*

Televising Boiler Gauges at a Distance—Photos 13 and 14 below show television camera set up in front of boiler gauges (left), and television receiver screen in engineers office (right), at Hell Gate station of Cons. Edison Co., of N. Y. The Utiliscope was developed by Farnsworth Telev. and Radio Corp.



Double Modulation — An Aid to Television?

By E. AISBERG
Editor, *Toute la Radio*, Paris

TWO kinds of signals must be transmitted in all present systems of television: 1. The *video-frequency* signals, which translate electronically the successive light values of the image analyzed; 2. The *synchronizing* signals, which are divided into *line pulses* and *frame pulses*, and which assure simultaneous movement of the electron beam in the television camera at the transmitter and in the cathode-ray viewing tube at the receiver.

Because the carrier can transmit only 1 modulation at a time, these 2 types of signals are transmitted *successively*. At the end of each transmission of video frequency which serves to reproduce the light values of one line, a short impulse constitutes the line-synchronizing pulse; at the end of each complete image, or frame, a series of short impulses constitute the frame-synchronizing pulse. Under the present standards, the line pulses occupy 18%, and the frame pulses 7.5%, of the total time of transmission.

Altogether, approximately a quarter of the transmission time is taken up by synchronizing signals. During this time, the screen remains dark. Several inconveniences result from this. First, the average brilliance of the image is reduced one-quarter, compared to what it would be if the luminous spot were *constantly* present. Further, for equal definition, the video frequency is higher, which causes an increase in the width of the modulation bands with all the inconveniences which accompany it.

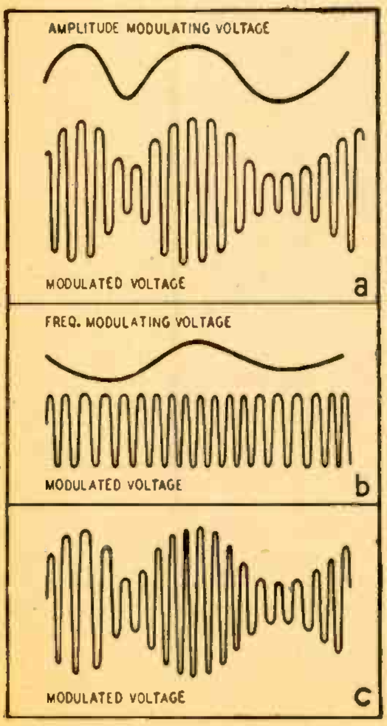


Fig. 1—Frequency and amplitude modulation combine to form a doubly-modulated carrier.

Finally, the synchronizing signals, especially when transmitted by amplitude modulation, are very sensitive to static disturbances (notably those of electric lights, motors, and automobile or airplane ignition systems) so that synchronism is easily impaired.

All these troubles would disappear if it were possible to transmit vision and synchronizing signals *simultaneously*.

Double modulation principle

The 3 principal modulation systems which serve to incorporate a signal into a carrier of higher frequency are: amplitude, frequency, and phase. Till now each of these systems has been used *separately*. But there is no reason why the same carrier cannot be modulated *simultaneously in frequency and amplitude*. Thus it might carry at the same time 2 varying voltages (Fig. 1), each of which might be independent of the other. It is possible to imagine many applications of this principle. For example, 2 radio programs could be broadcast on the same carrier, the one amplitude, the other frequency-modulated. Or again, a single program could be divided into 2 channels, one being reserved for the low and middle notes, the other for the higher ones. We can also imagine music being transmitted on one channel, and the second transmitting a voltage which would control volume expansion (dynamic range). Technicians can easily suggest many other applications of this principle.

The same principle can be used as the basis of a new television system, free of the inconveniences mentioned above, and which will have other substantial advantages. Instead of transmitting the vision and synchronizing signals alternately, we can transmit them simultaneously by using the 2 systems of modulation.

The video-frequency signals might be transmitted continuously by amplitude modulation. At the same time, the synchronizing signals could be transmitted by frequency modulation. Of course, the modulation percentage would have to be limited to a point where the carrier would be able to carry the transmission of synchronizing signals at all times. Note that this is not a point of inferiority to existing systems in which the modulation percentage of video-frequency signals must be limited to assure the correct functioning of the synchronizing signal separation tube. (According to present standards, the modulation percentage is limited to 75%.)

In this system the entire time is devoted to the transmission of light values. Thus the average brilliance of the image is increased. Further, frequency modulation is little affected by static or electrical interference, so stability of synchronization would be increased notably.

Instead of transmitting synchronization in the form of brief impulses (which considerably widen the modulation bands), it can be in the form of interrupted variable voltages occupying the whole time of transmission.

Let us see how we can utilize these principles in concrete fashion.

Double modulation transmitter

The transmitter is represented schematically in Fig. 2. The image is analyzed by an orthicon camera (for example). Sweep is determined by the saw-tooth voltages supplied by the 2 time bases: the high-frequency horizontal base affecting the analysis of the lines; and the vertical base, of a much lower relative frequency, assuring the succession of lines and the passage from one image to the next.

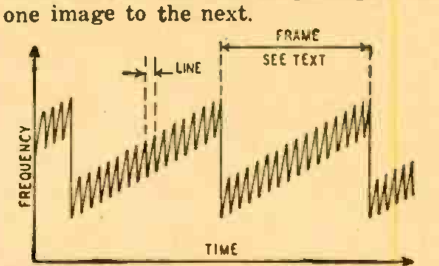


Fig. 3—Effect of two time bases on frequency.

The photoelectric voltages collected in the conventional manner are amplified in a video amplifier and *amplitude-modulate* the high-frequency voltage from the master oscillator. But the frequency of the master oscillator is varied by a reactance tube, which is simultaneously influenced by the voltages from the 2 time-bases. Thus *frequency* of the carrier wave varies as shown in Fig. 3. Note that the carrier is subjected to variations of relatively small amplitude but high frequency by the line time base,

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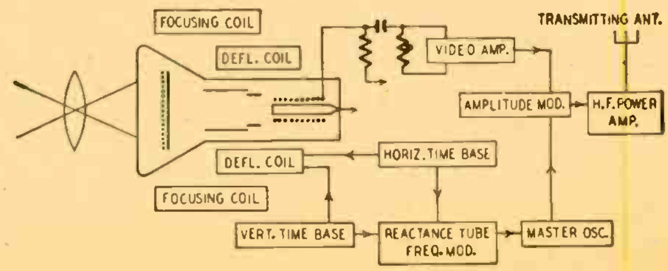

Fig. 2—A block diagram of the proposed transmitting system.

BLOCK THAT GHOST!

Care and skill in making the antenna installation makes the difference between good and bad images

By JORDAN McQUAY

THE chief complaint among new television-set owners is the presence of one or more overlapping images on the picture screen, resulting in a consistent double exposure (Fig. 1) or triple-exposure (Fig. 2) effect. Since the displaced images duplicate the main picture image in every respect, and usually with less intensity, they are appropriately known as *ghosts*. Their presence is *not* the fault of the picture tube or the television receiver. They are due entirely to inadequate or improper installation of the television antenna.

Elimination of these ghosts may require only *proper* siting and orienting of the existing antenna. Should this prove fruitless, a more directional type of antenna must be substituted and properly installed.

Fig. 1—Double-image ghost caused by direct and a reflected signal.

Fig. 2—A triple-image ghost shows there are two reflected signals.

Regardless of the location—whether town or country, city or industrial district—it is possible to receive television pictures entirely free of ghost interference. Such reception can be achieved only by considering the specific problems of each television location.

Ghosts now present in existing television systems can be blocked or eliminated by means of the same general method used for *new* installations. The work requires a practical knowledge of antennas and reflected waves. Siting is performed by two men, equipped with tools and patience.

Direct and reflected waves

The high-frequency waves used in television are similar in many respects to ordinary light waves. They travel in straight lines until their path is obstructed. The receiving antenna should be installed sufficiently high and in the clear so that it intercepts these *direct waves*. This means that the transmitting antenna of the television station should be visible, or "almost" visible, from the site of the receiving antenna. Reception may be possible when objects or surfaces partially obstruct the path of the direct wave, but usually the received signal is very weak.

Again similarly to light waves, the straight-line paths of television waves are affected by any kind of obstruction. Usually, the waves are diverted or reflected upon striking an object or surface. Much as a billiard ball is reflected angularly by a soft cushion, these waves, after reflection, continue their journey in a different angular direction, depending upon the original direction of the wave and the structural nature of the interfering object or surface. The waves lose some of their energy each time they are reflected. However, when reflected by *large* surfaces—such as steel buildings, storage tanks, or even mountainsides—very little energy may be lost.

Since many signals are radiated simultaneously and in all directions by the transmitting antenna, there is always a possibility that some of these reflected waves may reach the site of the receiving antenna (Fig. 3).

If the receiving antenna is not sufficiently directional, it will accept both the *direct* signal and the *reflected* signals. The frequency of both is the same, and therefore the television receiver—no matter how efficient or expensive—cannot differentiate between them.

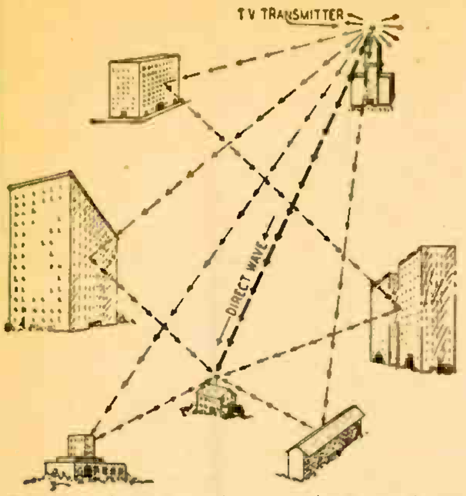

Fig. 3—Where the television ghosts are born.

The unwanted signals must be eliminated by the antenna system.

Since *any* reflected wave travels a greater distance than the direct wave, the additional time consumed causes the reflected signal to arrive *later* than the direct signal. The delayed signal appears on the picture tube as an *additional* image, which is always displaced horizontally and *to the right* of the direct image. The *amount* of this displacement

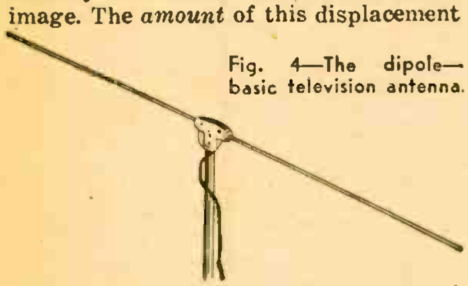

Fig. 4—The dipole—basic television antenna.

is a direct function of the additional time required for the reflected signal to travel the additional distance, with respect to the direct signal. If this additional distance is very small, the resulting displacement on the picture tube may be so small that it produces merely a blurry out-of-focus effect. More often, reflected signals travel considerably greater distances than the direct signal, resulting in more-or-less distinct multiple images on the television screen, as shown in Figs. 1 and 2.

These unwanted signals may be reflected by any number of types and kinds of large surfaces and objects. For this reason, ghost images are usually troublesome in the industrial or metropolitan districts of cities.

However, the general method of elimination of ghosts is the same for *all* types of television installations.

Proper siting

Since ghost images are the result of reflected signals arriving from directions which differ from that of the direct signal from a transmitter, their appearance on the picture tube is due entirely to *insufficient directivity* of the existing antenna.

This does not necessarily mean that another type of receiving antenna must be substituted immediately, because *in many cases* the existing antenna is improperly sited, improperly oriented, *or both,* due to careless or indifferent work at the time of the original installation. Therefore, the first logical step in blocking ghost reception is to make certain that the existing antenna is sited and oriented *to obtain the best possible reception* at the particular location.

At least two technicians or servicemen are needed to make a satisfactory television installation. The following more-or-less standard procedure is used to site and orient properly *any* type of television antenna.

One man, holding a pole upon which is mounted the antenna, is located on the roof of the house or building. The portable antenna is connected to the television receiver by a lead-in, which is loose and long enough to reach any location on the roof. A second man is located at the picture tube of the receiver to observe comparative signal strengths of the direct image and any ghost images. Some means of direct communication—such as a portable telephone or intercom—is used between the two men. Tests are conducted while the desired television station is on the air.

With the antenna held horizontally and broadside toward the direction of the station, the man on the roof explores various possible antenna sites, while the observer at the set notes comparative signal strength data for each of the various roof locations.

If 2 television stations are to be received with the same antenna, the entire procedure is duplicated for each station, and a suitable average or compromise location is selected as the best site for 2-channel reception. A similar process is used for 3- and 4-channel reception. However, antennas designed for multichannel operation—such as folded dipoles—are susceptible to ghosts, since they lack sufficient directivity.

When the best site has been determined, the antenna is temporarily mounted so that it can be rotated in azimuth. Again using the 2-man coordination system, the antenna is revolved while changes in the received image are observed at the image tube. Some ghost effects will disappear and reappear as the antenna is rotated. The object of this search is to locate a bearing position of the antenna which provides maximum strength for the direct wave, and the least interference due to wave reflections. At such a bearing position, the antenna is fixed in place, and is then considered to be properly sited and oriented. Usually, but not always, objectionable ghost effects are greatly minimized or completely eliminated by this process.

If, with the antenna properly installed and with all other components of the system functioning normally, ghosts still appear on the picture screen, a more directional antenna is required for ghost-free reception.

Ghost effects

Although unwanted for normal television reception, the consistent appearance of ghosts on the picture screen *during the installation* can be utilized to good advantage, since the images provide considerable information concerning the nature and origin of the reflected waves. This data is obtained directly from the picture tube of the set, without additional analyzing equipment or expensive paraphernalia. Once determined, the information is used in selecting the proper type of directional antenna to block or eliminate the ghost signals.

When the direct image and the reflected image are well separated on the picture screen, this indicates that the signals are converging at the antenna from 2 widely different directions. In such cases, the unwanted signal usually can be effectively blocked with an antenna having only a slight amount of increased directivity.

On the other hand, if the direct image and the reflected image are only displaced slightly, or if they are so close together that they cause a blurry effect, this indicates that the signals are arriving at the antenna from almost the same direction. In such cases, an extremely directional antenna is required to separate (in angle) the desired from the undesired signal.

When the intensity of the ghost image is weak in comparison with the direct image, the reflected signal is more easily blocked with a simple directional antenna. When the intensity of the ghost image is stronger than the direct image,

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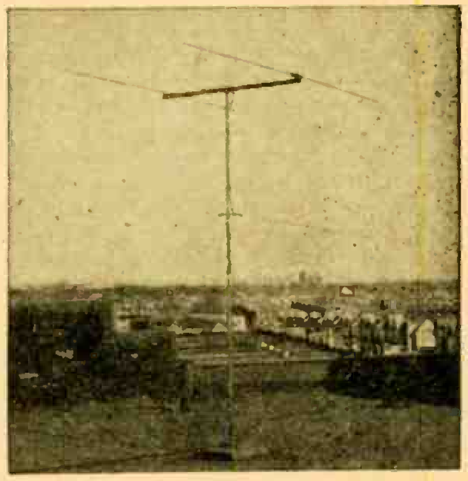

Service Division, Philco Corp.

Fig. 5—This simple antenna is often good.

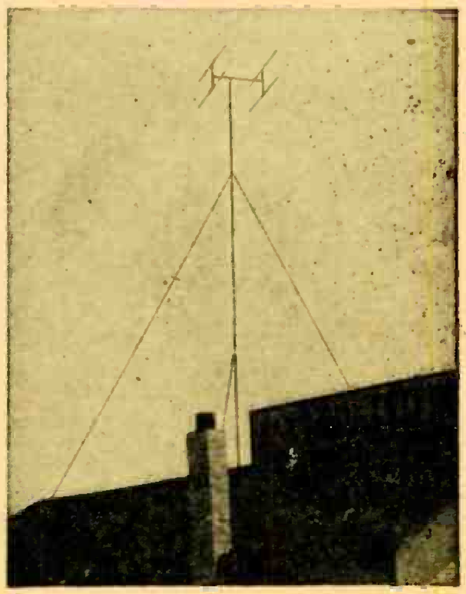

Fig. 6—Double doublet is highly directive.

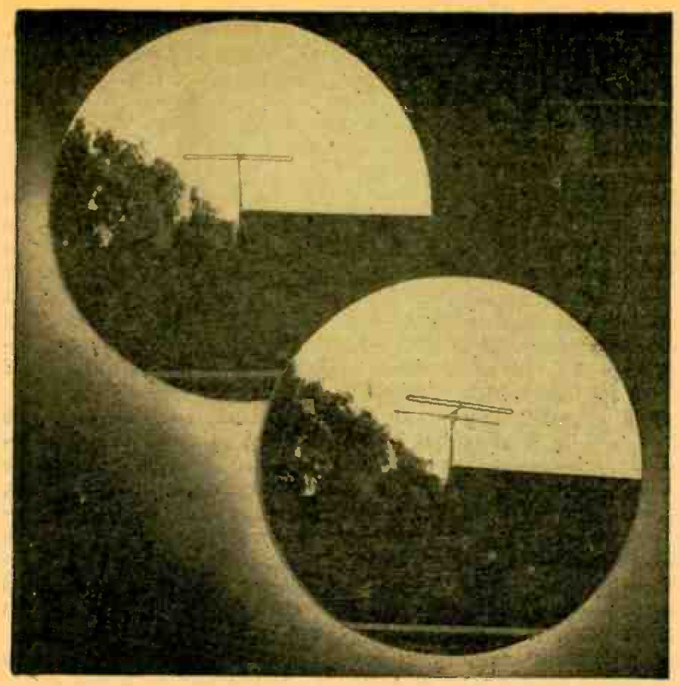

Photo by Ward Products

Fig. 7—Folded dipoles can be ghost free on only one channel.

it is sometimes possible to orient the antenna with respect to the *reflected* signal—rather than the *direct* signal—if the direct signal can be blocked satisfactorily so as to prevent interference with the desired (reflected) signal.

By turning or rotating the antenna at the roof site while observing the comparative strength or intensity of the direct and reflected images, it is often possible to identify the true bearing or direction of the *source* of the reflected waves—such as buildings, tanks, etc. When the source of trouble is known, it is often easier to deal with its effects.

This and other information can be determined directly from the picture tube, *regardless of the type of antenna*, provided the antenna has been properly sited according to the general installation procedure.

When a more directional antenna is required for ghost-free reception, this previously determined site *may* prove adequate for the new antenna as well. However, this roof location is not necessarily the best site for *all* types of television antennas. Therefore, any of the following types of directional antennas selected for installation must be *individually* sited and oriented according to the standard installation procedure.

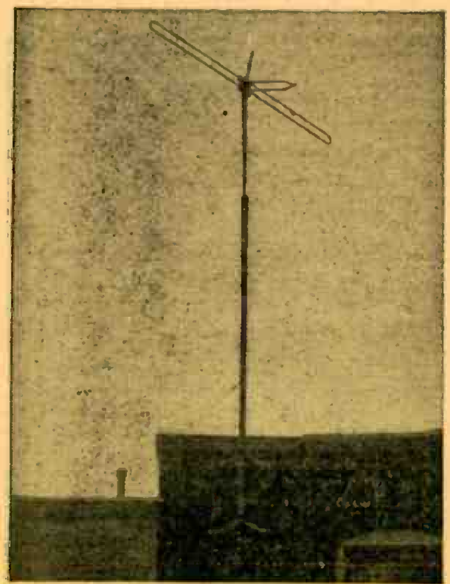

Fig. 8—The Duoband operates on all channels.

Basic types of antennas

There is no "ideal" antenna suitable for *all* kinds of television installations, because of the specific directional requirements and the individual nature of each location. In general, the *best* antenna is the simplest and most economical antenna which provides ghost-free reception for a particular location.

The simplest antenna—with the least directivity—is the fundamental, half-wave, resonant dipole (Fig. 4). Although tuned, this antenna is made only broadly resonant to prevent degeneration (loss of clarity and definition) of the high-frequency side-band components of the received direct signal. The dipole has an impedance of about 72 ohms at its center, and is always erected in a horizontal position.

A simple half-wave dipole is sometimes adequate for rural or suburban installations, where ghosts are rare. More complex and directional antennas are needed for good reception in the metropolitan and industrial areas of large cities, where multiple-signal reflections are prolific and troublesome.

It is conventional practice to use this lightweight dipole as the initial step in all *new* television installations, according to the standard procedure given previously. In some cases, it provides satisfactory reception and can be permanently installed at the location. In many cases, it is found inadequate because of its lack of directivity. Since the dipole is bidirectional, there is also the possibility that reflected waves may strike the antenna from the rear (Fig. 3). This directional inadequacy is remedied by adding either a reflector or a director. These *parasitic elements* convert the single dipole into a 2-element antenna with considerably improved directivity.

The reflector is a rod about 5% *longer* than the dipole, placed parallel and a quarter-wave *behind* it. The resulting 2-element antenna (Fig. 5) is sufficiently directional to block all *weak* reflected signals which arrive at a *wide* angular difference with respect to the direct wave.

When a director is used in place of a reflector, the action is almost identical. The length of the director rod is about 5% *shorter* than the dipole, and is placed parallel and a quarter wave *in front of it*. As in the case of the reflector, the complete 2-element antenna has good directivity.

Greater directivity can be provided with a 4-element antenna, known as the double doublet (Fig. 6); it is also known as a stacked array of two 2-element antennas. This consists of 2 dipoles, one above the other and connected in phase, and 2 reflector elements, one above the other and unconnected. The combination is a good one. It discriminates against undesirable ground reflections, thus providing a more distinct picture than is possible with a single dipole-and-reflector unit. The double doublet is broadly resonant, so broad that it might be classified with the wide-band or special types of antennas which follow. It has very pronounced directivity characteristics which make it extremely effective in blocking unwanted ghosts. It is frequently possible to minimize or eliminate ghost effects merely by changing the symmetrical position of one or more of the antenna elements, even by setting them at an angle with the strict horizontal. Again, it is important to realize that every television installation must be treated *individually* according to the specific directional problems posed by each location.

Folded dipoles

The directional characteristics of the folded dipole are about the same as those of the simple dipole. Somewhat similarly, the folded dipole can be used alone or with a reflector (Fig. 7), depending upon the degree of directivity desired. *(Continued on page* 128)

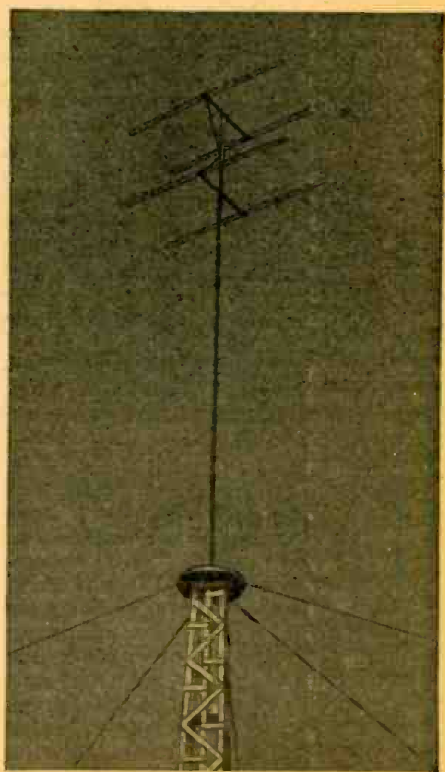

Fig. 9—A wide-band, highly directive antenna.

British Televisers

A wide range of television receivers are now being manufactured in Britain

By RALPH W. HALLOWS

JUST over 50 different models of television receivers were shown by manufacturing firms at the Radio Exhibition last October. Picture sizes ranged from 7 x 5 inches to 22 x 19 inches and prices from $204 to $6,000. The $204 outfit is the Pye table model, which receives only vision and the accompanying sound and shows an 8 x 6-inch image. Six thousand dollars is the price tentatively put on the Baird Grosvenor! This is an all-wave radio-auto-phonograph with a 22 x 19-inch picture shown on a flat screen by means of a large back-viewing tube, with its gun set at an angle to the long axis of the tube. Its radio side covers long, broadcast, and short waves in 11 full-scale tuning ranges. Though it was undoubtedly the showpiece of the exhibition, I doubt whether this giant set will go into regular production in its present form. There are, though, two others in the "millionaire" class for which you can place your order, if you're prepared to pay the price. The first of these is the Dynatron K329, an all-wave radio-auto-phonograph with a 10 x 8-inch picture and a price of $1,577; the second, also an all-wave radio-auto-phonograph, but with a 20 x 16-inch picture, is the HMV 1852 at $1,752, of which more later.

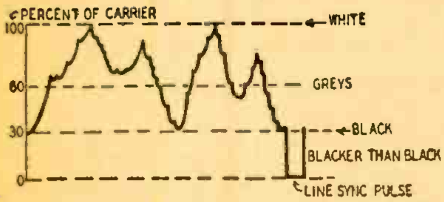

Fig. 1—British television modulation method.

There are two noteworthy general trends in the design of televisers today, compared with those of prewar years.

First, there is now no attempt to produce at rock-bottom price a set which might be called a televiser because it shows some kind of small, hazy picture. Before the war there were receivers, priced as low as $100, which could be used by means of v.h.f. adaptors in conjunction with ordinary broadcast receivers. Equipped with 3-inch cathode-ray tubes, they certainly presented images on their screens. But these images, with their defective interlacing, lack of steadiness, and poor contrast were often mere travesties of what was transmitted from the television studio. Despite its low price, there was very little market for this kind of televiser. Those who had predicted that television would become popular when something like an equivalent of the crystal-detector radio receiver was available were proven to be just about as wrong as it was possible to be.

Second, designers have realized that the man in the street wants an image of reasonable size in his vision receiver. No set offered now shows a picture smaller than 7 x 5 inches; the great majority of our sets present images approximately either 8 x 6 inches or 10 x 8 inches on their screens.

Manufacturers are still in doubt as to what kind of televiser, apart from picture size, the public wants. Some time ago it was believed that to be really popular a television set must incorporate an all-wave radio receiver. The idea was that Mr. and Mrs. Everyman wanted a home entertainment box that would bring in anything on the air in the way of pictures, speech, or music. Now there is some doubt about this. The present view is that they much prefer to have the ordinary radio receiver for broadcast programs and a separate specialized receiver for television. The great majority of the televisers now offered here handle only vision and the accompanying sound. I am inclined to believe that this will be found to be the solution of the problem, at any rate for the next few years. The broadcast radio receiver and the set which is a televiser and nothing else can both be made up in compact form. The all-wave radio *plus* television receiver is much more bulky, and the all-wave radio-phonograph-televiser is a rather formidable piece of furniture for the modern living room.

British television systems

Just one word about our vision transmissions before we go on to consider some British televisers in detail. Unless the main differences between the British system and those used in the United States are understood, it may be difficult to make sense of the schematics which follow. The first and most important difference is that British transmissions would produce a negative image—blacks and whites being interchanged—on the screen of an American receiver. With us white corresponds to 100% modulation, black to 30% modulation and the various greys to degrees

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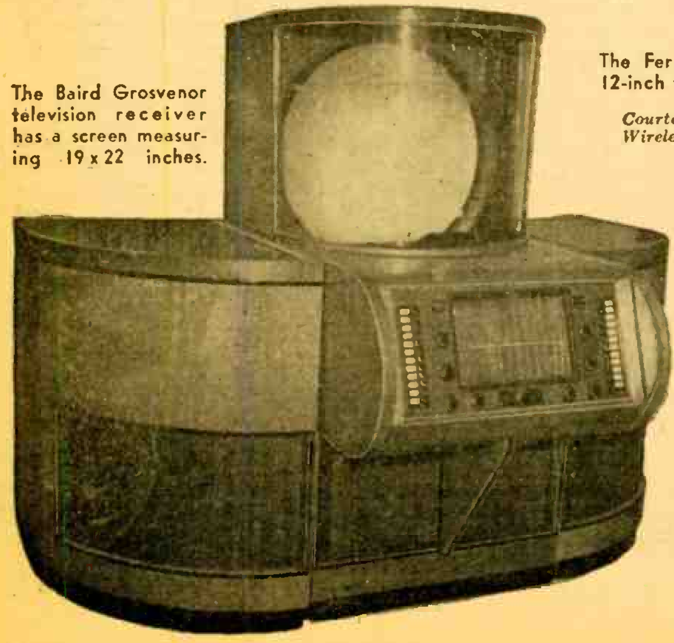
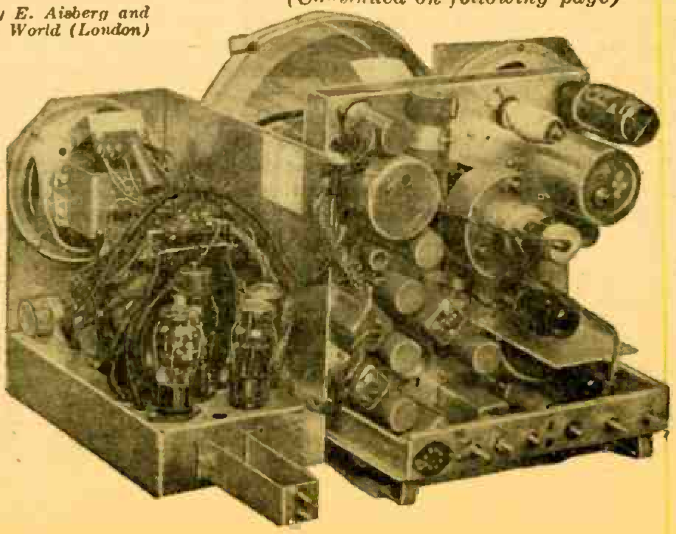


The Baird Grosvenor television receiver has a screen measuring 19 x 22 inches.



The Ferranti receiver uses a 12-inch tube and 2 speakers.

Courtesy E. Aisberg and Wireless World (London)

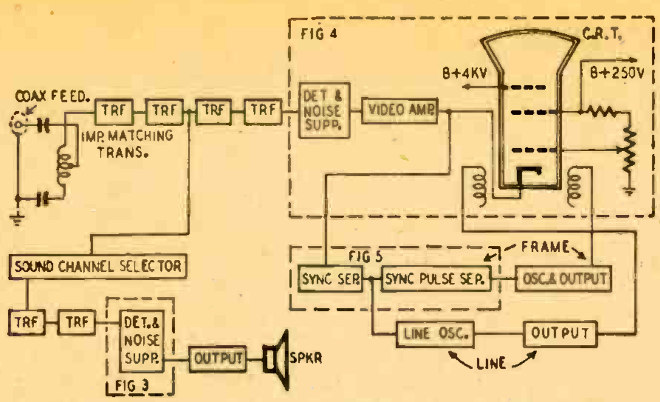


Fig. 2—The Pye televiser uses t.r.f. sound and vision circuits.

of modulation between a little above 30% (dark) to a little below 100% (pale). Our line and frame synchronization pulses are produced by dropping the modulation from 30% to zero and are thus "blacker than black." Fig. 1 shows diagrammatically the modulation corresponding to one line of a scan. In the British system each image is built up by 405 lines. It consists of 2 interlaced frames, each of 202½ lines. There are 50 frames and 25 complete images a second, the frequency of our standard a.c. being 50 cycles.

Though it is our least expensive televiser, the Pye (of whose circuit Fig. 2 gives a block diagram) is one of the most ingenious. It gives clear, steady pictures and is simplicity itself to handle, for the only 2 control knobs on the outside of the cabinet are for sound volume and picture brilliance. As the block diagram shows, sound and television channels each have 4 stages of r.f. am-

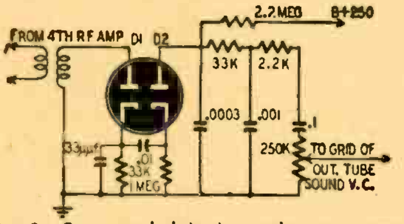


Fig. 3—Pye sound detector, noise suppressor.

plification, the first 2 stages in the set being common to both and sound being tapped off after the second by a pretuned selector circuit. Fig. 3 shows in detail the circuits of the double-diode used as sound detector and noise suppressor. On account of the very small values of the load resistor and capacitor of D1 (the detector) voltages due to automobile interference peak sharply. The output of D1 is taken from its cathode and applied to the cathode of D2. The plate of D2 is positive so it normally conducts. The adjustments are such that it does conduct so long as any audio signal of *normal amplitude* is applied from the detector or to its cathode; but when a high interference voltage peak is applied to it, its cathode is driven more positive than its plate, and it ceases to conduct.

A dozen interesting features on the television side could be described. I must, however, confine myself to the video amplifier with the preceding double-diode (Fig. 4) and the frame pulse separator (Fig. 5). They show two further clever uses of that versatile tube, the double-diode. Look now at Fig. 4. The very small (4.7μμf) capacitance in the cathode of the first (detector) diode of V1 supplies h.f. compensation. The second diode D2 serves as suppressor of interference from auto ignition systems. This diode is shunted across the resistor

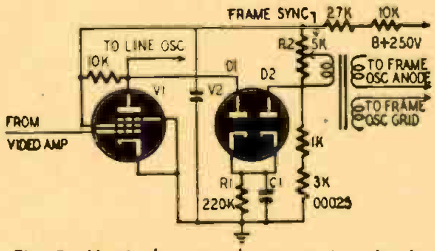


Fig. 5—Vertical sync pulse separator circuit.

R1, which, with C2 in series, is connected between grid and plate of V2, the video amplifier. The voltage variations in the plate circuit of V2 are applied to the cathode of the cathode-ray tube. Since those which produce whites in the image must make the cathode less positive with respect to the grid (which is the same thing as reducing the negative bias on the grid), it follows that at this stage the signal must be such that the whites are represented by negative swings and the synchronization pulses by sharp positive rises. The plate of V2 is also connected direct to the cathode of the second diode of V1. During a picture signal the diode D2 is normally nonconducting, and C2 keeps the voltage steady at about the peak white value; the amount of negative feedback in V2 is then minute. But when a signal peak due to ignition interference comes along, the cathode of D2 is driven negative. The diode conducts and considerable negative feedback occurs in V2, this suppressing the interference.

The third double-diode (V2, Fig. 5) acts in a novel way as frame synchronization pulse selector. You will recall that, in the plate circuit of the video amplifier, the picture impulses of the signal swing negative and the sync pulses positive. The grid circuit of the sync separator V1 contains a d.c. restoring network not shown in Fig. 5. This tube is closed during the negative picture part of each line and conducts only on the sync pulses. These appear, of course, as negative voltages in its anode circuit, which feeds D1 of V2 direct. During the picture part of each line when the sync separator is closed, the anode of D1 is at a higher positive potential than that of D2. D1 then conducts, but D2 does not. As C1 charges, the cathode potentials of both diodes become almost equal to that of the plate of D1. Along comes a sync pulse, dropping the plate potential of D1. Because of the time constant of R1-C1, the potential of the 2 cathodes falls more slowly. The time constant is such that a short line-synchronization pulse does not drop it far enough to cause D2 to conduct. The tube therefore makes no response to such pulses. The long frame-synchronization pulses, however, are accepted since their greater duration allows sufficient time for D2 to become conductive. R2 forms the frame sync control.

A medium-priced receiver

Another example of the moderately priced televiser is the Bush T91 console (block diagram of television portion in Fig. 6) which sells at $288. The sound channel, tapped off from the out-

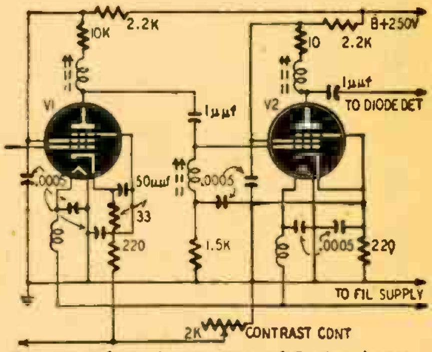


Fig. 7—R.f. tuning system of Bush televiser.

put of the second r.f. amplifier, is a superheterodyne with a triode-hexode frequency changer plus pentode i.f. plus double-diode-triode detector, a.v.c. and

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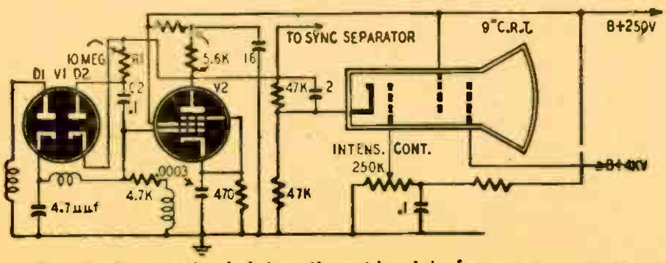

Fig. 4—Pye receiver's interesting video interference suppressor.

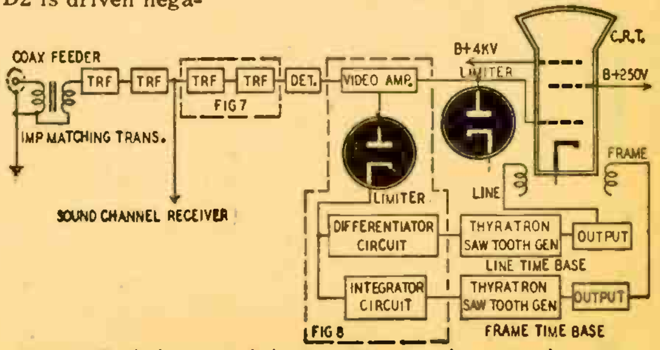

Fig. 6—Block diagram of the Bush T91, a medium-priced receiver.

TELEVISION AND FM ANTENNAS

By H. WINFIELD SECOR

RECEPTION of television and FM signals calls for special antennas capable of intercepting high-frequency waves with maximum efficiency over a broad frequency band. Most antennas designed for this service are based on the simple dipole of Fig. 1.

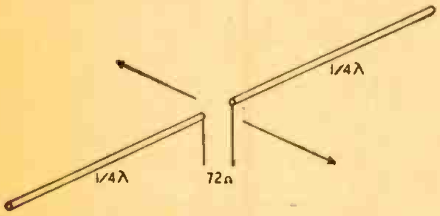

Fig. 1—The dipole, simplest and basic antenna.

The combined length of the 2 rods (or tubes) is equal to ½ the wave length, minus a correction (about 6% for high frequencies) to compensate for the so-called end effect. (The electrostatic capacitance at the ends of a half-wave dipole, and also the fact that the velocity of the wave or current is slowed down in traversing a conductor, requires the dipole to be slightly shorter than the electrical wave length in space.)

The formula for computing the length of the half-wave dipole is:

$$L \text{ (in feet)} = \frac{462}{f},$$

where f is the frequency in megacycles to which the antenna is to tune. F is ordinarily the geometric center of the band to be received: 97.6 mc for the 88-108-mc FM band; 62.2 mc for the center of the lower television band; 195 mc for the center of the upper television band. (The geometric center of a band is found by taking the square root of the product of the frequencies at the extremities of the band. Thus for the FM band it is equal to $\sqrt{88 \times 108}$, or 97.6 mc.) Sometimes an antenna is cut to the frequency of the weakest station to be received, instead of to the center of the band.

The lengths of dipoles, reflectors, and directors for various frequencies is given in megacycles in the chart of Fig. 2. To calculate the dimensions of an

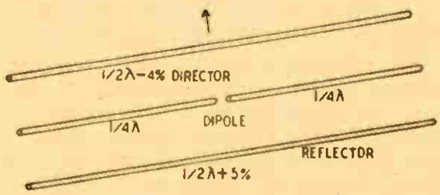

Fig. 3—Directional reflector-director-dipole.

antenna for the center of the FM band (call it 98 mc) for example we read across from 98 mc on the left-hand side of the chart until the horizontal line strikes the curve marked *dipole*, then look down to *length in inches*. There we find 56.7 inches for the length of the dipole (both legs), or 28⅜ inches for each leg. The length of the reflector, if wanted, is found to be 59.4, and the director length 54.4 or roughly 59½ and 54½ inches, respectively.

The impedance of a simple dipole is approximately 72 ohms. It may be matched by a 50- to 100-ohm transmission line. Fig. 3 shows how a reflector or director can be added to the dipole to increase the gain in a *forward* direction. Maximum gain direction is indicated by the arrow. For television reception the reflector is usually spaced ¼ wave length behind the dipole, to give broader tuning. The *reflector* is made 1.05 times the length of the dipole. The *director* element provides still greater gain in a forward direction. It is made 0.96 times the length of the dipole. Adding these elements makes the antenna response curve much sharper. The off-resonance response falls off quite rapidly. Fig. 4 is an interesting example of a dipole with director and reflector.

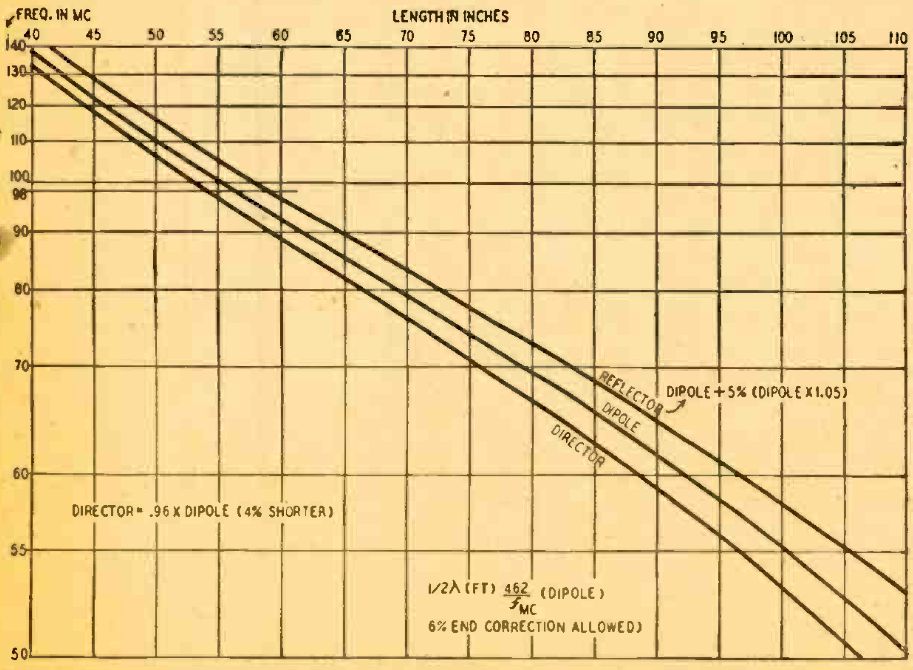

Fig. 2—The correct length of FM and television antennas can be calculated from this chart.

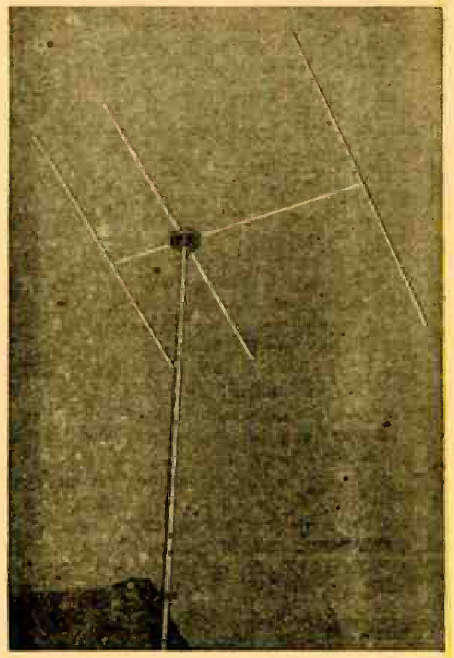
Fig. 4—A commercial type 3-element antenna.

The folded dipole at Fig. 5 provides a *broader frequency response* than a simple dipole, and is being widely used for both FM and television reception. It has an impedance of about 300 ohms, and is easily matched by a 300-ohm line. Most television and FM receivers have an input impedance of 300 ohms, so the match is good.

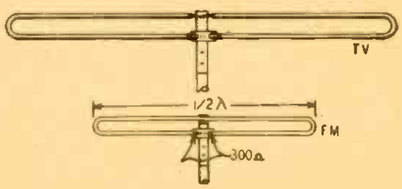

Fig. 5—Folded dipoles are becoming popular.

The vertical distance between the top and bottom elements of the folded dipole is made less than ⅛ wave length, and averages 3 to 4 inches. To improve

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the gain in a forward direction, a reflector is often placed ¼ wave length to the rear of it. The surge impedance is about 250 ohms for this combination, but it can still be matched by a 300-ohm line, as a mismatch as great as 2½ to 1 is tolerated in many television installations.

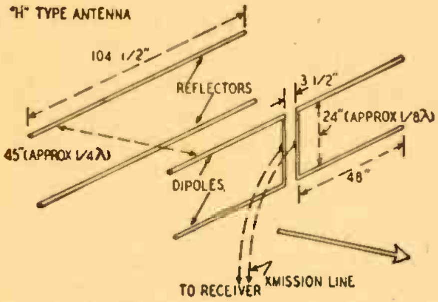

Fig. 6—Double dipole is sharply directional.

A *double dipole*, with reflectors, for TV reception is shown in Fig. 6. The arrow indicates the direction of maximum reception. The average surge impedance in this antenna is 200 ohms.

One of the broadest tuning antennas is the *double cone* type of Fig. 7, the

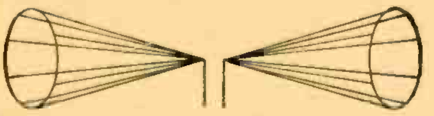

Fig. 7—The cone is a basic wide-band antenna.

nearest commercial approach to which is the *fan* type now coming into favor. The length of each cone is 0.36 wave length; the base of each cone subtends an angle of about 22 degrees. The cones can be wire cages or be made of thin sheet metal. The surge impedance is about 68 ohms at the center of the antenna and may be matched by a 72-ohm line.

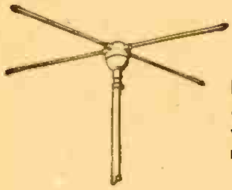

Fig. 8—The cross, an antenna type used where non-directional reception is desired.

The *cross-type* antenna (Fig. 8) is one of the newer designs and is non-directional. Two dipoles are interconnected by a quarter-wave phasing loop.

The tubes for the dipoles may be ⅜ to ½ inch in diameter of aluminum or dural stock. The limbs of the dipoles are often made telescopic, to permit adjusting the length to suit a given frequency.

Transmission lines

The principal types of transmission lines are twisted pair, the new plastic twin lead, and co-axial cable. Twisted pair (surge impedance 72 ohms) is the least efficient, but costs the least; the flat twin lead is efficient, but it may at times pick up interference; the co-axial cable is very efficient and free from interference pickup, but is expensive.

The flat twin lead is available in 75-, 100-, 150-, and 300-ohm impedances. Co-axial cable comes in a variety of impedances, such as 50, 75, and 93 ohms. Two lines may be connected in parallel to halve the impedance.

Locating the antenna

The higher the better—is a good rule for high-frequency as for all other antennas. Although the theoretical maximum transmission range is the optical horizon, some bending of the waves takes place through the atmospheric layers, and the formulas given below (including the chart of Fig. 9) take this refraction or bending of the waves into account. The formula for calculating the reception distance in miles is:

$$D \text{ (miles)} = 1.41 \sqrt{H \text{ (feet)}},$$

where H is the height of the transmitting antenna. The receiving antenna is assumed to be at ground level. If the receiving antenna is high, the range is increased proportionately; and the formula below can be used for computing the probable maximum distance for *regular* reception.

$$D = 1.41 \sqrt{H_t} + 1.41 \sqrt{H_r},$$

where H_t = the height in feet of the transmitter antenna, and H_r = the height in feet of the receiving antenna.

The distance over which v.h.f. signals may be heard varies considerably; this fall, one of the editors of this magazine had occasional (*but not regular*) reception from a dozen 88-108-mc FM stations, 150 to 500 miles away, using a simple dipole about 35 feet high. The calculated *regular* range for some of these stations was about 50 miles, so reception was probably due to freak reflections in a sunspot maximum year, or in some cases due to greater than normal bending of the waves at the horizon. The distance over which v.h.f. signals can be heard *regularly* does not vary greatly. The formula gives a good average value.

Long-distance reception

For v.h.f. reception at the extreme limits of the regular service area of a station, the dipole antenna may be raised to an extra high elevation, but this is not always possible.

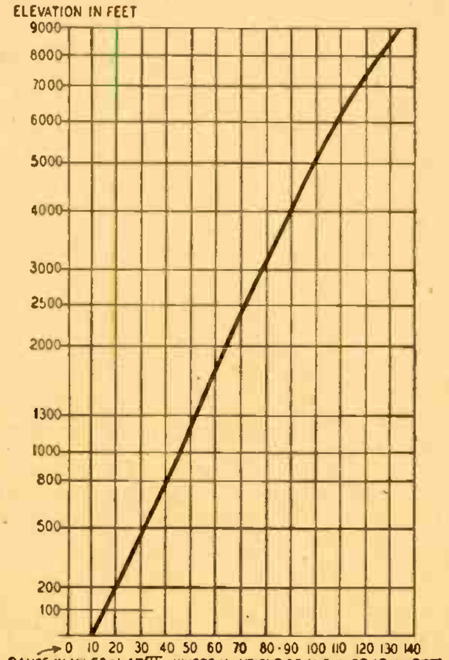

Fig. 9—Chart shows range vs antenna height.

A rhombic antenna is suitable for television or FM reception, as it covers a very wide band of frequencies, 60 megacycles for example when the antenna is designed for it. The rhombic is very sensitive to weak signals and is strongly directive. Charts and formulas for designing rhombics for different frequencies are given in radio textbooks and a number of special antenna handbooks are also published.

A single wire several wavelengths long is another possible antenna for long-distance reception.

New types of h.f. antennas

Designers of h.f. antennas have developed a number of novel types, with *broad frequency* coverage.

The Andrews Di-Fan TV and FM antenna is designed to intercept a broad band (all the TV and FM frequencies from 44 to 216 mc). The antenna is used with a 300-ohm line, and a performance curve shows it to be superior to a folded dipole.

Another new departure is to combine 2 antennas in a single unit, one for the reception of the lower h.f. channels and

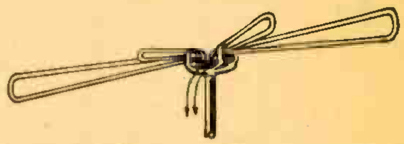

Fig. 10—A folded dipole for two frequencies.

the other for receiving the upper h.f. channels or frequencies. The 2 antennas are suitably joined by a special impedance-matching section. An array of this pattern is the Brach type 338 FM and TV (Fig. 10). The bands covered are 44-108 and 174-216 mc. It uses a 300-ohm line. Two folded dipoles are used.

The *cross-type* antenna for omnidirectional FM reception is favored by several manufacturers, notably Brach and The Workshop Associates. The upper and lower dipoles which form the cross are joined through a quarter-wave matching section. A 300-ohm twin conductor or cable usually connects the cross antenna to the receiving set. The joint impedance of the combination is about 125 ohms.

An adjustable V-type antenna is featured by Premax. The arms can be set at various angles to suit changes in polarization of the received wave. The impedance varies from 100 to 200 ohms, but may be matched by a 300-ohm line. The arms are of the proper length to resonate at the center of the FM band. (See Fig. 11.)

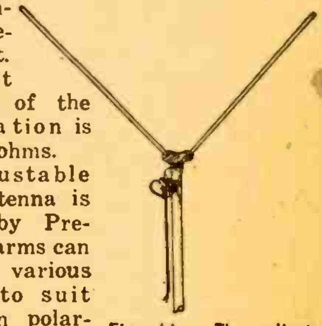

Fig. 11—The adjustable-V antenna.

(Continued on page 126)

WORLD-WIDE STATION LIST

Edited by ELMER R. FULLER

WELCOME to the new year, and may it bring you all kinds of happiness and good luck; and the best in dx. May it give you a renewed spirit to go after that dx. Reports for the past month have been much better and more useful than during the fall. Perhaps winter is having its usual good effect upon the short-wave bands. Reports have been received from Gil Harris of Massachusetts; Charlie Fox of Indiana; Charles Sutton of Ohio; Stathis Linardos of New York City; Joe Stanks of New Jersey; S. K. Steinfeld of Louisiana; R. C. Berens of Pennsylvania; John Winkler of Michigan; Bill Moore of Pennsylvania; the U. S. State Department; the Canadian Broadcasting Corporation; J. B. Yates of New York; the Australian News Agency of New York City; and the British Broadcasting Corporation.

Berne, Switzerland seems to be very active lately on 11.865 megacycles, being reported by nearly every observer. They are beamed to Australia on this frequency but come in very well on the east and west coasts. Their present schedule is Monday, Tuesday, Thursday and Friday, 0215 to 0330; and Tuesday 1000 to 1100. They are also heard to North America 2030 to 2230, EST. Reports of reception may be sent directly to the station in Berne, Switzerland.

Paris is now being heard very well on the east coast on 11.845 megacycles from 2100 to sign-off at 2245. They are also heard on this frequency from 1045 to 1130 but with much poorer results than at the later hour. This transmitter offers the best reception from France at the present time.

OLR3A from Prague, Czechoslovakia is being heard very well on 9.550 megacycles. We have not learned their schedule, but they have been heard as early as 1430 and have been known to sign off at 1700. The news is given in English at 1545 and 1645 hours. VLB9 in Shepparton, Australia, is being heard in the late afternoons with the news in English at 1530. The frequency is 9.615 megacycles. "The Voice of Australia" is also heard beamed to North America from 1000 to 1115 and 1500 to 1630 daily on 11.760 megacycles. The call used on this frequency is VLA8.

XMTA from Changsha, China, has been heard on the east coast at 0550 on 12.220 megacycles with a fair signal. This is a very good catch and was reported to us by Gil Harris. He also reports hearing PZR in Paramaribo, Surinam on 10.970 megacycles at 1717 hours with music. PJC1 in Willemstad, Curacao is being heard consistently on 7.250 megacycles from 1630 to 2130; but they are also on from 1130 to 1230 hours. We would like some reports on these hours so that we may check on their schedule for this noon broadcast.

EPB in Teheran, Iran, is being heard at 0715 on 15.100 megacycles. LKQ in Norway is being heard on 11.735 megacycles at 0800. A transmitter in Finland was reported being heard on 9.495 megacycles at 0710. PCJ in the Netherlands has been reported in the 25-meter band using 11.730 megacycles at 1820. Has anyone else heard this station? It was reported from the east coast in November. FHE3 from Dakar is reported by Charles Sutton at 0215 on 11.712 megacycles and is also reported as being heard at 1500 to 1600. SBP in Stockholm on 11.700 megacycles at 0140; and SDB2 in Stockholm on 10.780 megacycles at 2000 to 2100.

Inca, Peru is heard on 9.815 megacycles from 2000 to 2400 with a power of 150 watts.

All schedules are Eastern Standard Time.

Freq.	Station	Location and Schedule
11.720	CKRX	WINNIPEG, CANADA; 1000 to 2000
11.720	OTC	LEOPOLDVILLE, BELGIAN CONGO; 0530 to 9730
11.720	WRUW	BOSTON, MASSACHUSETTS; Central American beam, 1730 to 1900
11.720	WRUL	BOSTON, MASSACHUSETTS; Central American beam, 2000 to 2400
11.730	WRUL	BOSTON, MASSACHUSETTS; European beam, 1410 to 1700
11.730	KGEX	SAN FRANCISCO, CALIFORNIA; Philippine beam, 0030 to 0345; 0400 to 1005
11.740	COCY	HAVANA, CUBA; 0630 to 0100
11.740	CE1174	SANTIAGO, CHILE; 1700 to 2400
11.740	HVJ	VATICAN CITY; 0015 to 0025; 0830 to 0900; 1100 to 1145
11.750	GSD	LONDON, ENGLAND; 1215 to 1600, 1615 to 1200
11.770	WGEA	SCHENECTADY, NEW YORK; European beam, 1515 to 1805
17.770	KNBI	DIXON, CALIFORNIA; South American beam, 1900 to 2400
11.780	HP5G	PANAMA CITY, PANAMA; 0745 to 1000; 1200 to 2230
11.780		MOSCOW, U.S.S.R.; 0900 to 1000; 2000 to 2130; 2200 to 0100
11.790	WLWO	CINCINNATI, OHIO; South American beam, 2000 to 2200
11.790	WRUA	BOSTON, MASSACHUSETTS; European beam, 1430 to 1805
11.790	KNBI	DIXON, CALIFORNIA; Chinese beam, 0230 to 0345; 0400 to 1005
11.810	KCBF	DELANO, CALIFORNIA; Alaskan [illegible]r, 2215 to 0345
11.810	WOOW	NEW YORK CITY; European beam, 0500 to 0715
11.810	WGEA	SCHENECTADY, NEW YORK; Brazilian beam, 2000 to 2200
11.820	GSN	LONDON, ENGLAND; 2300 to 0030; 0100 to 0500; 1030 to 1430; 1700 to 2030
11.830	WCBN	NEW YORK CITY; Caribbean beam, 1715 to 1745; Mexican beam, 1800 to 0100
11.830	WNRX	NEW YORK CITY; European beam, 1400 to 1700
11.830		MOSCOW, U.S.S.R.; 2200 to 0600, 0730 to 0845 1100 to 1600
11.830	CXA19	MONTEVIDEO, URUGUAY; 0600 to 2200
11.830		CONSTANTINE, ALGERIA; 0030 to 0300; 1200 to 1800
11.840		MANILA, PHILIPPINES; East Asia beam, 0400 to 1005
11.840	VLC7	SHEPPARTON, AUSTRALIA; 0800 to 0915
11.846		PARIS, FRANCE; 0000 to 0045; 0100 to 0145; 0545 to 0615; 1045 to 1130; 1315 to 1730; 1830 to 2345
11.870	WNRA	NEW YORK CITY; European beam, 1715 to 1800
11.870	Munich II	MUNICH, GERMANY; European beam, 1200 to 1700
11.880		MOSCOW, U.S.S.R.; 2200 to 0600; 0720 to 1900
11.880	LRR	ROSARIO, ARGENTINA; 0600 to 1800
11.880		MOSCOW, U.S.S.R.; 2200 to 0230
11.890	KWIX	SAN FRANCISCO, CALIFORNIA; Japanese-Chinese beam, 0400 to 0930
11.900	KWID	SAN FRANCISCO, CALIFORNIA; South Pacific beam, 0015 to 0630
11.900	XGOY	CHUNGKING, CHINA; 0500 to 0630; 1045 to 1145
11.900	CXA10	MONTEVIDEO, URUGUAY; 1830 to 2115
11.930	GVX	LONDON, ENGLAND; 0515 to 0530; 0600 to 0630; 1700 to 0730; 0745 to 0900
11.960	HEK4	BERNE, SWITZERLAND; 1645 to 1715 except Saturdays
11.970	FZI	BRAZZAVILLE, FRENCH EQUATORIAL AFRICA; 0000 to 0230; 0445 to 0800; 0930 to 1030; 1100 to 2020
11.990	CSX	LISBON, PORTUGAL; 0800 to 1000
12.000	CE1180	SANTIAGO, CHILE; 0600 to 0800; 1600 to 2300

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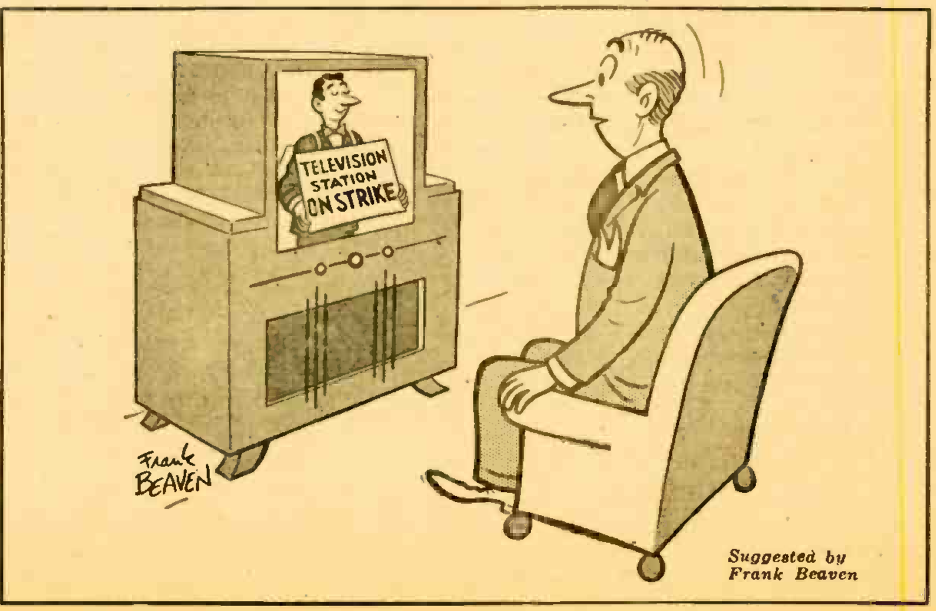

Suggested by Frank Beaven

Radio Set and Service Review

RCA 630TS Television Receiver

THE RCA Model 630TS is a 30-tube, table-model television receiver with a 10-inch direct-viewing cathode-ray tube which produces a picture 8½ inches wide and 6⅜ inches high. It is self-contained and receives signals on channels 1 through 13 with true FM reception of audio signals. Designed for operation from 117-volt, 60-cycle lines, it consumes 320 watts.

Seven operating controls are conveniently placed on the front panel. Symmetrical panel layout and concentric shafts on 6 controls simplifies operation of the set. The brightness, horizontal and vertical hold, contrast, volume and on-off switch, station selector, and fine or vernier tuning controls are on the panel. The vernier control provides a variation of ± 300 kc on channel 1 and 750 kc on channel 13.

The sound channel

The receiver's sound channel shares a 6J6 r.f. amplifier, 6J6 converter, and 6J6 oscillator with the video channel. There are then two 6BA6 21.25-mc i.f. amplifiers, a 6AU6 limiter, and a 6AL5 discriminator that feeds into an audio amplifier consisting of a 6AT6 and a 6K6-GT. The power amplifier develops 2.5 watts of undistorted power in a 5-inch speaker.

The video channel

Four 6AG5's are used in the 25.75-mc video i.f. amplifier stages. They are stagger-tuned to provide a 4-mc band width. The video detector uses half of a 6AL5 and works into a 2-stage video amplifier. The other half of the 6AL5 is the d.c. restorer. The second video amplifier drives the grid of the 10BP4 cathode-ray tube.

Sync signals are taken off the plate of the d.c. restorer and applied to a 6SK7 sync amplifier with such polarity that noise pulses greater than the sync are effectively eliminated. The output of the sync amplifier is positive. When these signals are applied to the grid of the 6SH7 sync separator, the video and blanking signals are removed, leaving only sync signals. These are properly polarized and clipped by the second sync amplifier, half of a 6SN7. The vertical pulses are passed through an integrating network to the vertical b.t.o. (blocking tube oscillator). The 6J5 vertical oscillator is coupled to the grid of a 6K6 which further amplifies the deflection signal and couples it to the vertical deflection coil.

The 6K6 horizontal oscillator produces sine waves of opposite polarity on the plates of the 6AL5 horizontal sync discriminator. Horizontal sync pulses from the second sync amplifier are passed through a differentiating network to the center tap on the secondary of T108, so that when the horizontal sync pulses and the horizontal oscillator are in phase, the output of the discriminator is zero. When the oscillator is out of phase, the discriminator develops a voltage that is applied to the grid of the 6AC7 reactance tube. This tube is across the oscillator winding and effectively varies the inductance to bring the oscillator back into phase with the sync pulses.

In some instances, the transmitted sync pulses may be unintentionally phase-modulated. Under these conditions, it may be difficult for the discriminator to follow variations in phase, and the picture will shift rapidly back and forth horizontally. If this trouble arises, and it has been determined that it is caused by phase modulation and not some maladjustment in the set, remove the connector from between terminals 2 and 3 on the sync link (J10 on the rear of the chassis) and place it between terminals 1 and 2. This connects condenser C171 into the circuit and increases the speed of the discriminator response, thus producing a more stable picture.

The horizontal oscillator generates sine waves between its cathode and screen grid. Its peak-to-peak grid voltage is in the order of 130. This high grid drive produces a square wave in the plate circuit. The oscillator plate is connected to a discharge tube (one-half of a 6SN7) through a differentiating network, C176 and R202.

The discharge tube shapes the wave form so the horizontal amplifier output tube produces the proper current in the horizontal deflection coil. A special output transformer matches the deflection coil and provides a source of energy for operating the kickback power supply for the anode of the picture tube. The operation of this circuit is discussed in the article *Servicing Televisers* on page 50 of this issue.

The low-voltage power supply delivers filament, plate, and bias voltage for the receiver. It uses two 5U4's in parallel delivering 400 volts d.c. at 290 ma. A 62-ohm speaker field coil is used with 160 μf of filter capacitance.

Servicing and installation

A number of controls, other than the i.f. and r.f. adjustments, are important to proper operation of this television receiver. These seldom require adjustments and are not mounted on the front panel. The horizontal centering, focus, vertical linearity, horizontal oscillator frequency, height and horizontal drive controls are on the rear of the chassis and have knobs for adjustments. Other controls are: width (rear chassis—screw driver adjustment), horizontal linearity (top chassis—screw driver adjustment), horizontal oscillator phase (bottom chassis adjustment), focus coil (top chassis—wing-nut adjustment), ion trap coil (top chassis—thumb-screw adjustment), and deflection coil (wing-nut adjustment from top of chassis).

Be careful when installing or servicing this or any television receiver. Voltages are lethal, and an *imploding* cathode-ray tube can do serious damage and cause personal—even fatal—injuries. *Do not install, handle, or unpack a cathode-ray tube without wearing heavy gloves and shatterproof goggles.* All persons not so equipped should be kept at a safe distance. The bulb of the tube is highly evacuated, and any undue pressure or scratches on the bulb can cause the glass to rupture.

Be careful when servicing the set with protective covers removed. There is danger of contacting high voltage, and HIGH VOLTAGE IS DANGEROUS!

For servicing this receiver, the manufacturer recommends a signal generator, sweep generator, oscilloscope, and electronic voltmeter.

The signal generator should provide frequencies between 19.75 and 27.75 mc, and 45.25 and 215.75 mc. The output on these frequencies should be adjustable and at least 1 volt maximum. If the signal generator is not crystal-controlled, a heterodyne frequency meter with crystal calibrator is required for checking the generator's accuracy. Make voltage measurements with an electronic voltmeter equipped with a high-voltage multiplier probe to permit measurements up to 10 kv. An r.f. sweep generator, covering from 18 to 30 r c with 1-mc sweep and from 40 to 90 n. and 170 to 225 mc with a 10-mc sweep, is required for use with an oscilloscope. The 'scope should

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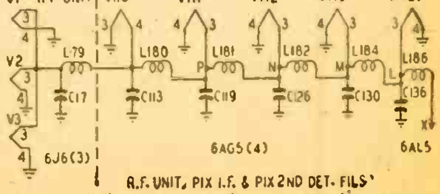
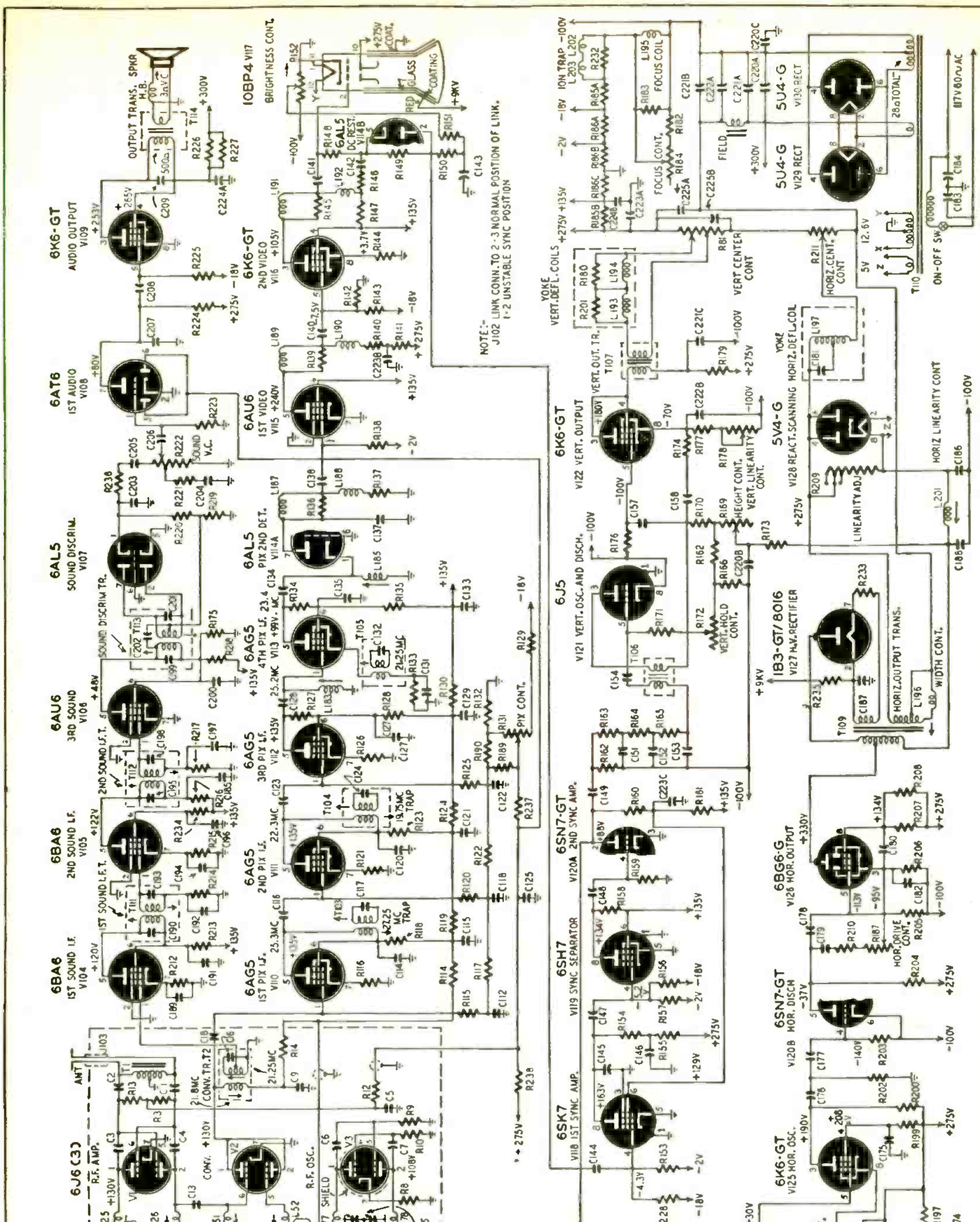


Some of the filaments have special circuits.



This schematic of the RCA 630TS, which is described on opposite page, is also Fig. 2 of the article, "Servicing Televisers," on page 50.

SERVICING TELEVISERS

The more common faults in a vision receiver and how to locate and remedy them

By MILTON S. KIVER

A TELEVISION receiver is two-receivers in one: a sound receiver and a "sight" receiver. Whatever occurs within the set must flash a trouble signal in the loudspeaker or the cathode-ray image tube, or both. It remains then for the serviceman to interpret such signals and correct the trouble.

The major servicing divisions of a television receiver are shown in Fig. 1. The type of signal present in each circuit is indicated, together with the front-panel and secondary controls. The diagram reveals that sound and video signals follow a common path only in the r.f. section of the receiver. Thereafter the two signals separate and follow individual paths.

The audio system leads to the loudspeaker; the video system to the cathode-ray tube, which also receives voltages from the horizontal and vertical deflection systems and the high-voltage power supply. In many of the newer sets, the high-voltage power supply is essentially part of the horizontal deflection system. This trend toward the flyback method of generating high voltages is on the upgrade.

To the intelligent serviceman these facts will immediately suggest the following:

1. If a circuit defect affects one system but not the other, the fault lies somewhere between the point where the audio and video signals separate and the end of the system affected.

(For example, a set brought in for repair worked normally on the sound but produced no images on the screen. Obviously the defect existed in some stage of the video system. Just as obvious was the fact that the front end of the set was operating normally because both audio and video signals were present there. One of the video i.f. tubes was found to be defective.)

2. A defect affecting both systems must exist in circuits which are common to both. Common stages include the r.f. amplifier, the mixer and oscillator tubes, and the low-voltage power supply.

3. The final image is a composite of several different voltages acting on the cathode-ray tube. Each voltage possesses its own definite characteristics, and from these indications the proper section of the receiver can be identified.

These are the essential servicing facts that the serviceman must know to tackle a television receiver effectively. Typical receiver troubles are analyzed in the following paragraphs to show how the analysis is carried from output indication to the specific stage and component. Whenever possible, the defect will be tied in with the television receiver schematic shown on page 49, which will be referred to as Fig. 2. The set shown is the latest RCA table-model receiver 630TS, employing 30 tubes, a 10-inch cathode-ray tube, flyback-type high-voltage power supply, and a phase-synchronized horizontal deflection system. The circuit was chosen because its design is followed by many radio manufacturers, all of whom are RCA licensees.

The test equipment required for a thorough servicing job consists of:

1. R.F. SWEEP GENERATOR with the following characteristics:
   (a) Frequency ranges:
   15 to 30 mc with sweep width adjustable to 10 mc;
   40 to 90 mc with a 10-mc sweep width;
   170 to 225 mc with a 10-mc sweep width.
   (b) Output constant on all ranges and on all attenuator positions.
   (c) Output variable up to 1 volt.
2. CATHODE-RAY OSCILLOSCOPE with a wide-band vertical deflection system.
3. VACUUM-TUBE VOLTMETER with a high-frequency probe permitting reliable measurements up to 250 mc.
4. SIGNAL GENERATOR capable of providing individual frequencies from 15 mc to 225 mc. This generator will serve to establish definitely the location of frequency points on the i.f. and r.f. response curves, to produce marker signals, and to peak trap circuits and individual tuning coils, when necessary.

Before we begin the analysis, a word first about checking tubes. They are by far the most common source of trouble in television receivers. This does not mean that, as soon as a receiver is brought into the shop, the tubes are all immediately yanked out and tested. What is meant is that, as soon as a defect is traced to a certain section of the receiver, the tubes in that section are tested first.

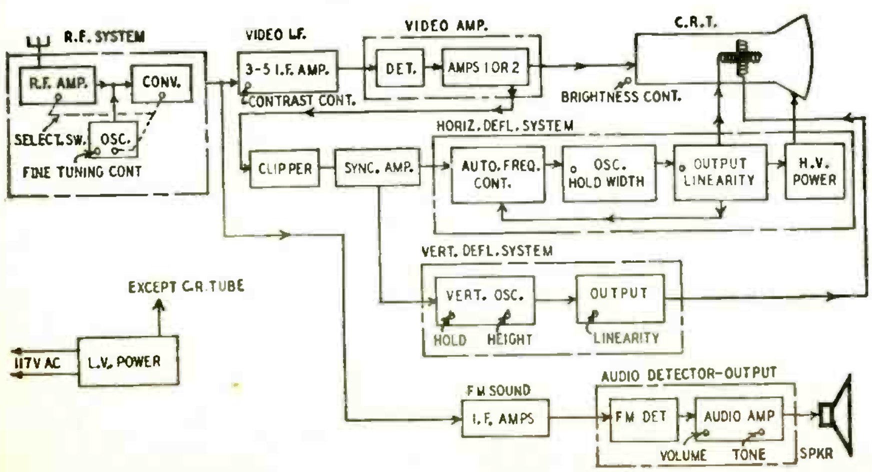


Fig. 1—Block diagram of typical televiser. Some sets have controls in addition to these.

R.F. system defects

A defect in the r.f. system, which can include the antenna and lead-in transmission line, is indicated by no picture, sound, or sync. On the screen, only the scanning raster is seen. The absence of both video and audio immediately points to the r.f. system where both signals follow a common path. Check tubes V1, V2 and V3 in this section. (Fig. 2.) Measure the oscillator grid voltage. The value should be between 4.5 and 6.5 volts. If these indications are normal, then a sweep (FM) signal generator should be connected across the input terminals and set at the audio carrier frequency. If the trouble lies in the antenna or transmission line, a single audible note will be obtained from the loudspeaker. Physical examination of the antenna system will generally reveal any broken conductors.

Trouble seldom arises in the tuned circuits of the r.f. stages. However, if one of the coils should open up, it can usually be detected by switching the set to a higher channel. Doing this automatically cuts out the defective coil, permitting the receiver to function normally again. If no stations are operating at the higher frequencies, loosen the transmission line and brush its end leads across the receiver input terminals. Bursts of noise will be heard in the loudspeaker (yes, even with FM), and flashes of light will appear on the screen. If the signal path is broken at any point in the r.f. system, these interference or noise voltages will be unable to pass and there will be no indication, either in the loudspeaker or on the screen.

An inoperative oscillator can usually be detected by noise heard in the loudspeaker and noise flashes visible on the image screen. No station is received in any position, and no oscillator grid voltage can be measured.

These are the primary difficulties that beset the front-end portion of the receiver.

Audio i.f. and a.f. system

Troubles arising in the audio portion of the receiver manifest themselves by the absence of sound from the loudspeaker and the appearance of a normal image on the screen. The defective stage can be localized, 9 out of 10 times, by tapping the grid terminals of each tube in the audio system in turn, starting with the audio output tube and working back progressively toward the receiver mixer. So long as the portion of the audio system is working, a thumping noise will be heard from the output when the finger taps the grid of a tube. This method of quick testing will work with most FM systems. When the results of the test are inconclusive, the use of a sweep signal generator is recommended. The method of testing now becomes one of signal tracing, noting where the passage of the signal becomes blocked.

Another difficulty sometimes encountered is distorted sound output (or no sound at all) coupled with poor image quality. The cause of this lies in the oscillator. Due to heat, dust, or prolonged operation, the oscillator frequency may drift sufficiently to detune the FM and distort the video signal. The solution is a realignment of each oscillator coil. On jobs of this sort, it is best to keep the set working in the shop for two to three days to make certain that the trouble does not reappear.

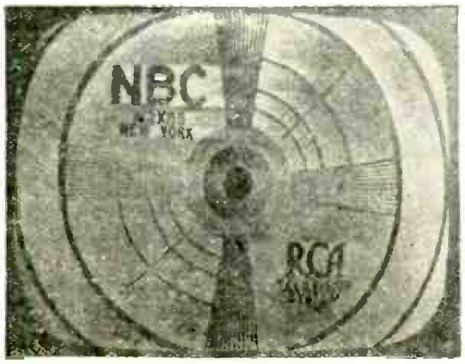


Fig. 3—A pattern due to oscillator trouble.

Video and video i.f. amplifiers

1. Large objects and letters appear smeared in image (see Fig 3), but sound comes through clear and undistorted. If the sound is unaffected, the trouble must be in the video system. The path exclusively devoted to the video signal contains the video i.f. amplifiers, the video detector, and the video amplifiers. Smearing in an image indicates poor low-frequency response or tube distortion. Therefore, the trouble is probably in the video amplifiers where special-frequency compensating networks are employed.

Check defective coupling, bypass condensers, or grid load resistors in the video amplifiers, V115 and V116. Check C138, C140, C141, C223B, R138, R142, R143, R148, etc. Smearing may be due to an overloaded video amplifier or a defective component affecting the low-frequency response. Overloading of the video amplifier may arise because of insufficient bias on the control, resulting in grid current. Check the bias and possible grid current of V115 and V116 (Fig. 2).

2. Loss of fine detail and blurring of small objects. This defect is most apparent when the station test pattern is received; the vertical wedges are not sharp and clear, and adjustment of the focus control does not clear up the difficulty.

The fine detail in a television image is a function of the higher frequencies. Detail losses may be due to improper alignment of the r.f. and i.f. tuned circuits; defective video amplifier tubes

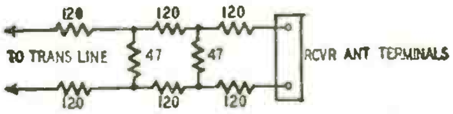


Fig. 4—Attenuation pad for weakening signal.

V115 and V116; defective peaking coils L187, L188, L189, L190, L191 and L192; and finally, defective interstage coupling condensers, such as C138, C140 and C141. It is well to remember that lower-priced receivers are generally designed for less than the full 4.0 mc video response. Consequently, the images in these sets will not contain as much detail as those produced in more carefully designed receivers.

3. High distorted image, especially when the contrast control is in maximum position. Sound, however, is clear. The contrast control is a gain control employed in the video i.f. system (R131, Fig. 2). If the image can be partially restored to normal by lowering the setting of the contrast control, it is an indication that too strong a signal is being received. Alter the position of the antenna or insert an attenuation pad between end of transmission line and receiver input terminals. (See Fig 4.)

If the distortion cannot be corrected by the contrast control the grids (possibly even the contrast control) have become grounded, causing all tubes controlled to operate at maximum amplification. Check grid bias of each i.f. tube.

4. Appearance of dark horizontal lines across an image (Fig. 5) may be due to either a poorly filtered powered supply or the existence of audio voltages at the image tube control grid. The following procedure will demonstrate how the source can be determined quite readily:

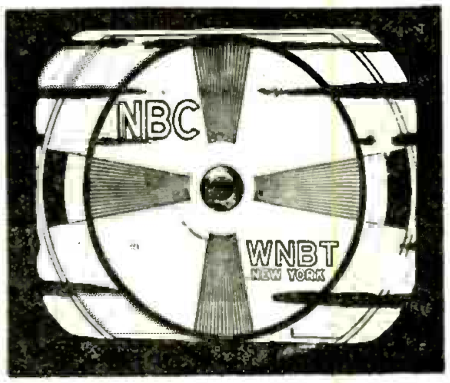


Fig. 5—Poor filtering causes this pattern.

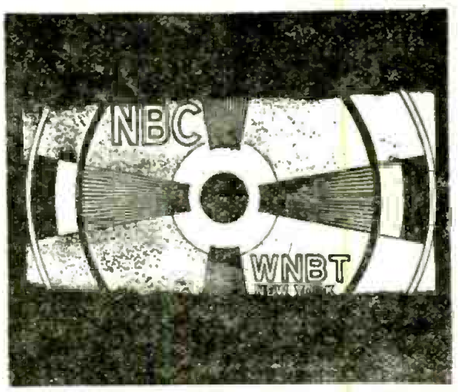


Fig. 6—Another pattern due to poor filtering.

a. *Poorly filtered low-voltage power supply.* Two stationary, wide black bars will appear across the screen accompanied by an audible hum from the loudspeaker. The low-voltage power supply is common to both systems. The cause will be traced to a defective filter condenser in the low-voltage power supply. (See Fig. 6.)

b. *Audio voltages at the grid of the image tube.* The dark lines produced vary in intensity. Sound signal is partially or totally distorted. This immediately points to some component in the r.f. stages. To correct, adjust the FINE TUNING control. When the same visual indication is obtained, with a normal sound output, the source of trouble is in the video i.f. stages. Realign the audio trap circuits. C15 is the FINE TUNING control. T2 and T105 are the audio traps in the video system.

The image tube

1. Cathode-ray tube screen is brightly illuminated and brightness control is ineffective; sound is normal. Image appears thin and washed out but is held perfectly in place by the sync. pulses.

Again a defective stage in the video system is indicated, according to ordinary reasoning. This time, however, the trouble is at the cathode-ray tube. The

(Continued on following page)

reasoning is: A weak signal will produce a thin, watery image, but this is always accompanied by noise spots (snow in the image) and poor synchronizing action. Since neither of the two latter are present, the bias control (brightness knob) of the cathode-ray tube must be the cause. Check the voltage between the control grid and cathode of the image tube. Check the brightness control R152 for continuity. If this potentiometer is good, try another cathode-ray tube. There may be leakage between the image tube grid and cathode. A gassy tube will produce the same symptoms.

2. Picture is small; mask not completely filled. Picture size is controlled by 2 factors: the vertical and horizontal deflection voltages, and the deflection yoke placement. Check the latter first by moving the deflection yoke along the neck of the tube. If this still doesn't produce the proper-size image, check the B-plus output of the low-voltage power supply. Too low voltage can be

Fig. 7—Deflection yoke is improperly placed.

the cause. When the image is small in one direction only, check the output of that particular deflection system.

3. Picture is on slant. (See Fig. 7.) For electromagnetic deflection tubes, rotate deflection yoke; for electrostatic deflection tubes, turn the tube to level up the picture.

4. No raster shows on screen. Check alignment of ion trap L203 and L202. Coils may be reversed, improperly positioned, or open. An additional cause producing the same absence of raster is

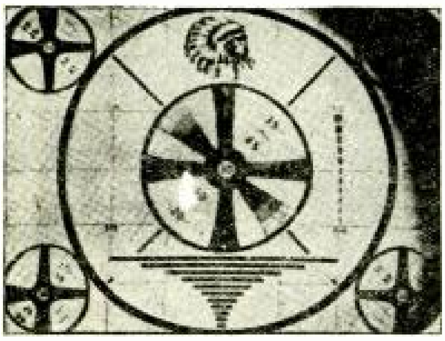


Fig. 8—The ion trap position is incorrect.

noted in the section dealing with horizontal deflection.

5. The appearance of a dark area on one edge of the screen can be traced directly to an improper alignment of the ion trap. (See Fig. 8.)

Vertical deflection faults

1. Thin horizontal line indicates a lack of vertical deflection voltage, just as it does in any oscilloscope. Check the vertical oscillator and vertical amplifier tubes. If these are in working condition, measure the voltage in these circuits. With power off, make resistance and continuity tests.

2. Picture "bounces" when set is jarred or heavy trucks pass nearby. Check all tubes in vertical system for microphonics. Best test is to replace each tube, in turn, with one known to be good.

3. Picture height is insufficient, but width is correct. If the set is functioning normally, adjustment of the height control will produce the proper picture height. Inability of the control to produce the desired height may be due to one of the following defects:

a. Defective vertical amplifier tube V122;

b. Lowered plate and screen voltages on vertical amplifier and vertical oscillator tubes V121 and V122.

4. A picture compressed at top indicates poor linearity of the vertical deflection voltage. The vertical saw-tooth deflection wave is developed in V121, amplified by V122, and then applied to the vertical deflection coils. Poor linearity, then, must be due to defects in these 2 circuits. Try correcting the image by adjusting R178, the vertical linearity control. However, if these adjustments fail, change the vertical output tube V122. If the defect still persists, check (preferably replace) C158, R174 (where deflection wave is produced), and C222B, C221C. Each of these components could affect the form of the vertical deflection voltage. Finally, grid, plate, and screen voltages should be checked against the manufacturer's recommended values. Line overlapping or image compression in the vertical direction can be due to lowered tube potentials.

5. Inability to center image vertically. (This analysis may also be applied to the horizontal centering control.)

a. *Electrostatic Deflection Tubes.* Open resistor in centering network. Check the contacts on the control potentiometer first. Then check continuity to cathode-ray tube socket from the centering resistors. Test for dirty contacts at socket of cathode-ray tube.

b. *Electromagnetic Deflection Tubes.* Test for open resistor in centering network. Measure the voltage across the centering control. If this is low, measure the low-voltage B-plus. A low value at either point can produce a restricted centering range. Finally, if all these points check properly, the trouble may lie in the cathode-ray tube itself. The electron gun may have become tilted due to some sudden jarring of the tube. In Fig. 2, the vertical and horizontal centering control resistors are R81 and R21.

Horizontal deflection

Most of the television receivers currently manufactured employ the *flyback* method of developing high accelerating potentials for the cathode-ray tube. Consequently, any trouble affecting the horizontal deflection system will usually kill the high voltage, eliminating all visible traces from the cathode-ray tube screen. When all the tubes in a television set are lit and the cathode-ray tube is dark, the serviceman should first concentrate on the horizontal deflection system. Sound will be heard in the loudspeaker.

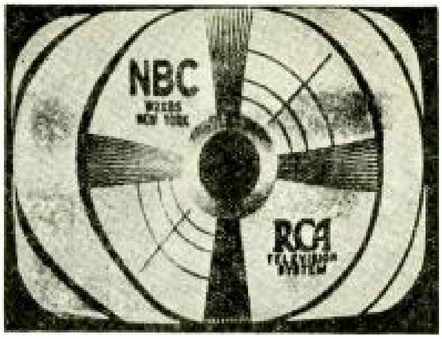


Fig. 9—Horizontal linearity circuit defect.

It is well to distinguish between a dark screen which is due to no high voltage, and a screen containing a scanning raster but no image. The latter difficulty, when accompanied by a normally functioning audio system, indicates a defective video system. In this case, the horizontal deflection system and the high-voltage power supply are both operating satisfactorily, as evidenced by the appearance of the scanning raster.

1. Lines in image are bent or elongated. (See Fig. 9.) This indicates a defect in the horizontal linearity circuit. Adjust the horizontal linearity control L201 according to the manufacturer's recommendations. If this fails, change the horizontal output tube V126 and the reaction scanning or damping tube V128. Check the saw-tooth generating network. (C179, R210 and R187). Finally, check all resistors and condensers directly associated with the horizontal linearity control.

2. Light vertical strips down left-hand edge of image are generally due to a defective damping tube V128. In the circuit of Fig. 2, C181 and R209 also may be at fault. With this defect, the picture may sometimes fold back on itself at the left-hand side.

The appearance of a dark vertical strip instead of a light strip generally can be traced to the horizontal output tube V126 or to an improperly adjusted horizontal drive control.

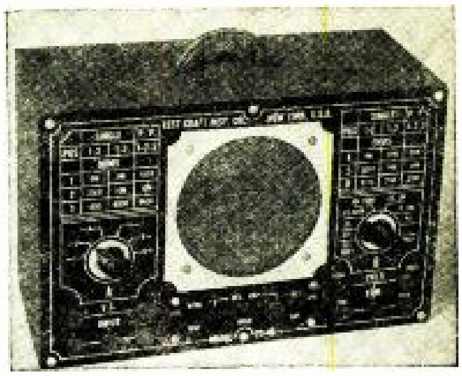
Interpretation the key

The key to television servicing is the serviceman's ability to interpret what he sees on the image tube and hears from the loudspeaker. The foregoing discussion illustrates how the effect is first studied by comparing the audible and visible outputs of the receiver and then deducing where the defect is. This process will be speeded up with experience and by a thorough knowledge of what each particular stage contributes toward the formation of the final image. The serviceman *must know* how a television receiver operates.

One final thought concerning television receiver servicing. The horizontal and vertical deflection systems develop distinctive wave forms which can be

(Continued on page 130)

Universal Speaker For Field or Bench



All indications are on the instrument's panel.

By SIDNEY S. FLEISCHMAN*

IT is a rarity when a test instrument manufacturer comes up with an instrument that can really be called different. This instrument, completely self-contained, is a universal test speaker. Included in it, in addition to the speaker, are a resistance-capacitance substitution decade, continuity tester, and output meter.

It has been designed, not as an auxiliary test instrument, but as a basic unit to be used in conjunction with other equipment for both rapid and efficient radio service work.

The test speaker section uses a simple method of speaker matching with a specially designed universal output transformer, which matches load impedances up to 25,000 ohms (Fig. 1). Dynamic and permanent magnetic types of speakers can be tested equally well. The various load impedances are selected from the chart on the front panel. (This feature in itself is most desirable, since the chart cannot be lost as instruction sheets sometimes are.)

A serviceman who suspects an open field can open the field circuit and easily select the proper field impedance from 500 to 2,500 ohms by plugging a pair of test leads into the proper tip jacks.

If the output transformer is suspected of being defective, open the primary circuit of the defective transformer and connect the test leads from the tip jacks marked INPUT to the plate and the B- of the output tube. Proper selection of the input with tip jacks 1, 2, and 3 depends entirely upon the output tube or tubes and the circuit being tested. Connection can be made to either push-pull tubes or single-ended stages. The load resistance and input jacks are selected according to the chart on the front panel.

A speaker suspected of having a defective voice coil can have a new voice coil substituted by plugging into the tip jacks marked V.C. The leads from the output transformer to the defective voice coil are opened and the connection made across the secondary of the output transformer in the receiver under test. Both capacitance and resistance substitutions are available on the front panel. Six resistance values of 400, 50,000, 100,000, and 500,000 ohms and 2 and 5 megohms are available, as well as 7 capacitance values, .001, .01, .05, 0.10, 0.25, 30, and 50 µf. These values, when used for grid-bias, coupling, bypass, and filter purposes, are perhaps the most common ones used in servicing. Simple continuity tests of resistance and capacitance are also available.

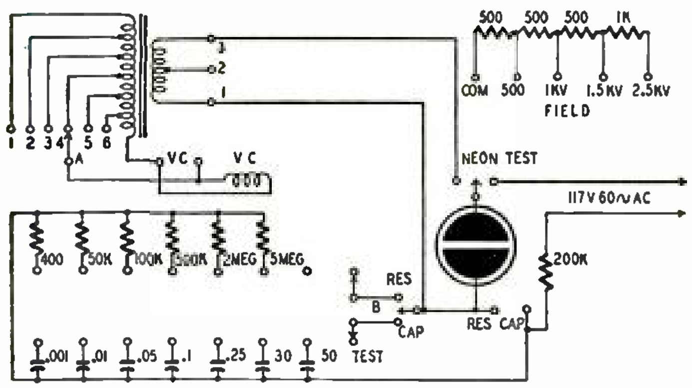
The line cord, located at the rear of the cabinet, should be plugged into any 117-volt a.c., 60-cycle source. Test leads are connected from the tip jacks marked "RES. and CAP." to the component under test. Be careful when handling the test leads, since some line potential is across the test leads during the continuity tests.

Condenser leakage can also be tested with the neon indicator. An open condenser is indicated by failure of the neon to light. If the condenser is shorted, the neon tube glows continuously. A leaky condenser is indicated by a series of rapid flashes, the percentage of leakage being determined by the rapidity of the flashes. Resistors can be tested for continuity in the same fashion. When checking resistors, the neon indicator glows continuously, the brilliancy of the neon varying with the resistance.

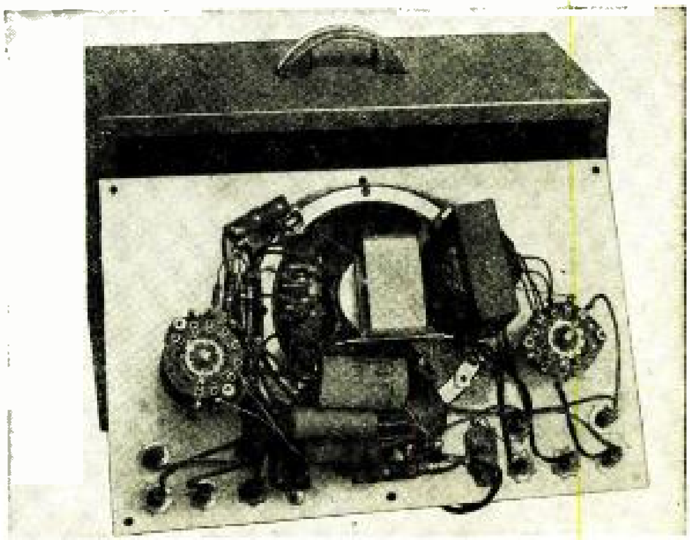
An output meter is also incorporated in the instrument. The receiver should be aligned in the conventional manner, the brilliancy of the neon tube being continuously observed. Maximum brilliancy indicates full and proper alignment.

Details of the physical construction of this instrument may be seen in the photographs. The condensers used in the instrument are rated at 600 volts, with the exception of the 2 electrolytic condensers which are rated at 150 volts. The resistors are rated at ½ watt. The voice coil of the speaker is 3.5 ohms, but this is immaterial since the speaker is fixed and the transformer varied. The tapped resistor, a heavy-duty, wire-wound type, is mounted on the side of the speaker. This resistor is tapped at 500, 1,000, and 1,500 ohms, the 2,500-ohm tap being the full-length or maximum resistance. It is used when making field replacements or substitutions. The entire unit is mounted on the front of the panel, the rear of which is easily accessible by removing the 6 panel mounting screws, and is housed in a grey wrinkled metal can measuring 10 x 7 x 5 inches.

*Test Craft Instrument Co., New York, N. Y.



As can be seen from the schematic, this is not simply a test speaker, but also has facilities for substituting condensers and resistors, as well as for continuity tests (with the neon tube). This makes it more versatile for use in the field and a real timesaver on the bench.



Rear view of the speaker panel, on which all components are mounted.

TELEVISION TROUBLE CHART

The screen of an improperly-operating television receiver is literally a sign board pointing out probable locations of the trouble. Special test patterns which are transmitted by television stations from time to time, particularly at the beginning of a broadcast, help the radioman find the defect.

In the chart below, which was prepared by engineers of the *National Radio Institute*, the effect on the television screen is described in the left-hand column. Its probable cause is listed in the middle column, and the likely remedy is given at the extreme right. Unless otherwise indicated, you may assume that the sound section of the receiver is operating normally and that all picture characteristics except those mentioned in the left-hand drawing are essentially normal.

OBSERVED EFFECT	PROBABLE CAUSES	REMEDIES
1. No image, pattern or spot on C-R tube even when brilliancy control is fully advanced.	1. Failure of high-voltage power pack. Excessively high negative bias on C-R tube grid. Image or pattern is entirely off the screen. Defective C-R tube.	1. Check high-voltage power pack. Check C-R tube bias. Check settings of beam centering controls. Try another C-R tube.
2. No image. Raster is present. Back traces are visible when brilliancy control is advanced, and are stationary.	2. Defect in video amplifier or its power supply connections. (Stationary raster indicates synchronizing impulses are controlling sweep circuits.)	2. Check tubes, parts and leads in the v.f. amplifier between the clipper connection and the C-R tube.
3. No image. Raster is present. Back traces are visible when brilliancy control is advanced, but are moving.	3. Defect in video i.f. amplifier, video detector, video amplifier stages ahead of clipper input connection.	3. Check tubes, parts and leads in signal and supply circuits of suspected stages. (Moving raster indicates synchronizing impulses are not controlling vertical blocking oscillator.)
4. No image. NO SOUND. Raster is present. Back traces are visible when brilliancy control is advanced, but are moving. Telecaster is known to be on air.	4. Defect in receiving antenna, preselector, oscillator or mixer-first detector. (Moving raster and absence of sound indicates that no signals are getting through the mixer-first detector output circuit.)	4. Check tubes, parts and leads in signal and supply circuits in and ahead of mixer-first detector. Check the low-voltage power supply serving these stages. Check the antenna system.
5. Only a spot on C-R tube screen. (No saw-tooth voltage on horizontal and vertical deflecting plates.)	5. Failure of power pack which serves sweep system. Defect in any voltage supply lead or part which is common to both horizontal and vertical sweep channels.	5. Check power pack serving sweep system, particularly the rectifier tube and filter condensers. Check common voltage supply connections to both sweep channels.
6. Horizontal line only. (No sawtooth voltage on vertical deflecting plates.)	6. Failure of the vertical sweep channel, due to a defect in the vertical blocking oscillator stage or between this stage and the vertical deflecting plates.	6. Check tubes, parts, leads and supply voltages, working from vertical blocking oscillator to vertical deflecting plates.
7. Vertical line only. (No saw-tooth voltage on horizontal deflecting plates.)	7. Failure of horizontal sweep channel, due to a defect in the horizontal blocking oscillator stage or somewhere between this stage and the horizontal deflecting plates.	7. Check tubes, parts, leads and supply voltages, working from horizontal blocking oscillator to horizontal deflecting plates.
8. Insufficient picture width. (Horizontal sweep voltage too low.)	8. Improper setting of horizontal size control. Defective tube, defective part or improper supply voltages in horizontal saw-tooth sweep oscillator stage or horizontal sweep output stage.	8. Adjust horizontal size control. If picture is still too narrow, check tubes, parts and supply voltages in horizontal output stages.
9. Insufficient picture height. (Vertical sweep voltage too low.)	9. Improper setting of vertical size control. Defective tube, defective part or improper supply voltages in vertical saw-tooth sweep oscillator stage or in vertical sweep output stage.	9. Adjust vertical size control. If picture is still too short, check tubes, parts and supply voltages in vertical saw-tooth sweep oscillator stage and vertical output stage.
10. Picture not centered with respect to mask. (Shifted to one side, to top or to bottom.)	10. Improper setting of vertical or horizontal beam centering control, giving improper bias on deflecting plates. Electromagnetic deflecting coils improperly positioned.	10. Adjust beam-centering controls. Adjust positions of electromagnetic deflecting coils; always turn off power when working on deflecting coils.
11. Picture is tilted with respect to mask.	11. Magnetic deflecting coils are not properly oriented. Electrostatic deflection type of C-R tube is not properly oriented.	11. Rotate electromagnetic deflecting yoke or entire C-R tube until the tilt is eliminated. Turn off power when making adjustments.
12. Two narrow, full-height pictures side by side, separated by a black vertical bar.	12. Horizontal sweep circuit is operating at one-half normal frequency due to improper setting of horizontal hold control.	12. Increase frequency of horizontal blocking oscillator by adjusting horizontal hold control.
13. Two short, full-width pictures one above the other, separated by a black horizontal bar.	13. Vertical sweep circuit is operating at one-half normal frequency due to improper setting of vertical hold control.	13. Increase frequency of vertical blocking oscillator by adjusting vertical hold control.
14. Right-hand half of picture superimposed on left-hand half.	14. Horizontal sweep circuit is operating at twice normal frequency due to improper setting of horizontal hold control.	14. Decrease frequency of horizontal blocking oscillator by adjusting horizontal hold control.
15. Bottom half of picture superimposed on top half.	15. Vertical sweep circuit is operating at twice normal frequency due to improper setting of vertical hold control.	15. Decrease frequency of vertical blocking oscillator by adjusting vertical hold control.
16. Entire picture slips or moves up or down. Picture is clear, with normal contrast and no abnormal interference patterns.	16. Vertical sweep channel is not "holding on to" vertical synchronizing impulses. Pulses at the input of the saw-tooth sweep generator may be too weak.	16. Check for defective parts or tubes in the vertical sweep channel, the frequency separator, the clipper and any synchronizing impulse amplifier stages if adjustment of the vertical hold control does not clear up the trouble.
16A. Same as above but with interference patterns.	16A. Excessively strong static or man-made interference pulses may be taking over control of the vertical sweep channel, or video signals may be getting through the clipper and affecting the vertical sweep generator.	16A. Listen to the vertical sweep output with headphones (high voltage off); video signals in this sweep channel may give a raspy tone instead of the usual steady tone (some sweep generator circuits will not pass video signals, so this test is not conclusive.) Adjust the hold controls.

OBSERVED EFFECT	PROBABLE CAUSES	REMEDIES
17. Entire picture slips or moves up or down. Picture is dim, with poor contrast and interference patterns.	17. The v.f. signal at the input to the clipper is too weak, indicating trouble somewhere ahead of the clipper, a poor antenna system, or too low signal strength at the receiver location.	17. Check all tubes and parts for defects which could cause low gain in stages between the clipper input and the antenna. Check the antenna system for signal pickup and interference pickup. Readjust vertical hold control.
18. Part of the picture (usually at the top) is highly distorted and shifted in a horizontal direction. Rest of picture is clear, with normal contrast and no abnormal interference patterns. No vertical movement.	18. Horizontal sweep channel is not "holding on to" horizontal synchronizing impulses, with result that picture "tears." Pulses may be too weak at the input of the saw-tooth generator. Video signals may be getting through the clipper and affecting the horizontal sweep generator.	18. Check for defective parts or tubes in the horizontal sweep channel, the frequency separator, the clipper and any synchronizing impulse amplifier stages if adjustment of the horizontal hold control does not clear up the trouble.
19. Part of the picture is highly distorted and shifted in a horizontal direction. Picture is dim, with poor contrast and interference patterns.	19. The v.f. signal at the input to the clipper is too weak, indicating trouble somewhere ahead of the clipper, a poor antenna, system or too low signal strength at the receiver location.	19. Check all tubes and parts for defects which could cause low gain in stages between the clipper input and the antenna. Check the antenna system for signal pickup. Readjust horizontal hold control.
20. All parts of picture are fuzzy—not clearly defined—and fine details are blurred.	20. Electron beam may not be properly focused on C-R tube screen, due to improper focusing electrode (first anode) voltage.	20. Adjust focus control for maximum clearness of sharply defined lines in picture. If this does not help, check the focus control and associated parts in the voltage divider of the C-R tube power pack.
21. Only the fine details in the picture are blurred or absent. Particularly noticeable on distant scenes or long studio shots.	21. Loss of higher video frequency components, due to attenuation of these components somewhere in the receiver. Consider whether it is due to original limitations in receiver performance.	21. Check alignment of video i.f. coupling units. Look for defects in the coils, condensers, resistors, and leads of coupling and equalizing circuits in the video i.f. amplifier, video detector and v.f. amplifier.
22. Picture is smeared, with white or black shadows at the right of each object.	22. Loss of lower video frequency components, accompanied by excessive phase shift at low frequencies.	22. Look for a shorted low-frequency compensating resistor in a v.f. amplifier load circuit, or an open plate or screen grid by-pass condenser in the v.f. amplifier. Look for defect in the coils, condensers, resistors and leads of video i.f. and v.f. coupling units and in low-frequency compensating circuits.
23. Vertical retraces are visible in picture.	23. Brightness and contrast controls are not properly set, or signal intensity at C-R tube input is inadequate.	23. Lower the setting of the brightness control and advance the contrast (gain) control. If normal brilliancy cannot be secured without having retraces visible, check all video signal circuits for a defective part. Check antenna pickup and television signal strength at antenna location.
24. Insufficient contrast between light and dark portions of the picture.	24. Inadequate signal strength at input of C-R tube. Sound i.f. carrier may be beating with video i.f. carrier in video detector to give a strong 4.5 mc. signal which brightens entire picture. Defective C-R tube or d.c. restorer.	24. Advance the contrast (gain) control and readjust the brightness control. Check sound I.f. rejector circuit in video channel. Look for defect in d.c. restorer circuit. Try a new C-R tube.
25. Excessive contrast between light and dark portions of the picture.	25. Excessive signal strength at input of C-R tube, due to contrast (gain) control being advanced too far, excessive signal input to receiver.	25. Lower the contrast control setting. Lower any sensitivity controls which are present in receiver.
26. Objects at left and right sides of image or at center appear wider or narrower than normal.	26. Non-linear horizontal sweep.	26. Adjust bias on horizontal sweep output tube until trouble is eliminated. Check horizontal saw-tooth sweep generator and horizontal linearity control circuit.
27. Bright vertical band along left side of picture.	27. Horizontal flyback time is too long. Picture signal is modulating electron beam as it approaches the left side of the picture during a slow horizontal retrace.	27. Look for a defective part in the horizontal saw-tooth sweep generator, particularly the parts which govern flyback time. Check for excessive capacity between horizontal deflecting plate leads and chassis. In a gaseous triode sweep generator, the current-limiting resistor may be too large.
28. One or two wide dark horizontal bands on picture. If receiver and telecaster are on different power line systems, these bars may move slowly up or down.	28. Excessive power line a.c. hum or ripple in video amplifier.	28. Check filter condensers in video and C-R tube power packs for opens and loss of capacity. Check plate and screen-grid by-pass condensers in v.f. amplifier. Check v.f. tubes for cathode to heater shorts.
29. Many irregularly-positioned horizontal black and white bars or geometric patterns on picture.	29. Sound signals are getting into the video channel and causing "cross talk."	29. Readjust the vernier tuning control. Check the sound i.f. rejector circuit at the video i.f. input. Look for open by-pass condensers if a common power supply serves both sound and video sections.
30. A pattern of fine lines or short diagonal bars appears on the picture at irregular intervals, and may or may not move.	30. Excessive diathermy interference. Carrier of police, amateur or aircraft station beating with video carrier. Intermittent high-frequency oscillation in video channel of receiver.	30. Trouble is external interference if it disappears when a television signal generator is connected in place of the antenna. Try new antenna position, or use a directive antenna oriented for minimum interference.
31. Moving white and black splotches or spots on picture and momentary loss of either vertical or horizontal synchronization.	31. Ignition interference due to automobile or other equipment employing a spark coil for ignition.	31. Move antenna farther away from street, and rotate for a maximum signal-to-noise ratio. Use a directive antenna.
32. Snowstorm effect on entire picture.	32. Signal strength at receiver input is too low; to get a picture, gain must be advanced so far that normal atmospheric interference and tube hiss affects picture.	32. If reception was normal at one time and television transmitter has not been changed, check antenna system. Check tubes, parts and voltages in preselector stage and mixer-first detector stage.
33. Dark brown or black spot in center of picture.	33. Bombardment of center of C-R tube screen by ions which come from the electron gun but are not controlled by the deflecting systems, destroying the fluorescent material in this region.	33. Replace C-R tube.
34. Ghost images in picture.	34. Signals are arriving at the receiving antenna over two or more different paths from the telecaster. Signals are being reflected back and forth in the transmission line due to improper match.	34. Change the position of the receiving antenna, or use a directive antenna so as to pick up signals over only one path. Match the receiver input to the transmission line.

(Continued on page 133)

Transatlantic News

By Major Ralph W. Hallows

RADIO-CRAFT EUROPEAN CORRESPONDENT

As had been anticipated, the Radio Exhibition proved a great success. During its ten days' run 440,320 people were admitted, and on several occasions the crowds inside the hall were so dense that doors had to be closed and "House Full" notices posted. On the whole the visitors got good value for their money, though some who expected to find clear evidence of revolutionary progress in broadcast receivers as a result of wartime developments were a little disappointed. For, apart from a few "stunts" never likely to reach the production stage, nothing in the broadcast line could have been called spectacular. Nothing, that is, of the kind to hit the listener right in the eye and make him say, "Well, things certainly have advanced in radio since I was last here eight years ago." One cynic was heard to remark that the only really notable advance was in prices!

Actually improvements and advances in radio were shown in plenty, as any visitor with a little knowledge of the subject soon realized. The mechanical side of receivers is far better (the war taught many things about making sets that stand up to hard service); the efficiency of components and of circuits is higher, ingenious design has enabled 4 tubes to do the work of 7 or 8. One point of great interest was the cleverness with which many makers contrived to substitute easily obtainable materials for those now scarce, without impairing either appearance or efficiency.

Being a dx addict, I was specially drawn to the communication receivers, very few of which have been seen in our radio stores up to now. The types now appearing are high standard, and the most exacting dx man could hardly want anything better. Some are moderately priced and simple, without such frills as S-meters or switch-in crystal control; but even these feature high sensitivity, oscillator stability, and good band-spread tuning. The best of the new communication receivers seem to have almost everything that one could ask for in a long-distance set. The General Electric BRT400, for instance, can be adjusted by a switch to any one of 6 degrees of selectivity between 0.5 and 9 kc, crystal control coming into action on the 3 narrowest band widths. Thirteen tubes are used, including several of the glass-based type. There are 6 wave-bands, and on each the effective length of the tuning scale is over 16 feet. This is real band-spreading!

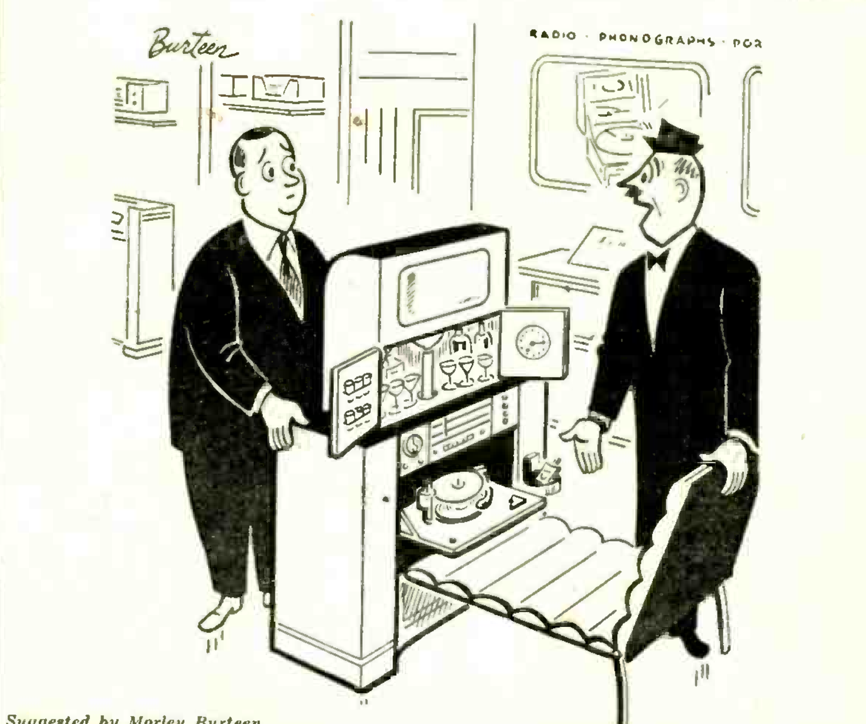
Telephone television

At first thought it might not seem possible that the wide band of frequencies needed for television modulation could be sent successfully over ordinary telephone lines, designed to deal with nothing higher than the 3,000-4,000 cycles a second required for the transmission of clearly intelligible speech. Nevertheless such lines are being used most successfully now in Britain for television outside broadcasts. Recently designed transportable repeaters make it simple to adapt subscribers' lines to exchanges and junction lines between one exchange and another for the purpose.

London now has a co-axial cable, specially laid and adjusted for television, which runs under many of the chief streets and can be tapped into at suitable points. It is very useful; but it was soon found to fall far short of meeting all requirements. More and more outside broadcasts were wanted from places which might be several miles from the nearest point of the cable. The mobile radio link is available, but there are localities in which it cannot be used on account of interference. Near airports, for example, 2-path reception is liable to occur—by the direct ray and by reflection from low-flying planes. Something had to be done about it. The answer was clearly *not* to run co-axial branches here, there, and everywhere. That would have been far too costly a business. The price of a co-axial cable and the cost of laying it are by no means the only expenses involved. Such a cable does not deal satisfactorily with very low frequencies, for on them its screening is unable to exclude interference noise. Before very low frequencies can be sent over a cable, they must be transposed, just as the accompaniment of a song may be transposed to a higher key by the pianist to suit a singer. The whole vision frequency band must be shifted upward so that it contains no picture impulses below 300 kc. That means complicated and expensive apparatus.

British subscriber telephone lines are of 6½-lb wire (6½ lbs per mile), insulated, lead-sheathed cables. The junction lines are similar, except that they

(Continued on page 104)



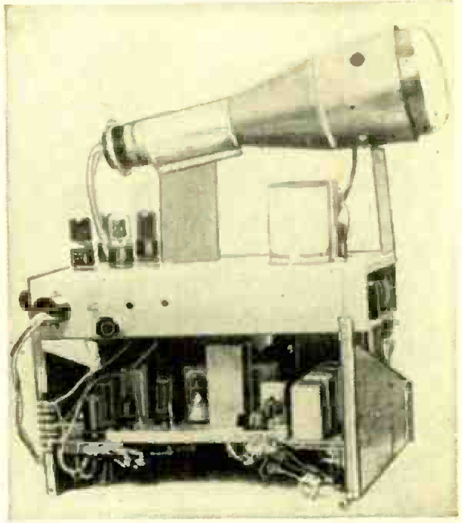
Suggested by Morley Burteen Chicago, Ill.

"Does it play, too?"

A GOOD TELEVISER FROM WAR SURPLUS

Parts from three or more pieces of surplus equipment are used in this receiver.

By ERNEST J. SCHULTZ, W2MUU



Side view of the receiver from the BC-1068.

WITH the flooding of local markets with large quantities of surplus radio gear, this radioman's long-cherished dream of a workable low-cost television receiver began the transition to active development. Little or no up-to-date constructional data on television receivers is available. Hours were spent collecting material from pre-war radio publications. We learned that the components needed for building a televiser differ little from those used in making an amateur-band receiver and a cathode-ray oscilloscope and that almost all the parts are available on the surplus market.

Television signals can be received with superheterodyne or t.r.f. receivers. Both have relative advantages and disadvantages. The t.r.f. receiver is simple but lacks sensitivity and needs a separate receiver for sound reception. The superhet has greater sensitivity and can be made to receive sound and picture signals simultaneously.

The television receiver differs widely from a conventional one because of several modifications and additions. The selectivity of a video receiver (in ham terms) is nil—ranging from 2.5 to 4 mc wide in the overall response. Video amplifiers, a sync separator and amplifier and what amounts to a complete cathode ray oscillograph, including high voltage power supplies, sweep oscillators and their associated amplifiers must be added to the receiver.

It took about a week to get our first set going and another week to get the "bugs" out of it. To simplify matters an i.f. strip reputed to have an operating frequency of 60 mc was bought for about $10.00 with tubes. This strip was modified to the circuit shown in Fig. 1 and performed as a t.r.f. receiver with 4 t.r.f. stages. When used in conjunction with the sweep and cathode-ray circuits shown in Fig. 2, a complete t.r.f. video receiver is obtained.

A 6H6 sync-pulse and video detector was connected to the output of the 4th r.f. amplifier. The synchronizing pulses and video signal were taken from the cathodes of the 6H6 and applied to the sync-pulse and video amplifiers mounted on the chassis with the cathode-ray tube and associated components. The 6AC7 sync amplifier is coupled to the 6H6 through an r.f. choke. This choke and the one in the plate of the 6AC7 are made of single pies from a 2.5-mh r.f. choke.

If a 60-mc i.f. strip is not available, one can be made easily by following the diagram in Fig. 1. The Western Electric 717-A's can be replaced with 6AC7's. Coils L1 to L5 are air-wound with 3 turns of No. 14 wire with an inside diameter of ½ inch. These are tuned with 3-to-25-μμf ceramic trimmers, C1 to C5. The filaments are wired in parallel with one side grounded. Each filament is bypassed with a 470-μμf condenser.

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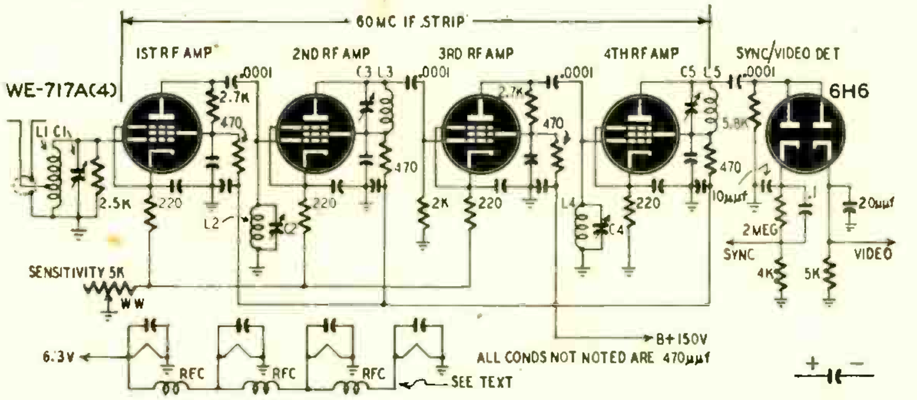

Fig. 1—The i.f. strip used as an r.f. amplifier in the first experimental receiver setup.

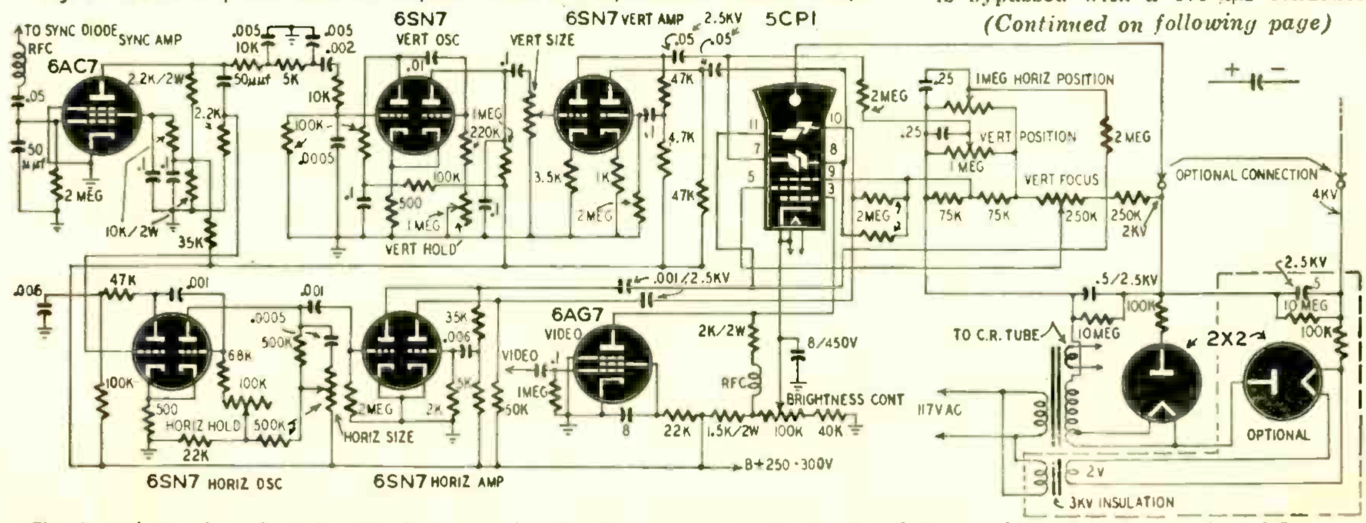

Fig. 2—Video and synchronizing circuits to complete the receiver when used with the r.f. stages of Fig. 1 or the superhet of Fig. 3.

The hot side of the filaments are connected together through small r.f. chokes made by winding about 19 turns of No. 23 enamel wire close on a 1-megohm 1-watt resistor.

In the first experimental setup, it was difficult to tune from one station to another as each coil of the i.f. strip was tuned individually. This disadvantage was overcome by using ganged tuning condensers in place of the trimmers shown in the diagram. This arrangement makes a satisfactory video receptor but a separate receiver is required for sound. We revamped an old Meissner FM converter for the job.

The second receiver

After experimenting with the t.r.f. circuit, we decided to give the superhet type of receiver a trial. A survey of the surplus scene disclosed that several receivers were available and decided in favor of the BC-1068-A. Only a few modifications are needed to convert this receiver for television, but several additions are necessary. The television stations in New York City at the present time occupy channels 2, 4 and 5 which are 54-60, 66-72 and 76-82 mc respectively. The BC-1068 tuning range was calibrated from 155 to 200 mc and we hoped that by the addition of shunt capacities, the r.f. section could be made to tune the range. This hope proved short-lived as subsequent tests showed that with enough capacity to tune in the lowest frequency station, we could not reach the highest frequency channel.

After giving more consideration to the subject, we decided that a simple oscillator-mixer combination with band switching could be installed with considerably less effort than taking apart the r.f. sub-assembly and rewinding all the coils. The r.f. sub-chassis and front panel were removed as shown in the photographs. The bottom shield of the r.f. section was retained and used as a chassis for the audio i.f. and amplifier unit.

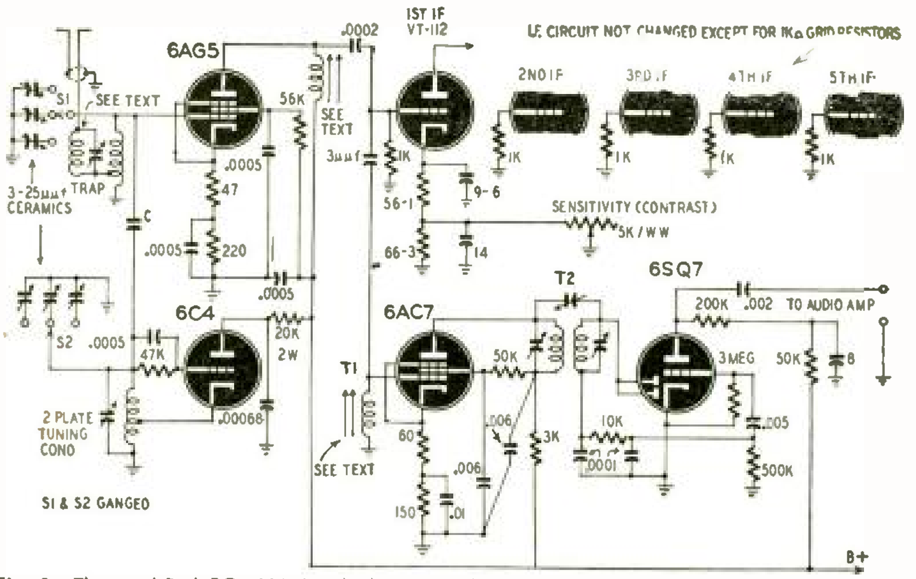

Fig. 3—The modified BC-1068-A, which was used as front end of the circuit finally adopted.

A new front end, consisting of a 6AG5 mixer and 6C4 oscillator, Fig. 3, was wired up. The antenna coil has 4 turns of No. 14 wire ½ inch in diameter and ⅝ inch long. This coil is tapped 1 turn from the ground end. The oscillator coil has 3 turns of No. 14 wire ½ inch long and ½ inch in diameter tapped 1 turn above ground. The parallel-tuned trap in the antenna lead (if needed) consists of 5 turns of No. 14 ½ inch in diameter and ¾ inch long tuned by a 3 to 30-μμf trimmer. Coupling between the mixer and oscillator is through gimmick C. This consists of 2 pieces of cambric-insulated hookup wire twisted together for about 1 inch.

The antenna and oscillator coils are tuned by switching pretuned 3-25-μμf ceramic trimmer condensers across them. A 2-plate variable condenser is permanently connected across the oscillator to provide vernier tuning for the audio channel.

We removed the first i.f. transformer of the BC-1068-A, consisting of parts No. 55, 95 and 101, designed to work from a diode mixer, and installed transformer No. 99; with condenser No. 5-3 removed from the tuning-eye, in the mixer plate circuit. To keeps leads short, mount the 6AG5 and 6C4 close to the first i.f. transformer as shown in the photograph of the r.f. chassis.

The i.f. channel of the BC-1068-A was used as is with minor additions. We shunted a 1000-ohm resistor between each i.f. grid and ground and inserted a 5,000-ohm contrast or sensitivity control in the cathode circuit of the first i.f. amplifier. The 6H6 second detector is converted, as in Fig. 4, to a video and sync pulse detector.

We replaced the video amplifier tube, 6SH7, with a 6AG7 and installed circuit components to supply the correct voltages. The 6SN7 cathode follower circuit was disconnected and the tube socket rewired for a synchronizing pulse amplifier using a 6AC7.

The sweep oscillator circuits and high-voltage power supply were built on a separate chassis with the cathode-ray tube mounted on top. The whole chassis is then fastened with brackets to the top of the 1068 receiver. Three controls,

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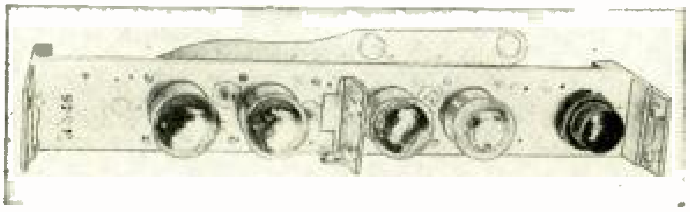
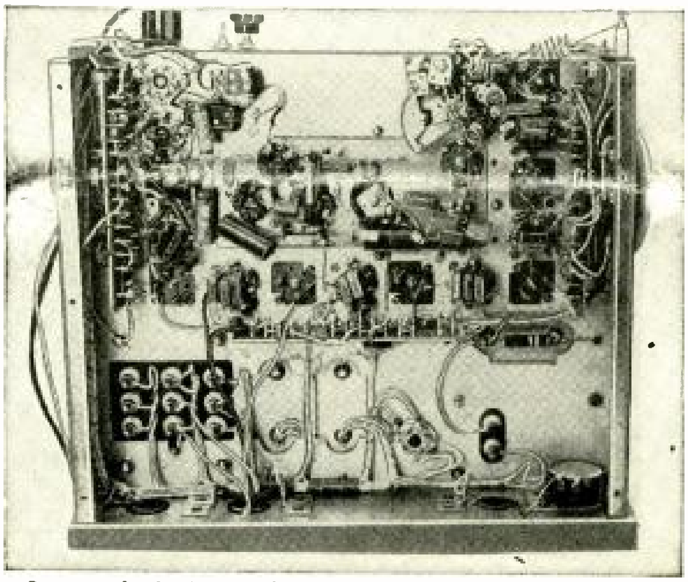


This is the 60-mc i.f. strip used in the t.r.f. video receiver.

Converted BC-1068. R.f. circuits at right, sound channel at center.



Bottom of r.f. chassis. The sensitivity control is at lower right.

Kickback Power Supply

Several television receivers use r.f. high-voltage supply systems

By W. H. BUCHSBAUM

ALL television receivers using cathode-ray tubes of a screen diameter of 10 inches or more require a second-anode voltage from 9,000 to 15,000. All tubes of this size are built for magnetic deflection, instead of for the electrostatic deflection used in smaller tubes. The high voltage requires a special transformer and a special filter system. If it is to be obtained from the 60-c.p.s. power line, relatively large condensers are needed to smooth out the rectified a.c. These condensers, as well as such a 60-c.p.s., 10,000-volt transformer, are expensive.

Another method of obtaining high voltage uses an r.f. oscillator, step-up transformer and rectifier, and an r.f. filter. This frequently used system has the disadvantage of greater cost and more components and, therefore, more possibilities for failure. R.f. power supplies are also likely to interfere with the video signal and produce an undesired pattern on the screen of the cathode-ray tube.

Magnetic deflection requires large currents to set up magnetic fields strong enough to deflect the electron beam in the cathode-ray tube. These currents are obtained with a step-down transformer as are the large sound currents in the voice coil, produced by the sound output transformer.

The flyback or kickback high-voltage power supply utilizes a single transformer to provide the required large current for the deflecting coils and also the second-anode voltage. We shall now see how, by an ingenious system and various conventional circuits, a voltage of about 9,500 volts and currents which reach a peak of 0.5 ampere are obtained with an input of only 350 volts d.c. at about 60 milliamperes. To provide a picture at the present standards of 525 lines per frame and 30 frames per second, using interlaced scanning, we need a force to sweep the electron beam horizontally at a frequency of 15,750 c.p.s. and vertically at 60 c.p.s. Furthermore the beam has to be moved from left to right relatively slowly and from right to left very fast, downward slowly, and upward very fast. The movement from right to left and from the bottom of the picture to the top is called the retrace, or flyback. For a 10-inch cathode-ray tube this horizontal flyback should be of 8 microseconds duration. The vertical flyback time is longer, but during both these intervals the cathode ray tube is blanked out, due to the blanking pulses contained in the video signal.

To have a magnetic scanning field vary in strength and polarity to give the above results, we need a saw-tooth current of 15,750-c.p.s. frequency and another saw-tooth current of 60-c.p.s. frequency, flowing through 2 sets of coils positioned around the neck of the cathode-ray tube. These coils are called the *deflecting yoke.*

When a saw-tooth current flows through a resistor, the voltage across it is a saw-tooth voltage (Fig. 1-a). A saw-tooth current flowing through a pure inductance would give a square wave voltage across it (Fig. 1-b), but every inductance contains some resistance so that in practice the saw-tooth current through a coil produces the voltage shown in Fig. 1-c, which is really a combination of a square wave and a saw-tooth wave. Such a voltage is obtained from a multivibrator or blocking oscillator by permitting the square wave to charge a condenser through a resistor. Naturally, the value of this condenser and resistor combination has to conform to the charging and discharging time of the square-wave frequency, i.e., 15,750 c.p.s. or 60 c.p.s.

Fig. 2 shows a typical circuit for obtaining such a voltage wave. It employs a blocking oscillator transformer T1, the oscillator tube V1 and the discharge tube V2, which is coupled directly to the grid of V1. The condenser C3 and resistor R4 shape the saw-tooth —square-wave combination which is then applied to the grid of the amplifier V3. This has to be a powerful tube. Usually one or two 807's in parallel or the specially designed 6BG6 are used for the horizontal sweep amplifier. The cathode resistor R6 provides some degeneration, thus keeping the gain of this stage at a safe limit. By varying the screen resistor R8 we vary the screen voltage and, therefore, the amplification. This potentiometer, as well as R3, which controls the plate voltage on the discharge tube V2, are usually mounted on the rear of the chassis and control the sweep width and the linearity to some degree. Plate voltage is supplied to the amplifier V3 through the primary of the deflection transformer. This deflection transformer, especially the one for the horizontal sweep (15,750 c.p.s.), has to be of special construction to pass all harmonics because the harmonic content determines the sharpness of the saw-tooth waves. Most of these transform-

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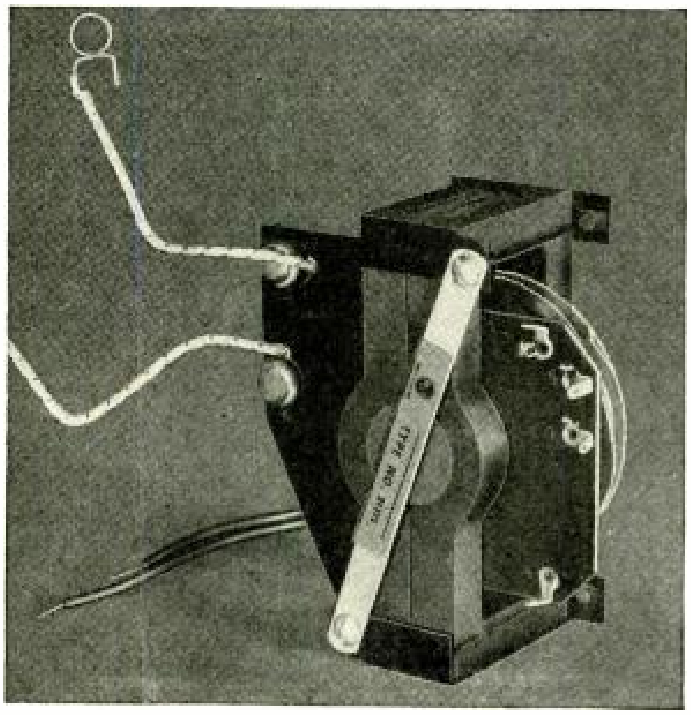

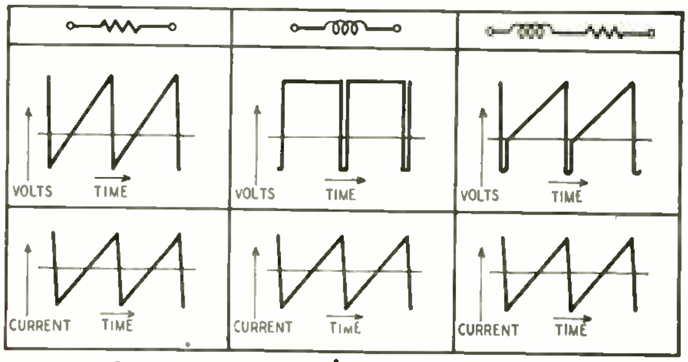

Fig. 1—Voltage and current waves in resistive-inductive circuits.
Left—The high-voltage transformer of the flyback power supply.

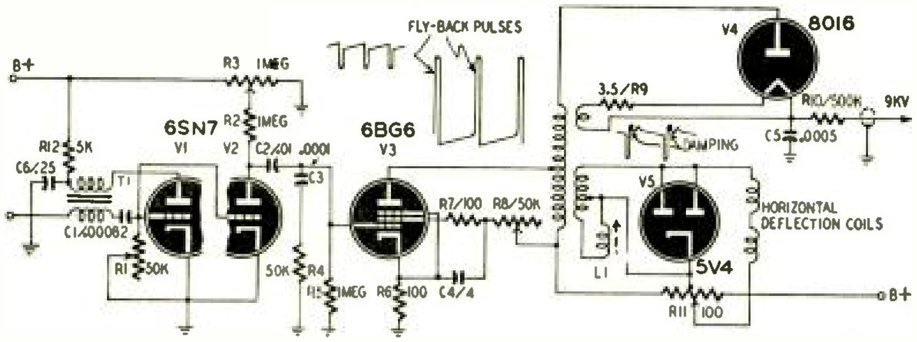

Fig. 2—This simple kickback high-voltage supply illustrates the principles discussed.

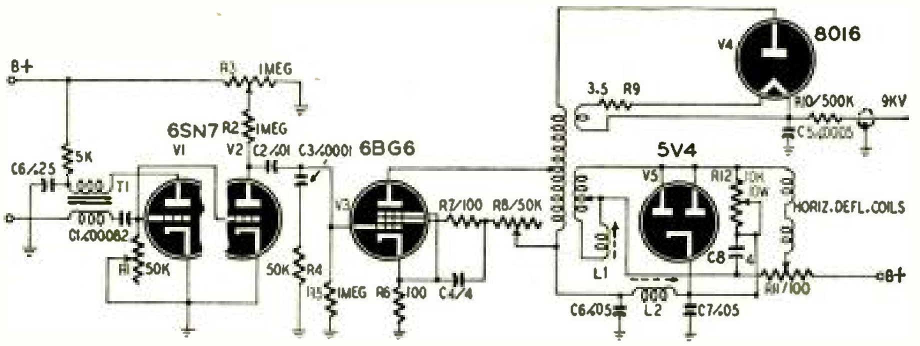

Fig. 3—Commercial model of kickback power supply as used in some recent teleceivers.

ers are wound on a molded powdered-iron core and use Litz wire. The transformer inductance increases the voltage of the rapid flyback pulses very greatly compared to the slower saw-tooth voltage. In Fig. 2 we see the saw-tooth voltage containing the flyback pulse as originally determined by the charging condenser C3 and R4. On the plate of the amplifier tube this same voltage appears inverted and the flyback pulses of much greater amplitude.

In actual practice the flyback pulses may reach as much as 6,000 volts. It is those high-voltage flyback pulses which are utilized to obtain the second-anode voltage. An additional winding on the primary acts like an autotransformer, stepping the voltage of these pulses up to 10,000. Then this voltage is applied to a rectifier V4, rectified, and filtered through the filter formed by R10 and C5, which is usually a 500-μμf, 10,000-volt condenser. The capacitance between the second-anode coating on the inside of the cathode-ray tube and the grounded outside coating provides the second part of this π-filter.

Filament voltage for the rectifier tube V4 is usually obtained by placing a 2-turn loop in the field of the horizontal output transformer. Since the filament voltage has to be 1.25 volts and a tolerance of ± 20% is the maximum permitted, the location of this loop is somewhat critical. To standardize this position, the RCA horizontal output transformer (RCA No. 211T1, see photograph) has 2 small bakelite discs which hold the filament loop in place. A 3.5-ohm resistor R9, is placed in series with the filaments to prevent excessive current drain and to prolong the life of the rectifier tube. Keep in mind that this loop is *hot*—9,000 volts d.c. Usually this loop is constructed of No. 18 polyethylene-covered wire which can easily withstand the high potential.

Most tube sockets do not provide sufficient insulation for the high voltage. Therefore it becomes necessary either to place the socket of the rectifier tube on well-insulated stand-offs, or to provide a bakelite or lucite mounting plate. On a dry day, 9,000 volts will arc over about ½ inch of air and over as much as ¾ inch when the humidity rises to 90%. Care must be taken to keep all high-voltage leads and connections at least 1 inch away from any grounded point. Corona may also appear if any sharp edges or very thin conductors leave the high-frequency current insufficient space on the surface of the metal. This may easily be recognized by a hissing noise and by the sight of small bluish needles which seem to stick out of the metal right into space. Smooth round joints and large-diameter wire are the best cures for corona.

In Fig. 2 the secondary of the transformer is connected to both horizontal deflecting coils and also to the center-tapped potentiometer R11 and a small shunting inductor L1. This potentiometer, one side of which is connected to B-plus, provides a small direct current through the deflecting coils. This small direct current adds or subtracts from the saw-tooth current and thus regulates the relative position of the electron beam in the cathode-ray tube. It is usually mounted in the rear of the chassis. Each television receiver has such a horizontal and vertical centering control.

The shunting inductor L1 is provided to make up for any nonlinearity caused by the current drain of the high-voltage winding which otherwise would tend to unbalance the transformer primary. This coil is permeability-tuned and may be adjusted for better horizontal linearity.

A duo-diode is connected directly across the secondary of the horizontal output transformer. Its function is to prevent any damped oscillations, and it is therefore called a damping tube. When large currents surge backward and forward through an inductive circuit, there is a tendency to continue this surging motion, just as a spring that is pushed down by a weight momentarily tends to bob up and down for a while. Such damped oscillations are very undesirable, since they would sweep the electron beam several times back and forth at the left side of the picture before resuming the sweep from left to right. The diode V5 acts as an open switch until the plates are driven positive by the rebound of the flyback pulse. When the plates go positive, this tube draws current. All this rebound current which would otherwise flow through the deflecting coil is thus shunted out by the diode and cannot act on the electron beam on the cathode-ray tube.

Only a few conventional rectifier tubes can pass a current of such a magnitude even if only for a few microseconds. The type 5V4 shown in our illustration has recently been reclassified since it was found to be the most economical tube for this purpose. Another type tube, the 6AS7G, was originally developed just as a damping tube, but its high price makes its application unwarranted.

The circuit of a kickback high-voltage power supply as used in the latest commercial models is shown in Fig. 3. The blocking oscillator transformer, discharge tube, and saw-tooth amplifier are as in the preceding diagram of Figure 2. The high-voltage autotransformer winding with the subsequent rectifier and the filter system remain the same, but some parts have been added in the secondary circuit. D.c. plate and screen voltage for the saw tooth amplifier are now obtained through the centering control R11, the transformer secondary, and then through resistor R12 which shunts the damping tube. Next this d.c. travels through coil L2 and then branches off into the primary to the plate and the screen resistor to furnish screen potential. The purpose of this arrangement is to gain additional d.c. voltage. Here is how it is done. The filter consisting of L2 and the condensers C6 and C7 prevents any saw-tooth current from the transformer primary from entering the secondary directly and, at the same time, prevents any of the saw-tooth current in the secondary from interfering with the primary circuit. The tapped resistor R12 is usually adjusted at about 6,000 ohms and shunts the damping tube.

When a rebound pulse drives the plate of the damping tube positive, the current flowing through it charges condensers C7 and C8. Condenser C7 is of such value that a 15,750-c.p.s. pulse tends to keep it charged at all times. In other words, the filter consisting of L2, C7, C8 and the damping diode act just like a regular rectifier and filter and provide a d.c. output voltage. This d.c. voltage is in addition to the regular

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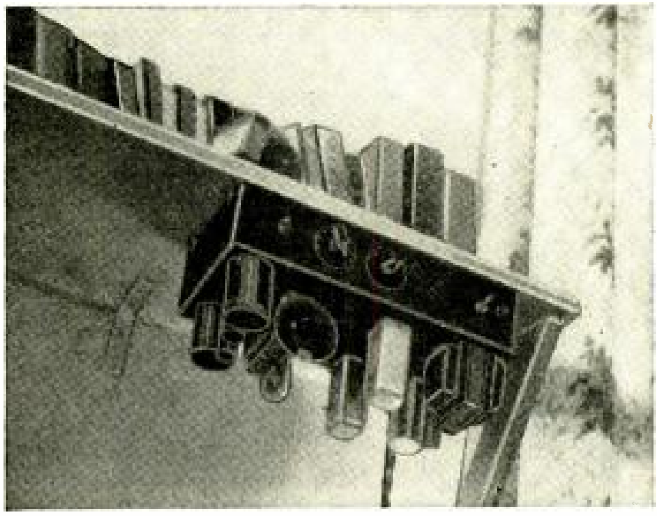
Hi-Fi Tuner Tribulations


The upside-down mounting is a space-saving arrangement.

By JAMES R. LANGHAM

BEFORE we moved to San Diego we used a simple little t.r.f. tuner. Very simple. All there was on the chassis was a single r.f. amplifier and an infinite impedance detector. That was, as I say, before we moved to San Diego.

One of the features of San Diego is its proximity to Mexico—Mexico has its own broadcasting stations. The Mexican stations aim their stuff to where the moneyed listeners are. Naturally. That means they beam their stuff up north with lots of power. And they pick their frequencies as closely as possible to those of the big network stations of this country so as to catch as many listeners as possible. Their frequency control is not so rigorous down there and if they drift even closer to the big gringo stations—quien sabe?

The XYL was the first to kick about it. She couldn't get the Sunday symphony over KNX, the Los Angeles CBS station. There was a Mexican station cluttering up Haydn with recorded western tunes.

"Okay," I told her. "Okay. As soon as I get time I'll fix it up."

KNX has 50 kilowatts and is about 125 miles north of San Diego. "I'll peak it up a bit."

A simple little t.r.f. without even a.v.c.—nothing to it. Set the oscillator to 1500 and peak it up. I did. Then I tuned to KNX and right in the middle of the CBS program was that nostalgic little ballad of the wide open spaces: "You Are My Sunshine."

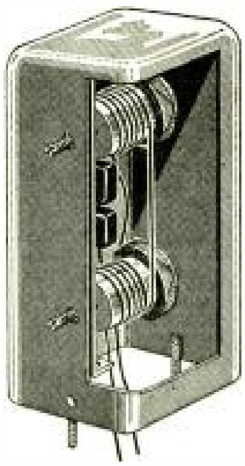
Well, I looked into the matter. The call letters of our Mexican station were XERB, and it beamed its signal north with a 50-kw final feeding a 2-element array. Its assigned frequency was 20 kc away from KNX. I'm not saying they drifted toward KNX because I made no measurement of their frequency.

At that time KNX was the only Columbia outlet for southern California, and the XYL had to have her Sunday symphony: It was wartime and new radios just weren't. I decided to build a wave trap.

Supers are selective

An oatmeal box and some 30-36 wire made a nice high-Q coil which I resonated with about 5 or 6 micromikes of silver-mica condenser. I still think it helped some, but the XYL claimed it just cut down the over-all level and left the symphony-to-Gene Autry ratio the same. At any rate it wasn't what you'd call satisfactory.

A fellow up where I worked had an old superhet chassis in his garage that he let me have (for $15.00, the robber!), and I spent several off hours getting parts to make it play. There was no cabinet, no dial, no speaker, and no r.f. stage; but it was a radio. I scored the 42 audio and tapped off the diode to get into my own amplifier.


Electric "tune control." Six turns are wound clockwise around i.f. primary and secondary.

Man alive, was that thing lousy! I lined it up without a scope and it kept spilling over and oscillating. Some ship's c.w. came booming in through the i.f., and there was plenty of converter noise. The only time the XYL would use it was when she wanted to listen to KNX. The rest of the time she would switch back to the simple little t.r.f. deal.

I couldn't get a 3-gang condenser then, so I re-wired the output socket into an untuned r.f. stage. That cut down on the converter noise. Then I borrowed a 'scope and wobbulator and flat-topped the thing. I stopped the oscillation by tin-snipping a shield from the XYL's tea canister (she made a few remarks about that) and stopped the c.w. by picking an i.f. where there were no ships.

We were living in cramped quarters then, and it was a little inconvenient to have both tuners around—one broad and one sharp. The XYL had a regular octopus of clip leads that she used to juggle around. First the NBC programs on the t.r.f., then the CBS symphony on the super, and then back to the t.r.f. for something else. All this had a faintly audible background of comment about shoemakers' children and radio engineers' wives.

One of her friends inherited a fantastic radio about then. It had a nickeled chassis, a lovely dial, more knobs than some transmitters, and cost around $2,000. The XYL readily admitted ours sounded better on some stations but: "It has variable-band-width, i.f. coils in it. I looked in back and it has a cam that pushes the coils closer and further apart. Couldn't you rig us up something along that line?"

A variable I. F. amplifier

That was a worthy thought. Overcoupling would broaden the band very nicely, but how could I control it? I wanted it sharp on KNX and broad over the rest of the dial. I took one of the i.f. cans off and apart and tried to figure out a way. No go.

Then the XYL got another good idea. "Why," she asked, "do it mechanically? What if you did it electrically? Maybe wind some extra turns on both primary and secondary. On a switch or something."

Inside an hour we had both i.f. coils apart and were arguing about how many turns. We couldn't count the turns already on the coils and I guessed 10 would be right. The XYL thought 2.

As a compromise we added 3 clockwise turns to the primary, brought up the wire and added 3 clockwise to the secondary, then brought the ends down to twist together. Then we put the whole thing back together and fired it up.

It worked. It broadened the band but not enough. You could hear the treble creep in when the ends were twisted together.

Off came the coils again. Off came the cans. Off came the 3 turns and on went 10 turns. By the time I had finished

(Continued on page 87)

5-100 METER MIGHTY MITE

This two-tube superregenerative receiver uses 3S4's and polystyrene plug-in coils

By BOB WHITE

The little radio can operate a loudspeaker.

THIS midget battery-operated receiver employs 2 type 3S4 miniature radio tubes which function as a sensitive superregenerative detector and a pentode audio amplifier. Seven specially designed plug-in coils give the receiver a continuous range of 5 to 100 meters. The circuit is shown in Fig. 1.

The receiver is 3½ inches high, 3½ inches wide, and 2½ inches deep. It weighs less than 1 pound. After the 1½ x 3½ x 2½-inch aluminum chassis was marked and drilled, the midget audio transformer and 3 miniature tube sockets were mounted on the chassis, and the tuning condenser (a 100-μμf air padder) and potentiometer were mounted under the chassis. The front panel was made from a sheet of white celluloid ⅛-inch thick. On this were mounted the phone jacks, the tuning dial marker, and the optional pilot light jewel and bracket. The panel was fastened securely to the chassis with 2 screws after the important parts were mounted.

Stranded flexible wire, preferably with rubber insulation should be used for the filament, amplifier, aerial, and battery leads. Solid hookup wire is best for wiring the detector. A careful job of soldering is essential.

For headphone reception the receiver will operate with 30 to 67½ volts on the plates, but for loudspeaker operation the latter voltage is required. The B-battery in the model pictured can be replaced easily because of the snap connections. The 2 filament flashlight cells are easily replaced without soldering. As Fig. 2 clearly shows, a large soldering luglike connector fits over each of the positive caps of the cells, and a sharp spearlike wire soldered to the flexible battery lead fits between the zinc case and the cardboard container.

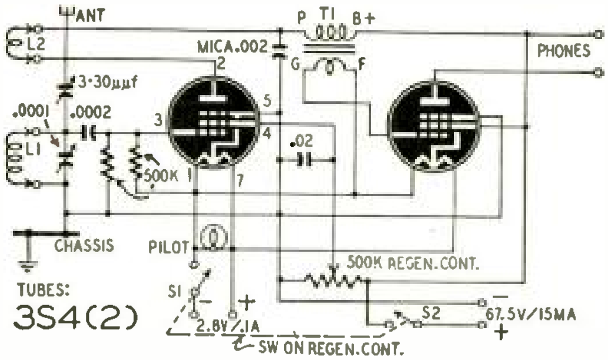
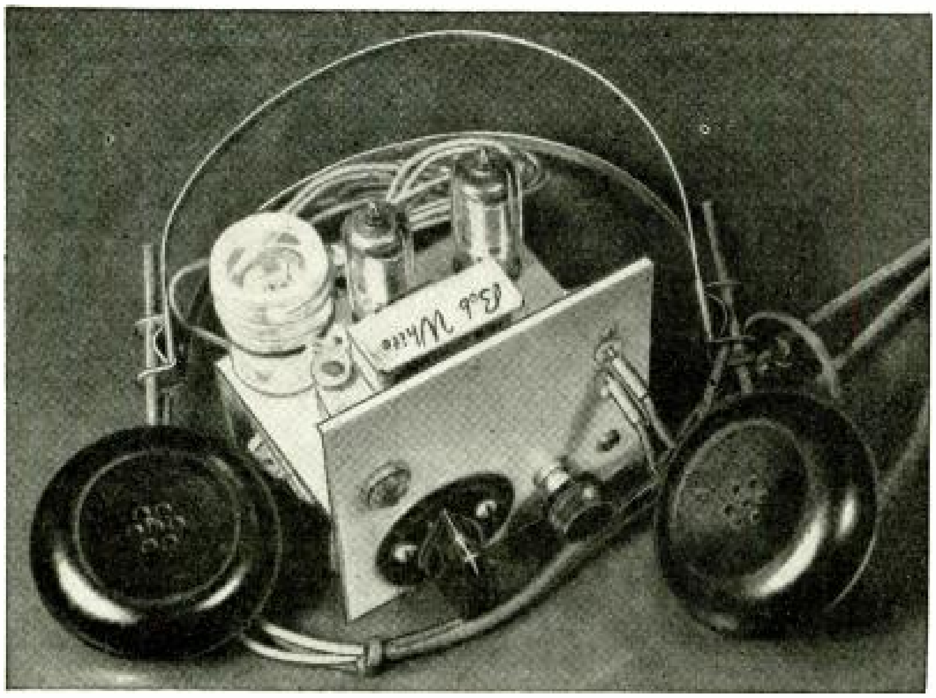


Fig. 1—The circuit. T1 is a midget audio transformer.

How the coils are made

The plug-in coils were made from polystyrene insulator cups, which are available as war surplus. A cup before being converted is pictured with the other coils. To make the coils, the following instructions should be carefully followed: Stiff wire about the same size as the pins used in miniature tubes is required. It should be straightened and cut into lengths about 3 inches long.

The bottom of each transparent cup is placed directly on top of a miniature socket, and the place where the pins should go through the bottom to fit holes 1, 3, 5 and 7 is marked with a pencil. The cup is then placed upside down, and the markings on the inside are indented on the bottom with a sharp center punch. An additional mark must be made to show in what direction the coil is to be plugged into the socket. (See Fig. 3 for coil details.) Although it is not necessary, a hole smaller than the wire may be drilled to help in the placement of the 4 pins. Hold the wire against the mark, or hole, with pliers, and touch a small-tip soldering iron to the wire, being careful not to touch the cup with the hot iron. The polystyrene cup will become soft, and the hot wire can be pushed through the form easily. Leave about ½ inch of wire protruding from the base. After the wire cools, it can be bent at the inside of the base to rest snugly against the wall of the cup. Applying the soldering iron on the inside to the part of the bent wire parallel to the base will force the horizontal section to sink into the base slightly so that it will be permanently, rigidly placed. After installing all 4 wires, straighten and trim the pins so that they will fit the socket properly.



The whole miniature receiver rests comfortably inside the headband of a pair of phones.

Next drill holes for the coil leads and follow the data given in the coil table. The leads of the coils are twisted around the stiff pins and then soldered. Push the hot wire and connection into the side of the cup on the inside to make it a permanent job. Trim the excess pin wire off above the connection. With the 5-6½-meter coil the grid winding is the same size wire as the pins so there is no need to solder the coil to the pins. After testing the coils, coat them with coil dope. CAUTION: If the soldering iron or drops of hot solder fall on the polystyrene cup, it will mar the finish; also, do not use solvent to clean the coil form because it will make the plastic sticky.

Operating hints

The receiver is provided with a d.p.s.t. switch on the superregeneration control; this eliminates the necessity of disconnecting the batteries when they are not in use. The pilot lamp can be unscrewed when desired for conserving the filament battery.

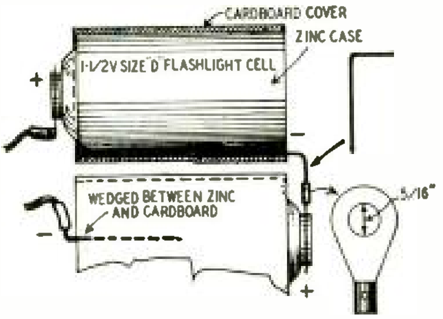
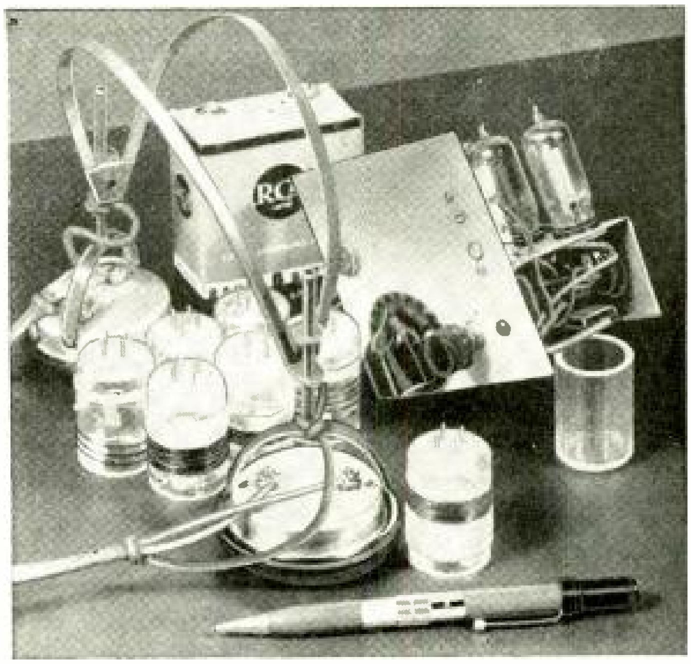


Fig. 2—The connectors for the A-batteries.

The receiver will not function properly if the batteries are not in good condition. Howling of the amplifier with the plug-in coils removed is most probably due to an old B-battery with high internal resistance. Fading of the signal after a few minutes or lack of pep is usually a sign of weak filament cells, and can be cured immediately by replacing them.

When the superregeneration control is advanced clockwise, it will first cause the receiver to regenerate. This type of oscillation is suited for c.w. reception. The point just below oscillation can be used for phone reception on the lower frequencies if a standard aerial is employed. When the control is advanced further, the receiver will superregenerate. The detector in this condition is very sensitive and somewhat broad tuning. Any increase of the control beyond this point will be of no benefit.



The little allwave radio is not as large as its own B-battery.

To protect your ears when phones are used, turn down the control before changing coils.

The high-frequency coils will probably not oscillate over the entire range of the tuning condenser.

The aerial need be only 3 feet long for satisfactory reception of foreign stations. To stabilize the detector at ultra-high frequencies, it is necessary to use a 3-foot ground wire connected to the chassis. With superregeneration on the lower frequencies, a high-pitched squeal may be heard. It can be eliminated by using a longer aerial and tightening the antenna trimmer condenser. If the detector fails to oscillate at high frequencies, loosen the antenna coupling condenser.

During tests conducted in Los Angeles, England and Australia have been received with good loudspeaker volume.

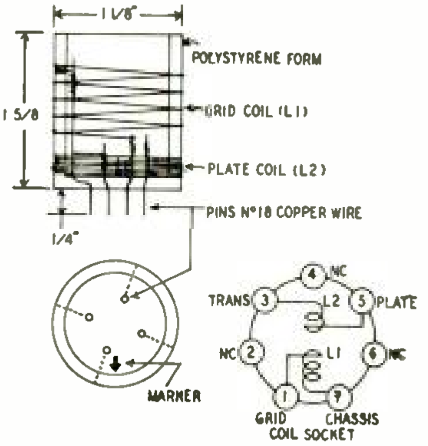
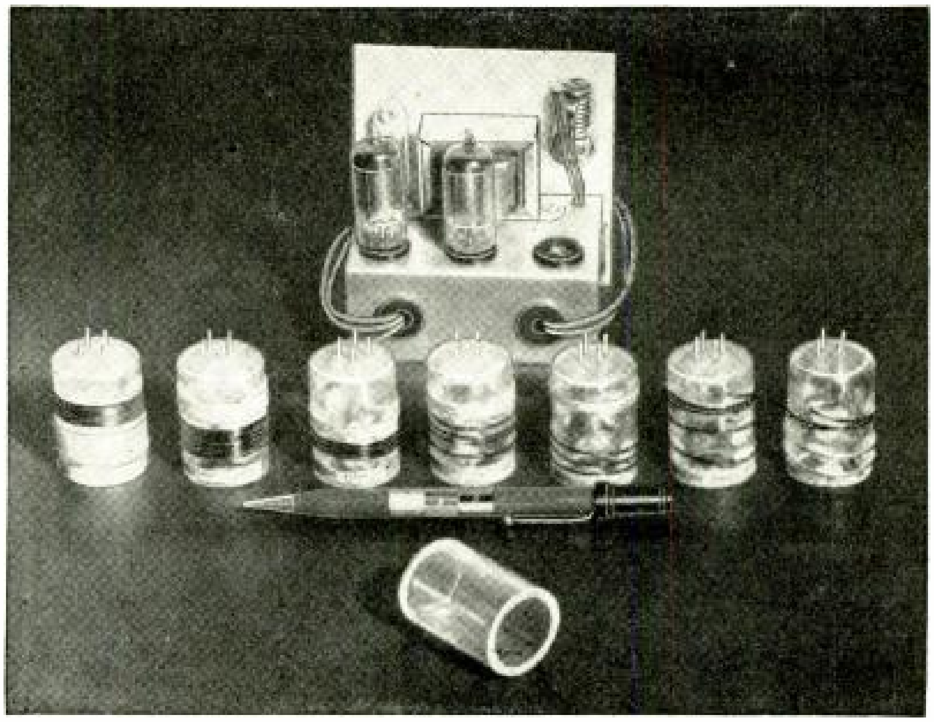


Fig. 3—Construction of the plug-in coils.

PLUG-IN COIL DATA TABLE

Plate coil and grid coil are wound in the same direction. Diameter of all coil forms is 1⅛ inches.

Approx. Wave Length (meters) of Coil	Grid Winding L1	Plate Winding L2
5-6½	2 turns spaced No. 18 wire	2¾ turns close No. 22 enameled wire
6½-9	2 turns spaced No. 22 enameled wire	3¾ turns close No. 22 enameled wire
9-13	3 turns spaced No. 22 enameled wire	5¾ turns close No. 28 cotton-covered wire
13-20	4¼ turns spaced No. 22 enameled wire	7¾ turns close No. 28 cotton-covered wire
20-40	7 turns close No. 22 enameled wire	7¾ turns close No. 28 cotton-covered wire
38-75	13 turns close No. 22 enameled wire	12¾ turns close No. 28 cotton-covered wire
65-110	21 turns close No. 28 cotton-covered wire	28 turns close No. 36 cotton-covered wire



Rear-chassis view, with coils removed. The six shown cover the band from 5 to 100 meters.

This Signal Generator Is Pocket Size

New Model has interesting Hartley Oscillator circuit and neon tube

By CHARLES URBAN *

POCKET signal generators have been described in articles from time to time. In almost all cases these devices used high-frequency buzzers with inductive and capacitive components to produce radio-frequency hash more or less confined to certain bands of operation. Such devices are limited where accurate radio diagnosis or alignment is required. This generator has been designed as a portable tool for rapidly estimating radio work to be done or to facilitate repairs made in the field. Its small size, operation on either a.c. or d.c., and high power output make it ideal to be carried in a serviceman's tool kit or in his pocket. The circuit design of the pocket generator maintains calibration even under rough treatment, an important factor not generally found in larger shop equipment.

The generator produces a modulated r.f. output equal in power to that of the conventional bench signal generator. This is made possible by using the miniature 12BA6, whose characteristics are identical with those of larger tubes commonly used to produce radio-frequency energy.

Space is saved by using a neon bulb to develop the a.f. modulating voltage. The bulb's oscillation is controlled to produce a note in the neighborhood of 400 cycles per second. The note produced by a neon-tube oscillator has a musical quality because of the numerous harmonics in its complex wave.

The 4 spot frequencies provided may be used in the servicing and alignment of more than 85% of all AM receivers built in the last 15 years and (to the best of our knowledge) all receivers built in the last 2 years. These 4 frequencies are 456 and 465 kc for the intermediate frequencies, and 550 and 1500 kc for the extremes of the broadcast band.

The new selenium rectifiers lend themselves to more compact design—therefore one of them was chosen, and an a.c.-d.c. circuit selected. Line voltages are isolated from the output and from the case, preventing any difficulties when working on other a.c.-d.c. equipment. The attenuator has been found especially useful in alignment work.

Hartley oscillator circuit

The circuit (Fig. 1) is a modified Hartley or electron-coupled oscillator. It is very stable, as can be verified by varying the supply voltage from 85 to 140 volts and observing the lack of drift. Such stability is of paramount importance in alignment work with a portable instrument which is subject to the differences in line voltage found in the field. The stability is due to choice of tube, relationship between the plate and screen voltages, and the series cathode resistor. The 12BA6 tube is the miniature equivalent of a 12SJ7.

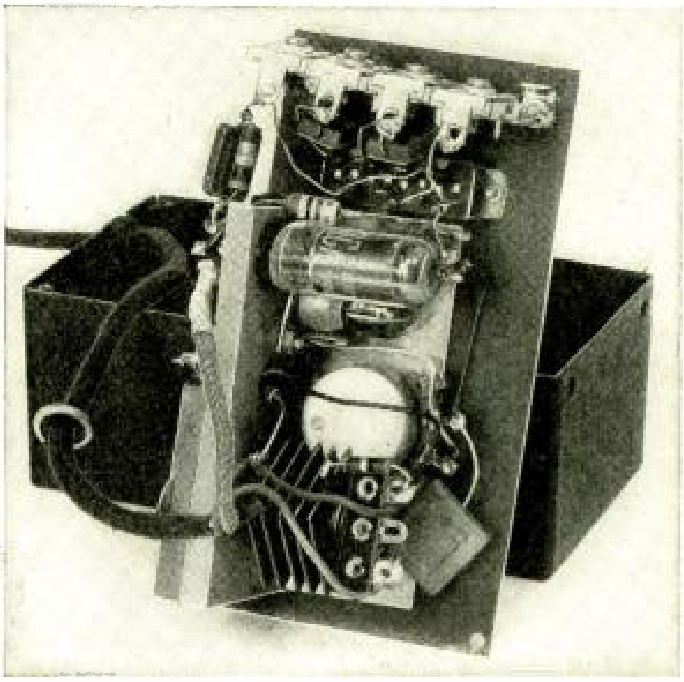
The oscillator coil is a conventional broadcast-band oscillator coil designed for Hartley operation with a 6SA7 tube in a circuit with an intermediate frequency of 456 kc. The 4 switch positions of the frequency-selecting system add capacitance across the coil, reducing the frequency. The 80-μμf trimmer remains across the coil at all times. The 3 lower frequency steps add capacitance in parallel with it.

All trimmers are of the compression type with ceramic bases. Those for the lower frequencies are shunted with fixed mica or ceramic units. The capacitance range is such as to give the maximum values shown on the schematics, though the proportions supplied by the fixed and variable parts may be varied somewhat. Any instability in the overall operation of an oscillator designed according to this circuit is likely to be due to poor mechanical construction of the trimmers. Other capacitance changes, such as those due to temperature variations, for example, would vary the frequency so slightly as to be not detectable on a highly selective receiver. Frequency change caused by an increase or decrease of a few micro-microfarads is very small when the total capacitance is in the order of several hundred micromicrofarads.

Suppressor modulation allows the neon tube's output to be introduced across a high impedance. This is necessary, since otherwise the neon tube will be loaded, and "pulling" and low-frequency oscillation—or no oscillation at all—will result.

The audio oscillator

The neon tube is connected in the familiar relaxation oscillator circuit.



An inside view of the small generator. The audio oscillator is a neon lamp and is seen just behind the 12BA6.

*Design Engineer, Radio City Products Co.

consisting of a resistor in series with, and a capacitor in parallel with it, the whole placed across a d.c. source. (See Fig. 2.) Current flows through the resistor and charges the condenser. Until the condenser is charged, the flow of current through the resistor produces a voltage drop which keeps the voltage across the neon tube too low for ignition. As the condenser approaches full charge, its voltage rises and the tube

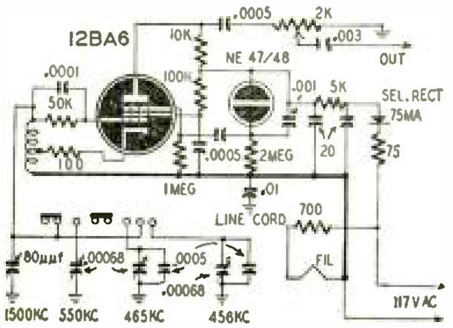


Fig. 1—Circuit of the 4-frequency generator.

"fires." The condenser then discharges through the tube and is ready for the next cycle. Frequency of oscillation is controlled by the voltage, the resistance in series with and the capacitance across the neon tube. Increasing either the capacitance or resistance reduces the frequency.

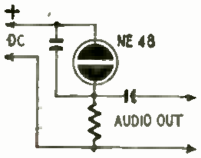


Fig. 2—The neon-tube oscillator. The output capacitor may vary between .0005 and .05 µf.

The series resistance not only acts as part of the time-constant circuit; it puts a high impedance in the path back to the power supply so that oscillation is not immediately damped out.

Neon bulbs may be found to have ignition and extinction voltages differing from one another by several volts. If the voltage across the bulb is too high (or the series resistance too small), it may not oscillate. The designer of such an oscillator can detect this trouble by listening as the unit is shut off. Immediately after the line voltage is interrupted, a growling noise can be noted in the receiver. It will last a few seconds and disappear. It is due to the voltage falling off in the filter condensers and passing the proper voltage (momentarily) for neon-tube operation.

If the voltage in the circuit is too low at all times, the tube does not glow. Remember, however, that during proper operation only one of the plates glows and the glow is not very bright.

The power supply

The selenium rectifier may be of the 100-ma or 75-ma type. Both are now generally available. The 75-ohm resistor acts to prevent excessive surge currents from damaging the rectifier or filter condenser. It acts also as a fuse to protect the rectifier in case of condenser breakdown. The 5,000-ohm resistor and two 20-µf condensers provide ample filtering.

The B-minus—which in an a.c.-d.c. device is one side of the line—is isolated from the chassis and the metal case. A .01 condenser between the B-minus point and chassis prevents electrostatic effects which might cause hum modulation of the oscillator and serves as a return for the r.f. circuit, which is grounded by connecting one side of the trimmers and output attenuator to chassis. It was felt that it was safer to bring one side of the trimmers to chassis than to B-minus, as the exposed metal plates of trimmer condensers might accidentally contact the chassis or the case. Should they be connected at the same time to the B-minus, this would place the case at line potential, which would be dangerous. Connecting them to chassis makes for safety.

A dropping resistor is needed for the 12-volt, 180-ma filament of the 12BA6. A linecord type was chosen, to keep heat out of the case. The tube's dissipation is surprisingly low—it develops less heat than the selenium rectifier. Temperature rise has not been found troublesome.

Normal B-voltage will be in the order of 135 volts with an input of 115 volts a.c.

To align the instrument, tune a radio receiver to 1500 kc and adjust the first trimmer till the modulated r.f. of the generator is centered on the dial setting. Repeat with the second trimmer for a receiver setting of 550 kc. For 456 and 465 kc tune the receiver to 912 and 930 kc respectively and adjust the generator till the 2nd harmonic is accurately set to these frequencies. The harmonics are strong and may be used, not only as an aid to alignment of the instrument, but also in construction and servicing short-wave equipment.

Whip Tuning Motor

By HARRY WINFIELD

THE simplest tuning motor, without an armature, brushes, rings, or commutator, is the so-called "whip" motor shown in Photo 1. It depends upon the *whip action* of a leather strap which causes a smooth metal drum to rotate.

This type of tuner, with 2 motors for bidirectional rotation, may be found in a number of war surplus stores. The author built a simpler one from an old electric bell. It is pictured in Photo 2.

The bell used for the tuning motor should be a fairly husky one, such as a Faraday type, if the motor is to be capable of turning a 2- or 3-gang tuning condenser. The model illustrated was tested successfully on 8 to 10 v d.c. and also on 12 to 15 v a.c. The lamp was a dropping resistor from 117v a.c.

The strap was a short piece of soft leather, fastened to a piece of rubber band at the rear end. The front end had a hole pierced through it so as to slip over the end of the bell armature. As the bell vibrates, the brass disc, over which the belt or strap rests lightly, begins to turn slowly. The action is really uncanny to those who have never seen the whip motor in action.

Adjustment of the play between the armature and the magnets needs careful attention, so that the maximum whip action is exerted on the leather strap resting against the brass or other metal drum. Fiber or bakelite drums may be used, but the author used brass in his model. The strap may be a piece of fabric or cloth, with a thin strip (or pieces) of cork glued to the inside surface.

The whip motor is unique, and experimenters will undoubtedly find pleasure in building models for various purposes. If you have a couple of old electric bells in your odd-parts box, you can put them to work in one of these motors.

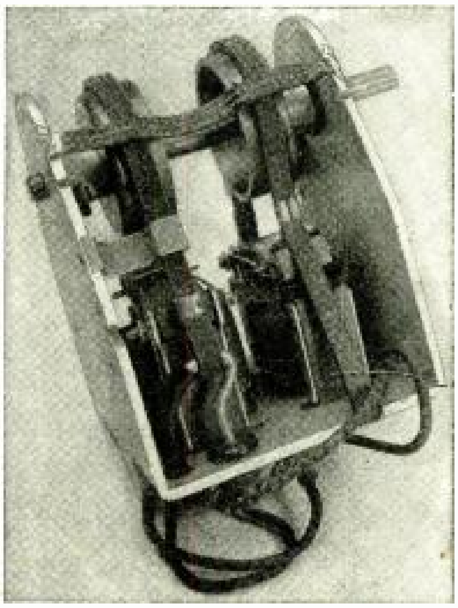


Photo 1—A bi-directional whip tuning unit. One wheel turns to the right, the other left.

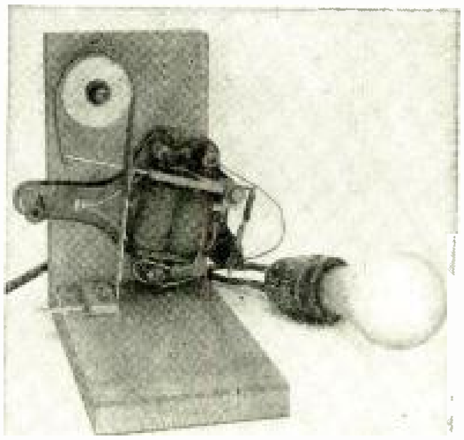
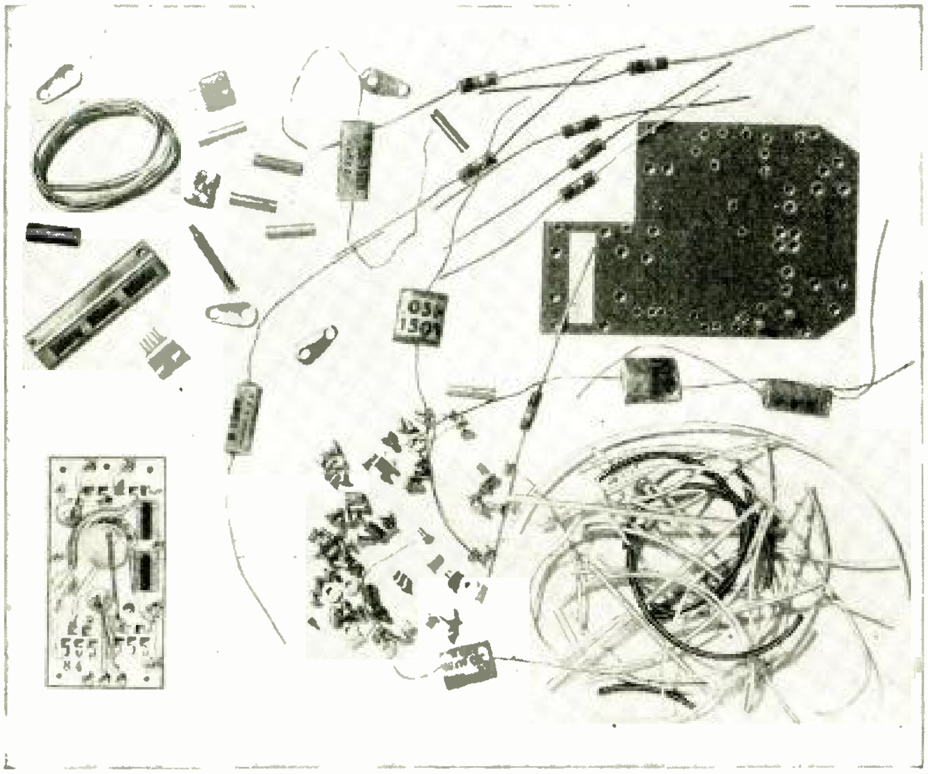


Photo 2—The discarded-doorbell whip tuner. The lamp is a resistor for dropping voltage.

Smallest Hearing Aid Uses Printed Circuits

The little case measures 4⅛ x 2⅜ x ⅞ inches

THIS hearing aid is the first civilian device to use the famous wartime printed circuits. This is reasonable. Hearing aids have to be compact and they have to be rugged. The printed circuit was designed to fit in the nose of a small-caliber shell (where there is little waste space) and to be fired from a gun—tougher treatment than the most abused hearing aid has to take.



The new hearing aid—whose chassis appears in the lower left-hand corner—compacts into little more than 1 x 2 inches the whole tangle of components shown in the rest of the photograph. The standard hearing aid chassis alone is several times as large as the complete ceramic unit with all its parts sprayed and printed on. Altogether 173 components and pieces are replaced by the printed circuits of the new unit.

The new hearing aid, manufactured by Allen-Howe Co., is a 3-tube device whose circuit (Fig. 1) is in no way out of the ordinary. Mechanically it has few features in common with older instruments. The whole circuit is sprayed on a steatite wafer 1⅛x2¼x3/32 inches in size, on which are also mounted the 3 small tubes.

What formerly was a complicated jumble of wires, resistors, inductors, and condensers—a total of 173 parts—has given way to a single amplifier unit of printed wiring and parts, occupying but a fraction of the space heretofore used. The third-dimensional effect of the usual electric circuit has been practically eliminated.

A feature of the printed circuit is that many of the components are actually manufactured in the process of "wiring up" the equipment. The entire manufacturing process is carried out in 4 simple steps:

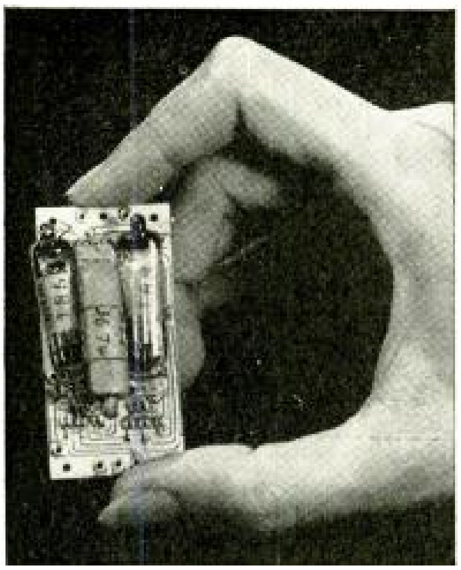
First, silver ink is brushed over a silk screen stencil onto a clean steatite plate or chassis. The resulting pattern on the ceramic is the exact circuit desired, but, instead of the copper wire ordinarily used in electrical circuits, a group of silver lines appears. The ink or paint consists of finely divided silver or silver oxide mixed with a binder to make a paste and thinned with a solvent such as acetone.

After application of the circuit pattern, the plate is heated to a temperature of between 1,300° and 1,500° f. This process bonds the silver permanently to the ceramic.

Second, the resistors are painted or sprayed through a second stencil, designed to make them fall into exactly the right places in the circuit. The resistor paint consists of a conducting material such as powdered graphite and an inert or nonconducting material such as mineralite or powdered mica. The plate is then baked in an oven at 300° f. to cure the resistors so their values will not change in use.

Third, the small, disc-like condensers are then applied directly to the wiring on the plate. The condensers measure from ⅛ to ¼ inch in diameter and are .04 inch thick.

Fourth, the device is assembled by adding the new subminiature vacuum tubes, small transformer, miniature microphone, batteries, 3-position tone



True size of the amplifier is emphasized by comparison with woman's hand which holds it, and which—to many eyes—it exaggerates.

control, volume control, and an ingenious plug-in arrangement which makes possible the use with a single assembly of a choice of the 3 types of receivers—crystal, magnetic air conduction and bone conduction. The entire assembly is housed in an anodized aluminum case.

The 3 kinds of receivers are part of an ingenious arrangement which adapts the one instrument to a wide range of hearing impairments. A crystal earphone is used for persons who require a great proportion of highs, and a magnetic unit for those whose hearing is most impaired in the lower registers. In combination with the 3-position tone control, almost any desired frequency-response characteristic thus can be secured.

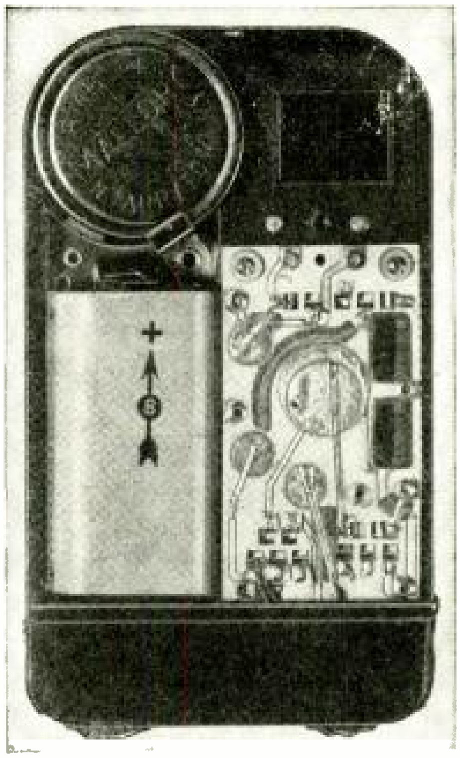
The third type of receiver is a bone-conduction unit for use in cases where the inner ear does not function. The instrument is adjusted for varying degrees of hearing sensitivity simply by changing the output tube. High-power, regular, and low-power output tubes may be used. Gain at its best is good. With a 1-millivolt input, the circuit delivers an output of 1.3 volts.

Altogether 48 combinations of frequency characteristic and volume are available—a large enough number to cover practically any individual case the acoustic consultant may encounter.

The greater part of the space in the case is taken up with batteries. Smaller batteries could no doubt have been used to reduce the size of the instrument still further, but the factor of battery longevity was felt to outweigh any advantages of greater compactness. In the photo at right, the bottom of a standard Mallory cell is visible at upper left. This is the A-battery. The B-battery is an Eveready Mini-Max of the hearing-aid type. The output transformer is at top right. The 2 controls—tone and gain—are seen at the bottom of the case. Between them is the receptacle for the plug-in arrangement. This is normally the top of the instrument, though apparently the photographer and artist were not aware of the fact, to judge by the lettering on the 2 batteries. The back of the unit is (naturally) toward the back of the case, and the 3 tubes are on the other side.

The front and back of the ceramic "chassis" are shown below—slightly larger than life size. The tubes are held in ingenious socket which occupies practically no space, yet holds the wire terminals of the tubes securely and makes an excellent electrical connection. The rectangular black areas are resistors, and are covered by a transparent insulating coating which may be seen in the photos. The back of the set contains most of the condensers. It is just possible to see that the large center one is a pair of condensers in series, a small disc over a large one, with 3 terminals. Connections to the outside circuits are made at the eyelets near the edge of the plates, and other eyelets are used to carry connections through the chassis from front to back. Connections to the condensers are made of strips of heavy foil or thin metal, silver-soldered to the condensers and to other connectors, or simply to the end of a printed-silver conductor.

The instrument is so rugged that servicing probably will be confined largely to replacing tubes and batteries. Should anything go wrong with the amplifier itself, the printed circuit reduces repairing to the simple operation of slipping in a new unit. This can be done on the spot. Persons who have had to wait while their units were sent back to the factory for repair will appreciate this improvement.



Rear view of the device with its cover off. A complete description is given in the text.

The set is a natural development of the printed circuits developed during the war for proximity fuzes by Dr. Brunetti and his staff. Credit is given by the makers of the instrument also to Alfred S. Khouri, project engineer for Centralab, designers and builders of the first printed circuits and to Joseph J. Knouse, who supervised development of tubes for the proximity fuze and who is now chief engineer of the Allen-Howe Corporation.

The hearing-aid field is obviously a "natural" for the printed circuit. Its inherent advantages are especially applicable to that instrument. But it will not be long before the printed circuit makes its appearance in other equipment, where either ruggedness under rough usage or vibration, compactness, or trouble-free operation are important.

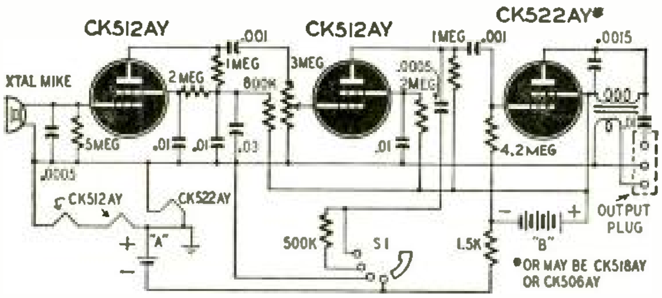
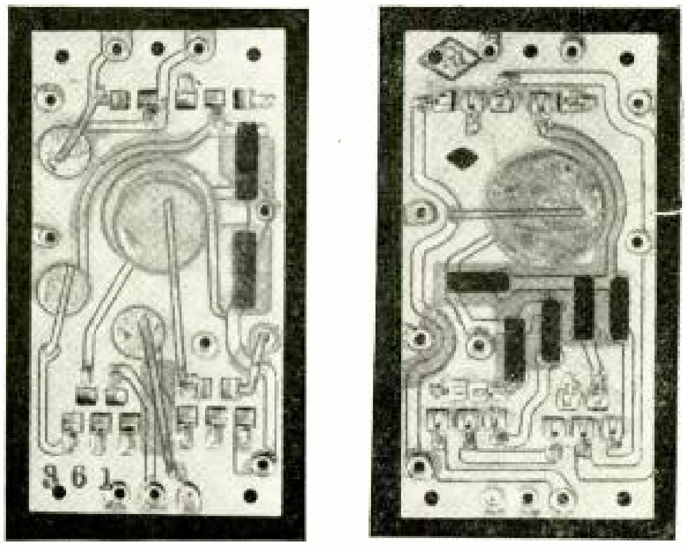


Fig. 1—The schematic of the hearing aid might be that of a standard instrument—or in fact that of a small amplifier of any kind. The volume control is in the second tube grid circuit, to work at higher noise levels and thereby reduce relative noise. The combination plug receptacle at right permits use of either crystal, magnetic or bone-conduction earphones.

Photo at right shows front view; photo at left shows back view.



Precision Frequency Meter Uses 3 Oscillators

The built-in calibrator makes this a laboratory-precision instrument

A freqmeter for radio station or laboratory.

ALMOST universally, amateur radio regulations require that some means be provided for accurately measuring the transmitter frequency. However, frequency measuring equipment is conspicuously absent from the average amateur station; even when the operator makes a practice of band-edge operation. It has been proved to many that you must not rely heavily on a receiver or transmitter of doubtful calibration accuracy in determining transmitter frequency or band limits.

This heterodyne frequency meter is designed for accurate measurements in the amateur bands and will satisfy exacting requirements for accuracy. Its versatility and accuracy make it equally useful in other classes of radio stations, laboratories and other installations where accurate measurements must be made over a wide range of frequencies. The factors involved in the construction and calibration of such equipment may be applied to variable frequency transmitter control systems as well.

A block diagram of the unit is shown in Fig. 1. Oscillator A is a variable-frequency oscillator tuning from 3.4 to 4.0 mc in 200-kc steps. The calibrating oscillator, B, tunes from 50 kc to 15 mc in 6 steps. It determines the approximate frequency of a signal being received on a receiver or applied to the input terminals of the heterodyne detector. Oscillator C is a crystal controlled secondary standard using 500-kc and 3.333-mc crystals. Signals from all oscillators are applied to the heterodyne detector and to external binding posts. By using the fundamentals and harmonics of the 3 oscillators, it is possible to measure accurately the frequency of any signal between 50 kc and 30 mc or possibly higher (depending on the strength of the harmonics).

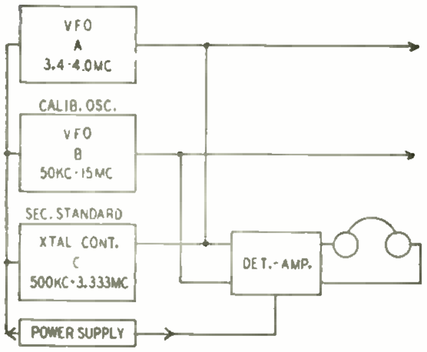


Fig. 1—Block diagram of the frequency meter.

The vernier oscillator

The vernier oscillator (Fig. 2) is the heart of the instrument, it is highly stable against mechanical, electrical and thermal changes. Its precision dial, with lens system, permits frequency measurements to within 50 cycles on the fundamental ranges of the unit. A high-C electron-coupled oscillator with a 37 tube assures stability against voltage variations. About 450 μμf are required to tune the 4-μh coil to the high end of the tuning range. The coil, L1, consists of 12½ turns of No. 14 wire on a 1-inch ceramic form. The windings are spaced the diameter of the wire or to tune to 4.0 mc when shunted with 400 μμf. The cathode tap is made about 3½ turns from the ground end of the coil. More about the cathode tap later.

When the oscillator is operating at its highest range, 3.8 to 4.0 mc (A), L1 is tuned by C6 and paralleled by the series combination of the main tuning condenser, C7 and padder C3. On the lower ranges, B and C, 3.6 to 3.8 and 3.4 to 3.6 mc respectively, trimmer condensers C4 and C5 are added to the tank capacity and padders C1 and C2 are switched in parallel with C3. The padders are adjusted to spread the tuning ranges over the desired space on the dial. In each case, the padders are adjusted to provide an additional 20 kc on each end of the calibrated tuning range when the tuning condenser, C7, is varied through its entire range. This makes the calibrated tuning range fall on the most linear part of the capacity-frequency curve of C7.

High accuracy and linear calibration curves depend on the values of trimmers and padders. Condenser C1 is a 100-μμf mica shunted with a 5 to 30-μμf trimmer adjusted to 24 μμf. Units C2 and C5 are 3 to 100-μμf padders set at about 40 μμf. C3 is an 80 to 200-μμf padder set at 115 μμf. C4 is a 75-μμf mica shunted with a 30-μμf padder set at 17μμf. The fixed tank condenser, C6, has a capacity of 380 μμf. A 2-plate variable condenser is connected across C6. It has negligible capacity and is used for front-panel control of minor frequency variations. It is controlled by the knob at the right of the optical system on the main tuning dial. All fixed capacities in the tuning circuit are mica units and the trimmers are ceramic condensers.

The dial of the oscillator is divided into 270 divisions over 180 degrees. The control knob is finely divided with 10 main divisions over 360 degrees. This control is connected to the main dial through 10-to-1 gears. One division on the main dial corresponds to 890 cycles on any range. The calibrated knob makes it easy to adjust the frequency to within 50 cycles or better.

The calibrating oscillator

The calibrating oscillator is in the center of the chassis. Its tuning ranges are: A, 50 to 150 kc; B, 150 to 350 kc; C, 350 to 1000 kc; D, 1 to 2.5 mc; E, 2.5 to 7 mc; F, 7 to 15 mc. The band switch has 7 positions: 1, marked 0, turns this oscillator off. The coils are tuned by a 2-section 18 to 480-μμf condenser. The sections are used in parallel for the three lowest ranges. A 5-plate 20-μμf midget variable shunts the larger condenser and is a bandspread condenser when one is needed. This is controlled by the calibrated knob at the lower right of the front view.

Six cathode-tapped test oscillator coils are used. (The author used European coils not available in the United States, but standard American test oscillator coils can be used, though the frequency ranges may differ somewhat from those given above. Coil manufacturers put out sets of test oscillator coils ranging from 50 kc to 20 mc.—*Editor.)*

The secondary standard

The frequency standard is used for checking the calibration of the variable oscillators and to provide check points on a receiver. The circuit is a tuned-plate oscillator using an EF9, a European tube that can be replaced with a 6S7-G without changing circuit constants. The frequency of such oscillators varies slightly with tank-circuit tuning, making it possible to adjust the output frequency to exactly 500 kc or

3.333 mc by beating with a signal from a harmonically-related radio station. If this does not provide enough variation, adjust the air gap in the crystal holder one way or the other.

Detector—a.f. amplifier

The heterodyne detector is a 6A8. Signals from the vernier and standard oscillators are fed in on the No. 1 grid and from the calibrating oscillator to the control grid. Beat notes between any combination of fundamentals and harmonics appear across the plate load resistor. These are coupled to the 37 a.f. amplifier tube through the volume control shown in the upper left corner of the front view. Signals are amplified and fed to the phone jack on the panel. A 2.5-mh choke and a .002-μμf condenser prevent r.f. from being radiated by the phone cord.

The vernier and crystal oscillators are connected to an output jack through a 1500-ohm resistor and a 500-ohm attenuator. This prevents the output from masking signals on a receiver and reduces signals fed to the mixer for comparison. The calibrating oscillator is fed to another jack without a variable attenuator.

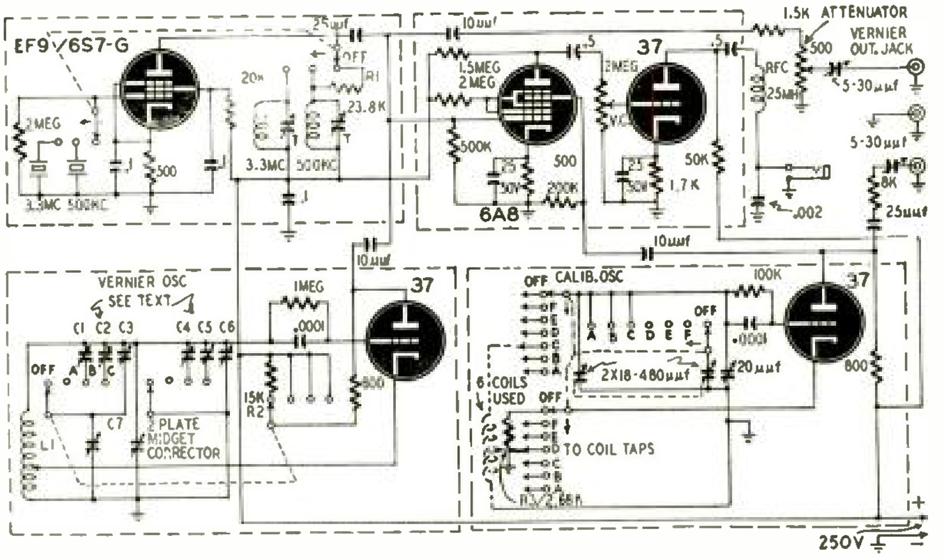


Fig. 2—Schematic. The coils are represented by a single dashed one. The bottom jack is the output from the calibrating oscillator.

Oscillator compensation

A 380-μμf condenser was used for C6 and a precision thermometer inserted in the oscillator compartment. When the unit was tuned to 3500 kc, the frequency drifted positive about 800 cycles with a 2-degree Centigrade change in frequency. This is equivalent to a .024-μμf capacity change. C6 was replaced with a 175-μμf condenser having a negative temperature coefficient of .0007-μμf per μμf per degree Centigrade. This was shunted by a 150-μμf mica and a trimmer adjusted to 55 μμf. The drift was reduced to 225 cycles for a 2-degree temperature change. We replaced the 175-μμf temperature compensator with one of 185 μμf and the same coefficient and the curve became flat after the initial warm-up as shown in curve C of Fig. 3. Curve A is the frequency-temperature curve without compensation. Curve B is the result of partial compensation.

The coil and tuning elements are in a metal box insulated on the outside with a layer of Masonite. Trimmers and padders are adjusted through holes in the side of the box. The holes are sealed after the unit is calibrated and compensated.

The calibrating oscillator is not compensated. It is in an uninsulated metal box painted with white paint. This reflects some of the heat radiated by the tubes and transformer.

Compensation against changes in the power supply load was accomplished by inserting R1, R2 and R3 in the circuits when their respective oscillators are off. These are selected to reduce the plate currents to equal those when the oscillators are operating.

(The position of the cathode tap on L1 is also a factor of stability against voltage changes. Adjust the cathode tap to a point where a 10-volt plus or minus variation in line voltage will have little effect on the frequency.—*Editor*)

Operation

Adjust crystals in the standard oscillator to proper frequency by comparing with signals from harmonically-related broadcast signals or WWV. This oscillator holds its frequency well and need not be checked very often.

The 7th and 8th harmonics of the 500-kc crystal will fall at 3.5 and 4.0 mc and can be used to check the calibration of the vernier oscillator. The 3.333-mc crystal can be used to check *(Continued on page 118)*

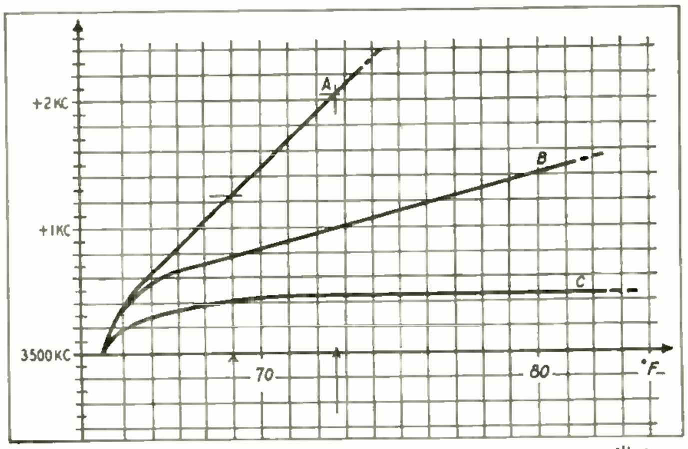
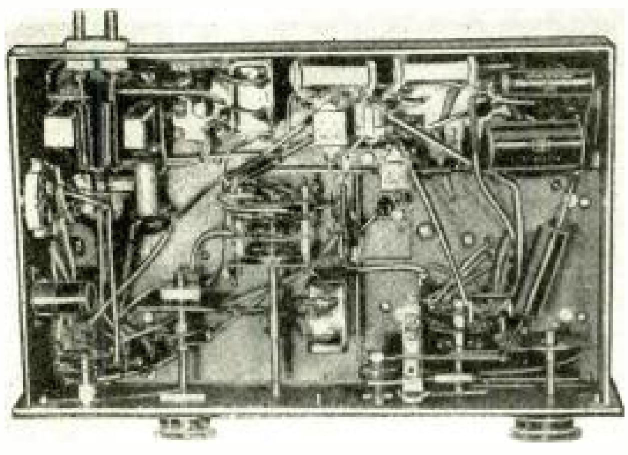
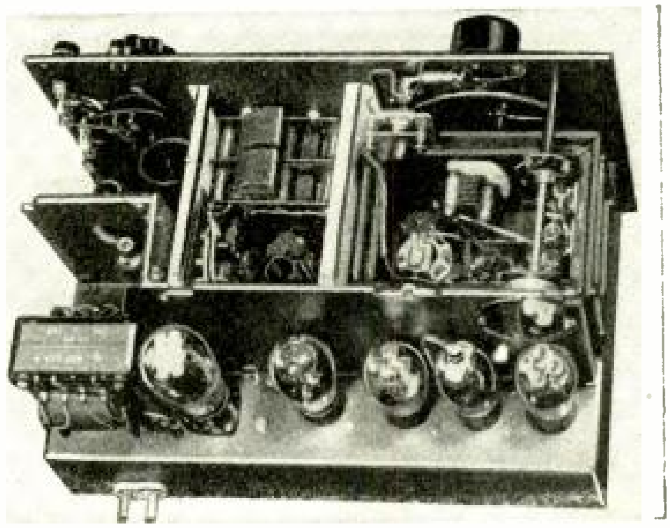


Fig. 3—Effect of temperature compensation on vernier oscillator.



Wiring is simple. Under-chassis controls and switches are shown.



The oscillators are shielded from each other by metal compartments.

Direct-Current Milliammeters In Radio Servicing

By OSCAR E. CARLSON

MANY articles on voltmeter and multimeter construction have appeared in this and other technical magazines. These articles usually refer to a certain specific value of milliammeter as the fundamental movement. More than one experimenter who has wished to build the equipment described has had a milliammeter of a different range and has not known how to adapt the circuit constants to his own instrument.

When measuring d.c. voltages in radio receivers, it is safe to obey the following arbitrary "rule of thumb": *The meter current for full scale should be no more than 5% of the current which normally flows in the circuit across which the voltage is measured.* This should be remembered *and adhered to*, or there is danger of considerable error.

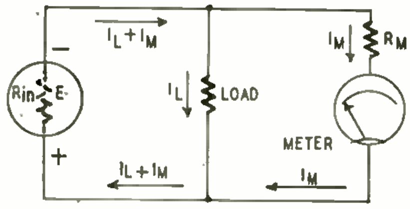


Fig. 1—Effect of meter on circuit voltages.

To illustrate this, assume a circuit like Fig. 1. Current flowing through the internal resistance R_{in} of the voltage supply will cause the supply voltage to drop as the load increases.

With the meter disconnected, the voltage across the load is $E-R_{in}I_L$. Upon connection of the additional load represented by the meter and multiplier resistance R_m, the voltage across the load becomes $E-(R_{in}I_L+R_{in}I_m)$. The error introduced therefore decreases as R_m *increases*, being zero if the meter resistance is infinite.

Nearly all d.c. voltages in radio receivers are developed across some resistor or a combination of ohmic resistance and impedance.

Typical receiver voltages

The d.c. voltage distribution from a rectifier power supply is shown in Fig. 2. Current (electron flow) is indicated by the arrows in that figure. Total current is flowing at points A and B.

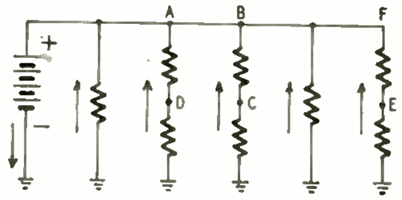


Fig. 3—Equivalent resistive circuit, Fig. 2.

Smaller currents making up this total flow at points C, D, E, and F. An equivalent resistive circuit is Fig. 3.

A voltmeter from points D, C, or E to ground then places a shunt resistance from the measured point to ground. A voltage drop between the measured point and the source voltage at A, B, or F due to the increased current flow across AD, BC, or FE causes the voltages to be lowered at points D, C, or E.

The current flowing to points A, B, or F may be from 40 to 150 milliamperes, depending upon the type of radio receiver. Using our 5% rule for a 40-ma

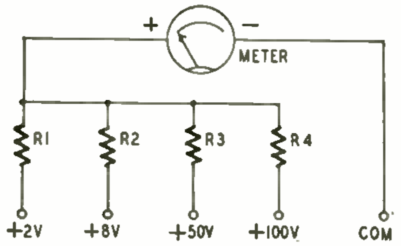


Fig. 4—A simple heavy-drain battery tester.

supply allows us a 2-ma drain for our voltmeter. A 2-ma meter would require a 500-ohm meter multiplier to limit current to 2 milliamperes when connected across a source of voltage of 1 volt. This is a 500-ohm-per-volt meter. A 0-100-volt meter using a 0-2-ma meter would then require a 50,000-ohm multiplier resistor. For a measurement across a source normally supplying 100 milliamperes, we could use a 0-5-ma meter and thus have a sensitivity in the order of 200 ohms per volt.

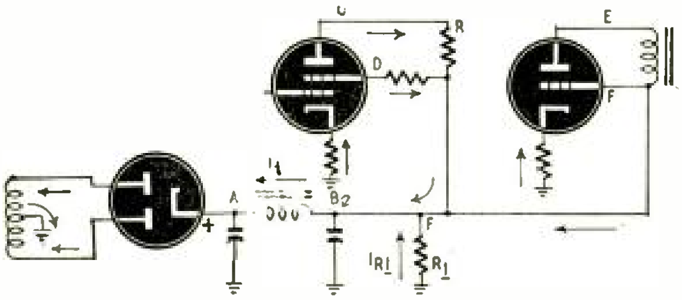


Fig. 2—Current distribution in power supply and part of a receiver.

Thus, for voltage measurements across the average radio receiver power supply, supplying 50 to 60 milliamperes, a 0-2-ma meter is the highest practical range that may be used as a voltmeter.

But suppose you have on hand a 5- or 10-ma meter and wish to make fairly accurate and meaningful voltage analyses. Remove a portion of the load from the power supply, for example, by disconnecting a plate and screen circuit which draws a 10-ma load. In an a.c. receiver we can do this by removing the selected tube from the socket. You may then measure the supply voltage with a voltmeter using a 0-10-ma meter. (The meter sensitivity would be 100 ohms per volt.) Adding a 50,000-ohm resistor in series with the 10-ma meter as a current-limiting resistor would make a 500-volt voltmeter. This would allow us to trouble-shoot the power supply and filter circuits with fairly accurate indications

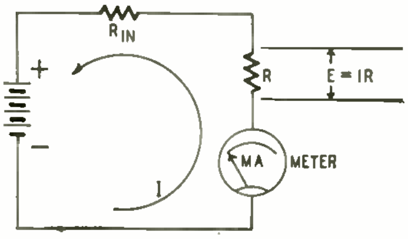


Fig. 5—Measuring voltage with milliammeter.

of what the voltages are, or would be, with the circuit restored to normal by reinserting the tube.

Make good battery testers

Such a voltmeter made from either a 10-ma or even a 50-ma meter is admirably suited to testing radio A- and B-batteries, since it imposes sufficient load to allow normal voltage drop through the batteries' internal resistance. Such a test on batteries is a better indication of their condition than a test with a 1,000-ohm-per-volt or higher instrument. In fact, when testing such batteries with a 1,000-ohm-per-volt or higher instrument, it is preferable to shunt a resistor across the battery to simulate the receiver load, and then measure the voltage developed across that resistor. B-batteries should be tested with about a 20-ma drain and A-batteries with a 50-ma drain. The necessary shunt resistor may be determined from Ohm's law as follows:

$$\text{Shunt R} = \frac{\text{Battery voltage (new)}}{\text{Specified current in amps.}}$$

As an example for a 45-volt battery with 20-ma drain:

Resistor=45/.02=2,250 ohms.

Fig. 4 illustrates a battery tester of the above type which may be made from a 0-5, 0-10, or a 0-100-ma meter. The unit using the 0-100-ma meter should not be used in conjunction with any

(Continued on page 85)

12-VOLT AMPLIFIER

By JOHN W. STRAEDE

THE amplifier described in this article is of interest for several reasons, possibly the most important being its extreme efficiency. The plate efficiency of the amplifier itself is good (35 watts of plate input giving 18 watts of audio power, equivalent to about 25 watts of usable power). The power pack—being vibrator powered—is also of high efficiency. For an average, mobile amplifier putting out 14 to 18 watts, the drain on a 6-volt battery is about 15 amperes or 90 watts. In this case the drain is just over 5 amperes from a 12-volt battery—only 64 watts. And the output is greater, effective output being nearly doubled.

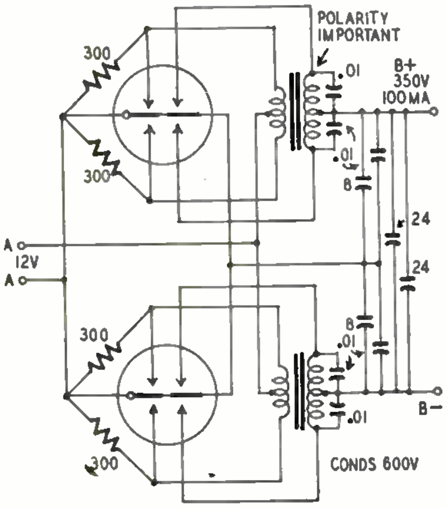
To gain this degree of efficiency, only standard parts are used with the exception of the 2 vibrator transformers, each of which has a standard primary but a 175-volt, 100-ma secondary. The lower the ratio between the windings of a transformer, the more efficient it can be made. The 12-volt, 3-ampere split-reed, synchronous vibrators are standard, the split reed being necessary to connect the outputs in series to give the needed 350 volts.

Besides being extremely compact, the amplifier itself has a number of novel circuit features such as the 1-tube electronic mixer recently described in RADIO-CRAFT. Class AB2 operation is provided for the 6L6 output tubes, but it is arranged that operation in the grid current region is only momentary; It is provided to allow for the peaks present in speech signals. Many of these peaks are clipped because of overload. Retaining them makes the reproduced sound more natural. Because little power is to be provided for the 6L6 grids, the coupling transformer has a higher ratio than usual. The over-all ratio of primary to entire secondary is 1 to 1½. In the transformer used, the primary inductance was 21 henries.

Decoupled, semifixed bias on the output stage also helps to provide momentary powers much greater than the rated output. A 24-microfarad condenser and 1,000-ohm resistor have a time constant of approximately 1/40 second, so for brief intervals of time the amplifier acts as if with fixed bias.

Large bypass condensers (2 of 24-μf) have a similar influence on the voltage of the 6L6 screen grids.

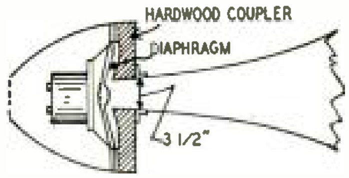
Automatic volume control (partly compression, partly limiting) has the very desirable effect of allowing the amplifier to be run at high volume levels without excessive overload. The necessary control voltage is obtained by rectification of part of the signal supplied to one of the output tubes. The d.c. voltage thus obtained controls the gain of the pentode into which both inputs are fed. Amount of control voltage can be regulated by a potentiometer or by a fixed voltage divider consisting of 0.2- and .075-megohm resistors in series.



Two vibrator units in parallel are employed.

Tone control system

The compactness of the amplifier allows no room for conventional tone controls, so a couple of switches are employed. One attenuates the highs by connecting a .005-μf condenser from the 6B8G plate to chassis while simultaneously connecting an extra condenser across the output. The other switch attenuates the lows by inserting an extra coupling condenser in series and by reducing the capacitance of the 6J5 cathode condenser. Even with highs and lows not attenuated (by pressing the switches), there is a certain amount of frequency restriction. This is good and is deliberately provided because there is little use in having an amplifier turn out notes which the speaker can't handle or which cannot be heard at a reasonable distance.



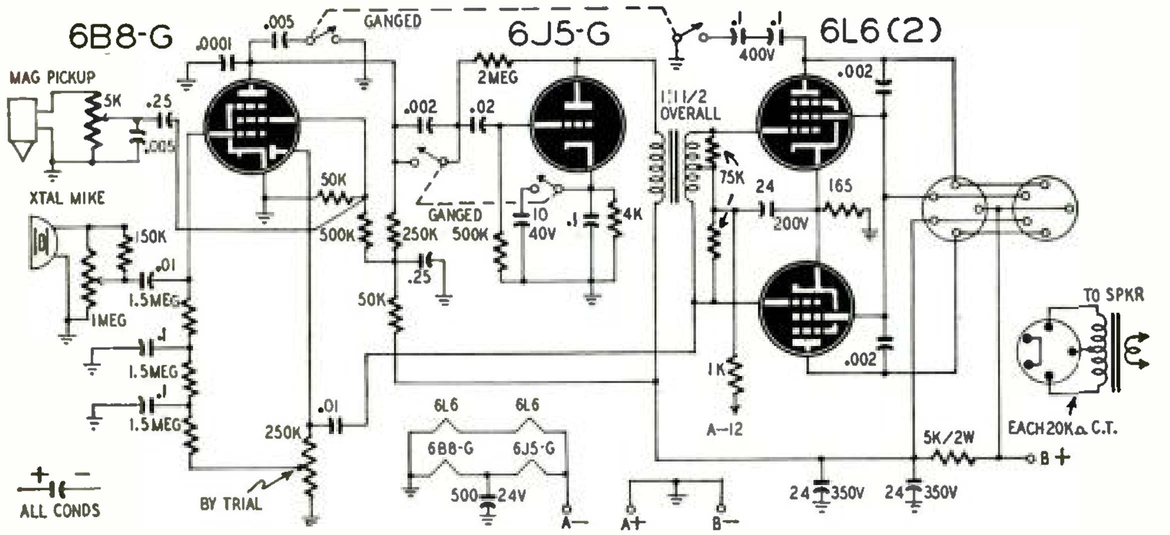
Method of coupling speakers to large horns.

To conserve output power it was decided to run separate 3-conductor, high-impedance lines direct from output tubes to each speaker. There is a safety link in each speaker plug so that the 6L6 screen voltage is removed if both speakers are disconnected.

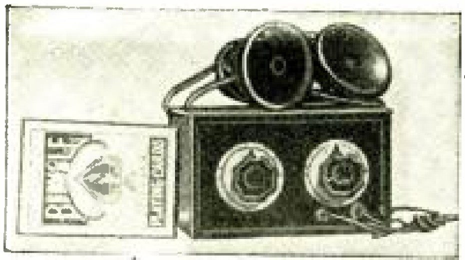
Negative feedback is employed on the driver stage to make up for the sudden decrease in load when the output tubes start to draw grid current. Shunt resistors across the transformer secondary help to stabilize the load.

American readers may wonder why tube sockets are so commonly employed as input and output sockets in Australia. Well, they're cheap, and those of one particular make are very reliable indeed. Their main disadvantage is their bulk.

(Continued on page 98)



The high-efficiency battery-powered amplifier uses an electronic mixer and a simplified tone control system.



A Modern Midget Set

Sub-postcard size crystal radio

By W. H. GRACE

DESPITE present-day advanced electronics, there are tens of thousands of crystal receivers in daily use in the United States alone. Naturally there are very valid reasons for this. There is no upkeep cost, and the fidelity of tone and clarity of crystal rectification are hard to beat.

The panel of the modern midget receiver described below is only slightly larger than a deck of ordinary playing cards. On one high-powered local station it operates a sensitive magnetic speaker with sufficient volume to be enjoyable several feet from the speaker. Three other locals can be heard on the loudspeaker with somewhat less volume.

The physical dimensions are shown clearly in the accompanying diagram (Fig. 1). The cabinet fits completely around the bakelite panel upon which all the components are mounted. The depth of the small wooden cigar-box cabinet is great enough to clear the condensers and coils. Antenna and ground connectors are short lengths of stranded, insulated wire passing directly through 2 holes in the back of the cabinet. Four small wood blocks are glued into the corners of the cabinet for the panel mounting screws.

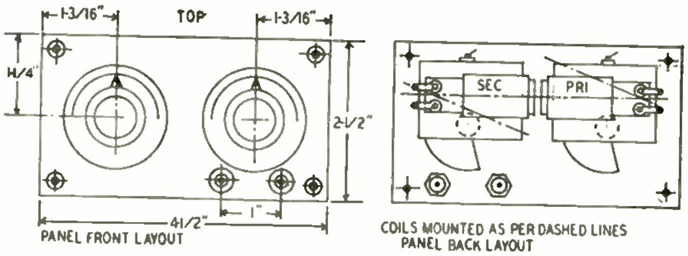


Fig. 1—Coupling may be varied by sloping coils (see dashed lines).

The circuit is a time-tested one, but the coils used will require some explanation. These coils are one of the secrets of this little set's performance and make possible its efficiency despite such miniature form.

Preparing the coils

The first step is to procure 2 standard BC antenna coils with high-impedance primary windings and bankwound *Litz* (Litzendraht) wire secondaries having approximately 250-μh inductance. Disconnect the 2 secondary leads from the lugs at the end of the coil form. These coils are wax impregnated, and the secondary lead adjacent to the primary is wrapped 1 full turn over and around the lattice-wound primary coil. These little coils are readily obtainable for a few cents at most good radio parts stores.

(If a few minutes are spent studying the construction of the coil, there is no trick to freeing this connection without injury to the fine wires composing the *Litz* cable. See Fig. 2). When both secondary leads are disconnected, lay them back across the secondary winding out of harm's way for the time being. Should the wax be hard, it can be softened quite easily by the application of heat from direct sunlight or by holding a heat lamp or electric iron near it for a short time. The wax is to be softened, not melted.

Next either unwind the primary coil or remove it by cutting across the wire with a very sharp knife. Only the *Litz* secondaries are used, one as the primary in the antenna circuit and the other as the secondary in the detector circuit. Resolder the 2 leads from the secondaries back to their respective lugs on both coils. *Be sure that all the fine enameled wires of the Litz cable are unbroken and that all are joined together at the terminal lug.* If this is not done, losses will be introduced which will impair the results.

Circuit details

Two midget variable condensers are used to tune the 2 circuits. Each section is of 365-μμf capacitance. The primary series condenser uses both stator sections, thus doubling the capacitance by connecting both stators together. The secondary condenser uses just 1 stator section; the other is left unconnected. The circuit is shown in Fig. 3.

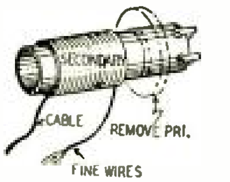


Fig. 2—Coil detail.

These condensers were used because they are easily obtainable in many radio stores at very reasonable cost and are of a low-loss type which works well in a crystal set.

The condensers are mounted by 1 threaded bolt directly on the panel, and the coils are attached with skinned bell wire to the condensers by direct soldering. This arrangement is very simple, as the electrical connections provide the mechanical support for the coils as well. Only 1 lead of the primary coil goes to the condenser, but a dummy lead supplying the needed additional mechanical support is soldered from the condenser frame to one of the unused lugs on the coil form to stiffen the coil mounting mechanically. Both coils are mounted in inductive relationship to each other. If additional selectivity is required, a slight bending of the coil supports will loosen the coupling. Once the coupling is adjusted to your antenna and location, no further attention is necessary.

The detector unit chosen was a germanium diode rectifier, the 1N34. These units are very compact and sensitive. One wire lead from the diode is soldered to a terminal of the phone jack, and the remaining lead goes directly to the end of the secondary coil nearest the primary, with which it is inductively coupled as shown in the diagram.

Phones, aerial, and ground

An excellent pair of high-impedance phones are absolutely a must for best results with any crystal receiver. Procure the best magnetic-type headset you can afford. It will prove a wise investment. Be very cautious of the war surplus bargain headsets so common at present; many are of improper impedance and design for crystal-set needs.

Good aerials and grounds are needed for peak performance of this receiver. Use only a good water-pipe ground. Solder the ground lead to the pipe if possible; otherwise attach it with a clean groundpipe clamp. The ground wire should be of at least bell-wire size.

Keep the ground wire as short as practical because excessive length appears to decrease the selectivity. Multiple grounds may well be experimented with. Three or more different grounds often increase the volume noticeably.

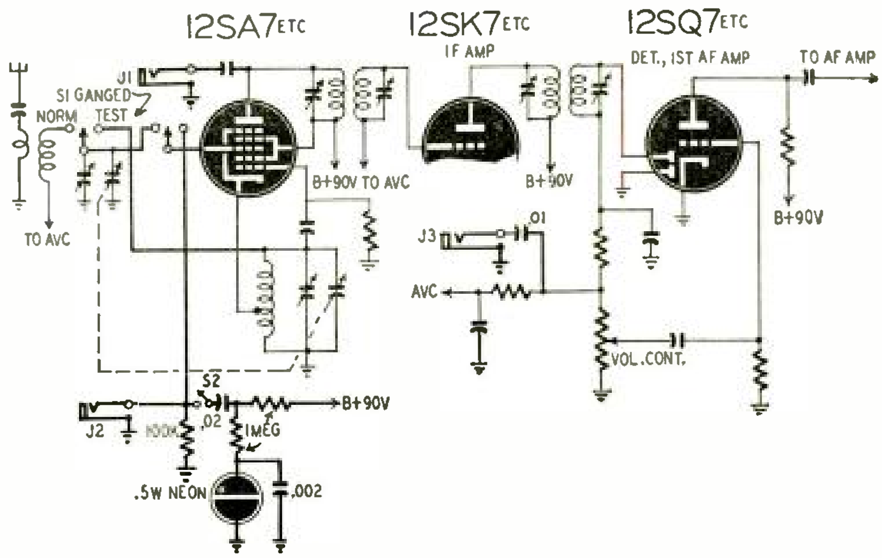
The antenna is most important, and the following suggestions apply to any crystal receiver. It is recommended that the aerial be between 125 and 150 feet long, of tinned copper wire, solid or stranded making little difference. No. 14 enameled wire also may be employed, but all joints must be soldered and both ends insulated with at least double insulators. Keep lead-in wire and the aerial proper as far away from all objects as the layout allows with as few right-angle bends as the job requires.

Combination Test Instrument

J. V. ROBERSON

A VERSATILE tester which can be used as a signal generator, signal tracer, phono amplifier, wireless oscillator, or a receiver can be made easily and economically from a small 5-tube superheterodyne receiver. Necessary switches and jacks can be mounted on the rear of the chassis. Alterations are confined to the first and second detector circuits. Changes are shown as heavy lines in the diagrams.

If possible, select a receiver with a 455- or 456-kc i.f. channel. Intermediate frequencies are reasonably well standardized, and such sets can be used for i.f.-signal tracing on other sets using the same i.f.



Switching makes this a signal generator, signal tracer, phono oscillator or an amplifier.

Signal tracer

For use as a signal tracer, connect a common ground between the tester and the set to be tested, throw S1 to NORMAL, and plug a single-conductor probe into J1. Tune the tester to a clear channel. The probe can be used to trace i.f. signals between the first detector plate and the detector input of the set under test. Sets using 455- or 456-kc i.f. can be aligned by applying the probe to the output of the set's i.f. system and aligning its trimmers for maximum signal in the speaker of the *tester*.

For a.f. testing, insert the probe in J3 and tune the tester to a clear channel with S1 in normal position.

Signal generator

To use the tester as a signal generator covering the broadcast range throw S1 to TEST. This disconnects the antenna circuit and places its tuning condenser in parallel with that of the oscillator, thus lowering the frequency to roughly that shown on the tuning dial. The signal is modulated by a relaxation oscillator using a ½-watt neon lamp. It is turned on or off by S2. Output is available at J1. An audio test signal may be taken from J2.

(It is advisable to calibrate the oscillator, using a chart to show the exact frequencies as compared with dial indications.—*Editor)*

Modulated i.f. signals are available at J1 by placing S1 in NORMAL position and tuning in a signal.

Phono oscillator-amplifier

Convert the unit to a phono oscillator by removing the neon lamp and connecting a phono pickup to J2. Connect a short antenna to J1 if one is needed. Opening S2 will increase the gain and remove the possibility of hum.

Connect the phono pickup to J3 and adjust the tester for a.f. signal tracing, and you have a small phono amplifier.

(The receiver selected for the tester should be a.c.-operated if possible. This will prevent trouble when making connections to a.c.-d.c. sets. If it is necessary to use an a.c-d.c. model as a tester, be sure to observe polarity when connecting the common ground. Connect a small 117-volt lamp to a pair of test leads and connect between the 2 chassis. If the light glows, reverse the line plug on one of the units.—*Editor)*

CHASSIS CRADLE

A good chassis cradle can be made from a few pieces of chemical laboratory equipment and 2 large C-clamps. Obtain 2 burette clamps with swivel jaws and 2 large ring stands. These can be had from scientific supply houses.

Discard the jaw assembly from the burette clamps and retain the base or support clamps. Select a bolt or threaded rod that will screw into the support clamp and weld one end to the center of a C-clamp. Screw the support clamp and C-clamp together and mount on a ring stand. The C-clamps are used to grip the chassis. Vertical and angular adjustments permit the chassis to be suspended above the work bench at a convenient angle.

J. A. BURNETT,
Tarleton Station, Kan.

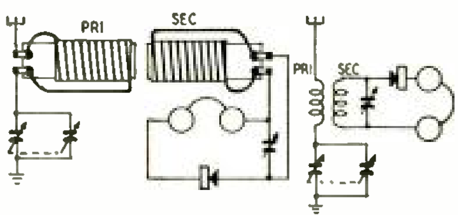


Fig. 3—Circuit of the midget crystal radio.

Get the aerial as high in the air as possible. Doubling the height will in many cases more than double the volume and number of stations received. If your location does not lend itself to a single-wire stretch of at least 100 feet, try 3 wires stretched fanwise as long as you can arrange them and you may still get good results. Each location will have its own best arrangement.

The operation of the receiver is so simple it hardly needs explanation. Turn the left-hand knob until a signal is heard, then turn the right-hand knob until resonance between the 2 circuits is established and loudest volume is obtained. A few moments of experiment will familiarize the listener with the synchronization of the dials.

If the set is to be used within 50 miles of a station, there should be little difficulty in receiving with good headphone volume. My set is located about 17 miles from New York City, and 18 local stations have been heard. Ottawa, Buffalo, Cincinnati, Washington and Richmond also have been heard without any particular effort. WCBS has sufficient strength to operate a sensitive magnetic speaker with surprising volume for a crystal set, and several other locals often produce a signal of enough magnitude to be heard on the speaker. High-resistance magnetic speakers are hard to procure today as the PM speaker is the present type made for electric sets. PM speakers are not suitable for use with this set.

It may interest the reader to know that the writer thought he was through with crystal sets back in 1914 but just got nosey to see what a modern crystal receiver could do in this day of super-powered broadcast transmitters.

POWER FOR THE BC-312

This easily obtained war surplus receiver can be converted to a 117-volt a.c. set

By GUY BLACK

MANY a short wave listener or amateur, after looking over the supply of high-frequency receivers, has decided to buy an army surplus set, particularly if his budget limits him to less than one hundred dollars. While these sets do not have the appearance, range of frequencies, or convenience of commercial sets, they are ruggedly built, sensitive, and selective.

One of the most common surplus sets is the BC-312—with various letters attached after the number, signifying different models. The differences are not great. The BC-312-A had a thermostatically controlled heater in the oscillator compartment, and a noise balancing network in the antenna circuit. The latter feature was retained in the BC-312-C, the next model, but was dropped from all later models. Models with the letters A, C, D, E, F, G, all have crystal filters but later models were sometimes supplied with them and sometimes without. On models with letters after the G, 24-28-volt operation is designated by the letter "X," as in BC-312-NX.

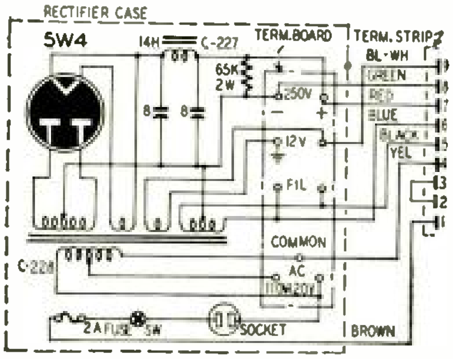


Fig. 1—The RA-20, designed for the BC-312.

Most BC-312's were designed to work from a 12-volt battery, and if 7.5 amperes is available, they may be so used. The connections are easy to make. If a plug is available to fit in the large socket on the front panel, connect 12 volts minus to pin D, and 12 volts plus to pin T. These are the two large pins in the socket. In addition, lug 8 on the terminal strip near the front right corner of the chassis must be grounded, which is easily done by connecting it to the bus bar running about 2 inches away. The lug is plainly marked. Without the plug it is necessary to connect 12 volts plus to lug 5, and 12 volts minus to lug 6.

At least 2 models of the BC-312, the HX and NX, were designed to operate from 24 to 28 volts, and of course will not operate from a 12-volt battery. If you are having trouble with your set, examine the dynamotor name plate, where there will be a notation of the correct operating voltage.

Most amateurs will want to convert these receivers to a.c. operation, and they are fortunate because the Signal Corps made provision for doing this. In this respect the BC-312 is superior to the more common BC-348 receiver, which was designed to operate from 24 to 28 volts only. By merely substituting the Signal Corps rectifier RA-20 in place of the dynamotor, the BC-312 is converted to the BC-342, designed for 110-volt a.c. operation. In fact, on many sets the name plate for the receiver is inscribed on both sides, one side reading BC-312 and the other reading BC-342. Fortunately some of these rectifiers are available on the surplus market. To install them, merely unsolder the dynamotor unit, remove the 2 bolts in the hinges and the 2 bolts connecting the standoffs to the chassis. Remove the metal plate at the back of the cabinet, through which the power plug must come. Before placing the RA-20 in position, it is best to solder the connections to the terminal strips, since at this stage there is more room to work. Before soldering, however, examine the under side of the terminal strip to see if there are not 2 jumpers, one connecting lugs 1 and 2, another connecting lugs 3 and 4. If so, remove these before connecting the rectifier.

The connections to be made are as follows:

- Lug 1 brown wire
- Lug 4 yellow wire
- Lug 5 black wire
- Lug 6 blue wire
- Lug 7 red wire
- Lug 8 green wire
- Lug 9 black wire with white tracer

In addition, solder a jumper from lug 2 to lug 3.

After arranging the excess wire, (which should be left on so it will be possible to work on the receiver without disconnecting the power supply) and fastening down the power supply make sure that there is a 2-ampere fuse in the fuse holder, and that nothing is shorted in these close quarters. The tube specified, VT-97, is a 5W4.

A home-built power pack

Those who cannot obtain an RA-20 can very easily build a suitable power supply. By removing the dynamotor and its filter it should be possible to build the power supply in the case and mount it inside the receiver as is done in the BC-342.

Building a power supply has some advantages. Larger filter condensers can be substituted for the dual 8-microfarad condenser used in the RA-20. The circuit is given in Fig. 1 for RA-20, with the parts identified by their Signal Corps nomenclature. It may be possible to get an exact replacement transformer or choke. The transformer would be particularly desirable, because of the two 12-volt windings. It will not be possible to obtain a commercial transformer with these filament voltages, but the same result can be obtained by connecting two 6-volt filament windings in series. In doing this, the phase relationship of the two windings should be noted since the voltages of the windings may cancel each other. The transformer must supply at least 90 milliamperes at 265 volts in addition to having two six-volt windings supplying at least 1.5 amperes each.

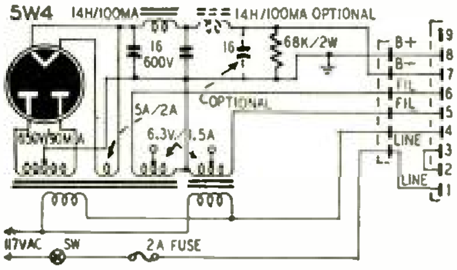


Fig. 2—Circuit with 12-volt filament supply.

One side of the pilot lamp circuit is grounded, so it is not possible to use the same winding to supply voltage for the pilot lamps as is used for the filaments. Since the dial is plainly marked it is best to ignore this difficulty, although if a separate winding were available of course it could be used for this purpose. The pilot lamps need not be 6 volts each in this case, nor does the extra winding need to be 12 volts. Bearing in mind that lamps are in series, any voltage lamp could be used if a winding with twice this voltage is available. A suitable power supply which could be built on a separate chassis is shown in Fig. 2. There is no switch shown in the diagram, because the power supply can be controlled by the on-off switch on the front of the receiver.

Revamping the X types

There are a number of BC-312-HX and NX sets around also. It is not possible to use the rectifier RA-20 with these models without making a few circuit changes first. Since the filaments are connected for 24-volt operation it is also rather awkward to heat the filaments,

(Continued on page 84)

the horizontal positioning, vertical positioning and the focusing potentiometers carry high voltage and must be insulated from the chassis. This can be done in a number of ways. We made an end panel out of Lucite for the scope chassis and used it to support the 3 potentiometers.

The parts on the upper chassis are from an oscilloscope foundation kit. It furnished the 5CP1 tube, its shield, high voltage transformer, 2X2 rectifier, a filter condenser, sockets and caps for both tubes. The cost was about $15.00. These parts are all available as surplus and can be bought individually if desired. A voltage-doubling circuit was wired in the chassis and can be used if desired. It supplies voltage for the intensifier anode, producing a brighter but smaller picture. In operation the addi-

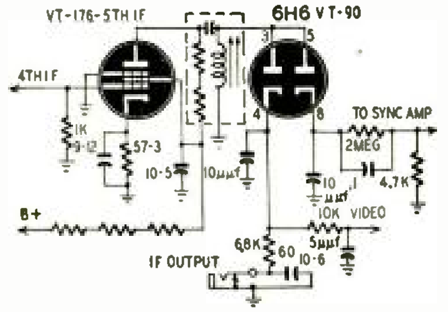


Fig. 4—6H6 is video and sync pulse detector.

tional brightness is seldom considered essential except in daylight viewing or in a brightly illuminated room. Although a 5CP1 tube is shown, a black-and-white tube such as a 5BP4 or 7EP4 can be used.

The sound channel is mounted on the metal plate which originally shielded the r.f. tuner. The first sound transformer T1 was made from the former input i.f. transformer and is a simple solenoid wound as in Fig. 5-a. There are 58 turns No. 30 d.s.c. jumble-wound to occupy ¼ inch.

It serves a dual purpose, as it is a series trap, preventing the audio from causing picture interference. The interstage T2 transformer was made from an air-tuned i.f. transformer constructed as shown in Fig. 5-b. Each winding has 40 turns No. 30 enameled wire spaced to

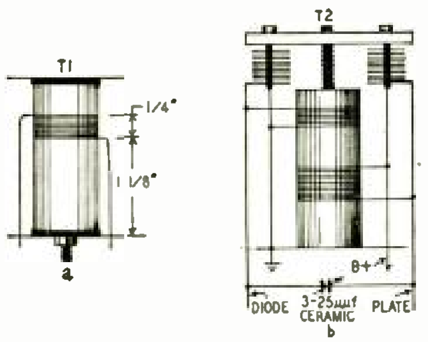


Fig. 5—Coil details are given in the text.

⅝ inch on a ⅝-inch form. Although a volume control is shown in the audio chassis, it is not used, the volume being controlled at the external audio amplifier. We intended at first to include an output audio amplifier on either the BC-1068 chassis or the picture chassis, but decided it was impractical when the

A GOOD TELEVISER

(Continued from page 58)

load already imposed on the power supply was considered. The transformer is undoubtedly oversized for the job and no heating takes place even after hours of operation. However, since a good audio system was already available, it was pointless to tax the transformer to the limit by adding the additional drain of a power amplifier.

As the spare holes and sockets the photographs of the picture chassis show, we experimented with many different types of sweep oscillators and amplifiers and the circuit of the ones shown give about the best linearity and ease of adjustment. Plenty of drive is available to accommodate a 7-inch picture tube and nothing but "scope" tube socket rewiring is needed to make the change.

Receiver alignment

Alignment of the receiver is simple. The BC-1068 receiver i.f. is already aligned and requires only a slight bit of touching up for optimum picture quality. The sound channel is aligned by connecting an audio-modulated 6.25-mc signal generator to the 6AG5 converter grid and tuning the audio i.f. transformers for maximum output. If no signal generator is available, the hit-and-miss system of trimming the audio i.f.'s will work when a television picture is being viewed on the screen.

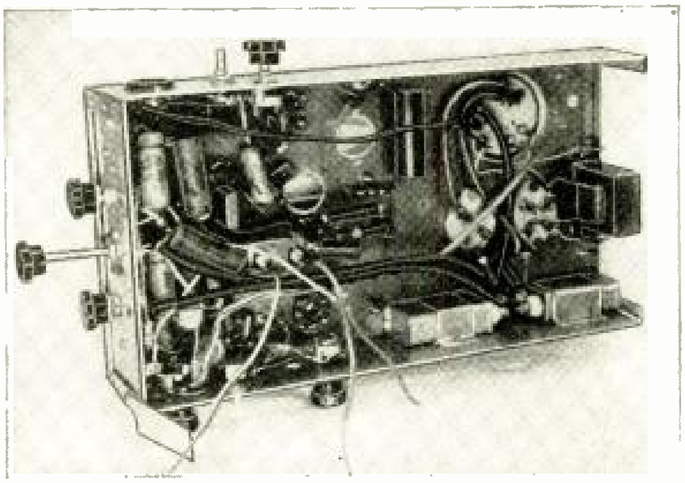
No instruments are required to align the r.f. section, although a wavemeter would be useful in setting the oscillator to the approximate desired frequency. The frequency of the local station and its operating schedule can be obtained by calling the station itself or by consulting the newspapers for programs. As a rule, to facilitate alignment and adjustment procedures, stations transmit a test pattern before scheduled programs and in some instances, maintain a regular test pattern schedule. The pattern is usually accompanied by an audio carrier modulated by a steady note to help adjust the sound system. Initial alignment is made with a pair of headphones plugged into the i.f. output jack on the 1068. With an antenna connected, set the vernier oscillator condenser to half capacity, rotate the bandswitch to the desired position and the sensitivity control to maximum. Rotate the oscillator trimmer which is in use very slowly till a loud hum-modulated signal is heard in the phones. Reduce the sensitivity to a lower level and peak the antenna trimmer for maximum. Then tune the sound for optimum clarity with the vernier capacitor. Center the square pattern on the screen with the centering controls and focus for finest lines with the focusing control *(Caution—these 3 controls have high voltage on them and should have insulated extensions or be cut off and adjusted with an insulated screwdriver.)* Adjust the horizontal and vertical size controls to make the square pattern the desired size, and the oscillator controls to lock the lines in place. The low-frequency oscillator controls the vertical lines and the high-frequency oscillator the horizontal lines. With a moderate signal level no difficulty is encountered in making the oscillators "sync in." However, the sensitivity control cannot be set too high on a strong signal or the picture will be distorted. Correct adjustment of the "brightness" control will erase the retrace lines visible when the control is set too high.

The trimmers have a range wide enough to cover the first five television channels. The operator may select the position of the bandswitch to correspond with any channel he desires. Only 3 channels were provided—one for each station active in the New York area. A switch with more than 3 positions can be installed to accommodate as many other channels as desired.

The antenna used for the set is a simple 80-inch dipole made of tubing and fed with a co-ax cable, however, any type of antenna may be employed. A change in the input circuit should be made if a higher impedance type of feed line is to work efficiently.

Very satisfactory reception has been obtained from the three stations in New York, WCBS-TV, WNBT and WABD, with the receiver in Bayside some 14 miles away. As the sensitivity control is advanced only a fraction of maximum, there is little doubt that good results could be had at greater distances. Some interference attributed to a high-band FM station was seen in the form of vertical lines when observing WABD. This was removed by inserting a parallel tuned trap in the antenna feed.

We have had many hours of enjoyment with the television receiver and gained much useful information concerning the operation of circuits somewhat apart from ham radio through its development.



Picture chassis, bottom. Position and focus controls at left, vertical size and hold at top, horizontal size and hold at bottom.

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. Six to 8 weeks is required to draw up answers involving large schematics.

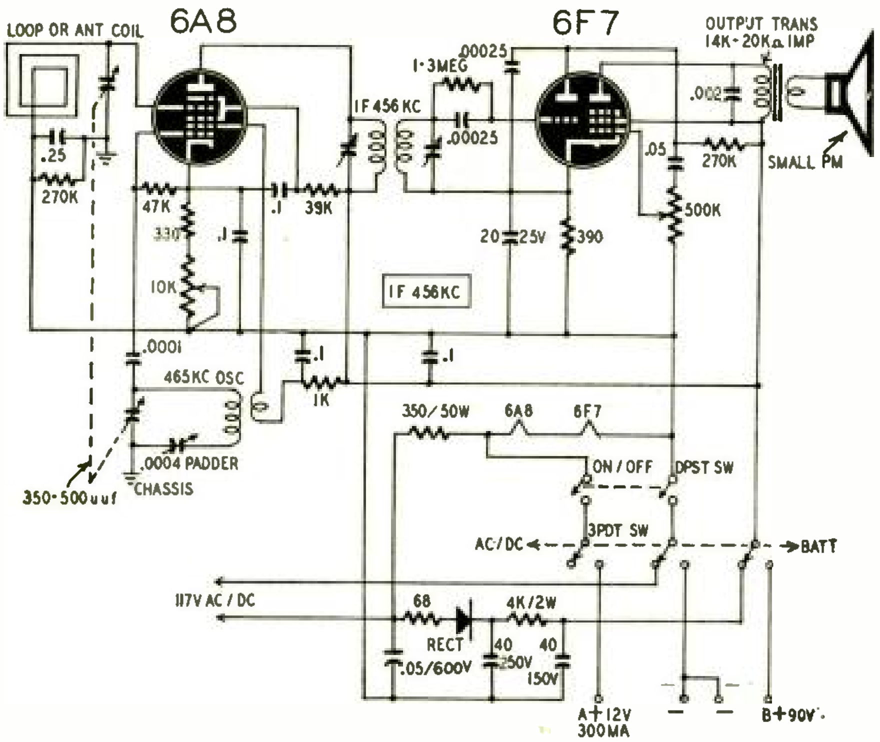
TWO-TUBE SUPERHETERODYNE

? *I am planning to build a 3-way portable superhet using a 6A8 and a 6F7, with a selenium rectifier for a.c. operation. Please supply me with a diagram.—L.T., New York, N. Y.*

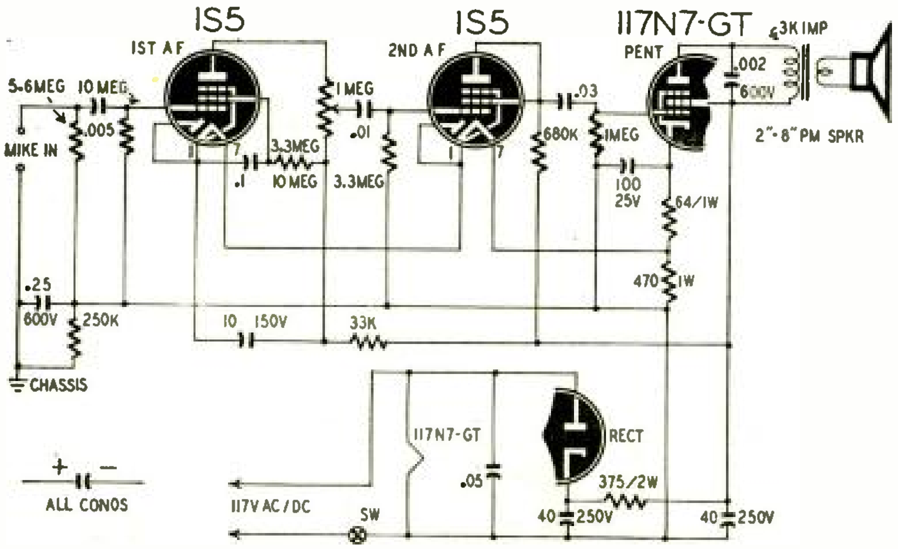
A. Here is the diagram you request. The tubes specified are not too applicable to battery operation. The filaments are connected in series and require a 12-volt A-battery capable of supplying 300 ma. They may be connected in parallel and operated from a 6-volt 600-ma battery with a 185-ohm, 100-watt dropping resistor for a.c. operation.

The 6A8 converts the incoming signals to the intermediate frequency, and they are detected by the triode section of the 6F7. Detection is at the intermediate frequency, though there is no i.f. amplification.

This set, because of its limited selectivity, probably will work better in isolated areas with a number of strong stations.



An a.c.-d.c. 2-tube superheterodyne usable (with limitations) as battery receiver.



Miniature a.c.-d.c. amplifier. Dry-cell tube filaments run on 117N7 cathode current.

MIDGET PA SYSTEM

? *I would like to have a diagram of a small public address amplifier using a 117N7 and one or two 1S5's as voltage amplifiers.—C.B.C., Toronto, Canada.*

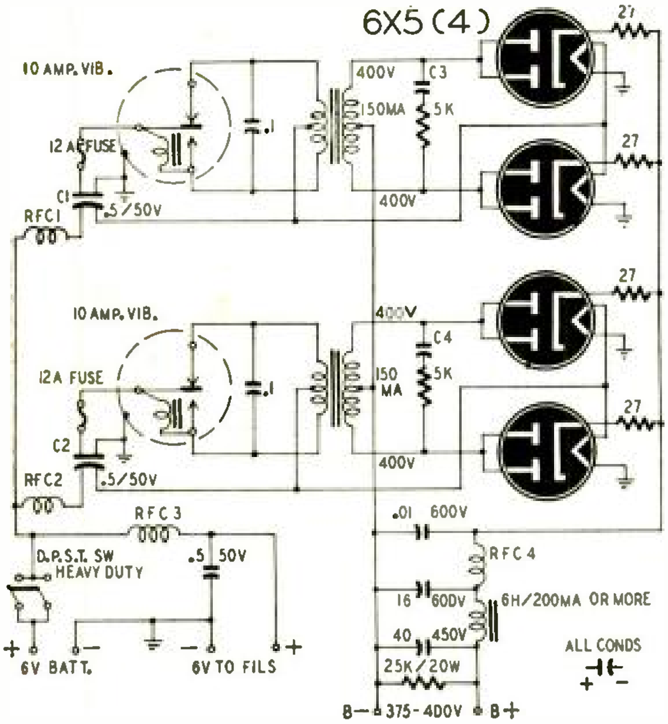
A. The amplifier diagram printed here will supply 1 watt or slightly more when used with the average crystal mike or pickup. Filament voltage for the 1S5's is taken from a tap on the cathode resistor of the power amplifier. Grid leads should be short and isolated from a.c. circuits by shielding.

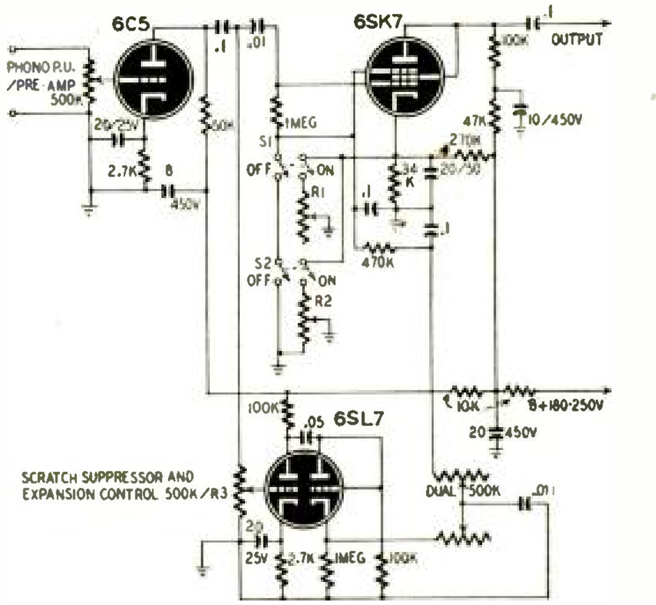
Hum is sometimes a problem in amplifiers of this type, and it may be necessary to bypass the No. 7 filament prong of each of the 1S5's to the negative lead with 100-μf condensers. Their working voltage may be low, about 3 or 6 volts.

SIX-VOLT POWER SUPPLY

? *Please print a diagram of a power supply delivering between 375 and 400 volts at 200 ma or more. The supply is to be operated from a 6-volt storage battery, using a nonsynchronous vibrator.—M.T., Hawaii*

A. If standard vibrator transformers are to be used, two power supplies must be operated in parallel to deliver the necessary current. Each supply uses two 6X5's connected as half-wave rectifiers feeding into a common filter. The buffer condensers C3 and C4 will require some experimenting to arrive at the correct values for the vibrator and transformers used. Vibrator buffer condensers having values between 0.002 and 0.01 μf and designed for 1,600 to 2,000 volts should be tried. The value should be adjusted for minimum vibrator current and minimum sparking at the points. C1 and C2 should be of the 4-terminal type designed for low r.f. impedance as





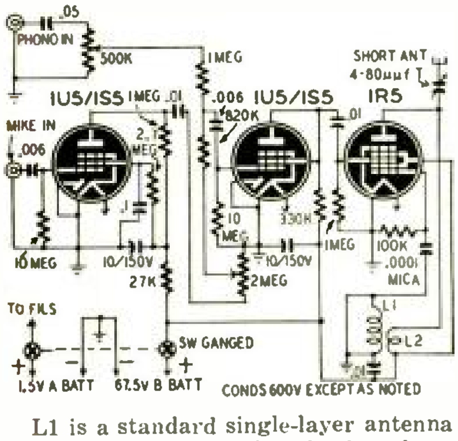
Left—Six-volt power supply. Above—Expander-scratch suppressor.

this type is more efficient for "hash" suppression.

PHONO OSCILLATOR

I want to build a battery-operated phono oscillator with separate channels for phono and microphone input. I want to use miniature tubes throughout. Can I use a 1R5 oscillator and 1U5's or 1S5's as voltage amplifiers?—A.H., Boelus, Nebraska.

A. This circuit will give good results. Shield all grid and plate leads up to the grid of the second 1U5.



L1 is a standard single-layer antenna or r.f. coil designed for the broadcast band. The tickler winding consists of about 20 turns of No. 30 enameled wire wound at the lower end of L1. The unit should be operated between 550 and 650 kc to obtain greatest distance and keep within FCC regulations.

SCRATCH SUPPRESSOR

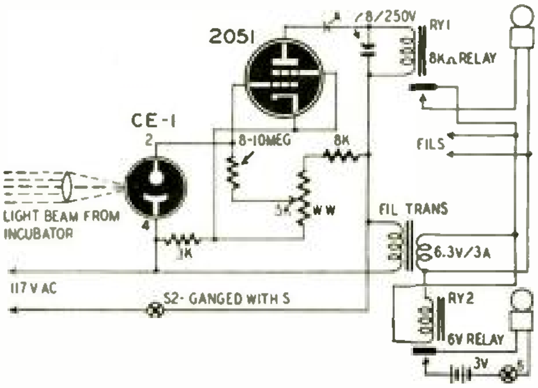
I have a small amplifier and would like to add a nondiscriminating scratch suppressor circuit such as the ones devised by Mr. Shaney some time ago. My amplifier uses a 6SC7 speech amplifier and phase inverter. Please include a preamplifier if one is needed. I plan to take supply voltages from the amplifier power supply.—G.R.F., Gadsden, Ala.

A. Here is the diagram you request. Volume expansion and variable time delay have been included in the circuit for your convenience. Scratch suppression and expansion are controlled by R3, and the variable time delay by the dual 500,000-ohm control in the return circuit of the 6SK7 suppressor. If the latter feature is not desired, the dual control may be replaced with single 500,000-ohm units with slotted shafts. These should be adjusted for best performance. R1 and R2 are 25,000 ohms each. They are adjusted to give low noise and good expansion range. S1 and S2 are expander and scratch suppressor switches, respectively.

PHOTO RELAY

I have a turkey incubator and would like a circuit for a photoelectric relay that will sound an alarm if the burners go out. Please include a relay to sound a different alarm in the event of power failure.—Wm. G.A., Vancouver, B.C.

A. The photo relay shown in the diagram meets your specifications. This is designed to work when the flame goes out in the heaters. Light from the flame is concentrated on the phototube with a lens. The phototube may be a CE-1 or equivalent. It develops a voltage that is applied to the grid of the 2051 as bias which prevents the flow of plate current. When the light fails, bias is removed and the 2051 conducts closing Ry1 which rings the upper alarm.

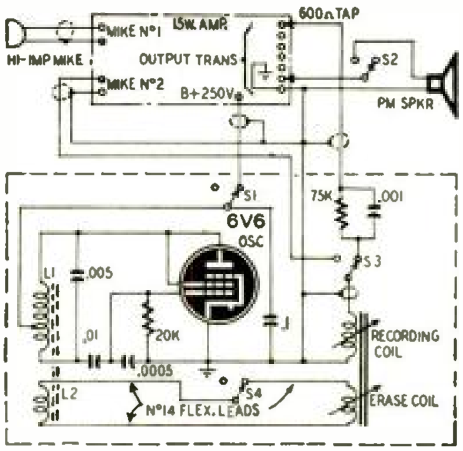


In the event of power failure, the armature of Ry2 drops out, closing the circuit to a battery-operated alarm.

The sensitivity of the unit is controlled by the amount of light and the setting of the 5,000-ohm control in the bleeder circuit. Ry1 is a sensitive relay that will throw at 10 ma or less. Insert a suitable resistor at A to limit the current to a value that can be carried safely by the relay that you select. An adjustable 5,000-ohm, 25-watt resistor will be about the value to use. Ry2 is a 6-volt relay with normally closed contacts.

ADDING A WIRECORDER

I have a Model A Wirecorder and a 15-watt amplifier. Will you draw a diagram showing how the 2 units can be combined.—G.Z., Cicero, Ill.



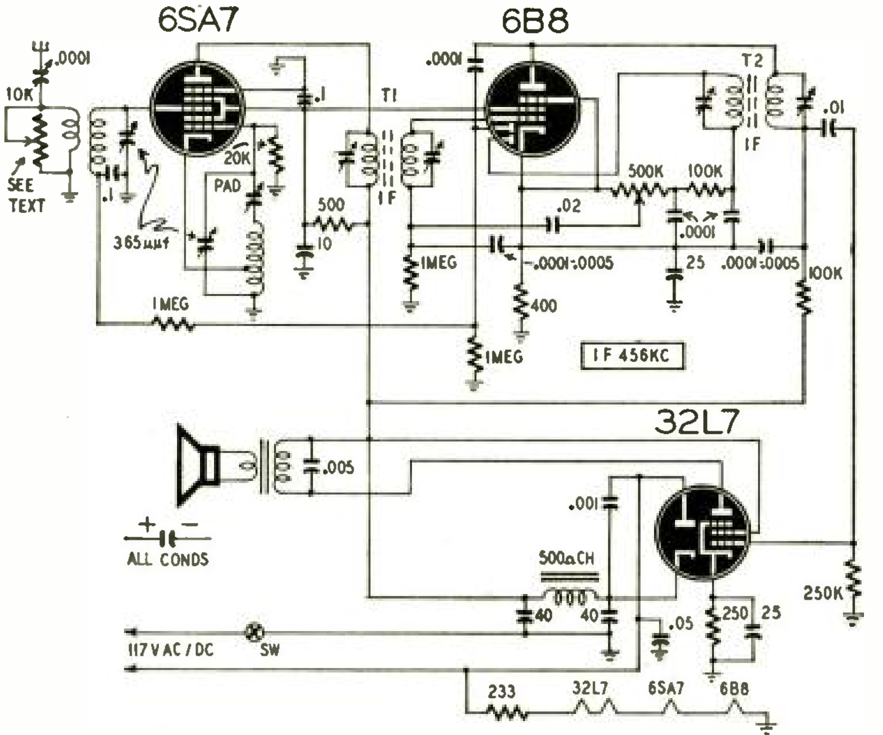
A. Here is the diagram requested. The equalizer and bias-erase oscillator are shown. S1, S2, S3, and S4 are ganged and are used for changing from recording to playback operations. This switch is shown in the recording position. L1 is the oscillator coil. It is 450 turns of No. 28 enameled wire, tapped at 150 turns from the grid end. This coil is wound on a 3/8-inch form 1 inch long with a powdered-iron core. L2 is 23 turns of No. 20 enamel, close-wound on top of L1.

RADIO-ELECTRONIC CIRCUITS

THREE-TUBE REFLEX SUPERHETERODYNE

Illustrated here is a circuit of a 3-tube reflex receiver that is simple and easy to construct and compares favorably with some 5- or 6-tube sets.

The circuit uses a 6SA7 as oscillator and mixer; 6B8 i.f. amplifier, diode detector and reflexed first a.f. amplifier, and a 32L7 power amplifier and rectifier. The antenna and oscillator-tuned circuit components are standard values designed to work with a 456-kc i.f. amplifier.



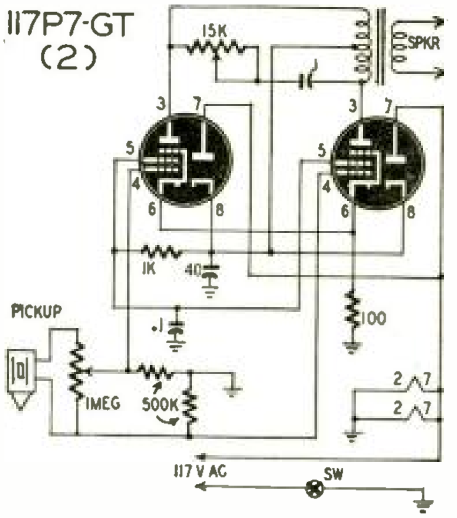
The i.f. signal is taken from the secondary of the second i.f. transformer T2 and detected by one of the diodes of the 6B8. The a.f. component of the signal is fed back to the control grid of this tube for further amplification. The amplified a.f. signal appears across the 100,000-ohm resistor in series with the primary of T2 and is taken off at this point and applied to the grid of the 32L7 power amplifier.

The remaining diode of the 6B8 is used to supply a.v.c. voltage for the mixer tube. All other circuit functions are conventional.

This set has a tendency to overload on strong local stations. This may be eliminated by connecting a 10,000-ohm control across the primary of the antenna coil as shown.

BOB WEBB,
Ashville, N. C.

PUSH-PULL TWO-TUBE AMPLIFIER



A minimum of parts and space is required by this phono amplifier.

It uses two 117P7 tubes with the pentode sections connected in push-pull and the rectifier sections in parallel. The crystal pickup used with this unit should have at least 1.5 volts output. Neither side of the crystal cartridge should be grounded to the frame. If the pickup is provided with a shielded lead, this should be replaced with 2 ordinary wire leads.

Ample room volume and good tone quality will be obtained if a good PM speaker and baffle are used with the amplifier, as well as high-quality parts throughout. Otherwise the volume is likely to be too low.

CARLETON PHILLIPS,
Corning, N. Y.

NOVEL AUDIO OSCILLATOR

Designed for use in radio servicing and for code practice, this audio oscillator is built around a 2-terminal Crosby oscillator which works into a 2-stage audio amplifier.

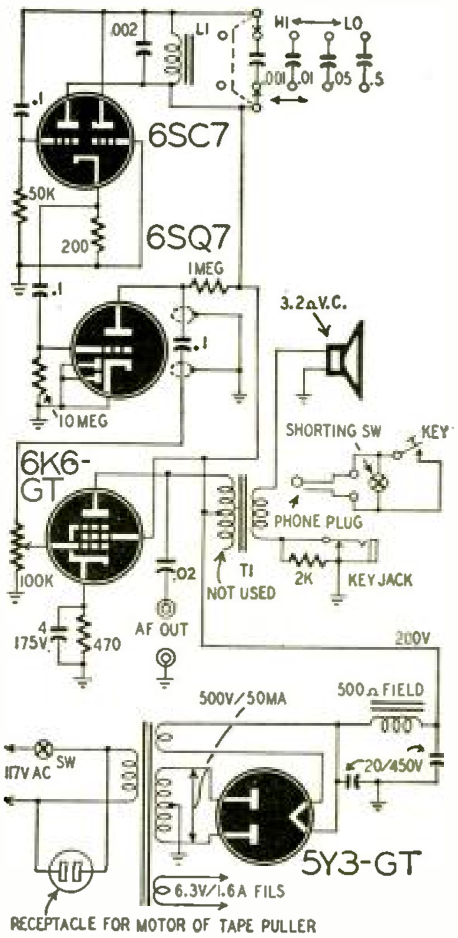
The tuning circuit consists of L1, a small a.c.-d.c. filter choke or the primary of a small audio transformer, and a .002-μf condenser. Lower frequencies are tuned by switching additional capacitance across the coil. Output is taken from the cathode of the 6SC7 and fed to the grid of the 6SQ7.

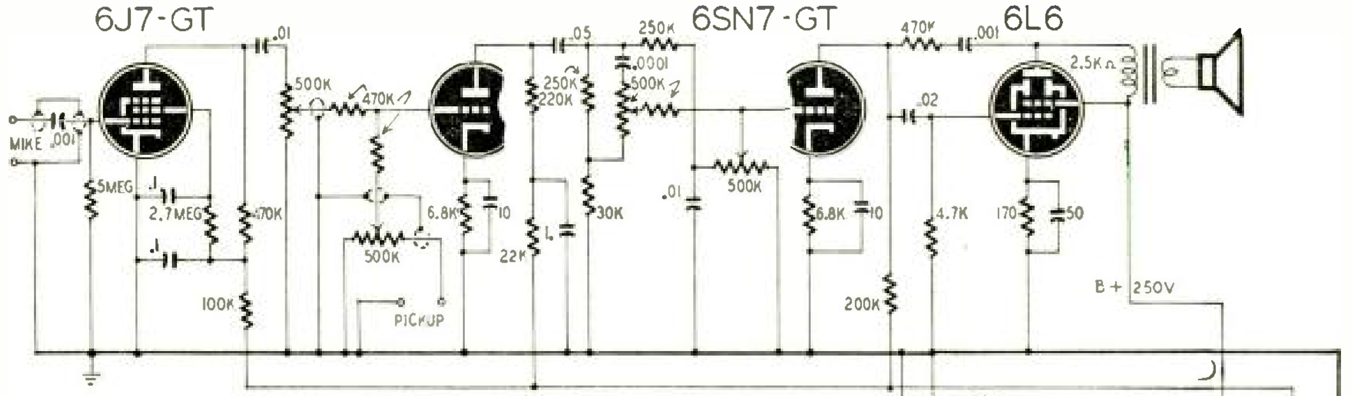
A keying jack is provided in the speaker voice coil circuit of a universal output transformer. When a key plug is inserted, a 2,000-ohm resistor is connected in series with the voice coil. Closing the key shorts the resistor.

I use this unit with a tape machine and have a receptacle in the 117-volt circuit for connecting the motor of the tape puller.

The power supply is conventional. A small transformer delivering about 250 volts to each rectifier plate at 50 ma works well. I use a dynamic speaker with its field coil in the filter circuit. A PM speaker may be used if a small filter choke is provided.

JAMES C. SOUKUP,
Minot, N. Dak.

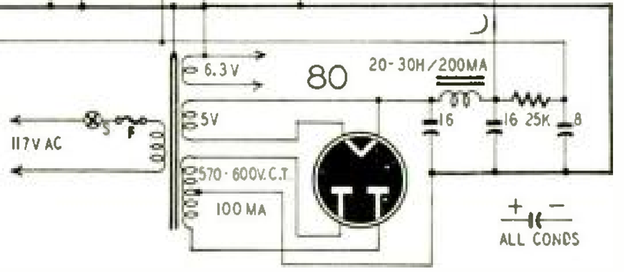




BELGIAN AMPLIFIER

The amplifier shown is suitable for low-power public address applications or for use as a phonograph and mike amplifier in the home. Individual volume controls for mike and pickup are provided in the grid circuit of the first section of the 6SN7, and bass and treble tone controls are in the second section.

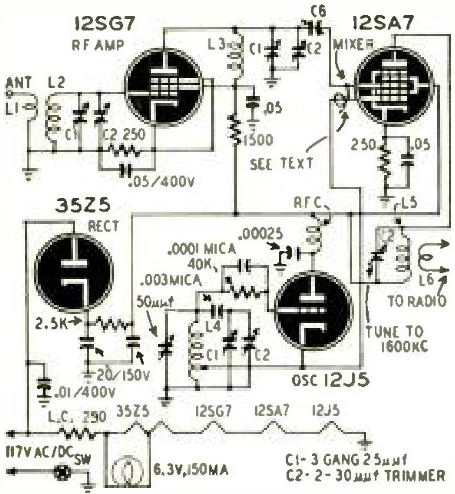
The amplifier is described in *La Radio Revue*, (Antwerp, Belgium). It uses a power transformer with primary taps for a.c. voltages most commonly encountered in Europe. Over-all frequency response is improved through inverse feedback between the plate of the 6L6 and the plate of the preceding stage.



20-METER CONVERTER

This converter is designed to enable its user to receive 20-meter signals with any receiver tuning to 1600 kc. It has a preselector stage to improve sensitivity and image rejection. It can be built on a 10 x 5 x 1½-inch chassis.

A 3-gang, 25-μμf-per-section, variable condenser is used for tuning, which is facilitated by a slow-motion dial. Each section of the tuning condenser is shunted with 30-μμf trimmers. A 50-μμf midget variable is used for band-setting in the oscillator circuit. The output of the oscillator is connected to grid No. 1 of the 12SA7. A short piece of hookup wire is connected to the No. 3 grid, and 1 turn is wrapped around the lead to grid No. 1.



The main tuning coils are wound on ⅞-inch forms. L1 is 4 turns of No. 24 wire wound 1/16 inch below L2. L2 consists of 12 turns of No. 19 wire spaced the diameter of the wire. L3 is the same as L2. The oscillator coil L4 has 10½ turns of No. 19 wire spaced the diameter of the wire and tapped 1 turn above ground. The output coil L5 is a standard single-layer broadcast coil. L6 is 10 turns of No. 24 wire wound at the lower end of L5. The ends of L6 are connected to a terminal strip for connections to the antenna circuit of the receiver.

Allow the converter to warm up and connect it to the antenna terminals of the receiver. Set the oscillator band-set condenser about half open and vary the tuning gang until a signal is heard. Adjust the r.f. and output trimmers for maximum output. Adjustments on the high end of the range should be made on a commercial station and on the low end on WWV's 15-mc signal.

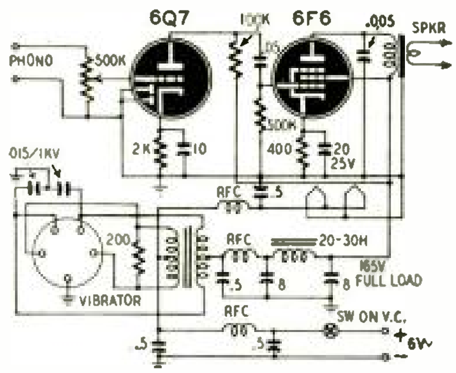
W. G. ESLICK,
Casper, Wyoming

6-VOLT PHONO AMPLIFIER

Ideal for mobile or emergency use or for use in areas away from power lines, this low-power phono amplifier is used with a spring-driven phono motor but a 6-volt d.c. motor can be used if desired.

The transformer and synchronous vibrator were salvaged from an old automobile radio. The r.f. chokes and efficient shielding prevent vibrator hum and hash. The chokes in the low-voltage leads are made by winding 2 layers of No. 18 wire on a form ½ inch in diameter. There are 35 turns on each layer. The r.f. choke in the B-supply is a winding from a 456-kc i.f. transformer.

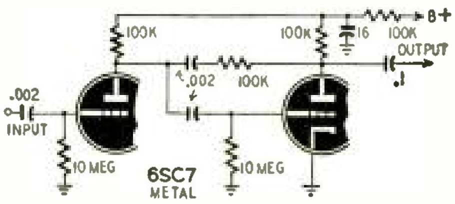
A cover plate is used on the bottom of the chassis. An under-chassis shield separates the power supply from the a.f.



components. The vibrator is a Mallory 245 or equivalent. W. G. ESLICK,
Casper, Wyoming.

PHONO PREAMPLIFIER

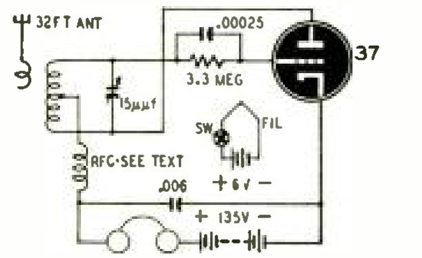
The circuit of this preamplifier was developed for use with the G-E variable reluctance and Caltron phono pickups. I don't think that you can beat it for



simplicity. It uses a 6SC7 with its sections in cascade. Contact bias is used on each grid and the cathode is grounded. The feedback circuit gives some bass boost, as the reactance of the .002-μf condenser increases with decreasing frequency. C. MCCLESKEY,
Baton Rouge, La.

10-METER SUPERREGEN

The circuit of this 10-meter superregenerative receiver can be used for world-wide reception. I use two 32-foot antennas at right angles to each other and select the one giving best results in the desired direction.



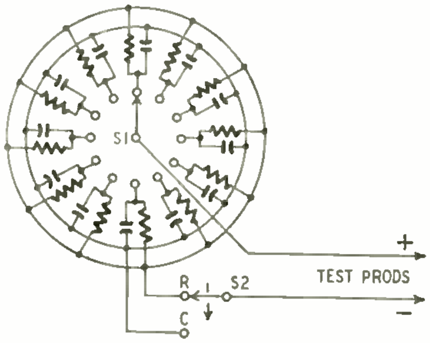
The grid coil has 30 turns of No. 14 wire on a ½-inch form. The turns are spaced to cover the desired tuning range. The antenna coupling coil is 2 turns of wire close to the grid end of the tuned coil. The r.f. choke consists of 100 turns of No. 34 d.s.c. wire on a ⅜-inch dowel. J. E. WALDEN,
Miami, Fla.

TRY THIS ONE

RADIO-CRAFT wants original kinks from its readers, and will award a one year subscription for each one published. We are especially interested in ideas which are illustrated with drawings or snaps, and make a liberal allowance for photos. Send your new ideas to RADIO-CRAFT today!

C-R DECADE BOX

Here is a simple capacitor-resistor decade box that I have found useful in radio servicing and experimenting. It consists of a single-pole, 12-position switch and one each of the most commonly used condensers and resistors. One condenser and one resistor are tied to each of the switch points and the other ends connected to common connections for condensers and resistors respectively.



The arm of the switch is connected to one test prod and the other prod is connected to the common condenser or resistor lead through a s.p.d.t. switch.

It is possible to connect other components such as coils, speakers, and chokes to S1 and use a multi-position switch in place of the s.p.d.t. unit shown.

WILHELM PEDERSEN,
Haugesund, Norway.

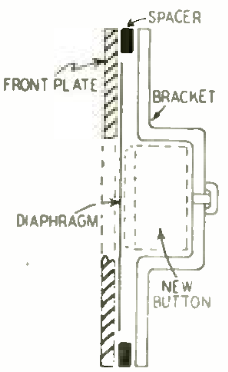
IMPROVING INTERCOMS

It is often desirable to increase the volume of one or more remote stations of an intercommunications system. Additional amplifiers can be used but they complicate the system and are not always practical. Try using a larger speaker and notice the improvement. Larger speakers are easier to drive since the cones offer less mechanical resistance and move a greater volume of air.

HAROLD PALLATZ,
Brooklyn, N. Y.

REPAIRING CARBON MIKE

Here is a method for replacing the buttons of carbon microphones. I replace the old button with one taken from a double-button throat mike—they are plentiful at radio-surplus stores.



Remove the button from the throat mike by removing the metal retaining ring. After removing all the button assembly from the telephone mike, place the new button, metal side to the diaphragm under the bracket. A spacer is cut from cardboard or thin leather and mounted between the bracket and front plate to equalize the pressure on the button. Draw the sections together evenly and tightly. These buttons should not be used with more than 1½ volts.

L. L. DARLING, JR.,
Norwich, Conn.

USEFUL TIME SAVER

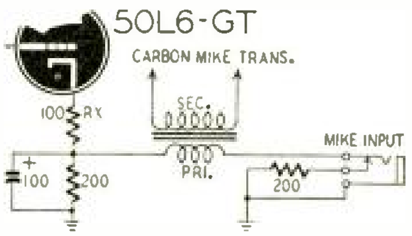
A china-marking pencil can be very useful in a radio service shop. In many cases, neither tube sockets nor chassis of a radio are marked with tube types and if the tubes must be removed from the set for testing, valuable time may be lost in getting them back in the correct sockets.

A marking pencil of this type is also useful in writing installation notes or other data directly on the surface of a tube. This generally last much longer than gummed labels.

STEWART HENRY,
Dalhousie, N. B.

NOVEL MIKE SUPPLY

This circuit eliminates batteries when using a carbon mike. The primary of the mike transformer is connected in the cathode circuit of the output stage across the biasing resistor. The values



shown are for a 50L6, but the circuit can be adapted to many other output tubes by changing the value of Rx.

W. L. WARDEN,
Barboursville, W. Va.

WIRELESS PHONO KINK

I find it bothersome and inconvenient to use the conventional trailing antenna on my wireless record player. I get away from this type of antenna by connecting a *good* 500-μμf condenser between antenna terminal and one side of the power line. Try both sides of the line, and use the one giving the best results. It is also worth while to try reversing the power plug on the receiver or phono unit.

ROGER E. HIEL,
Fitchburg, Mass.

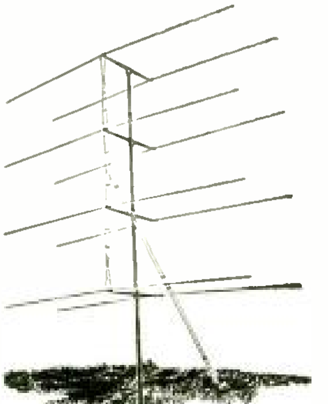
(A 1-kv mica condenser is safe and should work well.—*Editor*)

New RADIO-ELECTRONIC DEVICES

TELEVISION ANTENNA

LaPointe-Plascomold Corp.
Unionville, Conn.

The VEE-D-X is a long-distance television antenna designed for service in so called "fringe areas" and beyond. It has high forward gain and minimum pickup from sides and rear. The array is fundamentally a broad band antenna, but can be modified to give higher gain with reduction in band width.



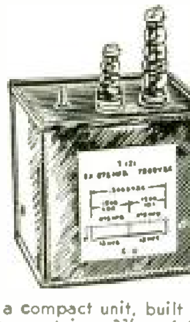
A Q-section matches the antenna to transmission lines of from 50 to 600 ohms impedance. Connections to the antenna are made with screw terminals or co-axial connectors, depending on the type of line.

Aluminum castings are used at all points of strain, and aluminum tubing is used for elements. It can be mounted on a 2-inch pipe without guys on the antenna proper. The unit weighs about 25 pounds and can be erected in approximately a half hour.—RADIO-CRAFT.

TELEVISION CAPACITOR

Cornell-Dubilier Electric Corp.
South Plainfield, N. J.

A television voltage-doubler capacitor T-121 with a dual .075-μf capacitance and voltage rating of 7,500 volts, d.c. is designed for use in television receivers and is equally suited for precipitator, voltage-doubler and photo-flash power supplies.



It is a compact unit, built into a rectangular container 3¾ x 4 9/16 x 5½ inches, with the over-all height of 8½ inches to the top of the terminals. It is equipped with brackets for upright or inverted mounting. Dykanol impregnated and filled, its hermetic seal assures efficient operation under all atmospheric conditions. The metallized glass terminals are solder-sealed with solder lug connections. The capacitor is equipped with voltage-divider discharge resistors.—RADIO-CRAFT.

COMBINATION TESTER

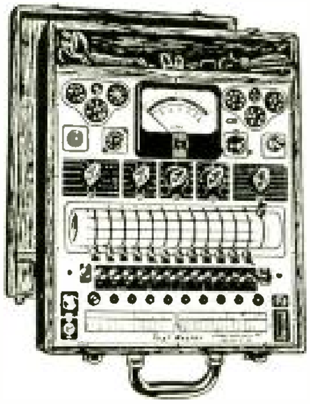
Precision Apparatus Co., Inc.
Elmhurst, L. I., N. Y.

The Electronamic Test Master includes a tube tester and a push-button-operated a.c. and d.c. multimeter.

The tube test circuit subjects tubes to individual element potentials swept over a complete path of operation, on a sinusoidal time base, covering a wide range of plate family characteristic curves. The path of operation is indicated on the meter in the terms REPLACE—WEAK—GOOD.

The circuit accommodates up to 12 elements, and tests all standard receiving and low-power transmitting tubes, including acorns, noval 9 pins, dual-capped h.f. amplifiers, etc. A free-point, 12-lever element selector is provided.

The set tester circuit is push-button operated and has 34 a.c. and d.c. ranges as well as testing facilities for radio A-, B-, and C-batteries under dynamic load. All standard set testing functions are available at 2 polarized tip jacks. It has a 400μa, 4⅝-inch meter. All circuits are insulated from the power line. All ranges are self-contained.



A.c., d.c., and output voltage ranges are 0-6-12-60-300-1,200-3,000 volts. Direct-current ranges are 0-600μa, 0-6-60-300-1,200 ma, and 0-12 amperes. Resistances to 10 megohms are metered in 4 ranges. There are 6 decibel ranges from 20 to 64 db.—RADIO-CRAFT.

THERMISTOR BRIDGES

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

The new Type T8N-7SE and T8N-6SE thermistor bridges provide r.f. power measurements up to 2 milliwatts at frequencies up to the shorter microwave regions.

Type T8N-7SE is designed for continuous duty at normal laboratory ambient temperatures where measurement in S, X, and K microwave bands may be made accurately with suitable r.f. measuring heads. The bridge is independent of frequency but should be used with appropriate thermistor mount. Two-milliwatt scale sensitivity is essentially linear, but a calibration curve is required for each r.f. head used.

The instrument, designed for 100-130-volt, 60-cycle a.c. input is rated at 25 watts, weighs 14 pounds, and measures

8 x 8½ x 10 inches. Tube complement includes one 6X5GT/G, two VR-105's and one VR-150.

Type T8N-6SE thermistor bridge which requires external oven and thermistor mount, contains a Wheatstone bridge circuit with 3 precision resistor arms and externally mounted thermistor; a stabilized 2,000-cycle source for the bridge; a stable d.c. source for substitution measurement of r.f. power; and an amplifier. It is independent of frequency and can be used as a balanced or unbalanced bridge providing accurate full-scale meter readings from 25 microwatts to 2 milliwatts.

It is designed for 115-volt, 60-cycle a.c. input and is rated at 150 watts, exclusive of external oven. It weighs 54 pounds exclusive of oven and thermistor mount, and measures 10¼ inches high, 21 inches wide, and 15 inches deep. Tube complement includes seven 12J5's, three 6Y6G's, two 5U4G's three 12SH7's, and two VR-90's.—RADIO-CRAFT.

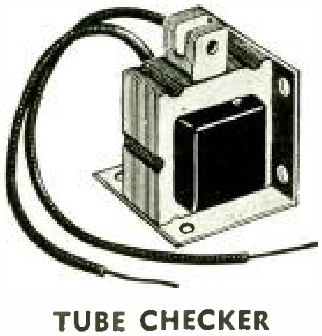
ALL-WELDED SOLENOID

General Electric Co.
Schenectady, N. Y.

For use where powerful pull is needed in a small space, such as in appliances, pinball machines, safety devices, trip mechanisms, and vending machines this new small all-welded solenoid develops a maximum pull of 0.26 lb. in a ½-inch stroke. It operates on 110 volts, 60 cycles.

An L-shaped mounting bracket permits horizontal or vertical mounting. Frame and bracket are welded together. The silicon steel frame laminations are welded together. Welding reduces eddy-current losses, since the welds are outside the magnetic flux path.

The removable coil is sealed inside a plastic housing. It is paper-layer-wound, heat-treated to remove moisture, and impregnated with a plastic. Plunger laminations of silicon steel are welded. A new type of pole shader, brazed into place, provides maximum quietness at a lower watt consumption. —RADIO-CRAFT.

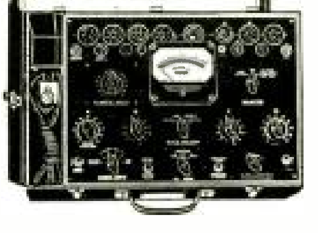


TUBE CHECKER

Weston Electrical Instrument Corp.
Newark, N. J.

The Model 798 Type 5 tests all receiving tubes, voltage-regulator tubes, and low-power thyratrons. It provides proportional mutual conductance ranges of 12,000, 6,000 and 3,000 micromhos under conditions which closely resemble actual operation. "Good-Bad" readings, also, are provided. Sixty-cycle a.c. potentials are used on tube elements, thereby approaching the zero plate load conditions most desired for mutual conductance tests. An internal 5-kc signal is applied to the control grid, and the resulting plate component of the h.f. signal is measured on a meter.

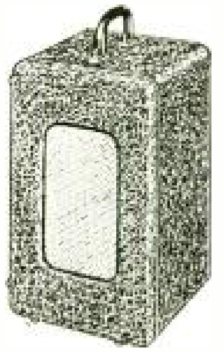
The tube checker weighs 23 pounds in its aluminum case and operates on 105-125 volts, 50 to 60-cycle a.c.—RADIO-CRAFT.



PORTABLE AMPLIFIER

Webster-Chicago Corp.
Chicago, Ill.

The Model 6 portable amplifier has an 8-watt push-pull circuit, with 3 tubes and a rectifier. Output is delivered through an 8-inch Alnico-5 speaker. It is especially suitable for use with the Model 65 portable record changer, or as an external amplifier and speaker for a Model 80 wire recorder.



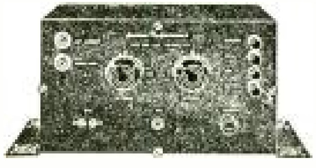
The unit has separate tone and volume controls, with the on-off switch on the tone control. The control panel is recessed so that knobs are flush with the outside of the case. Suitable space for pickup and power cords is provided. The 15¾X9½X9¼-inch case is finished in burgundy leatherette. The amplifier operates on 105-125 volts 50-60-cycle a.c. only. It weighs 18 pounds. —RADIO-CRAFT.

MOBILE TRANSMITTER

Eastern Amplifier Corp.
New York, N. Y.

The Model 600 mobile transmitter is designed as a self-powered unit with 10 watts output on frequencies between 27 and 30 mc. It uses a 2E30 crystal oscillator-doubler, one 2E30 in the power amplifier and another in the modulator stage, and an 0Z4 rectifier. It features push-to-talk operation with no stand-by current. The antenna tuner will match any antenna from 10 ohms to several thousand ohms.

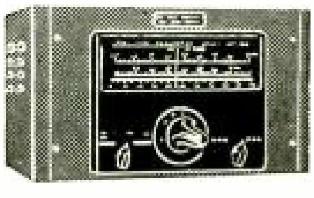
The unit, complete except for crystal and microphone, measures 10½X6X6½ inches. It is in a crackle-finished, shock-mounted box. Primary power is from a 6-volt vehicular storage battery.—RADIO-CRAFT.



U.H.F. CONVERTER

Columbus Electronics, Inc.
Yonkers, N. Y.

Model HFC 610 is available in 2 ranges: 27 to 30 megacycles, and 50 to 54 megacycles. It embodies a 6AK5 high-gain r.f. amplifier stage, a 6AK5 mixer, and a 6C4 stable oscillator. This converter has a self-contained, regulated power supply. It provides sharp tuning and separation between stations, low internal noise, image-free reception, and smooth tuning. It has a directly calibrated dial.—RADIO-CRAFT.



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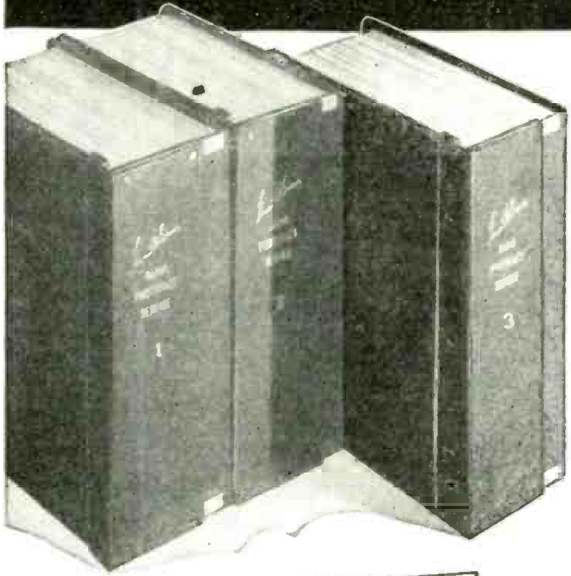

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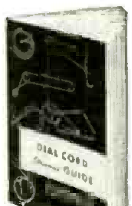

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POWER FOR THE BC-312

(*Continued from page 74*)

unless you are lucky enough to find a 24-volt transformer. One surplus item which will give approximately 24 volts is available and will work well for this or any other receiver requiring this voltage. It is a replacement part for the Collins TCS-12, and supplies 16.6 volts and 12.6 volts center-tapped. By using one half of the 12.6-volt winding in series with the 16.6 volts, one can get 22.9 volts, which will work very well for filaments.

It is also easy to change the wiring in the HX and NX so that only 12 volts is required for the filaments. To make these changes, remove the receiver from its case, and disconnect the dynamotor. Locate the filament lead from the beat frequency oscillator socket to the socket of the first i.f., connecting the filaments in series; both tubes are identified on the top of the chassis, although the beat frequency oscillator is completely enclosed and its socket is not accessible. On all tubes in this set, pins 2 and 7 are the filament connections. Disconnect this wire at the first i.f. socket, and connect it to condenser C78, plainly marked and in the very center of the part of the chassis exposed by the removal of the dynamotor. Connect the terminal on the first i.f. socket to which this wire was connected to C79, which is in the same bathtub type container as C78. Next, short out resistor RS-267, a long flat object fastened to the front panel, in front of the coil compartments. Both terminals are exposed and are easy to reach.

Next it is necessary to dig into the r.f. section. Take out the tubes, behind the condenser, and unscrew the 8 screws holding the cover plate—4 on the back and 4 on top. Four more screws must be removed to loosen the subchassis. Ease the grid leads down into their holes, and turn the chassis so as to expose the wiring. Remove the wire connecting the filaments of the first and second r.f., which are identified on the top of the subchassis. To each of the terminals just disconnected, fasten about 6 inches of wire, and twist these two wires together. Be sure you can identify them, however. At the end of the subchassis is a small vertical terminal strip containing the filament leads and others. By tracing the leads it is easy to discover which they are, and to connect the 2 wires so as to have 2 complete filament circuits, one including the mixer and second r.f., the other including the first r.f. and the high-frequency oscillator. It is not

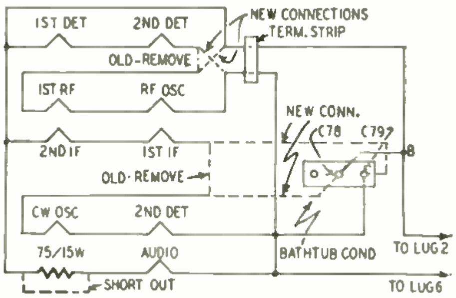
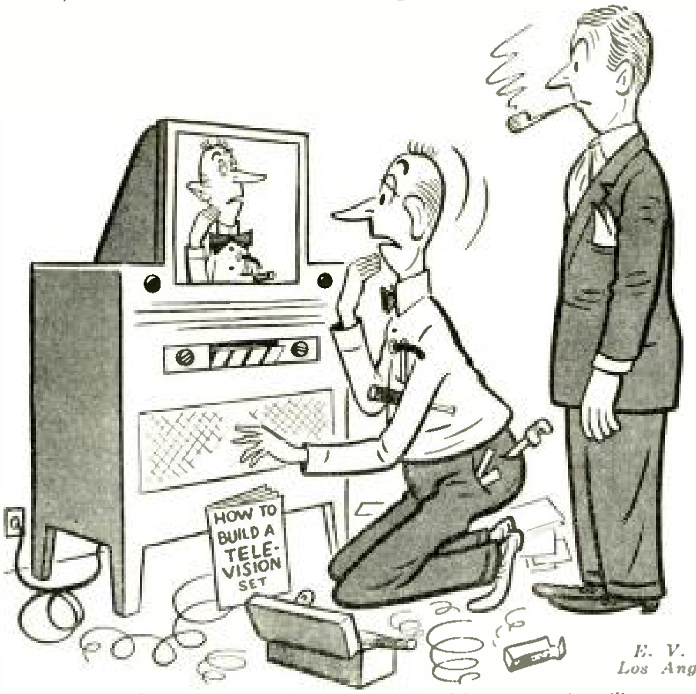


Fig. 3—Filament wiring for BC-312-HX and NX.

necessary to open the oscillator shield can to make these connections. Fig. 3 shows the original and the revised wiring of the HX and NX filaments. After replacing the subchassis and shield, making sure not to foul the grid leads and keeping the filament leads away from the other wiring as much as possible, the HX and NX can be treated like any 12-volt model of the BC-312. An RA-20 or a specially made power supply, as described above, can be used. The dial lamps should be replaced with 6-volt lamps, although the old 12-volt lamps will work fairly well.



E. V. Schwartz
Los Angeles, Calif.

"Must have made a mistake in the wiring somewhere!"

D.-C. MILLIAMMETERS

(Continued from page 70)

shunt resistance nor to measure the voltage of the batteries when they are being used in the radio receiver. Values of the resistors are:

METER RANGE & RESISTOR VALUES

Resistor	0-5 Ma	0-10 Ma	0-50 Ma	0-100 Ma
R1	400 ohms	200 ohms	40 ohms	20 ohms
R2	1,600 ohms	800 ohms	160 ohms	80 ohms
R3	10,000 ohms	5,000 ohms	1,000 ohms	500 ohms
R4	20,000 ohms	10,000 ohms	2,000 ohms	1,000 ohms

Let us look at Fig. 2 again. We have determined the voltage from the power supply across the portion of the circuit where the total current is available for the measurement. We wish, however, to

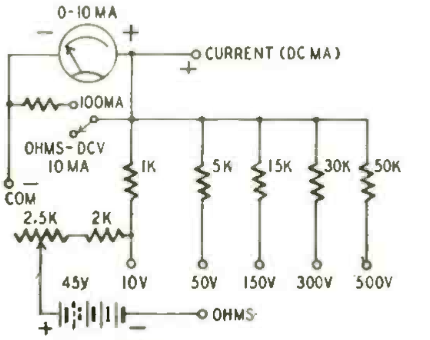


Fig. 6—A multitester useful in many circuits. Resistance of shunt is 1/9 that of the meter.

get a complete voltage check. From Ohm's law we know that E=IR. Therefore, if we insert a milliammeter in the circuit as in Fig. 5 and measure the current I, the voltage across R is IR. If in Fig. 2 we measure the current at C and know, or measure, the value of the plate resistor R, we can determine the voltage across R. The plate voltage at C is then the supply voltage minus the drop across R. This may be done for all plate and screen voltages.

Thus, by proper use of a milliammeter, a serviceman or experimenter can make fairly accurate voltage measurements of the d.c. voltages in a radio receiver. And he is not limited to that magic 0-1 ma meter he has wished for. A complete d.c. multitester circuit using a 0-10 ma meter is shown in Fig. 6. This includes an ohmmeter circuit which will measure accurately from 0 to 500,000 ohms. Two current ranges are provided, and the instrument should prove adequate for testing and servicing by the method outlined. Lower or higher values of meters may be used by proper change of circuit constants. A 5-milliampere meter would require multipliers of half the value of Fig. 6, and a 22.5-volt battery with the same ohmmeter resistors.

The experimenter may with the aid of this article put some of those old meters to work. He will realize, of course, that such instruments are limited in application, as outlined above. There is a very good reason for using 1,000-ohm-per-volt (or even 20,000-ohm-per-volt) meters, if the would-be user has them on hand or can obtain them easily. But for occasional experimental use, for measuring odd voltages and currents when no regular meter is available, and especially for use as battery testers, larger meters can be very useful.

EXTRA ELECTRIC CHARGE FOR TELEVISER?

Extra charges for electric power where television sets are connected to the line have been made in Connecticut, engineers of the Radio Manufacturers' Association charged last month.

The action of two Connecticut cities, Wallingford and Norwich, was cited by L. C. F. Horle, chief engineer of the Association, who reported that the Public Utilities Commission of Connecticut had permitted the Borough Electric Works of Wallingford to charge $2.50 extra a month for electric power where a television receiver is installed, on the assumption that added power was required.

Earlier it had been reported that owners of sets in Norwich have been required to pay $1.26 extra on their monthly bills, not as a direct charge for electricity, but for having the set connected to the line.

Mr. Horle said that a survey of fifteen sets showed that power demand "contrasts not at all with the demand and power factor of many domestic appliances whose wide usage at normal power rates effectively destroys any sound basis for distinctive rates for television receivers."

The feeling among the radio officials was that the power companies were defeating their own best interests by discouraging the use of sets.

KICKBACK POWER SUPPLY

(*Continued from page 60*)

B-plus flowing through this circuit, so that we actually gain a small amount of voltage.

The name *power feedback* has been given to this circuit. It has proven its economy in many instances. The centering control has been slightly changed so that it no longer requires a center tap, but that tends to make the adjustment somewhat one-sided.

The greatest disadvantage of the kickback high-voltage power supply is the rather tricky adjustment and the relatively poor regulation of the high-voltage section. To adjust it for best operation it is necessary first to set the saw-tooth amplitude control R3 to maximum sweep amplitude, then adjust the screen resistor R8 for best linearity and maximum brightness. Next the 2 permeability-tuned coils L1 and L2 are set for the best linearity and size, and damping resistor R12 is set for linearity and size. Once these controls are set, it will be necessary to repeat this procedure to obtain the best possible picture. When all these adjustments are made and a good picture is received, it should not be necessary to manipulate these controls again.

The slightly poor regulation of this type of power supply will be noticeable only when the adjustments outlined above have not been made properly. It will show itself as a difference in size between a bright and a dark picture. If the controls are set properly, this effect will become practically invisible.

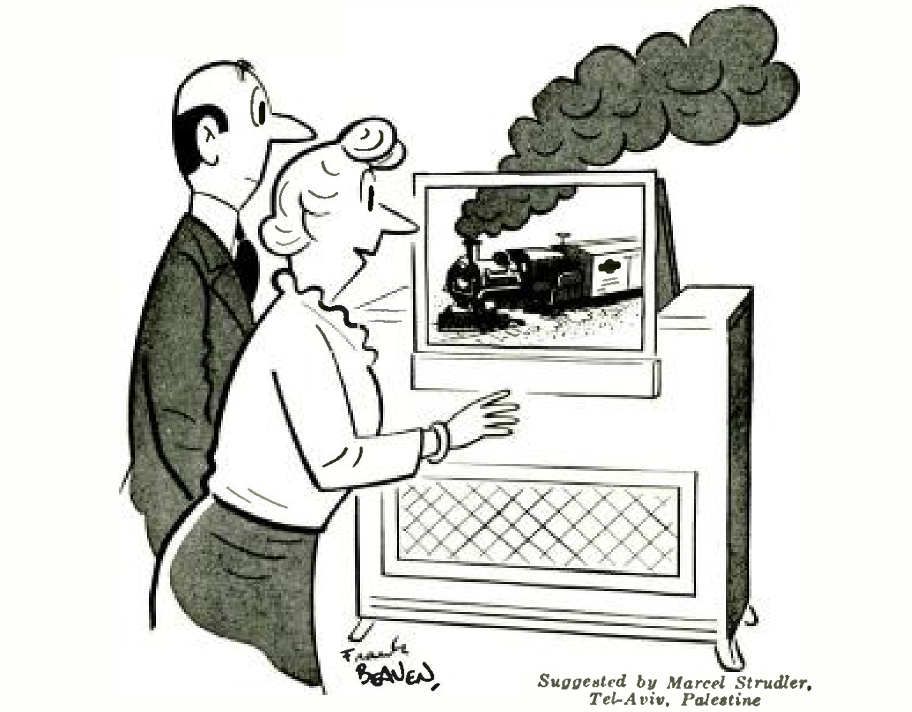
In conclusion it may be said that the outstanding advantage of a kickback high-voltage power supply lies in its economy, not only in the number and price of the components involved, but also in power consumption, which is a very important factor when designing a small table-model television receiver. Further advantages are in the fact that it is very unlikely that a collapse of the sweep could leave a bright spot on the face of the cathode-ray tube, which would burn a hole in the fluorescent screen. Actually, this is possible with this type of high-voltage supply only if an open circuit exists between the secondary and the deflecting coils, something that will happen only in rare instances.

It can be seen from the above description that such a system lends itself readily to the mass production of small table models and many types of console models as well. As a matter of fact, the latest RCA 10-inch table model, as well as the Philco and some television kits, use a kickback high-voltage power supply, and many other manufacturers are planning its use for their new models.

EMERGENCY FIELD SUPPLY

It is often necessary or desirable to use an electrodynamic speaker with an amplifier designed for use with PM units. This can be done by passing the plate current of the output tube through the field of the speaker before it goes to the output transformer. If the amplifier has a push-pull output stage, connect the speaker field between the B-plus and the center tap of the output transformer. An 8-μf condenser across the field will give higher volume and better quality, but may be omitted without harmful results.

A. D. DENTON,
Herts, England



Suggested by Marcel Strudler, Tel-Aviv, Palestine

"There must be some leakage."

HI-FI TUNER TRIBULATIONS

(Continued from page 61)

both i.f. transformers the XYL had rigged up a dual rotary switch on the underside of the chassis. She had a rod running back and a switch placed very nicely under each i.f. hole. A nice deal except for putting transformers back.

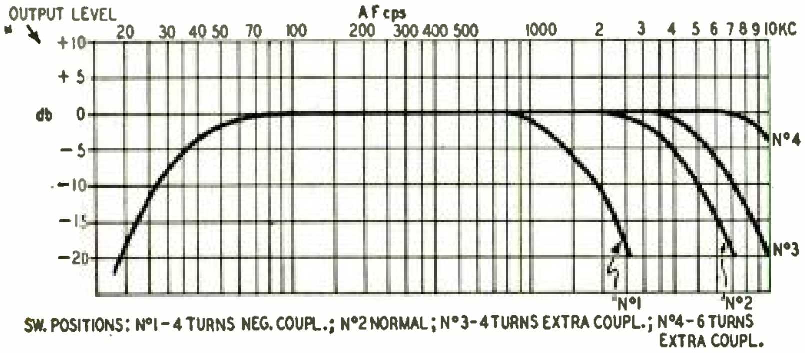
This time it was a wee bit too broad. Stations ran into each other. Six turns would be about right, I said. "There are 4 positions on this switch," the XYL commented. "Maybe we could have 4 band widths?"

I was thinking. If adding clockwise turns to each coil would increase the coupling and broaden the band, then adding clockwise to one and counter-clockwise to the other should decrease tion right on the nose. Then the XYL twisted the switch and you could hear the highs coming in a step at a time.

The next day I took the tuner to the lab where I worked (over the XYL's protest) and ran some curves at lunch time. It looked fine.

The next Sunday the XYL didn't switch tuners once. She listened to the NBC programs in the broad position and they were fine. The program fairly sparkled. Almost as nice as with the t.r.f. At noon she tuned in KNX on the No. 1 position. On No. 2 there were some highs and no Mexican station. On No. 3 there were more highs and still no Mexican music. She turned to No. 4 and there were still more highs and still no XERB with Bob Wills.

"What the hell?" We looked at each other with arched eyebrows.



Fidelity curves of the receiver with the selectivity control in each of its four positions.

the coupling and sharpen the band. A sharp position would be handy for alignment and also for tuning stations right on the nose. "Okay," I said. "This time I'm all set. We'll fix it up right."

I got out the 30-36 wire and I laid the turns in deeply. To the No. 1 switch position I wired 4 turns clockwise on the primary and then 4 turns counterclockwise on the secondary. No. 2 I left open. No. 3 had 4 turns clockwise on both primary and secondary. No. 4 had 6 turns clockwise on both primary and secondary.

It worked! Beautifully. In the narrow position it was a cinch to get any sta-

She deliberately went hunting for XERB on the dial. I'll be damned if they weren't off the air! What's more, they didn't come on again.

I got my draft notice about then so I quit the job. Before I left we drove down into Mexico to see XERB. Their antenna tower was knocked down and broken. The stub end stuck up in the air about 10 or 15 feet.

I don't know yet whether a windstorm or a low-flying plane or what that did it, but XERB was off the air for some time. Maybe some other music lover went down and sabotaged the tower. I never did find out!

RADIONIC ELECTROMIX

Eddy Current was a *conductor* on a *Wave train* which used to pass over the *Wheatstone Bridge*. One day, passing down the aisle he saw a *standing Wave* and found a seat for her. She told him her name was *Jenny Rator* and asked him the *transit time*. Eddy got *shunt-excited* and his heart started *motorboating*. He asked her if he could be a *wave guide*. Seeing his *thermal agitation*, her *admittance* got the better of her, and she told him she already had a boy friend named *Mike Rofarad*. In well-*modulated* tones she told him she was *biased* against *Mike* because his *input capacity* needed a *volume control* and unless he *limited* his *amplitude* he always got *loaded*. At this *cross talk Eddy Current* saw her *driving point* and said he would try to be a *converter* for Mike Rofarad. At noontime, at the *Antenna Feed* he was putting a *pi-section* into his mouth with a large *insertion loss* when he saw *Mike*. He was *stagger-tuned* as usual and was finding it difficult to maintain his *vertical position*. His *stability* was poor and he was highly *unbalanced*. Suddenly he yanked out an *electron gun*, *focused* it at Eddy Current, and pulled the *trigger*. The *shot effect* was terrific. When the *space charge* had cleared away, a large *cavity* was found in the *ground*, and Mike Rofarad had disappeared. When Eddy saw Jenny Rator that night, he told her what had happened. Her *crystal* eyes watered and in the *intensity* of her grief she nearly had a *breakdown*. Then Eddy began to *sweep* her off her feet. Eyeing her *characteristic curves* he pledged her undying *fidelity* and presented her with an *intensifying ring*. Feeling the *mutual induction* between them, they decided to try *critical coupling*, and were hence *matched* by a preacher. Then they went out to celebrate, got *saturated*, and became a very *twisted pair*.

—*E. A. Uttendorfer.*

FM INSTALLED IN CINCINNATI BUSSES

FM receivers have been installed in public busses by the city of Cincinnati, for the enjoyment of passengers. The sets will be operated for one-hour periods daily for a one month test period. Technicians believe it will be possible to provide music at a level high enough to give passengers entertainment and yet not loud enough to interfere with conversation.

An automatic volume control specially designed for the receiver holds the level normal whether the busses are near or far from the transmitting station.—*G.L.*

TECHNOTES

. . . . TELEVISION SETS

When adjusting television sets, it is difficult to watch the picture and manipulate the controls, in back, at the same time. I overcome this difficulty by using a flexible cable about 2 feet long with a coupling on one end and a knob on the other. Tighten the coupling on the control shaft. The controls can then be adjusted one at a time while standing in front of the set.

H. Ackerman,
Brooklyn, N. Y.

. . . . EMERSON 522

Complaint: Severe hum, loudest with the volume control set for *minimum* volume. Tubes checked good. Filter condensers could not have caused the trouble, because then the hum would have been loudest for maximum setting of the volume control. By tapping all components and connections, I located a high-resistance joint at the cathode pin of the 12AT6 socket. A slight heater-to-cathode leakage will develop a voltage across such a faulty connection, thus varying the bias on the grid of the tube. Cleaning and resoldering the connection cured the trouble.

Joe Fiederer,
Worcester, N. Y.

. . . . EMERSON GC448

One complaint on these sets is that they play on batteries but not on a.c. or d.c. lines. I find that resistors R16 and R17, 1500 and 950 ohms respectively, often increase in value. These units are easily located since they are mounted upright near the 117Z4 rectifier. Replacing them with 10-watt units of proper value cures the trouble.

W. O'Brien,
Fulton, N. Y.

. . . . GASSY BEAM TUBES

Sometimes a 35L6 or similar tube in a.c.-d.c. sets goes slightly gassy and causes distortion. When replacements are not immediately available, try reducing the grid leak to 75,000 or 100,000 ohms. The lowered resistance reduces the voltage drop when the grid draws current.

Louis Pastore,
Peterboro, Ont.

(Be sure to replace the original grid leak when the tube is replaced.—*Editor)*

. . . . SPEAKER MOUNTING

When installing a radio with detached speaker in an old car, it is often quite a problem to find a suitable spot for the speaker.

I have solved this problem satisfactorily by mounting the speaker on the heavy fiberboard liner on the inside of the side cowl. Cut a hole in the liner and mount the speaker between the liner and cowl. If a finished grill is not available, make one from fine screen wire. The large enclosed space surrounding the speaker improves its tone quality.

Harry W. Booz,
Hopewell, Va.

U. S. TELEVISION STATIONS IN OPERATION

STATION	CHANNEL
WRGB General Electric Co, Schenectady, N. Y.	4
WABD Du Mont Television, New York, N. Y.	5
WNBT National Broadcasting Co., New York, N. Y.	4
WCBS-TV Columbia Broadcasting System, New York, N. Y.	2
WPTZ Philco Corporation, Philadelphia, Penna.	3
WFIL-TV Philadelphia Inquirer, Philadelphia, Penna.	6
WTTG Du Mont Television, Washington, D. C.	5
WMAL-TV Evening Star, Washington, D. C.	7
WNBW National Broadcasting Co., Washington, D. C.	4
WBAL-TV Hearst Radio, Baltimore, Md.	11
WTVR Havens and Martin, Richmond, Va.	3
WBKB Balaban and Katz, Chicago, Ill.	4
WWJ-TV Detroit News, Detroit, Mich.	4
WEWS Scripps-Howard Co., Cleveland, O.	5
KSD-TV St. Louis Post-Dispatch, St. Louis, Mo.	4
WTMJ Milwaukee Journal, Milwaukee, Wis.	3
KTLA Paramount Pictures, Los Angeles, Calif.	5
WBZ-TV Westinghouse Radio Stations, Inc., Boston, Mass.	4

COMPOUND VIEWING SCREEN

The viewing screen of a projection type television receiver may be a complex affair, RCA engineer I. G. Maloff told the Optical Society of America at their recent Cincinnati meeting. One such screen is a sandwich of 2 transparent plastic lenses and a sheet of plastic with a silica opacifier in it.

Two 15 x 20 inch lenses, used for the front and back of the screen, concentrate the light in the desired viewing field. The rear piece is a "Fresnel" field lens—a thin Plexiglass sheet molded with a series of fine, concentric, circular ridges, somewhat like the surface of a phonograph record. The front of the screen is a multiple-element lens of narrow vertical cylinders molded in Plexiglass. Laminated between these is a thin Vinylite sheet containing enough silica opacifier to render "moire" effects unobjectionable and to disperse the light so that no "hot-spot" is formed.

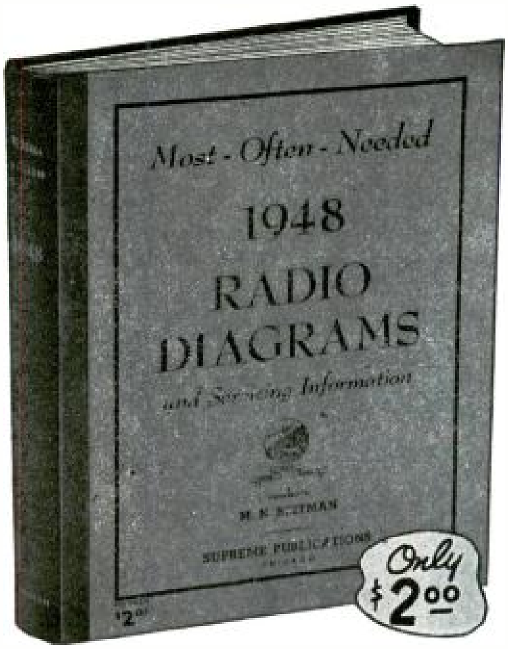
The screen provides a brightness gain of 7.5 and, in combination with large aperture reflective optics, provides a 15 x 20 inch picture having highlights with a brightness of more than 50-foot-lamberts, which compares favorably with direct-viewing kinescopes and more than satisfies the recommendations for good motion picture theatre practice.

The screen is used in the new RCA Model 648 PTK television receiver.

TELEVISION IN SCHOOL

Television has been made a regular part of the general school program in the Nutley (N. J.) High School. A receiver specially adapted for classroom use was presented to the Board of Education by a local manufacturer, Industrial Television, Inc. A large-screen direct-viewing receiver, its viewing tube and loudspeaker are set up on a platform which may be rolled out onto the auditorium stage when needed, then moved back into the wings after use. Controls are installed in a separate unit permanently mounted backstage.

Quadrupling of the service area of Philco's television station WPTZ in Philadelphia is expected when the station's new 552-foot tower is put into service. According to Ernest B. Loveman, company vice-president in charge of television, the new tower will bring television signals within reach of more than 4,000,000 people.



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NEW RADIO-ELECTRONIC PATENTS

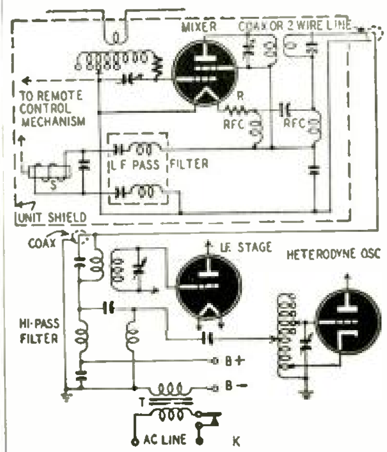
By I. QUEEN

V.H.F. RECEIVING SYSTEM

Harold B. Stott, Glen Olden, Pa.
(assigned to Radio Corp. of America)
Patent No. 2,428,300

Greatest signal-to-noise ratio is obtained when an antenna is erected as high as possible above its surroundings and when the leads to the receiver are short. This is true especially at the higher frequencies. Generally it is not possible to satisfy both conditions at the same time.

One solution to the problem is disclosed and illustrated here. The mixer stage is placed within an enclosure adjacent to the antenna and is connected to the receiver itself by a single co-axial or parallel lead transmission line. This line feeds power to the mixer stage, transmits oscillator output to the mixer, and also transfers the i.f. mixer output to the receiver. In addition, the line feeds an a.c. voltage to tune the antenna circuit.



The d.c. plate supply for the mixer is connected across the transmission line as shown. This voltage also supplies filament power after being dropped through R. Voltage from the local oscillator is applied to the mixer input through the line and heterodynes against the incoming r.f. to produce the usual difference frequency. The i.f. voltage is transmitted back along the line and appears at the i.f. transformer at the other end. Note that a high-pass filter prevents it from affecting the oscillator.

The low-voltage secondary of a line transformer T is connected in series with B−. This voltage actuates the winding of an a.c. solenoid S. The solenoid filter prevents passage of d.c. or r.f. The solenoid is part of a step relay in which a plunger advances a ratchet gear each time the key K is depressed. This control tunes the antenna circuit in synchronism with the oscillator to the desired channel.

The relatively low i.f. suffers only negligible attenuation along the transmission line. The loss of power at the oscillator frequency is unimportant, since this voltage may be increased as necessary.

SUPER-HIGH-FREQUENCY WATTMETER

John Evans, Kingston, N. J.
(assigned to Radio Corp. of America)
Patent No. 2,427,094

Ordinary power meters are ineffective at very high frequencies, and thereupon indirect methods must be used. Some laboratories measure power by the heat which is generated. The heat is applied to a thermocouple which converts the power to electricity.

This is an improved method for measuring power at super-high-frequencies without the need

(Continued on page 96)

Illustrated: Westminster Model—with television, AM-FM radio, automatic phonograph. Cabinets designed by Herbert Rosengren.

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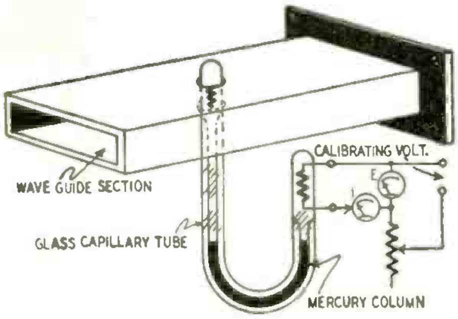
for calibrated thermocouples. In addition the generated heat is constantly compared with a known source so that changes are detected at once. A U-shaped glass tube is partially filled with mercury under gas pressure from each end. At each end of the tube there is a resistor. Terminals from one resistor are available for external connection.

One end of the glass tube is placed within the wave guide where power is to be measured. At this end the resistor is one-half wave length long and thus acts as an antenna to pick up maximum



power from the wave. The generated heat causes the gas at this end to expand and thus lower the level of the mercury column as compared to the height on the other side of the tube. At the same time, however, an alternating current is applied to the other resistor thus expanding the gas on this side. When the mercury column on each side has the same height, the r.f. power is equal to the a.c. power which may be read on the meters.

BEVERAGE INSPECTION

Paul Weathers, Upper Darby, Pa.
(assigned to Radio Corp. of America)
Patent No. 2,427,319

All bottling plants require some form of inspection for possible foreign particles. With this apparatus it is possible to perform the inspection

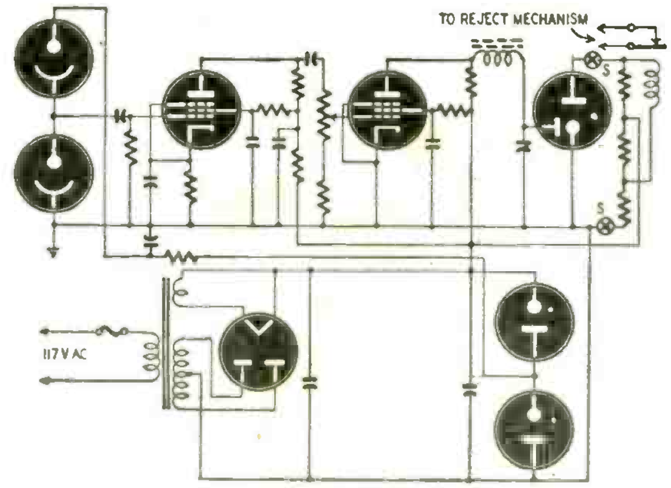
NEW RADIO-ELECTRONIC PATENTS

(Continued from page 94)

automatically and rapidly, and to reject those bottles which contain undesired particles.

A suitable mechanism holds each bottle and spins it rapidly for a short time at about 1,700 revolutions per minute. Then the spin is abruptly stopped, while the contents continue to move due to centrifugal force. Each bottle comes to rest in front of a light beam which shines through it and on to a photoelectric cell. Particles within the bottle interrupt the light beam as they move, thus generating a signal. The larger particles are responsible for stronger signals; and since they interrupt the beam for a longer period, they generate lower frequencies than smaller particles. These signals are applied to an amplifier. To produce the same signal on larger particles as on the smaller ones the amplifier's frequency response curve rises sharply. Since the smallest particles of interest will generate a frequency of approximately 300 cycles per second, the amplifier is designed for a sharp cutoff beyond this point.

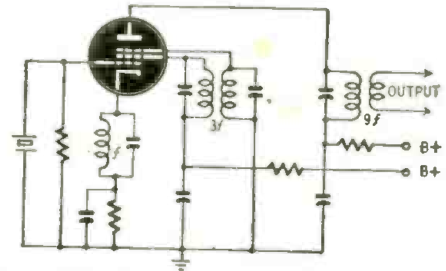
The amplifier output is applied to a gas tube, for example an OA4-G, which operates a relay at breakdown. This occurs when a bottle contains large particles and thereupon causes a strong signal. Automatic apparatus then may reject the bottle by shunting it out of the normal path.



HIGH HARMONIC GENERATOR

Joseph C. Ferguson, Fort Wayne, Ind.
(assigned to Farnsworth Tel. & Radio Corp.)
Patent No. 2,427,204

Pentodes and beam-power tubes generate strong 3rd harmonics. In this invention these harmonics



are used to advantage to give a high harmonic output. *(Continued on page 135)*

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HAROLD E. ENNES,
Engineer, Station WIRE

Here are coordinated facts, standards of good operating practice written by an operator in operators' language.

TABLE OF CONTENTS

288 Pages. $3.30

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12 VOLT AMPLIFIER

(Continued from page 71)

The power supply

The power pack is entirely enclosed in metal and is located behind the amplifier. Each vibrator is of the synchronous type, but operation is reliable because each handles less than 2¼ amperes though its maximum rating is 3 to 3½ amperes.

Inputs of the 2 packs are in parallel, but their outputs are in series. Each output is smoothed by a low-voltage electrolytic while the total output has a bank of 24-microfarad, 500-volt electrolytics across it. Originally the pack had a filter choke and fewer electrolytics, but the choke was removed to give higher output voltage and better regulation. An extra 12 volts is obtained by putting the pack in series with the input voltage.

Buffer condensers absorb the peaks due to the vibrators and can be of somewhat lower voltage than usual, 600-volt working or 2,000-volt test being sufficient if a reliable make is chosen.

When the amplifier and pack are assembled in their case, two 5-ampere switches control the battery currents supplied to filaments and pack. The switch for the pack acts as a stand-by, cutting the total battery drain down to 1.2 amperes, yet keeping the tubes heated and ready for immediate use.

This amplifier was designed to work with certain accessories, and it is important that the correct types of microphones, pickups, and loudspeakers be used. As inputs a Shure 707A crystal-diaphragm microphone and a medium-impedance magnetic pickup similar to the Garrard E were used. Output was fed to a pair of 8-inch PM speakers, the cones of which were stiff and straight-sided, the acoustical resistance of the exponential horns removing any peaks.

Part of the efficiency of the speakers is due to the way they are coupled to the metal horns, which are 24 inches long, 24 inches in bell diameter, and 3½ inches in throat diameter. Turned hardwood pieces act as acoustic transformers between the diaphragm and horn throats.

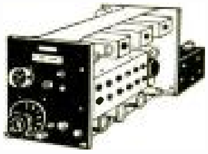
The combination of a.v.c., semi-Class-AB2 operation, semifixed bias, and improved speaker efficiency results in a very high acoustic output with comparatively low battery drain.

SIMPLE PROBE

Recently I built a signal tracer which required a .00025-μf condenser in the probe. I tried inserting it in a test prod, but the condenser was too large. Having a discarded fountain pen on hand, I removed the pen point and bladder, inserted a bolt about 1 inch long in the hole, and fastened the condenser to it, then, I drilled a hole on the other end for the shielded wire. This makes a probe which is neat yet requires only a few minutes to construct.

GENYO TAJII,
Madrone, Calif.

R4-ARR2 RECEIVER



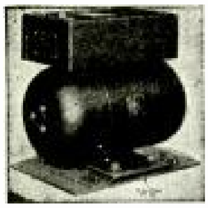
UHF receiver, approx. 300 mc with following tubes, 7-9001's, 3-6AK5's, 1-12A6.
New $17.50
W/dynamotor $19.20
Less dynamotor, W/xfmr for filaments $19.00

FINEST QUALITY "Communications" LOWEST PRICES

TEST SET 159 TPX

Measures frequency between 150 & 200 mc. by heterodyne method. Power of Xmtr can be directly measured. Measures DC voltages up to 500 Volts. Original operation on 110 V. 400 cy. but conversion kit makes it operable on 110 V. 60 cy. new, complete with tubes, crystal & conversion kit and data for 110 V. 60 cy operation $55.00

DYNAMOTORS



PE 73 CM Power supply for BC 375. Input: 28 VDC. Output: 1000 VDC @ 350 Ma. Starting relay, filter, etc. $4.95

Mfrs.: Write for quantity, prices & discounts on above item.

BD 77, Power supply for BC 191. Input: 14 VDC. Output: 1000 VDC @ 350 Ma. New, with spare fuse links, etc. $5.95

PE 101C, Input: 13/26 VDC @ 12.6/6.3 A. Output: 400 VDC @ 135 Ma., 800 VDC @ 20 Ma. (9VAC @ 1.12 A.) $3.49

PE 86 N. Input: 28 VDC. Output: 250 VDC @ 60 Ma. Westinghouse w/Filter $1.95
Without Filter $1.60

PC 77, Input: 12 VDC, Output: 275 VDC @ 110 Ma. 500 VDC @ 50 Ma. $3.25

DAG 33 A, Input: 18 VDC @ 3.2 A, Output: 450 VDC @ 60 Ma. $2.45

DM-33A. Input: 28 VDC @ 7 A. Output: 540 VDC @ 250 Ma. Power supply for modulator of SCR 274 N $3.95

Dyn. Model 23350. Input 27 VDC @ 1.75 A. Output: 285 VDC @ 75 Ma. 1.75

DM-21: In 14VDC 3.3A Out 235VDC 90 ma. with filter $2.59

DM-25: In 12VDC 2.3A Out 250 VDC 50 ma. $2.49

DM-34: In 14VDC 2.8A Out 220VDC 80 ma. $2.49

DM-42: In 14VDC. Out 515/1030 VDC 215/260 ma & 2/8 VDC $3.95

PE206—A ROTARY INVERTER Input 27½ volts at 38 amps. Output: 800 volts at 500 volt amperes. New complete with enclosed starting relay, voltage regulator, filters, and spare fuse links, etc. 10½"x5¾"x11½". Wt. 36 lbs. With Instruction book. $12.50

Power Unit Type 15

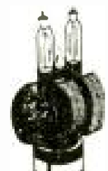
Complete power supply for SCR 522. Input 12VDC. With starting relay, blower, etc. Totally enclosed. Wood case $7.89

GIBSON GIRL EMERGENCY XMTR

Transmits automatic SOS signal on 500 kc emergency wave. Can be manually keyed to transmit additional information. No Batteries required. Hand cranked. $25.00

With kite, parachute, etc. $35.00

MICROWAVE TUBES



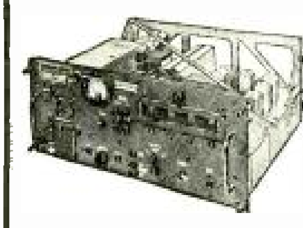
3J31 (1 cm) $17.50
Magnet for 3J31 .... 6.00
2J32 (10 cm 25.00
Magnet for 2J32 .... 10.00
2J38 (10 cm) with magnet 37.50
WE700A (L band) 45.00
WE720BY (S Band) 1000 KW... 25.00
2K25 723AB Klystron 7.75
QK 59, QK 60, QK 62 Tunable packaged Magnetrons, 10 cm..ea. 45.00
Small Quantities of Other Types. Write for Information.

MacKay Radio Transmitter

Model 167-BY. A CW Xmtr with range 2 to 24 mc. Power output: 200 Watts from 2 to 16 mc, 150 Watts from 16 to 24 mc. Complete, with 110 VDC rotary power supply $350.00

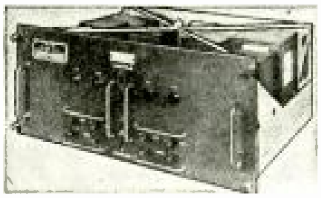
Cross Pointer Indicator

Two 0-200 microampere movements. 3" case, many applications $2.50



BC 1267 TRANSMITTER & RECEIVER. NEW 1 KW pulse oscillator on 154 to 186 mc. Can be converted to CW or Voice operation on 144 to 148 mc band. Receiver is a superhet with 2 stages of RF, 5-stagger tuned IF stages. Plenty of room on chassis for additional changes, with tubes. New. $75.00

POWER SUPPLY RA 105 A.



Operates on 117 V. 60 cycles. Output voltages: 2000 V D C, 510 V D C, 415 V D C, 300 V D C, 290 V D C, 3.3 V A C. Size: 10"H X 23-⅞"L X 18 - 13/32" wide. Weight: 118.5 lbs. New, complete with tubes $40.00

INDICATOR I-221. NEW. Remote antenna direction controller & indicator, using 2 selsyn motors. 360 deg. rotation. Operates on 117 VAC. 60 c.p.s. with tubes. New $50.00

Mounting rack (FM79) for above 3 units with blower. APX size 4'x2'x2' $35.00

Control unit BC 1073 Consists of pulse generator, and a wavemeter which measures frequencies from 150 to 210 mc. The pulse generator makes an excellent square-wave generator with variable pulse-widths. The wavemeter can be modified into a UHF oscillator. 117 VAC, 60 c.p.s. operation $50.00

ANTENNA. AN 128 A NEW. 2 parallel vertical dipoles working against a square reflector. Impedance is 50 ohms. Broad band pass. Makes an ideal antenna, with high gain & directivity on 2 meters APX 5'x4' $40.00

Complete Set RC 118 Xmtr & Rcvr BC 1267 & power supply RA. 105. Both units with tubes, used, in excellent condition $47.50

COMPLETE TRANSMITTER AND RECEIVER RC145

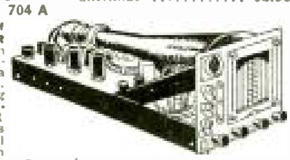
BC 1267 RA 105 A, Indicator I 221, may be operated as independent units, or the complete set of components combined to form a unit may be purchased at this special price—with mounting rack FM 79, crated $190.00

Gov't cost, $5000

MOTOR DRIVEN SWITCH

Switch operates at 1800 rpm, using internal 24 VDC motor. Switch is DPDT, and was originally designed for automatic switching of YAGI radar antennae $2.00

INDICATOR BC 704 A



Indicator, Part of Radar Set SCR 521. Makes an excellent foundation unit for a high gain scope. Has following tubes: 4-6AC7, 3-6H6, and 1-5BP1 CR tube. Comes enclosed in metal shield. New, with all tubes, less power supply ....
With wooden carrying case $24.95

MINE DETECTOR AN/PRS 1

Will indicate buried metallic & nonmetallic objects, such as water pipes, sewer pipes, tree roots, water pockets, etc. Uses earphones and meter for aural and visual indicators. Operates on principle of changes in radiation resistance. An ideal gadget for campers, geologists, home-owners. New, complete $12.75
With Batteries $21.65

HEADSETS

Dynamic mike and headset combination. A high quality, efficient unit, used in B-19 tank Xmtrs. Mike & phones complete, new $2.75

HS 30 HEADSET: A featherweight headset with insert type phones that cut background noises to a minimum. Low impedance (500 ohms) assures efficiency & high fidelity $.85

Matching transformer to match 500 ohms to 8000 ohms output .... $.35

R-15 headsets: 8000 ohms impedance, rubber cushions. Comes with 8' cord & plug PL 55. New $1.95
Used, in good condition . $.60

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All primaries 117 V. 60 cycle. Filament Xfmrs:
#5058: sec #1: 6.3V @ 2 A CT; sec #2: 6.3V @ 2 A CT $2.45
#5126: 5V @ 3 A CT, 5V @3 A CT, 5V @6 A CT, $3.25
#5100: 6.3V CT @ 1.2 A, 5000 volt test $2.45
#5085: 6.3V NCT @ .6 A, 6.3V NCT @ 1.5 A $1.85
#5057: 6.3V CT. @ 1 A, 5V CT @ 3 A, 5V CT @ 3 A $2.75
#UX 6899: 5V @ 5.5 A, 5V @ 5.5 A, 29,000 V test $24.50

VIBRATOR TRANSFORMER

Input: 24 v. 12 v. or 6 v. Output: Two 120 v windings @ .175 amp. Plus 11 v winding. Ea. $1.50

SPECIAL

Transformer to supply filaments of equipments using 12-volt tubes. Input: 117 V 60 cy. Output: 26 Volts @ 2 A $1.50

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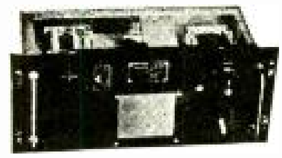
6 Hy @ 150 Ma $2.00
6 Hy @ 300 Ma $4.50
1 Hy @ 800 Ma. 7.5 ahms $8.95
Dual choke. 2-2 Hy @ 100 ma .... $ .90
Dual choke, 7 Hy @ 75 Ma, 11 Hy @ 60 Ma ... $1.95
8.5 Hy @ 125 Ma $1.95
25 Hy @ 65 Ma $1.25

Tuning Units

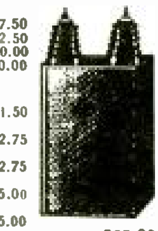
From TCE & GP-7. Ideal basis for ECO rig. Ranges: A 350 800 kc. B 800-1500 kc. E 4.525-6.5mc. F 6.2-9.05mc. Complete set of 5 $11.00

Units F. Each $2.75
Units A.B.E. Each $2.00

From BC 191 & BC 375 TU 6B, 3000 kc to 4500 kc, TU 9B-7700 to 10,000 kc, TU 10B-10,000 to 12,500 kc. TU 22 B 350 to 650 kc. Will supply closest unit to Specified Frequency at time of shipment. Each, $2.75



OIL CONDENSERS

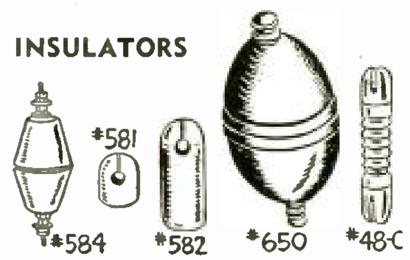


.25 mf @ 20 KV, Aerovox $17.50
1.5 mf @ 6000 V DC Aerovox.. 12.50
1 mf @ 25 KV. 60.00
.5 mf @ 25 KV. 40.00

MICA

.08 mf @ 1500 VDC, Sprague MX60 ....$11.50
.03 mf @ 2000 VDC, CD 551A 50 .... 12.75
.015 mf @ 2000 VDC, Sangamo, G1 .... 12.75
.00015 mf @ 20 KV, Aerovox 1970-404 .... 25.00
.0001 mf @ 20 KV, Sangamo G3 .... 25.00
.0051 mf @ 15KV, Sangamo G4 .... $25.00
.006 mf @ 10KV, Sangamo G3 .... $17.50
.002 mf @ 15KV, Sangamo $20.00
Isolating Capacitor, Cornell-Dubilier PL 1417 106-110 mmf @ 10KV AC (peak) Each ... $3.50
MFRS: Send your requirements for bathtubs, Micas, Hardware, resistors, & connectors

INSULATORS



#490: Lapp-bowl feed thru. Similar to National XS 3 Made of high quality glazed porcelain. Fits 2¾" hole. 6¾" L x 3" diam. $1.50

#581: Feed-thru. Made of steatite. Similar to National XS 1. Fits 1⅜" hole. 5" L x 1⅜" diam. Ea. $.49 or 4 for $1.50

#582: Antenna feeder support. Holds twinex line also. 3" L x 1¼" diam. Hole size: ⅜" Each $.17 or 10 for $1.00

#581: Same as #582, except it is 1½" Long. Each $.12 or 12 for $1.00

#48C: Antenna support insulator. Made of fine quality steatite, with nickel plated reinforced ends. Non-corrosive. 4" L x ⅝" diam. ....Ea. $.25

Antenna Feed Thru Insulator: 3" cup shaped pair with flexible whip antenna mounting. Can be used either as feed-thru or whip & mast base. A MUST at this low price $1.00

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CONDENSER CHECKERS

When aligning shorted variable condenser plates, I connect a flashlight battery and bulb in series, connect them across the sections of the condenser and adjust the plates until the lamp remains dark while the condenser is varied from minimum to maximum capacitance.

A simple test for variable or *paper* condensers is to place them in series with a 20- or 30-watt lamp and a 117-volt a. c. line. If a variable condenser is shorted, the lamp will light until the short is cleared. A shorted paper condenser will cause the lamp to glow *brightly*. A good condenser will cause a dim glow, the brightness depending on its capacitance. A very high capacitance will make the lamp glow brightly. Once you are accustomed to the series-lamp test, you will be able to judge the capacitance of the condenser by the brightness of the glow it produces. In rare cases, an open condenser may cause a dim glow if its leakage is high.

HARRY WINFIELD,
New York, N. Y.

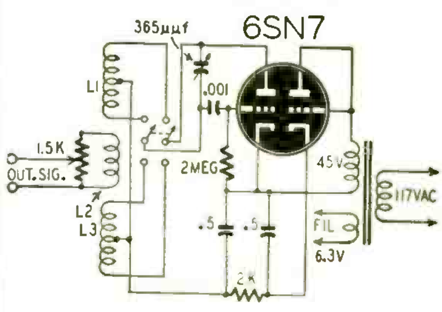
(Mr. Victor Buchannan of Mason City, Iowa, has another suggestion for locating the point of contact in shorted variable condensers in radio receivers. He disconnects all leads from the condenser and connects the stator plates to a *plate* of the rectifier tube in the power supply. An insulated knob is placed on the shaft and the condenser plates opened all the way. When the power is turned on, the condenser is closed until sparks are observed between the plates. Power is turned off immediately, and the condenser plates examined closely. Small dark spots indicate the points of contact.—*Editor)*

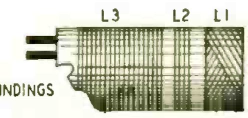
SIGNAL GENERATOR

Intermediate and standard broadcast frequencies are tuned by a 365-μμf condenser in this very useful signal generator.

The low-frequency coil L1 is a jumble-wound, center-tapped winding of 500 turns of No. 28 or 30 enamel wire on one end of a 1-inch form. (A center-tapped secondary of an i.f. transformer may be used if available.) The broadcast coil L3 is 60 turns of No. 28 enamel wire tapped at the center. The output coil 12 has 5 turns, and is wound in the space between the tuned coils.

VICENTE ANT. JEANNOT V.,
Ciudad Trujillo, Rep. Dom.





RADIO KITS and PARTS

BUY THE PROGRESSIVE UNIT WAY!

Our prices for radio kits and parts have always been amazingly low. NOW, mass sales have made possible even further drastic reductions through our revolutionary PROGRESSIVE UNIT Plan.

The Progressive Radio Kit, for instance—earlier reduced from $19.75 to $14.75—can now be purchased at a cost of *two kits* for $28.15 and *three kits* for only $41.50!

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Progressive AMPLIFIER KIT

This newest Progressive Kit—complete with all parts, tubes and a 12-inch speaker—will enable you to build a newly-designed, high fidelity, humless amplifier for phonograph, AM or FM tuner or microphone.

Regulated power supply maintains constant voltage supply. DC heater supply, whether amplifier is used on AC or DC, provides humless operation by eliminating cathode-heater leakage hum. Contains degenerative feedback for improved frequency response, balanced phase inverter and push-pull beam power output. Every stage thoroughly decoupled to improve low-frequency response and prevent motorboating. Tone control completely variable. Six-tube performance. Uses 1-VR 105, 1-12SL7, 2-50L6's and two selenium rectifiers.

PROGRESSIVE UNIT PRICES ON AMPLIFIER KIT

1 kit	$25.75
2 kits	49.50
3 kits	69.00

IDEAL AMPLIFIER FOR YOUR TELEVISION KIT

NOW BUILD 15 RADIOS

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ABSOLUTELY NO KNOWLEDGE OF RADIO NECESSARY

YOU NEED NO ADDITIONAL PARTS

THE PROGRESSIVE RADIO KIT is the ONLY COMPLETE KIT. Contains everything you need. Instruction Book, Metal Chassis, Tubes, Condensers, Resistors and all radio parts. The 36-page book written by expert radio instructors teaches you to build radios in a professional manner. You start with one-tube receivers, then build two-tube receivers, then three-tube receivers. (The three-tube receivers are equal to four-tube receivers because of the addition of a selenium rectifier.) You then construct a powerful public address system which will permit you to address large audiences. Then you make three different transmitters so you can get a real thrill out of being on the air. Before you are done with this kit, you will have built 11 receivers, 1 Public Address System and 3 transmitters.

SPECIAL FREE OFFER

Electrical and Radio Tester sent absolutely FREE with each Progressive Radio Kit. PLUS FREE membership in Progressive Radio Club. Entitles you to free expert advice and consultation service with licensed radio technicians. Write for further information or ORDER your KIT NOW!

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1 Kit	$14.75
2 Kits	28.15
3 Kits	41.50

RADIO PARTS SCOOP!

NO SURPLUS—ALL PARTS GUARANTEED BRAND NEW!

PHONES—Single Head Set

1000 Ohms. DC. Reg. Price $1.65
Buy 1 for $1.10 and save 55c
Buy 2 for $1.90 and save $1.40
Buy 3 for $2.55 and save $2.40

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50 paper tubular condensers. Values from .002 mfd. to .1 mfd., 400 v.dc to 600 v.dc.
Regular Price $5.00
Buy 1 kit for $1.95 and save $3.05
Buy 2 kits for $3.80 and save $6.20
Buy 3 kits for $5.55 and save $9.45

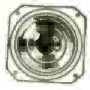
RESISTOR KIT

100 carbon resistors. 1/3 watt, RMA color coded. values from 330 ohms to 2.2 megohms.
Regular price $5.00.
Buy 1 kit for $1.50 and save $3.50
Buy 2 kits for $2.80 and save $7.20
Buy 3 kits for $3.90 and save $11.10

SELENIUM RECTIFIERS

Regular price $1.10
Buy 1 for 79c and save 31c
Buy 2 for $1.54 and save 66c
Buy 3 for $2.25 and save $1.05

12" ALNICO SLUG SPEAKER

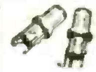


Regular price $8.00
Buy 1 for $5.60 and save $2.40
Buy 2 for $10.80 and save $5.20
Buy 3 for $15.95 and save $8.05
(No more than 3 to a customer)

ELECTROLYTIC CONDENSERS

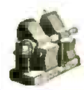
20-20 mfd. 150 W.V.DC.
Regular Price 75c
Buy 1 for 30c and save 45c
Buy 4 for $1.16 save $1.84
Buy 7 for $1.96 save $3.29
Buy 10 for $2.65 save $4.85
40-40 mfd. 150 W.V.DC. Reg. Price $1.05
Buy 1 for 45c and save 60c. Buy 4 for $1.70 and save $2.50. Buy 7 for $2.80 save $4.55. Buy 10 for $3.80 save $6.70. 10-10 mfd. 450 W.V.DC. Reg. Price $1.25. Buy 1 for 65c save 60c. Buy 2 for $1.24 save $1.26. Buy 3 for $1.74 save $2.01.

ANTENNA AND RF COIL SET



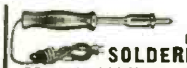
(broadcast Band) Reg. Price $1.00
Buy 1 set for 59c and save 41c
Buy 2 sets for $1.10 and save 90c
Buy 4 sets for $2.08 and save $1.92

VARIABLE CONDENSER



(420-420 mfd.)
Regular Price $1.80
Buy 1 for $1.45 and save 35c
Buy 2 for $2.60 and save $1.00
Buy 3 for $3.60 and save $1.80

Famous Make SOLDERING IRON



55 watts 110/120 volts.
Regular price $2.50
Buy 1 for $1.90 and save 60c
Buy 2 for $3.60 and save $1.40
Buy 3 for $5.10 and save $2.40

Radioman's Combination LONG NOSE PLIERS and CUTTERS 6" exceptional quality. Hydryzed for extra toughness. Diamond-tested cutters. Regular price $1.95
Buy 1 for $1.45 and save 5 .50
Buy 2 for $2.70 and save $1.20
Buy 3 for $3.60 and save $2.25

PROGRESSIVE RADIO TOOL KIT

A Progressive Electronics Special.
Contains 55 watt 110/120 volt soldering iron, radioman's combination long nose pliers and cutters. amber handle screw driver. Polystyrene alignment tool.
Regular price $4.95
Buy 1 kit for $3.25 and save $1.70
Buy 2 kits for $6.10 and save $3.80
Buy 3 kits for $8.70 and save $6.15
(No more than 3 kits to a customer)

MAIL COUPON TODAY

PROGRESSIVE ELECTRONICS Co., DEPT. RC-9
22 Havemeyer St., Brooklyn 11, New York

SIRS: Please send me the following ....

....

Enclosed find check or money order (postage prepaid) for $...... Send C.O.D. (I will pay postage). Send additional information on radio kit.

NAME ....

ADDRESS ....

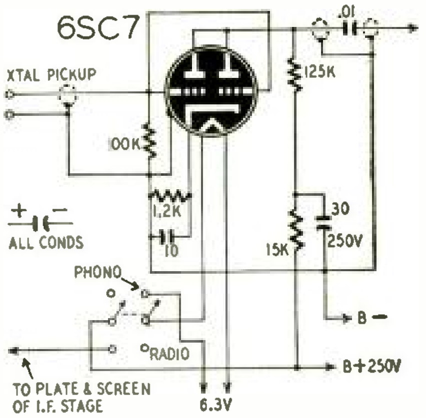
CITY ..............................ZONE......STATE..............

Licenses for television receivers in Britain cost approximately $8.00 per year—twice as much as the Britisher has to pay for an ordinary radio receiver.

PHONO PRE-AMPLIFIER

Many record players fail to give satisfactory volume when connected directly to the a.f. system of some radios. This simple, inexpensive pre-amplifier can be added to various sets to give the necessary signal boost. If it is constructed carefully, there should be no trouble with hum or feedback.

The output is connected to the high side of the volume control or to the grid



of the first a.f. amplifier of the radio. If the volume of the receiver is controlled in some section other than the audio circuit, then the 100,000-ohm resistor in the grid circuit of the 6SC7 may be replaced with a variable control with the arm tied to the grid. Be sure to shield the leads to and from the control.

Operating voltages are obtained from the set. When the switch is thrown to PHONO it opens the screen and plate-supply leads to one or more i.f. or r.f. stages and puts voltage on the filament of the 6SC7.

This pre-amplifier may also be found useful in a straight record player, especially if a magnetic pickup or some of the new low-output high-fidelity pickups are used or if for any other reason output is low.

ALAN SMITH,
Shaftsbury, Vt.

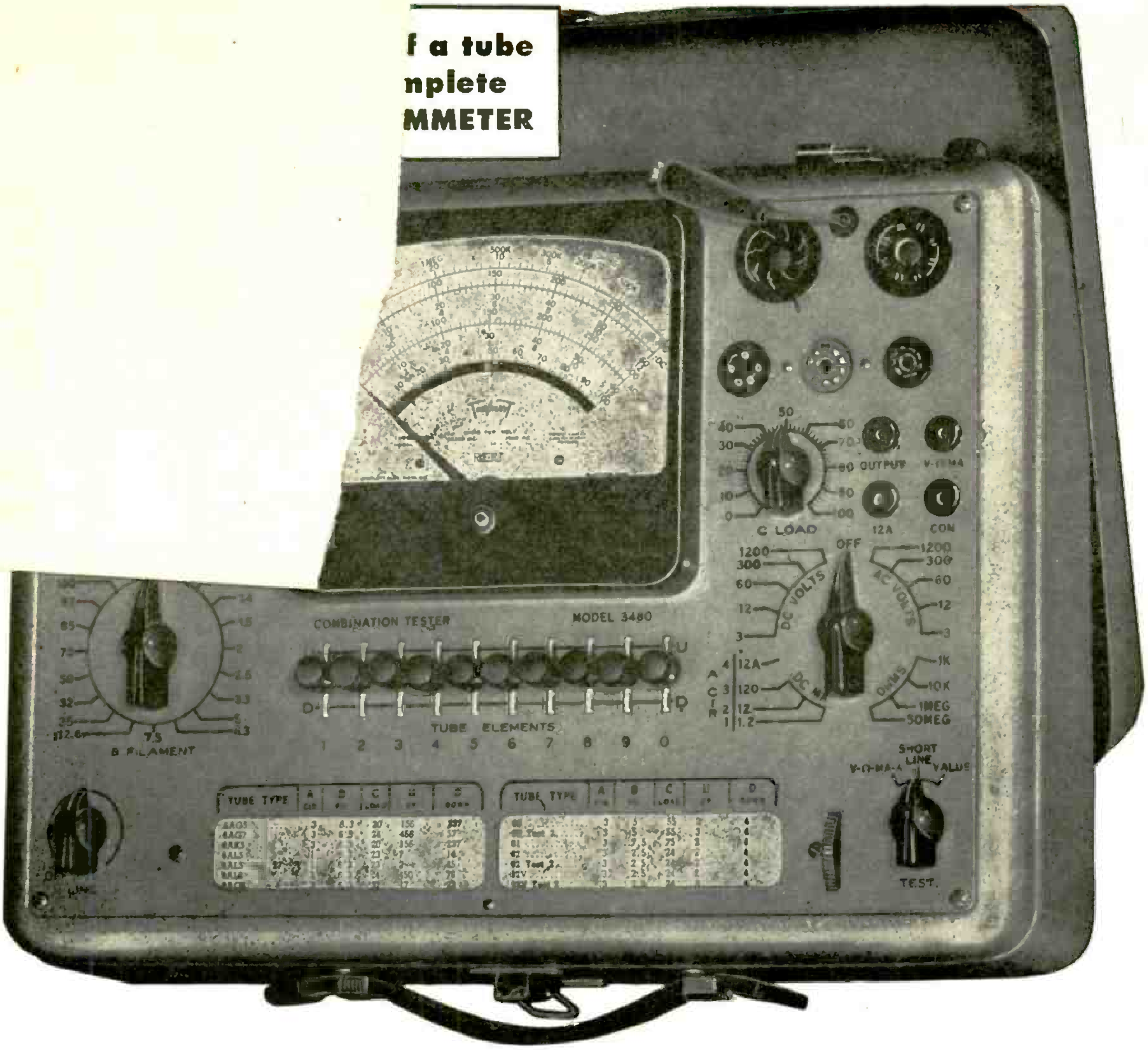
CRYSTAL PICKUP SUBSTITUTE

While serving overseas as a sound and movie serviceman, I needed a replacement cartridge for a crystal pickup. None were to be had. As a substitute, I used a Signal Corps receiver R-30, a part of a headset HS-30. After disassembling the receiver I removed the projection from the cap and used a reamer to enlarge the resulting hole slightly. A small hole was drilled in the back of the bakelite housing for mounting on the pickup arm.

The diaphragm was reinserted in the cap, and a needle holder, taken from a discarded crystal cartridge, was soldered to the diaphragm. The needle holder passes freely through the hole in the cap. The unit is assembled and bolted to the pickup arm with a small bolt through the hole in the back. Leads from the unit are connected to the amplifier input. If the high notes sound tinny, a thin cardboard washer placed between the cap and the diaphragm will remedy the condition.

H. E. MORSE,
Columbia, S. C.

f a tube
nplete
MMETER



Look at that picture again. There are twenty-three distinct features to give you everything you need in a combination tester.

Note the new up-to-the-minute, no back-lash roll chart, for quick, complete and accurate reference. Note the individual sockets for *all* tubes, including the new 9-prong and hearing aid types. Exclusive lever-switching provides individual control of each tube element, and enables you actually to "picture" your circuit!

Note the complete Volt-Ohm-Mil-Ammeter—18 ranges on a large 6" meter to cover all your requirements. With Model 3480 you've got a tester that's good for dozens of jobs, beautiful...*and a standard for accuracy.* Buy it at your jobber. Or write for bulletin No. 3480. Address Dept. L18.

Model 3480

Combination Tube Tester and Volt-Ohm-Mil-Ammeter

PRECISION FIRST...TO LAST

Triplett

TRIPLETT ELECTRICAL INSTRUMENT COMPANY, BLUFFTON, OHIO

TRANSATLANTIC NEWS

(Continued from page 56)

are of 10- or 20-lb wire. Experiments, made over short distances at first, gave promising results. The telephone pairs introduced some phase distortion, but this could be ironed out by all-pass equalizers. There was heavy attenuation of the highest frequencies, but to maintain them was merely a matter of using amplifying repeaters at sufficiently short intervals. Today, outside broadcasts regularly take place with up to 8 miles of ordinary telephone lines in the link between the television camera and the main transmitter. Combined equalizing and repeater units, weighing under 150 lbs apiece, are used. With these inserted every 1½ miles, a vision frequency band of 2 mc is transmitted. This gives a good, clear picture. The better definition of the full 2.7-mc band could be obtained by the use of more repeaters, but results with present methods have been so satisfactory that it has not been thought worth the additional expense. Future developments may well permit television to make wide use of long-distance telephone land lines. Such a development would be a big step toward the solution of the problem of providing nation-wide television service.

Some sunspots!

When will the present sunspot cycle reach its maximum? Some expect it to do so by the end of this year; others give the cycle the best part of 2 years from now before it reaches its peak. Meantime, as H. W. Newton of Greenwich Observatory told a recent meeting of the Royal Astronomical Society, it has produced the biggest spot ever recorded on the sun's disk, a fiery maelstrom over 100,000 miles in diameter. Further, it has already seen more solar activity than any other premaximum period in the last hundred years.

Curiously enough, it has hardly run true to form from the radio point of view. There *have* been short-wave blackouts, but they have not been so numerous nor so severe as one might have anticipated. Britain was remarkably free from thunderstorms during the past summer and static was less troublesome than might have been expected.

Short-wave reception during a magnetic disturbance usually provides some interesting experiences in this country. The Canadian and northern U. S. stations are, as a rule, the first to fade out. When this happens, the South American stations often come in with great strength. This is perhaps not surprising when you consider that the North Magnetic Pole has a great-circle bearing about 20 degrees west of north from Britain, and that the greater part of the United States lies between great-circle bearings a good deal north of west. A due west great-circle bearing from London runs just about through the Panama Canal! And did you know this one? The North and South Magnetic Poles are a very long way from being antipodes of one another. That being so, there can be only 2 great-circle paths (rather wide ones, since the poles are areas and not points) between them, the long one and the short. The short path runs close to the British Isles. Magnetic disturbances are centered at these poles, and that may be why stations with a northwesterly great-circle bearing from us so quickly disappear at such times.

Loudspeaker "color"

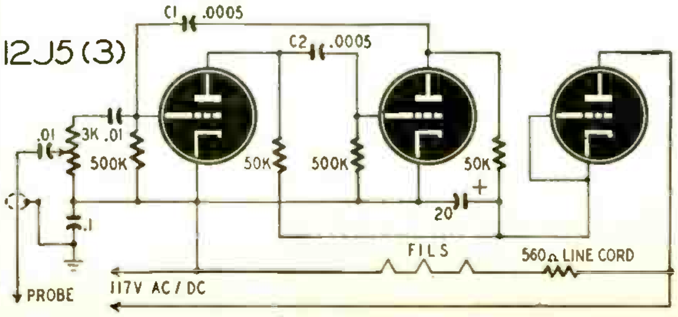
Every high quality enthusiast knows that ideally the radio receiver should have no "tone" of its own. It should reproduce faithfully sounds made in the broadcasting studio without adding any coloration. He knows equally well that actually individual receivers definitely do place their own stamp on the reproduction of music. To a trained ear two different receivers, each rated electrically and electromechanically as being in the highest fidelity class, do not reproduce a given musical passage in precisely the same way. Each gives the music its own unmistakable color.

Light has been thrown on this difficult point at a meeting of the Physical Society by Dr. E. G. Richardson. He has established after much research and experiment that the characteristic

(Continued on page 110)

A MULTIVIBRATOR TROUBLE-SHOOTER

This a.c.-d.c. multivibrator can be used for trouble shooting by signal injection and gives good results, with little drop in signal from the middle a.f. range to 30 mc. It is handy for checking a.f., i.f., and r.f. stages of radio receivers.



Other tube types can be used if they have the same current requirements and a suitable line-cord resistor is used. The fundamental frequency can be changed by changing C1 and C2.

C. N. PETERSON,
Valparaiso, Ind.

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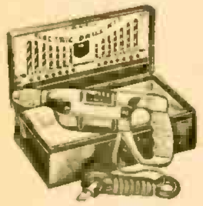
85-428. ONLY... **$2.98**

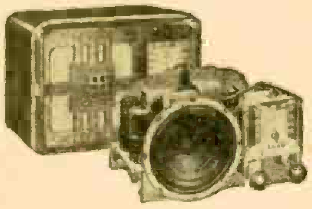
4 WATT PHONO AMPLIFIER

Top value. Easily handles 10" PM speaker. Inverse feedback for truer fidelity; built-in output transformer. Use with any phono-motor, crystal pickup and PM speaker. Supplied with 1-6SL7GT, 2-25L6GT, 1-25Z6-GT. 5¼" x 4" x 4¾". For 105-125 volts AC-DC.
83-071. ONLY... **$12.75**



EAGLE DRILL KIT

A perfect light-duty ¼" electric drill, complete with 14 popular size drills for iron, steel, wood, plastic. 1100 rpm motor; self-lubricating oilite bearings, heavy chuck, 7 foot cord. In sturdy case for easy carrying. For 115 volts AC-DC.
46-027. ONLY... **$15.95**



KNIGHT RANGER KIT

Ultra-modern Superhet — nothing like it at the price. Covers 550-1600 Kc.; built in loop antenna; latest 5" PM dynamic speaker; handsome walnut plastic cabinet. Easy to build. Complete with all parts, tubes, full instructions. 83-275. **$14.95**

20 WATT HI-FI PHONO AMPLIFIER

For high-fidelity reproduction. Inverse feedback; adjustable automatic volume expansion; bass and treble tone controls, dual input; high gain; frequency response. ± 1 db from 20-20,000 cps. For 110-120 volts 60 cycles AC. Size: 17¼" x 11¼" x 9⅜". 93-103.
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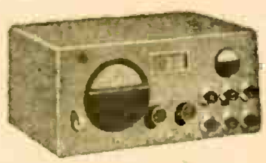
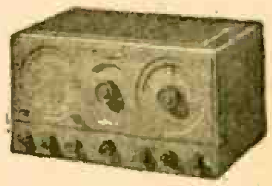


HALLICRAFTERS SX-43
Less Speaker, $169.50



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Complete, $130.00

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Less Speaker, $200.00

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A radar and IFF network which would completely protect the continental United States from air raids is planned for use in any emergency, James Forrestal, Secretary of Defense, revealed last month.

WORLD-WIDE STATION LIST

(Continued from page 47)

12.080		MOSCOW, U.S.S.R.; 0800 to 1100
12.090	GRF	LONDON, ENGLAND; 2300 to 1615; 1700 to 2030
12.210		VIENNA, AUSTRIA; 1145 to 2030
12.250	WXFD	ADAK, ALASKA; 1800 to 0100
12.260	TFJ	REYKJAVIK, ICELAND; Sundays, 0900 to 0930
12.440	HCJB	QUITO, ECUADOR; 0600 to 1000; 1400 to 2330; Sundays, 0700 to 1630; 1700 to 2200
13.050	WNRI	NEW YORK CITY; European beam, 0600 to 1800
13.050	KCBR	SAN FRANCISCO, CALIFORNIA, Oriental beam, 2215 to 0100
14.390	VR6AA	PITCAIRN ISLAND, SOUTH SEA ISLANDS; 0450
14.560	WNRX	NEW YORK CITY; European beam, 0600 to 1800
15.000	WWV	WASHINGTON, D.C.; U.S. Bureau of Standards; frequency, time, and musical pitch; broadcasts continuously day and night
15.110	GWG	LONDON, ENGLAND; 0000 to 0400; 0600 to 1015; 1100 to 1315; 1500 to 1600
15.110	HCJB	QUITO, ECUADOR; 0500 to 1200; 1330 to 2230
15.120	HVJ	VATICAN CITY; 0830 to 0930; 1100 to 1145
15.130	WOOC	NEW YORK CITY; European beam, 1000 to 1800
15.130	KGEI	SAN FRANCISCO, CALIFORNIA; Alaskan-Chinese beam, 1700 to 1945
15.130	KCBA	DELANO, CALIFORNIA; South American beam, 1900 to 2400
15.140	GSF	LONDON, ENGLAND; 2300 to 0400; 0600 to 0815; 9830 to 1745
15.150	WRCA	NEW YORK CITY; European beam, 1100 to 1215; 1300 to 1700; Brazilian beam, 1800 to 1900; 2000 to 2200
15.150	KCBA	DELANO, CALIFORNIA; Alaskan beam, 2215 to 0345
15.150	Munich II	MUNICH, GERMANY; East European beam, 1245 to 1400
15.150	SBT	STOCKHOLM, SWEDEN; 0130 to 0215; 0600 to 0700; 1000 to 1315
15.160	JZK	TOKYO, JAPAN; 1730 to 1815
15.170	TGWA	GUATEMALA CITY, GUATEMALA; 1200 to 2000
15.180	GSO	LONDON, ENGLAND; 2300 to 1200; 1230 to 1745
15.180	CKCX	MONTREAL, CANADA; 0800 to 1200
15.190	TAQ	ANKARA, TURKEY; 0000 to 0200; 0415 to 0730
15.200	WRUA	BOSTON, MASSACHUSETTS; European beam, 1100 to 1400
15.210	WBOS	BOSTON, MASSACHUSETTS; European beam, 1100 to 1700; South American beam, 2000 to 2200
15.220	JTL3	TOKYO, JAPAN; 1800 to 0230
15.230	VLG6	MELBOURNE, AUSTRALIA; 2100 to 2300
15.230		MOSCOW, U.S.S.R.; 2200 to 2400; 0530 to 0830; 0915 to 0930; 1030 to 1330
15.250	WLWK	CINCINNATI, OHIO: European beam, 1200 to 1700
15.250	KRHO	HONOLULU, HAWAII; Philippine beam, 0230 to 0345
15.250	KNBX	DIXON, CALIFORNIA; Chinese-Japanese beam, 0400 to 1005
15.250	WLWR2	CINCINNATI, OHIO: European beam; can beam, 1800 to 2400; Sundays, 1900 to 2400
15.260	GSI	LONDON, ENGLAND; 0400 to 0430; 1030 to 1400
15.270	WCBN	NEW YORK CITY; European beam, 1200 to 1630
15.270	WCRC	NEW YORK CITY; South American beam, 1900 to 2400
15.270	WCBN	NEW YORK CITY; European beam, 1200 to 1630
15.280	WNRE	NEW YORK CITY; European beam, 1100 to 1800
15.290	WRUA	BOSTON, MASSACHUSETTS; Central American beam, 2000 to 2400
15.290	WRUL	BOSTON, MASSACHUSETTS; European beam, 1130 to 1400; 1410 to 1700; South American beam, 1730 to 1900
15.290	VUD11	DELHI, INDIA: 0045 to 0115; 0200 to 0400; 0500 to 0700; 0730 to 0745
15.300	GWR	LONDON, ENGLAND; 0600 to 0900; 1045 to 1330; 1400 to 1430; 1700 to 1800
15.310	GSP	LONDON, ENGLAND; 2345 to 0030; 0100 to 0500; 0600 to 0815; 1200 to 1315; 1615 to 1845
15.310	VLC4	SHEPPARTON, AUSTRALIA; 2045 to 2145; 0010 to 0045; 1730 to 1800; 1900 to 1915; 2200 to 2225
15.310	HER6	BERNE, SWITZERLAND; Saturdays, 1000 to 1200
15.320		MOSCOW, U.S.S.R.; 2200 to 2300; 0000 to 0500; 0530 to 0800; 0830 to 1100
15.330	WGEO	SCHENECTADY, NEW YORK; European beam, 1200 to 1805
15.330	KNBX	DIXON, CALIFORNIA; South Pacific beam, 0030 to 0345; South American beam, 1900 to 2400
15.330	KCBA	DELANO, CALIFORNIA; Philippine beam, 0400 to 0930
15.340		MOSCOW, U.S.S.R.; 2200 to 0800; 1000 to 1100
15.350	WLWR2	CINCINNATI, OHIO; North African beam, 1300 to 1700
15.350		PARIS, FRANCE; 0700 to 0900
15.350	WRUA	BOSTON, MASSACHUSETTS; North African beam, 1100 to 1800; Central American beam, 2000 to 2400
15.450	GRD	LONDON, ENGLAND; 0100 to 0500; 0600 to 0700; 1700 to 1845
15.590	FZI	BRAZZAVILLE, FRENCH EQUATORIAL AFRICA; 0445 to 0800; 0930 to 1030
17.440	HVJ	VATICAN CITY; 0715 to 0845
17.530	FZI	BRAZZAVILLE, FRENCH EQUATORIAL AFRICA; 0000 to 0130; 0445 to 0745; 1100 to 1700
17.700	GVP	LONDON, ENGLAND; 0800 to 1115; 1200 to 1600
17.710	GRA	LONDON, ENGLAND; 0600 to 0815
17.730	GVQ	LONDON, ENGLAND; 0100 to 0500; 0800 to 1215
17.750	WRUW	BOSTON, MASSACHUSETTS; European beam, 1130 to 1400
17.760	KWID	SAN FRANCISCO, CALIFORNIA; South American beam, 1900 to 2400
17.760		PARIS, FRANCE; 0700 to 0900; 1100 to 1230
17.770	OTC	LEOPOLDVILLE, BELGIAN CONGO; 0500 to 0930; 1130 to 1645
17.770	WOOW	NEW YORK CITY: European beam, 1700 to 1815
17.780	WNBI	NEW YORK CITY: European beam, 1100 to 1800; South American beam, 1900 to 2400
17.780	KCBR	DELANO, CALIFORNIA; Japanese-Chinese beam, 2330 to 0345
17.790	GSG	LONDON, ENGLAND; 0500 to 1030
17.800	WLWO	CINCINNATI, OHIO; European beam, 1200 to 1700
17.800	OIX5	LAHTI, FINLAND; 0130 to 0200; 0500 to 0545; 0800 to 1700
17.800	KRHO	HONOLULU, HAWAII; Chinese beam, 0245 to 0345; Japanese-Philippine beam, 2030 to 0200
17.810	GSV	LONDON, ENGLAND; 0100 to 0400; 0500 to 1430
17.800	WLWK	CINCINNATI, OHIO: South American beam, 2000 to 2200.
17.820	CKNC	MONTREAL, CANADA; 0830 to 1500
17.830	WCBX	NEW YORK CITY; European beam, 1100 to 1630; South American beam, 1800 to 1900; Brazilian beam, 2000 to 2200
17.830	VUD10	DELHI, INDIA; 0430 to 0700; 0745 to 0800; 2215 to 0215
17.840		BRUSSELS, BELGIUM; 0500 to 0630; 0045 to 0115; 1000 to 1245
17.880	KGEX	SAN FRANCISCO, CALIFORNIA; South American beam, 1900 to 2400
17.860	WGEX	SCHENECTADY, NEW YORK; European beam, 1100 to 1700
17.950	WLWLI	CINCINNATI, OHIO; European beam, 0645 to 1545
17.950	WLWL2	CINCINNATI, OHIO; North African beam, 0645 to 1545
17.950	WLWLI	CINCINNATI, OHIO: South American-Central American beam, 2115 to 2215 except Sundays
18.020	GRQ	LONDON, ENGLAND; 0100 to 0500; 0830 to 0845; 0900 to 1430
18.080	GVO	LONDON, ENGLAND; 1030 to 1245; 1300 to 1500
18.130	PMC	BATAVIA, NETHERLANDS INDIES; 2330 to 0930
18.160	WNRI	NEW YORK CITY: European beam, 1000 to 1700

(Continued on page 127)

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

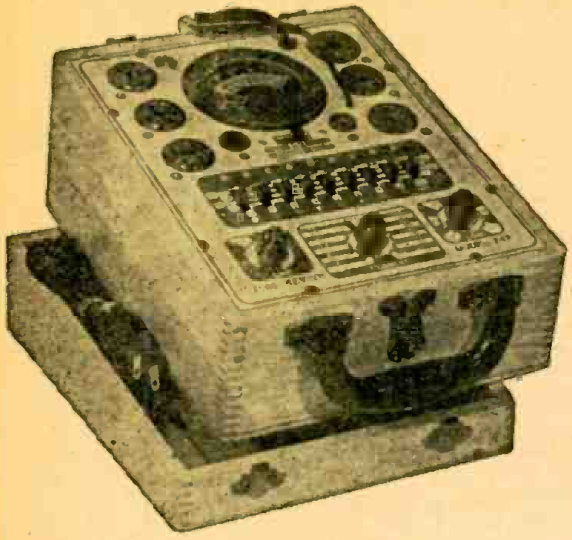
TELEVISION STEPS OUT!
(Continued from page 35)

all cities in the states listed will have television service immediately. Areas with the heaviest concentration of population will come first within the range of video stations; other areas will obtain this service subsequently.

This station, plus experimental transmissions from W6XAO, represents Pacific Coast television.

To bring the best in television entertainment to multitudes living away from urban centers, network planners are
(Continued on page 114)

SENSATIONAL VALUES



The New Model 247
TUBE TESTER

Features: The Model 247 incorporates a newly designed element selector switch which reduces the possibility of obsolescence to an absolute minimum. Any pin may be used as a filament pin and the voltage applied between that pin and any other pin, or even the "top-cap".
The new free-point system described above permits the Model 247 to overcome the difficulties encountered with other emission type tube testers when checking Diode, Triode and Pentode sections of multi-purpose tubes, because sections can be tested individually when using the new Model 247. The special isolating circuit allows each section to be tested as if it were in a separate envelope.
The Model 247 provides a super sensitive method of checking for shorts and leakages up to 5 Megohms between any and all of the terminals. Continuity between various sections is individually indicated. One of the most important improvements, we believe, is the fact that the 4 position fast-action snap switches are all numbered in exact accordance with the standard R. M. A. numbering system. Thus, if the element terminating in pin No. 7 of a tube is under test, button No. 7 is used for that test.

Model 247 comes complete with new speed-read chart. Comes housed in handsome, hand-rubbed oak cabinet sloped for bench use. A slip-on portable hinged cover is included for outside use. Size: 10¾" x 8¾" x 5¾".

ONLY $29.90 NET

The New Model 650 SIGNAL GENERATOR

RANGES:
100 Kilocycles to 35 Megacycles on Fundamentals.
25 Megacycles to 105 Megacycles on Harmonics.

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- ★ Uses a Hartley Excited Oscillator with a Buffer Amplifier.
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Complete with coaxial cable, leads and instructions.

$39.95

The New Model CA-11 SIGNAL TRACER

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.

$18.75 NET

The New Model 670 SUPER METER

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".

$28.40 NET

Available for Immediate Shipment From Stock—20% Deposit Required on All C.O.D. Orders

MOSS ELECTRONIC DISTRIBUTING CO. DEPT. RC-1, 229 FULTON ST. NEW YORK 7, N. Y.

TRANSATLANTIC NEWS

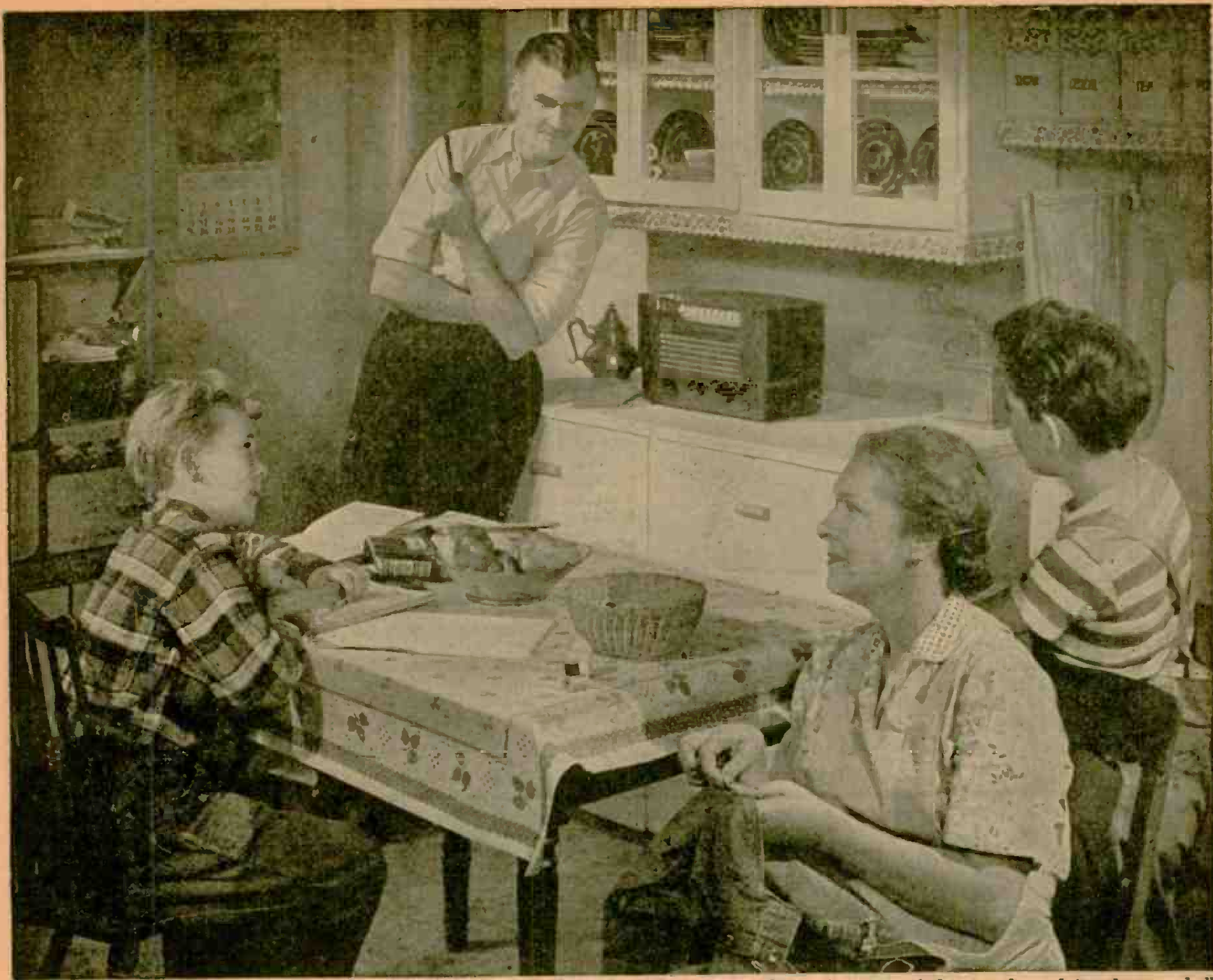
(Continued from page 104)

timbre of a musical instrument is determined, not by the sustained vibrations of its string (or column of air) and those of its wood or metal body, but by what he calls the "starting up vibrations." In other words, every musical instrument has its own particular way of getting into its stride when producing a note. It is this initial process which determines its own special tone. His experiments showed (and they confirm and are confirmed by results obtained by Professor F. A. Saunders of Harvard) that even a trained ear cannot detect whether a sustained note is being produced by, say, a viola or a clarinet, so long as the listener is not allowed to hear either the beginning or the end of the note.

Richardson's experiments with organ pipes showed that the metal of which they are made has no effect on the *sustained* notes produced—one could not tell one kind from another. But each pure metal and each alloy has its own special way of settling down to a steady rate of vibration and of coming to rest after vibrating.

Tone is then entirely a question of *transients* — of the method of transition from rest to vibration and from vibration to rest. To apply these discoveries to the radio comes to just this: No matter how good we make the electrical parts of our receivers, the starting and stopping vibrations of the loudspeaker cone of the cabinet on any note are almost bound to add some color to the reproduction. Even if electrical perfection were attainable, those bits of fabric and of wood or plastic which form essential parts of today's radio receiver would still be there to balk the striver after genuine high fidelity.

A sad thought; though fortunately the human ear is so accommodating that few radio sets sound as bad in practice as strict acoustic theory says they should!



"Our American concept of radio is that it is of the people and for the people."

Freedom to LISTEN – Freedom to LOOK

As the world grows smaller, the question of international communications and world understanding grows larger. The most important phase of this problem is *Freedom to Listen* and *Freedom to Look*—for all peoples of the world.

Radio, by its very nature, is a medium of mass communication; it is a carrier of intelligence. It delivers ideas with an impact that is powerful . . . Its essence is freedom—liberty of thought and of speech.

Radio should make a prisoner of no man and it should make no man its slave. No one should be forced to listen and no one compelled to refrain from listening. Always and everywhere, it should be the prerogative of every listener to turn his receiver on or off, of his own free will.

The principle of *Freedom to Listen* should be established for all peoples without restriction or fear. This is as important as *Freedom of Speech* and *Freedom of the Press.*

Television is on the way and moving steadily forward. Television fires the imagination, and the day is foreseen when we shall look around the earth from city to city, and nation to nation, as easily as we now listen to global broadcasts. Therefore, *Freedom to Look* is as important as *Freedom to Listen*, for the combination of these will be the radio of the future.

The "Voice of Peace" must speak around this planet and be heard by all people everywhere, no matter what their race, or creed, or political philosophies.*

President and Chairman of the Board, Radio Corporation of America.

**Excerpts from an address before the United States National Commission for UNESCO.*

RCA

RADIO CORPORATION of AMERICA

FREEDOM IS EVERYBODY'S BUSINESS

NEW RCA TUBE MANUAL

The long-awaited new edition of the RCA tube manual has now been published. The RC-15, as the new book is called, was put on the market at the beginning of December. The present edition is the first since 1939.

In addition to greatly expanded coverage in its regular sections, the new edition presents information on new developments in FM, up-to-the-minute technical data on miniature receiving tubes, and installation and application information on the latest model television broadcast receivers.

The sections on tube and circuit theory have been expanded to 55 pages. The Circuit Section, illustrating a wide variety of electron-tube applications, has been thoroughly revised. The complete Receiving Tube Classification Chart has been brought up to date. In this quick-reference chart receiving-tube types are classified by cathode voltage and tube function, and types with similar characteristics are grouped.

Formulas and examples for the calculation of power output, load resistance, and distortion for A1, AB-1, AB-2, and B classes of service have been included and cover both single-ended and push-pull amplifiers using either triodes or pentodes.

New application data including circuits on ratio detectors, discriminators, limiters, and multivibrators are presented.

List price of the new RCA Receiving Tube Manual remains $.35.

TELEVISION STEPS OUT!

(*Continued from page* 108)

now plowing into the ground thousands of miles of concentric or co-axial cable capable of carrying televised images from coast to coast and making possible networks similar to those that have been spun by radio stations into a gigantic web. Television images bound on highly directional microwaves over a series of towers from New York to Boston. Later they will be sent from New York to Chicago—and beyond.

The Federal Communications Commission has hitched its wagon to the star of television expansion and is cooperating with broadcasters to develop this potentially gigantic service. With such a co-operative effort in full swing, there is no doubt that 1948 looms big for television.

Although home television is the vogue, there is feverish behind-the-scenes activity in the motion picture industry to introduce theater-size television at your favorite movie house. In the East and Far West, it may happen early this year.

The revolution that marked the end of the silent era of movies undoubtedly will appear insignificant to the advances in entertainment which theater-type television will bring to the screen of the average movie house.

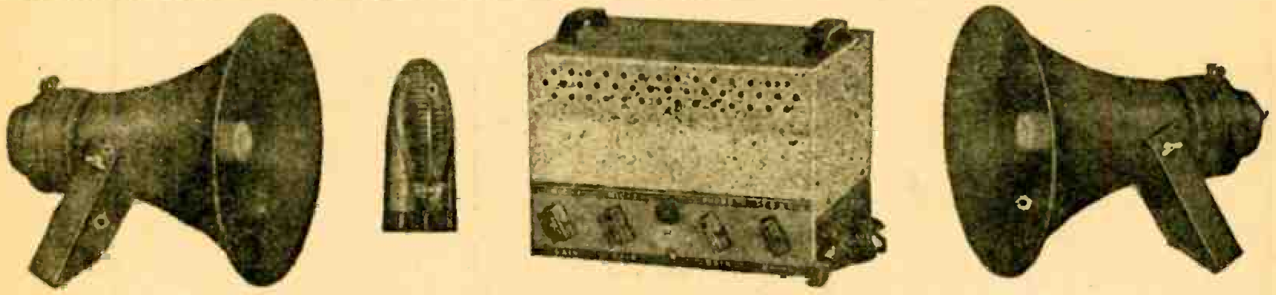
The march of television progress has begun; it cannot be halted; it *Will* not be stymied. Television is here!

At Last! - A High Quality

POWERFUL—COMPLETE

SOUND SYSTEM

FOR ONLY $92.50



The Complete Moss P.A. System Includes:

1 DELUXE 25 WATT AMPLIFIER
2 POWERFUL 35 WATT REFLEX PROJECTORS
1 SHURE MODEL 718A "VERSATEX" CRYSTAL MICROPHONE
PLUS 50 FT. OF CABLE, PLUGS, CONNECTORS, ETC.

At last, one single system, designed to meet the requirements of most indoor and outdoor installations, offered as a complete package at a sensationally low price. Check the specifications of this most versatile system, then check the values of the various components included. We know you'll be amazed at this truly sensational value. Please note none of the items included are "surplus". All parts are standard and guaranteed. Like all other Moss Values this System is offered with the understanding it may be returned for full credit or refund if it does not meet with your complete approval after a 10-day trial.

The complete Moss P.A. system will efficiently meet the following P.A. installation requirements:

INDOOR:

(A) Large size auditorium accommodating up to 5000 persons (low noise level).
(B) Medium size dance-floor accommodating up to 1000 persons (medium noise level).
(C) Medium size Fight Arena (high noise level).
(D) Medium size skating rink (high noise level).

OUTDOOR:

(A) Large outdoor meeting accommodating up to 3000 persons (low noise level).
(B) Small Ball Park (high noise level).
(C) Small stadium (medium noise level).

Amplifier Specifications

TUBES—2-6SC7, 2-6L6, 1-5U4G, 1-6N7.
CHANNELS (3)—2-Mic Gain 125DB, 1-Phone 87DB.
RESPONSE—40-12000 cycles plus or minus 7DB.
OUTPUT IMP.—2-4-8-15-500 ohms at both "Speaker Terminals." Strip or sockets. Handles 2 microphones.
OUTPUT POWER—25 Watts 3% dist. 35 Watts peak. Hum level 57DB below output.
DUTY—Continuous—PROTECTION—Fused 2 amp. slow blow.
CASE—Steel two-tone black and silver crackle. Blue panel White letters.
CAPACITORS—Oil coupling condensers and hermetically sealed electrolytic filter condensers.
SOCKETS—Output and rectifier sockets steatite.
DIMENSIONS—8¾ x 10 x 14⅛ inches.
POWER INPUT—110-125 Volts 60 cycles.

Reflex Projector Specifications

POWER (CONSERVATIVE) — 35 WATTS
POWER (PEAK) — 55 WATTS
FREQUENCY RANGE — 130 to 5000 C.P.S.
AIR COLUMN — 3½ FT.
BELL DIAMETER — 15"
PROJECTION — ½ mile
DISPERSION — 80°
IMPEDANCE — 8 ohms
FINISH — Attractive two-tone crystalline

Microphone Specifications

Model 718A "Versatex" is an extremely versatile high-output diaphragm type crystal microphone. The "Versatex", the versatile crystal microphone, is suitable for placement on table top, or other flat surface; it fits conveniently in the palm of the hand for use as a hand microphone; and it may be used on a conventional floor stand. The "Versatex", the versatile crystal microphone, has typical semi-directional properties. The crystal used is a Bimorph unit with special process moisture-proofing.

The Moss P.A. System comes complete with amplifier, projectors, microphone, connectors, cables, plugs, etc.

ONLY $92.50

10% deposit required with C.O.D. orders

MOSS ELECTRONIC DISTRIBUTING CO.

Dept RC-1, 229 FULTON STREET, NEW YORK 7, N. Y.

Minimum order $3.00—All prices subject to change—25% deposit with COD orders

GENERAL ELECTRIC 150 WATT TRANSMITTER

Cost the Government $1800.00
Cost to you $44.50!!!!

This is the famous transmitter used in U.S. Army bombers and ground stations, during the war. Its design and construction have been proved in service, under all kinds of conditions, all over the world. The entire frequency range is covered by means of plug-in tuning units which are included. Each tuning unit has its own oscillator and power amplifier coils and condensers, and antenna tuning circuits—all designed to operate at top efficiency within its particular frequency range. Transmitter and accessories are finished in black crackle, and the milliammeter, voltmeter, and RF ammeter are mounted on the front panel. Here are the specifications: FREQUENCY RANGE: 200 to 500 KC and 1500 to 12,500 KC. (Will operate on 10 and 20 meter band with slight modification). OSCILLATOR: Self-excited, thermo compensated, and hand calibrated. POWER AMPLIFIER: Neutralized class "C" stage, using 211 tube, and equipped with antenna coupling circuit which matches practically any length antenna. MODULATOR: Class "B"—uses two 211 tubes. POWER SUPPLY: Supplied complete with dynamotor which furnishes 1000V at 350 MA. Complete instructions are furnished to operate set from 110V AC. SIZE: 21½x23x9¼ inches. Total shipping weight 200 lbs., complete with all tubes, dynamotor power supply, five tuning units, antenna tuning unit and the essential plugs. These units have been removed from unused aircraft but are guaranteed to be in perfect condition.

BENDIX SCR 522—Very High Frequency Voice Transmitter-Receiver—100 to 156 MC. This job was good enough for the Joint Command to make it standard equipment in everything that flew, even though each set cost the Gov't $2500.00. Crystal Controlled and Amplitude Modulated—HIGH TRANSMITTER OUTPUT and 3 Microvolt Receiver Sensitivity gave good communication up to 180 miles of high altitudes. Receiver has ten tubes and transmitter has seven tubes, including two 832's. Furnished complete with 17 tubes, remote control unit, 4 crystals, and the special wide band VHF antenna that was designed for this set. These sets have been removed from unused aircraft and are guaranteed to be in perfect condition. We include free parts and diagrams for the conversion to "continuously variable frequency coverage" in the receiver.

The SCR522 complete with 24 volt dynamotor sells for only $37.95. The SCR 522 is also available with a brand new 12 volt dynamotor for only $42.95.

AUTOMATIC WIRE STRIPPERS will strip up to 1000 wires per hour, a handy tool for any service job—$3.52. Six Foot Asbestos Insulated Flat Iron Cord, one end has a male plug, the other end has a standard flat iron socket. Your price—50c each or 10 for $4.

Miniature plier set contains one of each of the following: Needle nose, flat nose, parrot nose, standard nose. All contained in a leatherette case. Your cost—$1.98.

METER RECTIFIERS—Full wave, may be used for replacement, or in construction of all types of test equipment—$1.25. Half Wave—90c.

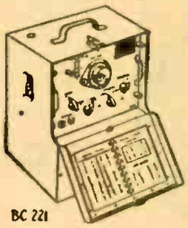
MICROPHONES—All nationally known brands. Bullet crystal—$5.45;. Bullet Dynamic—$7.45; Mike Jr.—60c; Handy Mike—90c; Lapel Mike—93c; SHURE T-17 MIKES, with push to talk switch—99c.

20 ASST'D COIL FORMS, including 11 ceramic, 3 polystyrene, and 6 fiber, all useful sizes—50c.

VARIABLE CONDENSERS: 350 MMFD, 5 gang—$1.95; 4 gang—$1.49; 3 gang—83c; 2 gang—79c; 7.5 to 20 MMFD, 1750v spacing, extra long shaft Hammarlund—69c; miniature variables, 25 MMFD—39c; 50 MMFD—49c; 75 MMFD—59c; 100 MMFD—69c; 140 MMFD—79c.

FLUORESCENT LIGHT BALLASTS. Single 30 or 40 watt, $1.68; Dual 40 watt High Power Factor—$3.75.

HEADPHONES—Highest quality Signal Corps headsets with 12" cord and plug $1.25. 5' rubber covered patch-cords with phone plug and socket—45c.

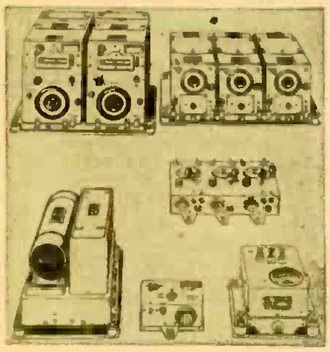


BC 221

BC-221 FREQUENCY METERS with calibrating Crystal and calibration charts. A precision frequency standard that is useful for innumerable applications for laboratory technician, service man, amateur, and experimenter at the give away price of only **$36.95.**

Six assorted **POWER** and **AUDIO TRANSFORMERS**, all new $1.98
Ten assorted R. F. Chokes including high frequency types .... $ .35
Five assorted **AUDIO** or **FILTER CHOKES** .... $ .99
One Hundred assorted **RESISTORS** $1.95
Ten new **JAN CABLE CONNECTORS**, including many popular types .... $ .99
Ten assorted **WIRE**-Wound **BLEEDERS**, 50 and 100 Watt, many with taps $2.49
Six assorted **OIL FILLED CAN TYPE CONDENSERS**, all with mounting brackets $1.49
Ten assorted **METAL & BAKELITE KNOBS**—(no wooden knobs) .... $ .39
Six assorted **VARIABLE CONDENSERS**, including butterfly types $1.49

The above nine assortments, totaling over $12.00 at the unbelievable bargain prices listed; can be purchased together as one lot at a super-special total price of $9.95, a value so incredible that you will rub your eyes as you read this, our new year get-acquainted offer. All merchandise guaranteed to be as advertised.



SCR-274N COMMAND SET

The greatest radio equipment value in history

A mountain of valuable equipment that includes 3 receivers that use plug-in coils, and consequently can be changed to any frequencies desired without conversion. Also included are two Tuning Control Boxes; 1 Antenna Coupling Box; four 28V. Dynamotors (easily converted to 110V. operation); two 40-Watt Transmitters including crystals, and Preamplifier and Modulator. 29 tubes supplied in all. Only a limited quantity available, so get your order in fast. Removed from unused aircraft and in guaranteed electrical condition. A super value at $29.95, including crank type tuning knobs for receivers.

Westinghouse 9 Amp. R. F. METER with special linear scale $3.89

Outdated EVEREADY 90 Volt and 1½ Volt Battery Pack. This is a unit larger than an auto battery. Regular price $12.00. Your cost $1.49

Outdated BRIGHT STAR standard flashlight cells. Carton of 48 .... $1.00

1947 Edition Editors & Engineers Radio Handbook. Regularly $2.50, now $1.79

1947 Edition Amateur Radio Relay League Handbook. Regularly $1.25, now .... $.89

We are overstocked on the following Rider's Manuals Rider's A. C. Calculation Charts (Complete coil and transformer design data). Regular price $7.50. Temporarily reduced to $5.00

Rider's Automatic Record Changers and Recorders. Regularly $9.00, now $5.95

ICA #1081 BLACK BAKELITE POINTER TYPE KNOBS. Regular List 20c each .... 25 for $1.00

RT-1579 consists of a three stage (cascade 6SJ7's and 6F6 output stage) high gain, high fidelity amplifier with 60 cycle, 110V power supply on the same 13½x14½ chassis, which is protected by a substantial steel cover over tubes and parts. Made by Western Electric with typical quality components such as a husky power transformer and oil condensers, this unit is obviously intended to give years of trouble-free service with no more need for repairs than a telephone. Disconnecting one wire each, from the special input and output filters, will result in as high a fidelity amplifier as can be obtained. Your cost with tubes, diagram and parts list included—$14.95.

We also offer the RT-1579 with a Raytheon Magnetic Voltage Regulator already installed beneath the cover. Imagine an amplifier complete with tubes, built to Western Electric quality standards, and immune to line voltage variations besides, making it perfectly suited for the most difficult industrial, circus, carnival, or commercial installations, offered for a total price of only $19.95, our price for both units.

BUFFALO RADIO SUPPLY, 219-221 Genesee St., Dept. 1C. BUFFALO 3, N. Y.

Cable Address: BUFRAD

RADIOMEN'S HEADQUARTERS — WORLD WIDE MAIL ORDER SERVICE!!!

AT LAST YOU CAN AFFORD A LABORATORY STANDARD MICRO VOLTER

The famous Measurements Corp. Model 78B, 5 Tube Laboratory Standard Signal Generator FOB Boonton, N. J., that sold new for $310.00 net, is available in perfect condition for 25 to 60 cycle, 115 V AC operation. Until now this is the sort of top-flight lab equipment that discriminating buyers have only vainly hoped would be released at a bargain price. Worth every cent the manufacturer asks, but available FOB Buffalo while our limited supply lasts for only $79.95.

Such companies as Admiral Corp. and John Meck, Inc., have ordered from us and repeated many times on these 78 generators for use in their labs and production line testing. "REMEMBER THAT A STANDARD IS ONLY AS RELIABLE AS ITS MAKER."

Model 78-B Standard Signal Generator. Two Frequency Bands between 15 and 250 megacycles.

TRANSMITTING RF CHOKES, 4 PIE, 350 Ma.—25c or 5 for $1.00.
INTERRUPTION FREQUENCY COILS for super-regenerative receivers or the tremenduously popular FM adapters for standard broadcast sets. Iron core with a resonant frequency of 50 KC—39c; Air Core, 100 KC— 29c.
30 MC IF TRANSFORMERS, double slug tuned—25c **VIDEO AMPLIFIER PLATE COILS**—Slug tuned—25c. **REMOTE CONTROL UNIT**: Aluminum case 4x3x2" containing 2 potentiometers, triple pole switch, 4 knobs, gear mechanism, counter and phone jacks—59c.
MODULATION TRANSFORMERS—10 watt, metal case, 98c; 30 watt, open-type, $1.95; 40 watt, cast aluminum case, $2.95; Class "B" input transformers, cast aluminum case, $1.95; Transceiver audio transformer, 65c; Transceiver modulation transformers, 65c.
LINE FILTERS—110V—each unit contains two 2 mfd. oil filled condensers and a 15 amp. iron core choke. This filter has innumerable uses such as oil burner line filter, etc. A ten dollar value for 98c.

$9.95 TAKES ALL THREE BIG BARGAINS

1. AUDIO AMPLIFIER

Undreamed of value. Uses 6V6's. Has 4 microphone inputs brought to jacks at rear panel. Various output impedances available at rear panel connections. Steel case with chrome handles. 9" long x 9" high x 6" deep. Tubes included. New in original carton. Shipping weight 15 lbs. SUPER SPECIAL—$4.95 while supply lasts.

2. RADIO HEADSETS

Latest supersensitive type with rubber earpieces. Every pair guaranteed perfect. $.50 per pair OR 3 PAIRS FOR $1.00.

3. HOME WORKSHOP AT BARGAIN PRICE

Accurate and precise 2 speed guaranteed hobby lathe, the essential machine for the home workshop. Sturdy enough for light production work or factory standby service. Supplied with 56" of belting for connecting to any available electric motor or power take-off, such as on a jeep or tractor. Also included in this unbelievable offer are such accessories as a ½" drill chuck with specially hardened tool steel jaws, a 4" electric furnace high speed grinding wheel, a cotton buffing wheel with a large supply of buffing compound, and a 4" steel wire scratch brush. Your cost $6.00. Sole export agent. Distributor inquiries invited.

RT1463 7 tube amplifiers containing 3-7F7, 1-7Y4, 3-7N7, 4 potentiometers, numerous resistors, filter and bypass condensers, filter chokes, power and audio transformers, and six sensitive plate relays. A military development that provided amazing stepless control proportional to correction required, for ailerons, rudder and elevator, in the original application. A control amplifier of the ordinary type would deflect the rudder by some arbitrary amount when the ship was blown off the course to port or starboard. The result would either be that the correction was insufficient and the plane continued off course, or the correction would be too great, starting a series of tackings that would greatly increase fuel consumption and elapsed time in reaching the objective. This phenomenal unit, with its 3 amplifiers and six 5000 ohm relays in bridge circuits, will accurately control any 3 operations, related or unrelated, in minutely adjustable uniquely quantitative variations in either forward or reverse directions. 9"x7"x8" black crackle aluminum case. Brand new in original carton $12.95, or used $9.95.

SCR-284 TRANSMITTER-RECEIVER—This medium power transmitter and the accompanying 7 tube very sensitive receiver are naturals for 80 or 40 meter operation (phone or CW), on either fixed stations or mobile applications. These units are brand new and come complete with 17 tubes, key, microphone, 200 KC calibrating crystal and instructions and diagrams for use with up to 100 watts input to the final stage on 40 or 80 meters for either phone or CW, using vehicle or 110 Volt power supply. Your cost $39.95

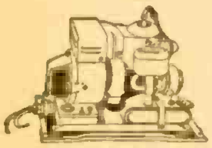
GENERAL ELECTRIC RT-1248 15-TUBE TRANSMITTER-RECEIVER

TERRIFIC POWER—(20 watts) on any two instantly selected, easily pre-adjusted frequencies from 435 to 500 Mc. Transmitter uses 5 tubes including a Western Electric 316 A as final. Receiver uses 10 tubes including 955's, as first detector and oscillator, and 3—7H7's as IF's, with 4 slug-tuned 40 Mc. IF transformers, plus a 7H7, 7E6's and 7F7's. In addition unit contains 8 relays designed to operate any sort of external equipment when actuated by a received signal from a similar set elsewhere. Originally designed for 12 volt operation, power supply is not included, as it is a cinch for any amateur to connect this unit for 110V AC, using any supply capable of 400V DC at 135 MA. The ideal unit for use in mobile or stationary service in the Citizen's Radio Telephone Band where no license is necessary. Instructions and diagrams supplied for running the RT-1248 transmitter on either code or voice, in AM or FM transmission or reception, for use as a mobile public address system, as on 80 to 110 Mc. FM broadcast receiver, as a Facsimile transmitter or receiver, as an amateur television transmitter or receiver, for remote control relay hookups, for Geiger-Mueller counter applications. It sells for only $29.95 or two for $53.90. If desired for marine or mobile use, the dynamotor which will work on either 12 or 24V DC and supply all power for the set is only $15.00 additional.

ARMY BC-312 COMMUNICATIONS RECEIVER

This receiver covers the frequency range of 1.5 MC to 18 MC in six direct reading bands. The dial, that is driven with split gears to prevent backlash, has 4500 logging divisions per band with approximately 600 divisions on the 20 and 40 meter ham bands and 1000 divisions on 80 meters. Two stages of RF before the converter in this set give it a very high signal to noise ratio and maximum sensitivity. Outstanding features of this receiver are: BFO with pitch control send receive relay, jacks on the front panel for headphones and speaker output, and mike and key inputs. All tubes are standard 6 volt types. This receiver was designed to withstand rough usage in the field and for operation from vehicles while in motion, so it is ruggedly constructed and contains a dynamotor power supply—Your cost $49.95. Conversion kit to 110 V AC is available for $6.50

PE-109 32-Volt DIRECT CURRENT POWER PLANT



This power plant consists of a gasoline engine that is direct coupled to a 2000 watt 32 volt DC generator. This unit is ideal for use in locations that are not serviced by commercial power or to run many of the surplus items that require 24-32V DC for operation. The price of this power plant is only $59.95. We can also supply a converter that will supply 110v AC from the above unit or from any 16-32V DC source for $29.95.

CLOSING OUT

THE FOLLOWING DESIRABLE ITEMS IN "AS IS" CONDITION AT SACRIFICE PRICES TO MAKE ROOM IN OUR WAREHOUSE FOR INCOMING STOCK.

947A ONE KILOWATT HIGH FREQUENCY TRANSMITTER. This relay-controlled transmitter includes a 115V, 60 cycle power supply, protected by 8 magnetic circuit breakers, that alone is worth more than the price we are asking for the whole rig, even on today's surplus market. On the front panel are six 3½" GE or Weston meters, including 250 MA, 50 MA, 1000 MA, 150 V AC and 1500 V DC at 1000 ohms per volt for screens and plate. The rack-type 21" x 15" x 36" unit contains six amplifier and rectifier tubes aggregating over $60.00 at WAA current wholesale prices. Western Electric's price to the government was $1500.00. Shipping weight 500 lbs. Your cost at close-out price $39.95

BC-412 5" RADAR OSCILLOSCOPE. Easily converted to a first class lab. scope or to an excellent home television receiver using the instructions in the August 1947 RADIO NEWS. Furnished with a brand new 5BP4 tube for the television application or a brand new 5BP1 for the scope application. Specify your choice. Sold at close-out price $29.95

5 INCH RECEIVER INDICATOR SCOPE. This unit, originally sold by Western Electric for $2500.00 includes a 13 tube receiver with 7 IF stages; 2 tube multivibrator sweep generator; 2 tube sweep amplifier; video amplifier; pedestal impulse and sweep generator, and 115 volt, 60 cycle supply with 2 x 2 for high voltage. Equipped with more than 15 tubes of the 43 originally used and including a brand new scope tube in original carton. Makes a wonderful laboratory instrument and is better adapted for television than any other war surplus item. Reduced close-out price $39.95

TRANSFORMERS—All types in stock. **AUTO-TRANSFORMERS**: Steps up 110v to 220v, or steps down 220v to 110v—$1.95. **FIL. TRANS.**: 6.3v, 20 Amps.—$1.98; Universal Output Trans. 8 Watt—89c; 18 Watt—$1.29; 30 Watt—$1.69. **AUDIO TRANSFORMERS**: S. Plate to S. Grid, 3:1—79c; S. Plate to P.P. Grids—79c; Heavy Duty Class AB or B, P.P. Inputs—$1.49; Midget Output for AC-DC sets—69c; **MIKE TRANSFORMER** for T-17 Shure microphone, similar to UTC officer type—$2.00. Stancor SB or DB mike to line or grid—$1.95.

POWER TRANSFORMERS—Half-shell type, 110V, 60 cy. Centertapped HV winding. Specify either 2.5 or 6.3V filament when ordering.

For 4-5 tube sets—650V, 40MA, 5V & 2.5 or 6.3V $1.49
For 5-6 tube sets—650V, 45MA, 5V & 2.5 or 6.3V 1.75
For 6-7 tube sets—675V, 50MA, 5V & 2.5 or 6.3V 1.90
For 7-8 tube sets—700V, 70MA, 5V & 6.3 or two 2.5V .. 2.35
For 7-8 tube sets—700V, 70MA, 5V & 6.3 (25 cycle) 3.60
For 8-9 tube sets—700V 90MA, 5V-3A, 2.5V-3.5A, 2.5-10.5A 2.85
For 9-11 tube sets—700V, 100MA, 5V & 6.3V-4A 2.85
For 9-15 tube sets—600V, 150 A, 5V & 6.3V 2.95

CONDENSERS—PAPER TUBULAR 600 WV—.001, .002, .005—8c; .01, .05—9c; .1—10c; .25—23c; .5—36c; **ELECTROLYTICS**: 8mfd 200v—20c; 10mfd 35v—20c; 30mfd 150v—23c; 20/20mfd 150v—35c; 30/20 150v—46c; 50mfd 150v—43c; 8mfd 475v—34c; 10mfd 350v—65c; **OIL CONDENSERS**: 4mfd 600v—49c; 2mfd 600v—29c; 3X.1mfd 600v—29c.

FILTER CHOKES: 200, 300, 400, 500 ohm light duty—59c; 200 or 300 ohm heavy duty—99c; 250 ma 35 ohm, made for U.S. Navy, fully shielded—$1.95; 75 ohm 125 ma—25c or 25 for $4.25; "Meissner type" tapped filter chokes—25c; 8 amp. iron core A filter—25c; Choke-condenser combination, ideal to replace any size speaker field when installing PM speakers—79c.

110 V. CIRCUIT BREAKERS of Magnetic type: Following Current Ratings in Stock: 1.25, 3, 4, 8 Amps. Please specify. $1.95 each.
Seven Assorted I.F. Transformers—$1.98; Five Asstd. Oscillator Coils—69c.

SPEAKERS-PM dynamic type-4"—$1.55; 5" $1.55; 6"—$1.95; 8"—$3.95; 10"—$5.95; 12"—$7.50.

SELENIUM RECTIFIERS—Dry disc type 1½" by 1", 1.2 Amp. maximum, suitable for converting DC relays to AC, for supplying filament source in portable radios, converting DC meters to AC applications, and also may be used in low current chargers—90c.

5" "SO" RADAR P.P.I. OSCILLOSCOPE, complete with 9 tubes. This unit contains magnetic deflection yokes, Selsyn motor, and self contained 110 V power pack designed to run on the AC supply on LST and PT boats. Various ranges from 2 to 80 miles. The most satisfactory scope available for navigational radar or panoramic television applications. Uses 807 tube in final power stage that provides yoke deflecting current. Your Cost $39.95

"SO" RADAR ECHO BOXES. The perfect calibrated cavity wavemeter $10.00

LORAN INDICATOR OSCILLOSCOPE, including 26 tubes with 5" cathode ray tube. Govt. instruction manual supplied with each of these $37.95

2" OSCILLOSCOPE complete with tubes and brand new $9.95

BUFFALO RADIO SUPPLY, 219-221 Genesee St., Dept. 1C, BUFFALO 3, N. Y.

Cable Address: BUFRAD

SENCO A Gold Mine of SAVINGS!

Bright future for television is seen by Frank M. Folsom, executive vice-president of RCA Victor. "By the end of 1948," he says, "it is estimated that there will be 750,000 television receivers in the United States.

FREQUENCY METER

(*Continued from page 69*)

the calibrating oscillator. (If a 2.5-mc crystal is substituted, its even harmonics will fall at 5, 10, 15 mc, etc., making it easier to check against WWV and other standards.—*Editor*)

To measure frequencies in the amateur bands, use the vernier oscillator. Connect a short antenna to its output jack and loosely couple to the receiver input circuit. Adjust the oscillator for zero beat with the signal and read the frequency from the dial and multiply the figure by the order of the harmonic. If the signal is not in the range of harmonics of the vernier oscillator, use the calibrating oscillator to adjust to zero beat. If the frequency is below 3.4 mc, compare harmonics of the calibrating oscillator with the fundamental or harmonic of the vernier oscillator. Higher frequencies are measured by zero beating with the fundamental of the calibrating oscillator and comparing its harmonics with those of the vernier oscillator. For example: Assume a frequency of 5.125 mc; not in the harmonic range of the vernier oscillator. Adjust the calibrating oscillator to zero beat. Its second harmonic, 10.250 mc with the third harmonic of the vernier oscillator when it is set at 3.4 mc. Other harmonics of both oscillators may be used if care is taken not to confuse them and thereby misread the result.

To measure the exact frequency of a nearby transmitter, connect a short antenna to the jack from the appropriate oscillator, to pick up the signal jack. Use phones to indicate zero beat between signal and oscillator. Determine the frequency by zero beating with the fundamental or harmonics of the vernier oscillator or by combinations of beats between the oscillators in the instrument and the transmitter harmonics.

The unit can be used as an unmodulated signal generator by using the calibrating oscillator and coupling to the desired circuit. Close coupling to a load does not disturb the calibration. It can also be used as an audio frequency generator by producing beats between any two of the oscillators. The voltage output is taken from the phone jack. The signal level will be low but is usually strong enough to be useful under most conditions. — *B. J. Cederqvist, OH2NL*

SPRAGUE TRADING POST

SWAP—BUY OR SELL

FOR SALE—Meissner, 150B transmitter complete with exciter, tubes, coils, manuals, accessories and spare parts, phone and cw 150 watts output, ready to go, in perfect working order, $275. D. C. Smyth, W1BOE, 14 Norwood St., Portland 5, Me.

FOR SALE—BC342-N a-c receiver like new, $60; Neat 150w, c-w transmitter and power supply coils for 20, $100; CML 2 meter converter and power supply, $30; converted SCR522, 2m transmitter and power supply, $38. Lyman C. Willard, Jr., WYDQB, 937 Bolling Ave., Norfolk, Va.

WANTED—Utah Add-a-unit transmitter kits, will consider separate units or all 5 complete. Jack D. Clement, Jr., W6NTR, 6612 Andasol Ave., Van Nuys, Calif.

FOR SALE—Components of ham station. SX-28 receiver, $150; National NTX-30 transmitter, $70; S-20-R receiver, $40; Supreme scope. E. Harris, W9KNK, 3319 Catalpa, Chicago 25, Ill.

FOR SALE—Slightly used postwar Hallicrafters S-38 receiver in A-1 shape, $40. C. J. Johnson, 605 E. Second Ave., Mitchell, S. Dak.

WILL TRADE—New Mallory 6.44v, 1.5 amp. output dry-disc rectifier. Want meter size rectifier or low range a-c meter. Also have telegraph vibroplex and Morse telegraph transmitter, both needing some repairs, for trade. A. P. Nielson, 1521 W. 62nd St., Seattle 7, Wash.

FOR SALE—National HRO receiver RAS-3, rack mounted with power supply and speaker in 40" open frame rack. Have 9 sets of coils 50kc to 30,000kc, $75 f.o.b. C. H. Campen, W3LVC, 3413 Gwynns Falls Parkway, Baltimore 16, Md.

WANTED—Inbred international code practice tapes for automatic photoelectric keyer. Edwin Conrad, 900 Guy Bldg., Madison, Misc.

FOR SALE—Hallicrafters SX-28 receiver, with matching speaker in new condition, $175 F.O.B. Robert Wickham, Route 1, Beloit, Kans.

FOR SALE—Precision 920P tube and set tester, Vomax VTVM crystaliner signal generator, set of Rider's Manuals, battery charger and voltohmmeter, all nearly new, in perfect condition, $300. Harry Altman, 3989 Coolidge Ave., Culver City, Calif.

FOR SALE—Hallicrafters receiver S-41-G like new; 6 tube ac-dc superhet tube including rectifier tube covers, 550kc to 300 megacycles in 3 bands, $30. L. Latterman, Jr., 211 Mohawk St., Utica 3, N. Y.

WANTED—Old issues of Modern Electric, Popular Electricity, Q.S.T. 1919 and 1920. Cash or will swap for other old issues. J. T. Lipani, 157B Leverett St., Boston 14, Mass.

FOR SALE—Two new BC348-N army radio receivers converted to a-c current with matched speaker in cabinet, $80 ea. Perfect. Roscoe J. Bailey, Weston, W. Va.

FOR SALE—FB7XA with National preselector and power pack, 80-40-21-10 bandspread; all new bypass and filter condensers, $45. Wilbert Schwark, W9IHG, 193 West 12th St., Fond du Lac, Wisc.

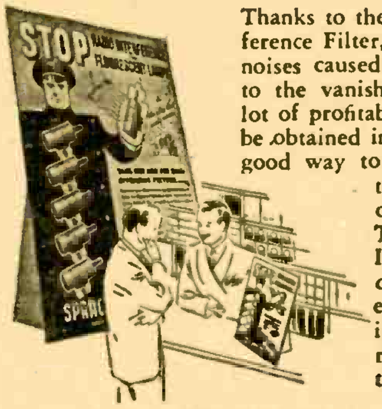
FOR SALE—G.I. Dual speed home recording mechanism, turntable, recording head, pickup head but less amplifier, $25. Used only few times. S. Graham, RFD No. 1, Lincoln Park, N. J.

WILL TRADE—New Hallicrafters S-36 FM-AM, covers 2 & 6 meters, comb from 27.5 mc to 143 mc in 3 brands with tubes and shock mounting less speaker. Want good camera in like condition as Leica, Kodak Medalist II or good reflex camera. E. G. Kistner, 3112 "D" Berkley Drive, Philadelphia 29, Pa.

FOR SALE—Stewart-Warner cabinet radio, 8 tubes, chassis and speaker only, $30 C.O.D. or will trade for FB7 nat. Frank Bou, 3131 N. Perch St., Philadelphia 33, Pa.

Cut yourself a bigger slice of the profitable business of minimizing radio

INTERFERENCE from FLUORESCENT LIGHTS



Thanks to the Sprague IF-37 Interference Filter, it's easy to cut radio noises caused by fluorescent lights to the vanishing point. There's a lot of profitable service business to be obtained in this field — and one good way to get it is to display this big Sprague easel card on your counter. The card contains six IF-37 Filters and tells customers how they effectively reduce radio interference from fluorescent lights — even the kind that is conducted through power lines to remote fixtures.

Order a supply of filters and cards from your Sprague jobber today. Cash in on this fast-growing business. One Sprague IF-37 Filter installed according to directions on each fluorescent fixture does the trick. And, in addition to selling IF-37's to customers, don't fail to use them to filter fluorescent lights in your own store, thus assuring better, quieter radio and television demonstrations!

Sprague IF-37 Filters Are Underwriters Approved

FOR SALE—Factory wired and aligned television i.f. containing both picture and sound channels; postwar design using 2 6BA6's, 2 6AH6's, and 2 6AL5's, $32.50. Hartland B. Smith, W8VVD, 467 Park Ave., Birmingham, Mich.

FOR SALE—Preamplifier for Caltron 300 or 301 phono pickup, complete with 7F7 tube and instructions for connection to any amplifier or radio, $5. Donald Wentworth, R.F.D. No. 2, Franklin, Nebr.

FOR SALE—Complete NC-100 ASD radio receiver, range 200 to 400 kilocycles and 1300 to 30,000 kilocycles; power supply 115v, 50 or 60 cycles, or 25 cycles; excellent condition, $120. Gabriel Cassetta, 352 S. Duquesne Ave., Duquesne, Pa.

WANTED—B & W 160 meter HDVL, KW swing link coil. H. A. Davison, W9VFF, 115 Bensyl Ave., Danville, Ill.

FOR SALE—Minerva tropic master, 8 tube 2 band radio receiver; tuning ranges, 550 to 1600 kc, 5.5 to 18 mc; totally enclosed in gray metal cabinet, perfect, $39 or will trade for test equipment. Maxim Appliance, 320 S. Central, Bartow, Fla.

WANTED—Sargent receiver II, universal 9.5 to 20,000 meters; state condition and price. Panchen Moore, 1787 Flagler Ave., N. E., Atlanta, Ga.

FOR SALE—New 861 tube, 872, 805, 03Z, 805, 830, 03A and others; CTC hermetically sealed transformers and chokes, new, not surplus. Want BC610 transmitter complete and working. State price delivered in York; also 6 propeller pitch motors. Nelson K. Stover, W3BBV, 1357 Hill St., York, Pa.

SELL OR TRADE—Pair of 2 meter transmitter-receivers, one portable and one 110v ac with built-in speakers for standby and Western Electric handsets, never used. Also Motorette motor scooter like new. Want Hallicrafters receiver and transmitter. W. T. Stripling, Box 912, Kermit, Texas.

SELL OR TRADE—Two Jensen type D-151 bass reflex peri-dynamic enclosures, new in original shipping cartons. Less than cost, or what have you? Bert E. Zielesch, 1340-143 W. Grand Ave., Wisconsin Rapids, Wisc.

WANTED—SX-25, SX-17 or similar receiver. Will answer all letters. John S. Forrester, 230 W. 79th St., New York 24, N. Y.

FOR SALE—TR-4 on 2 meters, worked over 150 miles for W1KLN, spare HY75, HY615, AC power supply by Abbott, 6 volts dc power supply, $50. McMorrow, 132 Oakwood Ave., Troy, N. Y.

FOR SALE—10" original Vibroplex Bugs, used but in excellent condition, $5. M. E. Kunkle, Box 81, Harrison City, Pa.

FOR SALE—Instructograph, standard spring wound model with oscillator, 10 tapes, headphones, less batteries, $25. Marc Molyneux, Jr., 402 S. Conception St., Mobile 21, Ala.

FOR SALE—Hallicrafters SX-24 with speaker, complete coverage 540 Kc, through 43.5 Mc, in A-1 condition; aluminum elements for 10 meter 3 element beam and home built R-9'34 less coils, $90. John E. Horton, Jr., 2407 Harriet St., Racine, Wisc.

FOR SALE—Hallicrafters sky champion S-20R in perfect condition with W-E phones, $55. Maurice Ergang, 34 Hillside Ave., New York 34, N. Y.

WANTED—342 or 348 receiver in good condition and converted to AC operation. Julio Bellber Arroyo, % Pan American Airways, Inc., San Juan, Puerto Rico.

FOR SALE—RAK7 communications receiver with 110v power supply, $40. D. M. Perkins, 106 N. Park Circle, Elkton, Md.

FOR SALE—Hallicrafters, S-22R, new; will sell for $50. Lloyd E. Matter, 900 High St., Williamsport, Pa.

FOR SALE—Broadcast monitor equipment including high quality speakers, amplifiers, professional recorder, FM-relay receiver, etc. Write for list. George E. Beggs, Jr., School Lane, Warrington, Pa.

FOR SALE—Webster-Chicago 80 wire recorder with volume and recording level indicator, complete with microphone and 3 spools of wire, $140, or what have you? Nina Bodenham, Riceville, Iowa.

FOR SALE—Hallicrafters SX-28 receiver excellent condition, $150. Chester M. Luchessa, W6BRV, 817 Jackson St., Albany 6, Calif.

FOR TRADE—Patterson 16 Communication receiver with 5 band receivers; 535 kilocycles to 37 megacycles (8 to 550) meters, all in good working condition. Need good signal generator and voltohm meter. John P. Goncel, 713 N. Pelham Road, Jacksonville, Ala.

FOR SALE—Complete BC610 audio system speech amp-driver-modulator to modulate KW rig, also SX25 receiver and 450TLS. Want 100th's, 35T's. George Pasquale, 9421 Thornhill Road, Silver Spring, Md.

WANTED—SX28A. Will trade NC200 in excellent condition and pay difference. Chuck Borysewich, W2GWQ, 1066 President St., Brooklyn 25, N. Y.

FOR SALE—RME-45 communications receiver, $150. C. E. Wampole, 1827 Pearl St., Anderson, Ind.

WANTED—Coils for 20-40-80 meter ham bands to fit BC610 exciter. Give price and details. C. H. Schindler, 103 Pine St., Perryville, Mo.

FOR SALE—BC-701-A receiver, complete with 12 tubes, $35; also 1-150 d-c voltmeter, $1.75; dynamic speaker, $5; 58, 35/51, 2A7, 2B7, 27, 80, 2A5 and 47 tubes, $.35 ea. Robert Berles, 16106 Kedzie Ave., Harvey, Ill.

FOR SALE—Federal transmitter tenrio 500 watt c-w converted for 10 meter amateur band, with all tubes, $150, and brand new Turner U9S dynamic mike on stand, $25. Ernie's Radio, 402 N. 3rd St., Hamilton, Ohio.

WANTED—Ham receivers reasonably priced, no surplus. Best Radio Shop, 3349 Fulton, Cleveland 9, Ohio.

FOR SALE—NC100X with S-meter and 10" matching speaker, $75. W2BVR, 123 Park Place, Schenectady, N. Y.

FOR SALE—SX-25 in very good condition, just completely checked. Want HRO, 1946 model or older. Malcom N. Wiseman, 216 Elm St. N. W., Washington 1, D. C.

FOR SALE—New post-war Tri-let 1621 tube tester, $35; 7 volumes RCA service notes, 1931-1938, $6; and Clough-Brengle 185 unimeter, in metal case, perfect, $35. Winter Sales & Service, Spooner, Wisc.

Sprague Products Company, North Adams, Mass.

JOBBING DISTRIBUTING ORGANIZATION FOR PRODUCTS OF SPRAGUE ELECTRIC CO.

ASK FOR SPRAGUE CAPACITORS and *KOOLOHM RESISTORS *by name!*

*Trademark Reg. U. S. Pat Off.

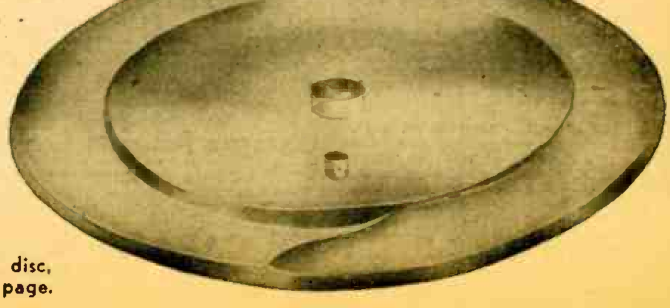
C. FRANCIS JENKINS—TELEVISION ADVENTURER
(Continued from page 34)

man, of the de Forest television subsidiary. In July, 1929, he recommended that the drum type of scanner be dropped. The drum receiver, he said, caused the neon tube to burn out in a few hours, due to its being run at a very high intensity to compensate for the 60% loss of light in transmission through the quartz tubes. The commutator also introduced disturbances which had to be filtered out of the receiving set, and was also subject to delicate timing adjustments.

At about the same time, a prominent publicity engineer similarly attacked the work of the Jenkins organization as a whole: "I am perturbed at the progress made by others in the television field compared with that of the Jenkins organization: A year ago, at Lexington, Mass., I saw better pictures than Jenkins shows today . . . The RCA 60-line pictures are very good, better in detail than the Jenkins pictures . . . All others are showing half-tones while we play around with silhouettes . . . The work of Bell Labs. is far ahead of anything we can dream of today . . . The Jenkins prizefight film is years behind what others are showing; it is so poor that I shouldn't care to invite newspaper men to see it . . . It is only from true friends that you can learn the truth, so pardon my frank criticism . . ."

In 1930 shortly after this frank denunciation, Jenkins was asked to design a new receiver. He submitted the old drum type with quartz rods, which would not be acceptable to the radio public. His career as an inventor, or rather as an up-to-date designer, was ended, and his frenzied efforts to "beat the field" affected his heart. In August, 1931, it was reported that he was seriously ill, and that his life was despaired of. Three years later, after a lingering illness, he passed away.

(Continued on following page)



The prismatic scanning disc, described on opposite page.

The prismatic ring

One important element in Jenkins' early apparatus deserves full description here, since no clear explanation has been heretofore published of its nature and the method of its functioning; that is, the prismatic disc or ring.

This consisted of a glass disc (or ring) of selected mirror plate, ground along its outer circumference in a graduated way. From one end to a point half-way round it had its base outward; from this half-way point around to the other end it had its base inward. The warp from one end to the other was gradual. A beam of light passing through this device, when it was rotating, was caused to oscillate, having its hinged action fulcrumed in the plane of rotation of the prism ring. The oscillation was always in the plane of the diameter of the disc from the point where the light passed through the prismatic section.

In effect, the prismatic ring was comparable to a solid glass prism which changes the angle between its sides, "giving to a beam of light passing therethrough a hinged or oscillating action on one side of the prism while maintaining a fixed axis of the beam on the other side of the prism," to quote the inventor directly.

A beam of light passing through a prism is bent toward its base. By mounting 2 disc prismatic rings so that their axes intersect at right angles, the beam can be bent both up and down, and left and right. Nearest the photograph to be scanned is the ring which bends the beam vertically, the other bends it horizontally. The second prism makes 100 revolutions to one of the first.

"For transmitting radio-pictures," said Jenkins, in his book entitled *Vision by Radio*, "we slice up the picture (figuratively) into slices .01 inch wide, by sweeping the picture across the light-sensitive cell with these rotating prismatic rings. With each downward sweep the picture is moved .01 inch to the right, until the whole picture has crossed the cell . . . The cell converts the light strengths into corresponding electrical values . . . In receiving, with the rotating prismatic rings we draw lines with a point of light across a photographic plate, varying the density as this is done by reason of the varying strength of the incoming signal.

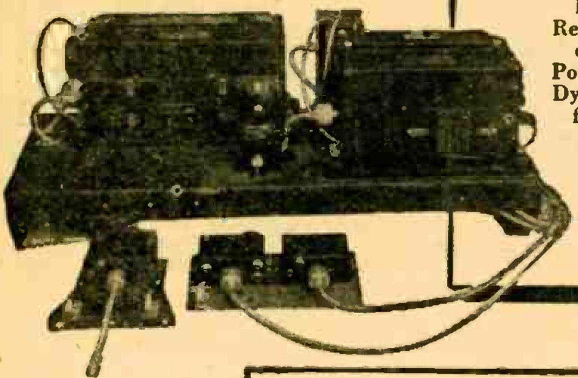
"For sending radio-photographs the picture is projected with a magic lantern through 4 overlapping prismatic rings, 2 of which in rotation sweep the picture vertically across the light-sensitive cell, at the same time that the image is being moved laterally by the other pair of prisms. The light cell in its housing changes the different light values of the picture into electrical values. A rotating perforated disc between lens and cell changes the direct current into interrupted direct current, which is then sent through the amplifying transformer."

The reference to "4 overlapping rings" means that for horizontal as well as vertical prism scanning each disc really consisted of 2 placed side by side, overlapping, for optical correction. In the first prismatic rings there had

(*Continued on page* 124)

Coast-to-coast network television within 2 years is predicted by NBC executive Frank E. Mullen.

ESSE Specials!



RU-16GF-11

Transmitter & Receiver—12 Volts. *(Do not confuse this with RU-17GF-12 which is 24 Volts.)*

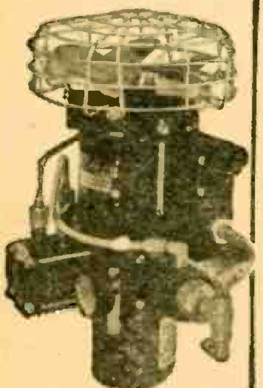
Transmitter frequency 3000-4525 and 6000-9050 Kc. Frequency changes by means of plug-in coils.

Receiver frequency 195-13,575 Kc. Frequency changes by means of plug-in coils.

Power output 12 watts on voice, CW, or MCW.

Dynamotor input 12 V. DC at 10 amps.—output 435 V. at 143 Ma., well filtered.

Mounted on rack about 13"x31" (transmitter and receiver shock-mounted). Has receiver remote tuning control with cable, junction box, receiver switch box, test meter and cord, antenna relay unit, instruction manual, and all tubes. All coils included.
Shipping weight approximately 100 lbs.
We have but a few of these left and will sell them at this bargain price of **$49.75**

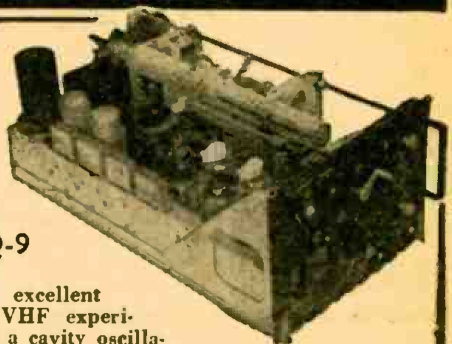


AIR COMPRESSOR

Made by the Cornelius Manufacturing Company. This small compressor will pump pressure up to 1500 lbs. per square inch. Compressor is 3-stage type air-cooled, powered by a 24 V. DC motor. This is one surplus item which your shop cannot afford to be without. Ideal for use with airgun, small paint sprayer, and numerous other applications.

This fine precision-built compressor
only $12.95 ea.

RADAR TRANSMITTER T-39/APQ-9



Contains many excellent parts for the VHF experimenter such as a cavity oscillator using 2-RCA 8012 tubes rated at full output to 500 Mc. Tubes are forced air cooled by 24 V. DC motor, which is easily converted for 110 V. AC operation. Other valuable parts such as a pair of 807's, 2-6AC7, 1-931 and 1-6AG7 tubes; ceramic switch, potentiometers, gears, revolution counter, etc.

PRICE $12.50

CP-11/APS-15

Contains following tubes: 13-6SN7-GT's, 3-6SA7-GT's, 1-5Y3-GT. 1: 24 V. motor and blower (blower will operate on 110 V. 60 cy.), 4 one megohm precision wire-wound resistors, 80-86 Kc. crystal, numerous other transformers, condensers, etc. Shipping weight approximately 25 lbs.

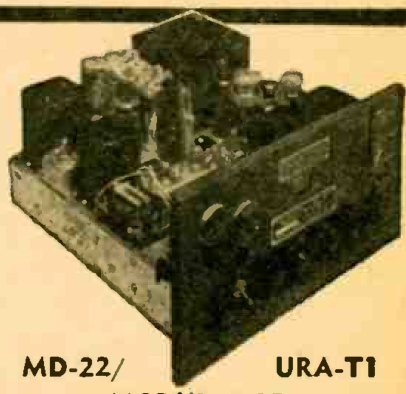
Price $9.95

RADIO TUBES

We're overstocked — we're unloading

7C5	each—$.35
7F7	each— .35
7Y4	each— .35
6V6	each— .35
CW-931	each— .35
30 (VT-67) *(Hi-freq.-low-loss base)*	each— .35
6SN7	each— .35
VT127A	each—3.75
0Z4	each— .70
12A6	each— .35
1625	each— .35
1629	each— .35

All tubes checked before shipment.



MD-22/URA-T1 MODULATOR

Comes in metal carrying case. Size approximately 7"x12"x16". Operates from 6 or 12 V. DC or 110 V. 60 cy. AC. Was used by the Army as a source for jamming, by random noises, keying, or bagpipe systems. Contains 1—6SN7, 1—6V6, 1—6X5, 1—2050, and 3—991 tubes. Has jacks for microphone, output monitoring or connection to transmitter. Hams, experimenters, or servicemen can easily modify this to use as a source of audio power.

Price $12.95

2-METER BEAM ANTENNA

Portable or fixed, manually operated or can be used with beam motor, for use in 100-156 Mc. band. Easily adapted for ham or experimental use. Contains tuning unit which matches output of transmitter to antenna, 18′ steel mast with brass tube containing co-ax cable and fittings inside steel mast (OD color), "H" frame for holding dipoles, 3 sets (4 per set) dipole rods, compensator or sense antenna for "H" frame, 2 steel truncated cones used as antenna support and feed-through, 360 degrees bearing indicator, and handwheel for rotating. Brand new packed in six boxes, total weight approx. 600 lbs. Limited quantity and in much demand.
Place order now **$147.50**

ANTENNA KIT 2A-264-126

Consists of 1 canvas bag containing 20 ceramic insulators each 3″ long—1¼″ dia. with screw-in type eyelets, one covered wire 5′ long, 1 covered wire 10′ long, 1 covered wire 35′ long, 2 covered wires 25′ long each, 5 covered wires 20′ long each, (all wires included have ⅛″ thimbles and 6″ connecting leads at each end), wire 150′ long, (all of this is stranded copper wire covered with weather-proof insulation). Brand new, packed in original boxes. Can be useful to any ham, serviceman or experimenter.
Each kit **$6.75**

BC-966-A IFF

A 2-meter transmitter and receiver. Contains following: Pioneer Gen-E-Motor—18 V. input, 450 V. 60 Ma. output; 65 watt—40 ohm resistor; 1 Mfd. 1000 V. condenser; 4—10W current relays; 4—7193, 7—6SH7, 3—6H6; Eclipse Carbon pile type voltage regulator; etc. Requires only slight modification for 2-meter operation.
Price **$4.75**

UHF MOTOROLA ANTENNA

Antenna for 27-42 Mc. complete with matching sections, 100 ft. amphenol transmission line, guy wires and 8 ft. shipping box as shown. Brand new. ......ea. **$35.00**

ROTATOR MOTOR FOR YOUR BEAM ANTENNA

24-33 V. AC or DC operated. Reversible—only 3 wires required. Approximately ¾ RPM. 7056 to 1 gear reduction (no free swing). Powerful motor. Rugged precision gear train, and sturdy thrust bearing—will support and turn any ham beam. Weather-proof housing. Motors are easily converted into an FB beam rotator! Conversion data included.

Rugged motor as pictured....**$9.95** ● Same type motor only lighter constructed (not pictured)....**$8.95**

Either of above motors with antenna mounting plates welded on—$4.00 extra.

All equipment advertised herein is unconditionally guaranteed to the customers satisfaction to this extent: Return any item advertised within five days after delivery for full refund except transportation charges (both ways).

ESSE Radio Co
130 W. New York St.
Indianapolis 4, Ind.

Unless Otherwise Stated, All of This Equipment Is Sold As Used
CASH REQUIRED WITH ALL ORDERS
Orders Shipped F.O.B. Collect

C. FRANCIS JENKINS

(Continued from page 121)

been a slight error, which was corrected by Jenkins by using 2 rings, (one with a plus error and one with a minus error) and cementing the 2 rings together.

The prismatic rings were not intended for radio movies at first, but for a high-speed continuous camera (as opposed to the ordinary intermittently moved film), and were so described by Jenkins at the Montreal meeting of the SMPE in May, 1920.

The prismatic ring device was really a deflection apparatus, or, in other words, a scanner. It took the place of the scanning disc but was continuous in operation rather than intermittent. Jenkins was very proud of this device, because it emphasized elegance in the solution of scanning. Simply speaking, he used an "interposed variable prism" instead of a helical scanning disc. It was a very complete and technically elegant device even though complicated and expensive.

Jenkins the man

The indomitable will and faith which C. Francis Jenkins always exhibited are clearly evidenced by his oft-expressed statement, "If a thing is very difficult, it is as good as accomplished; if it is impossible it will take a little time." The same idea is shown in his treatment of two brilliant scientists whom he obtained from one of the great laboratories of the country. "They did not last long with us," said Jenkins later, "because they spent too much time proving why it wouldn't work instead of figuring how to do it."

He wanted his assistants to carry out his ideas implicitly, even when they were impractical or even impossible. He sur-

Suggested by: Grego Banshuck, New York City rounded himself in his Washington laboratory with young men and women, "because," he said, "if Jenkins tells them it can be done, they believe it." This had much to do with his final failure, for a few trained engineers in his employ might well have been able to carry his plans from an amateur to a practical status.

However, he gave full credit to these idolizing assistants. After he had succeeded in broadcasting radio movies in 1929, he stated in his dedication of his book *Radio Movies and Television*, published in that same year:

"This thing is done, the long pull is ended. We are broadcasting radio-movie entertainment to thousands, and the credit, in no small measure, is due to the clever and charming young folks who have worked with me—Sybil L. Almand, Florence M. Anthony, Vera T. Hunter, John N. Ogle, Stuart Jenks, Paul Thomsen and Elwood Russey."

He was a man of great vision, with the courage of his convictions, of indomitable will and boundless energy. He loved his fellow men, and was in turn respected by all who knew him and loved by those who had the opportunity of being associated with him. But he had great defects: he was an amateur first and last, and to him inventions were playthings; he would not have others with him who might translate his devices into more practical form, but insisted that they be made by his "adoring assistants" exactly as he directed. Burning with ambition, he admitted no thought of fault or failure, and when he had reached the high point of the old scanning technique, he could not go beyond. Others did.

During his life span, he built the prototype of the moving picture projector now in every movie theater; he invented the spiral-wound all-pasteboard container still so universally used; and as his contributions to radio and television, the foregoing pages will suffice. He was a member of the Franklin Institute, the American Association for the Advancement of Science, the National Aeronautic Association, and was founder and first president of the Society of Motion Picture Engineers.

Pasted in his Washington laboratory was the motto:

"They said it couldn't be done, but he, poor fool, didn't know it and went ahead and did it!"

which is another form of the common expression:

"People saying it can't be done are constantly being interrupted by people doing it."

And, as Zworykin might have said:

". . . by people doing it better!"

The foregoing abstract has been obtained from Mr. Jenkins' three published books—[*Vision by Radio* (1925), *Radio Movies and Television* (1929), *The Boyhood of an Inventor* (1931)]; from *Proceedings of the Society of Motion Picture Engineers*; and from numerous other publications; but chiefly from data copied by the author from Mr. Jenkins' scrapbooks, by permission of the late Mrs. Jenkins, and through the kind intermediation of Miss Florence Anthony, former assistant to Mr. Jenkins and later companion to his wife. Many of the photographs accompanying this article were likewise obtained through the courtesy of Mrs. Jenkins.

TELEVISION AND FM ANTENNAS

(Continued from page 46)

A multiple FM folded-dipole antenna, as designed by Rauland, is shown in Fig. 12. It has 7 folded loops or dipoles arranged horizontally, and it tunes to all frequencies from 88 to 108 mc. The center of each loop is spot-welded to the ground plate. The antenna requires no special orientation. The broad directivity pattern is shown in Fig. 13. The average standing wave ratio is 2, and the surge impedance 300 ohms.

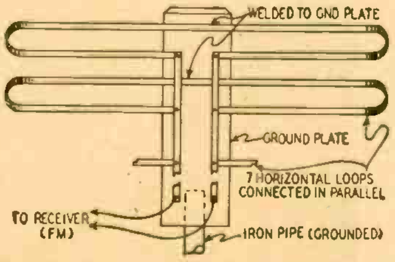


Fig. 12—Part of a multiple doublet antenna.

The double dipole and reflector array shown in Fig. 6 is peaked for 62 mc (center of the lower television band). As the curve of Fig. 14 shows, the surge impedance varies from 100 ohms at the lower end of the band, to 350 ohms at the upper end, the average impedance being about 200 ohms. The standing wave ratio is also shown; if this falls

(Continued on page 138)

PROGRESS IN TELEVISION
(*Continued from page* 22)

mit the eye to see enlarged images of microspecimens formed with these invisible radiations. The flying-spot microscope, shown schematically in Fig. 11, serves instead to present the greatly enlarged microscope images to extended audiences, with a brightness which is independent of the illumination of the specimen. For this purpose a television scanning pattern formed on the very-short-persistence fluorescent screen of a cathode-ray tube (a "flying-spot tube") is imaged by a high-resolution optical

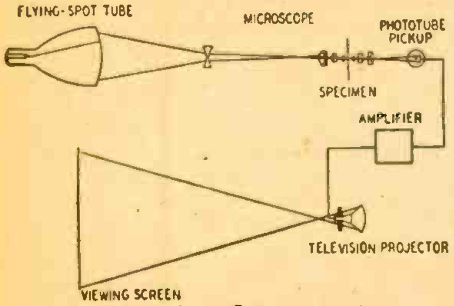


Fig. 11—Action of the flying-spot microscope.

microscope to greatly reduced scale on the microspecimen. The transmitted light is directed by a second microscope objective onto the cathode of a multiplier phototube. The amplified output signal of the latter modulates the beam current in the kinescope of a television projector which forms a greatly enlarged image of the microspecimen on a screen, its deflection being synchronized with that of the flying-spot tube.

Many of these developments are still in an experimental stage. However, they illustrate the fact that television broadcasting represents but one phase of the application of television techniques. Industrial television offers a possibly even broader range of opportunities to the researcher and experimenter and may be expected to develop into a tool of increasing value in the coming years.

WORLD-WIDE STATION LIST
(*Continued from page* 106)

20.000	WWV	WASHINGTON, D.C.: U.S. Bureau of Standards
21.470	GSH	LONDON, ENGLAND: 0500 to 1215
21.460	KCBA	DELANO, CALIFORNIA: South American beam, 1900 to 2400
21.500	WOOW	NEW YORK CITY: European beam, 1100 to 1500
21.530	GSJ	LONDON, ENGLAND: 0500 to 0815
21.550	GST	LONDON, ENGLAND: 1030 to 1130
21.570	WCRC	NEW YORK CITY: European beam, 1100 to 1630
21.590	WGEA	SCHENECTADY, NEW YORK: European beam, 1200 to 1500
21.610	WNRA	NEW YORK CITY: European beam, 1000 to 1700
21.640	GRZ	LONDON, ENGLAND: 0600 to 0900
21.650	WLW82	CINCINNATI, OHIO: North African beam, 1200 to 1500
21.650	WLWSI	CINCINNATI, OHIO: European beam, 1200 to 1500; South American beam, 1900 to 2400
21.690	WLWLI	CINCINNATI, OHIO: European beam, 1100 to 1700
21.730	WNRX	NEW YORK CITY: European beam, 1100 to 1330
21.740	KCBF	DELANO, CALIFORNIA: Japanese-Chinese beam, 1700 to 2330
21.750	GVT	LONDON, ENGLAND: 0100 to 0500; 1030 to 1130
25.000	WWV	WASHINGTON, D.C.: U.S. Bureau of Standards; continuously day and night
26.100	GSK	LONDON, ENGLAND: 0615 to 1000
30.000	WWV	WASHINGTON, D.C.: U.S. Bureau of Standards; continuously day and night
35.000	WWV	WASHINGTON, D.C.: U.S. Bureau of Standards; continuously day and night

BLOCK THAT GHOST!

(Continued from page 42)

For general television use, the folded dipole has several advantages. It has an impedance (center) of 300 ohms, which permits exact matching with standard 300-ohm ribbon lead-in. Because of this relatively high impedance the folded dipole has a wide band-pass characteristic, which permits operation over a wide range of frequencies. Although resonance is determined by the length of the folded dipole, the dimension is not critical. For this reason, the folded dipole—sometimes known as a wide-band antenna—has only fair selectivity.

This sacrifice of selectivity also affects, to a lesser degree, the directivity of the antenna. Therefore, it is more difficult to block unwanted ghost signals with any of the conventional types of folded-dipole antennas.

Although this antenna is usually capable of receiving several television channels, ghost-free reception of only one channel is certain. When a folded dipole is oriented for ghost-free reception from one station, such a fixed position of the antenna will rarely provide ghost-free reception of the other television channels, since the *locations* of the transmitting stations and all of the various sources of image reflections *will be different* with respect to the site of the receiving antenna. Any attempted use of folded-dipole antennas for reception of more than one television station must be based on a compromise orientation which, from the outset, precludes any possibility of ghost-free reception on all of the desired channels.

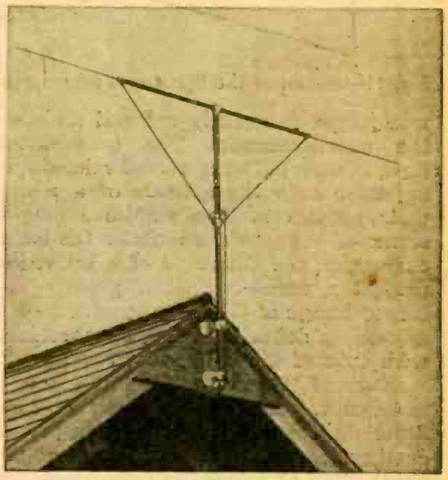


Photo by Premax Products

Fig. 10—Extended-V, an all-channel antenna.

An important variation of the basic folded dipole—known as the Duoband antenna (Fig. 8)—has a *bat wing* addition to a normal dipole, permitting wide-band operation of the antenna in both the high- and low-frequency television bands. Admittedly, there is only slight improvement in the directivity of antenna on any of the channels in the low-frequency band. When used on any of the high-frequency channels, however, the small bat wings provide a very sharp directional pattern, permitting ghost-free reception on at least 1, and sometimes 2, of the so-called upper channels. If greater directivity is needed on any of the lower channels, a more-or-less conventional reflector element is attached a quarter wave behind the large folded dipole.

A combination of 4 folded dipoles, connected in phase (Fig. 9), provides exceptionally high directivity over a wide range of operating frequencies. As for all types of folded dipoles, however, its chief drawback is that when the antenna array is oriented for ghost-free

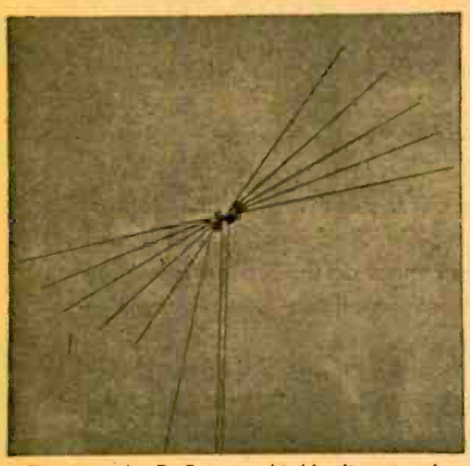
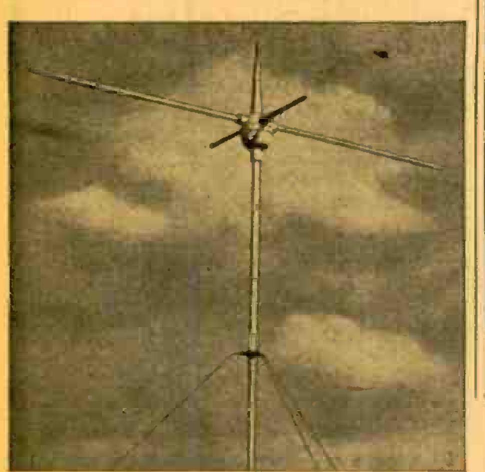


Fig. 11—The Di-Fan, not highly directional.

reception on one channel, multiple-image interference may often hopelessly mar reception on *other* television channels.

Special types

A number of other antennas have been designed for all-channel reception, but only a few of these special types are sufficiently directional to provide ghost-free reception of a single channel.



Kings' Electronics

Fig. 12—This antenna turns to best position.

The extended V-type dipole (Fig. 10) combines some of the better features of the simple dipole with an ability to operate equally well on any television channel. Entirely ghost-free reception is usually possible on one channel, depending on the orientation of the antenna. This is the only television antenna which compensates for the wave distortion normal to all television signals, and therefore gives a much clearer picture. With an impedance rating of 300 ohms, a standard transmission line can be connected directly to the antenna.

Another wide-band type of antenna is the Andrew Di-Fan (Fig. 11) which operates with equal efficiency on any television channel. It has characteristics similar to the previous type, but is somewhat less directional. Ghost-free reception is usually possible on one channel, depending on the antenna orientation.

Last, but by no means the least in importance, is a rotatable television antenna (Fig. 12) which can be oriented by remote control (from the receiver) to provide ghost-free reception on any desired television channel. In operation, the antenna is rotated with the receiver switched to the desired channel. By observing the received image (or images) on the picture tube, the antenna can be properly oriented for optimum or ghost-free reception. A fixed antenna can then be installed in many locations.

Demand for quality radios is creating shortages in dealers' stocks. Large numbers of small table models are still loading down the shelves, but winter production of better-class console models is not expected to meet the demand.

SERVICING TELEVISERS

(Continued from page 52)

checked readily with an ordinary oscilloscope. Consequently, it is to the serviceman's advantage to become familiar with these wave forms and to check their form each time trouble has been traced to either of these two systems. Typical wave forms found in the deflection circuits of the RCA receiver are shown in Fig. 10. Section A of the figure is at terminal A of T108 sync. discriminator transformer (95 volts peak-to-peak), B is the plate of the horizontal oscillator, 225 volts peak-to-peak (pin 3 of V125). C is the plate of the horizontal

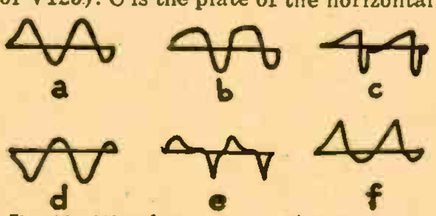


Fig. 10—Waveforms are an aid to servicing.

discharge tube, pin 5 of V120-B (78 volts peak-to-peak). D is the cathode of the horizontal oscillator control, pin 5 of V124 (1.5 volts peak-to-peak). E is the input of the horizontal discharge tube junction of C176, C177, and R202 (100 volts peak-to-peak); and F the cathode of the horizontal output, pin 3 of V126 (11.5 volts peak-to-peak). For other sets, wave forms may be slightly altered. Manufacturers, realizing their importance, have shown a tendency to include wave form diagrams in their servicing bulletins. Often the voltage shapes in all sections of the receiver are shown, although experience has indicated that only the deflection systems lend themselves readily to this form of analysis.

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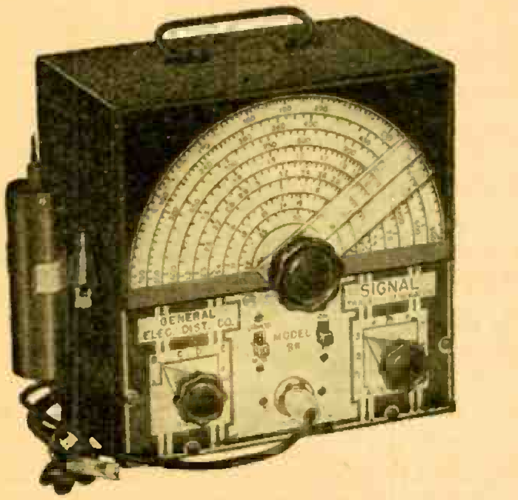

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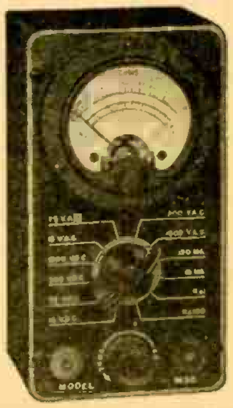

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RECENT TELEVISION BOOKS

The Future of Television, revised edition by Orrin E. Dunlap, Jr.
Harper & Brothers. 1947

Here Is Television, by Thomas Hutchinson
Hastings House. 1946

Radio Broadcasting and Television, an annotated bibliography, by Oscar Rose
H. W. Wilson Co. 1947

Servicing of Television Receivers
Philco Corporation. 1946

Telecasting and Color, by Kingdon S. Tyler
Harcourt, Brace & Co. 1946

Television for Beginners, by James R. Cameron
Cameron Publishing Co. 1947

Television—The Eyes of Tomorrow, by William C. Eddy. Prentice Hall, Inc. 1945

Television Handbook for Projectionists
RCA Service Company. 1945

Television—Papers on Television published in the RCA Review, Volume III, 1938-1941. Volume IV, 1942-1946 RCA Review

Television Primer of Production and Direction, by L. A. Sposa. McGraw-Hill Book Co. 1947

Television Programming and Production, by Richard Hubbel. Murray-Hill Books. 1945

Television—the Revolution, by Robert E. Lee
Essential Books. 1944

Television Show Business, by Judy Dupuy
General Electric Co. 1946

Television Simplified, by Milton S. Kiver
D. Van Nostrand Co., Inc. 1946

Television Standards and Practice, by Donald G. Fink. McGraw-Hill Book Co. 1943

Television Techniques, by Hoyland Bettinger
Harper & Brothers. 1947

Television—Today and Tomorrow, by Lee de Forest. Dial Press. 1942

Time Bases, by O. S. Puckle
John Wiley & Son. 1943

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Television Frequency Channels

(Lower TV band)

No. of Channel	Freq. Covered Mc.	Center of Channel Mc.
1	44-50	46.9
2	54-60	56.9
3	60-66	63
4	66-72	68.9
5	76-82	79
6	82-88	85

Center of the lower TV band—62.2 mc

(Upper TV band)

No. of Channel	Freq. Covered Mc.
7	174-180
8	180-186
9	186-192
10	192-198
11	198-204
12	204-210
13	210-216

Center of the upper TV band = 194.1 mc.
Fm broadcast band = 88 to 108 mc. Center of band = 97.6 mc. (98 approx. value).

BUILT-IN TELE LINES

Installation of transmission line for a television antenna in new houses was advocated recently by Dan Halpin, sales manager for RCA Victor television receivers. Inclusion of wiring for television would give the builder an important new selling point and serve as reassurance to the prospective buyer against added expense later, he said.

A 300-ohm transmission line would run from the room where the television receiver is to be used to the attic or upper portion of the building. This transmission line can be terminated in a standard electrical outlet box at the receiving point, and run through the partitions like bell wire, requiring no conduits nor sheath. A length of approximately 20 feet of the line should be left coiled in the attic for future connection to the antenna.

The line should be covered with standard loom or other insulating tubing where it enters the standard electrical single outlet box at the receiving location. It may be tacked to the studding or other framework of the house with standard fibre head telephone tacks.

The wire cannot be run nearer than three inches to metal laths, pipe, or other conducting material.

The terminating outlet for the line should be adjacent to a power outlet capable of furnishing 120 volts, alternating current, 60-cycle, 400-500 watts. About 100 feet of transmission line will be required for the average residence.

TELEVISION TROUBLE CHART
(Continued from page 55)

OBSERVED EFFECT	PROBABLE CAUSES	REMEDIES
35. Picture appears momentarily, then disappears. Sound is unchanged.	35. Loose connection in a video signal circuit.	35. Look for loose connections, particularly in leads to C-R tube socket.
36. Picture scrambles for a while without changing in average brightness, then returns to normal.	36. Loose connection or defective tube in the scanning system.	36. Look for loose connections in clipper or frequency separator if scrambling occurs.
37. Picture is trapezium-shaped (not rectangular).	37. Deflecting system is out of balance.	37. In a balanced electrostatic deflecting system, check the output tubes in each sweep channel. In an electromagnetic deflecting system, look for shorts between turns in a deflecting coil.

The above chart is reprinted from the *National Radio News* (National Radio Institute, Washington, D. C.)

DOUBLE MODULATION

(Continued from page 39)

and to greater swings at a lower frequency by the frame time base.

Thus, the current supplied to the transmitter's r.f. power amplifier is modulated simultaneously in amplitude by the video frequency and in frequency by the line and framing signals.

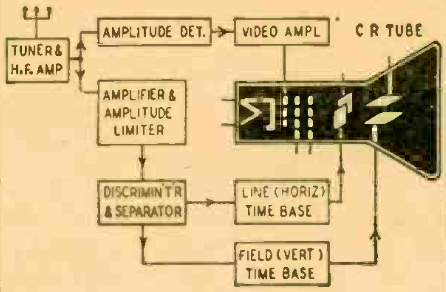


Fig. 4—Receiver hookup for proposed system.

The r.f. tuner and amplifier section of the receiver (Fig. 4) is conventional. It must be able to receive the whole band of modulated frequencies with negligible attenuation. Its output is divided into 2 channels: Channel one is applied to a normal detector of amplitude modulation (a diode for instance). The detected voltages reproduce the video-frequency signals of the transmitter. After ordinary amplification, they are applied to the deflecting yokes of the tube.

The second channel includes an amplifier and limiter which brings all amplitudes to a single level. Amplitude modulation is thus eliminated, and only frequency modulation remains. This is detected by a standard discriminator, which produces *voltages* having the same form as the *frequencies* of Fig. 3.

The components of these voltages are separated into 2 parts by a suitable filter: the higher frequency one (line synchronizing signals), and the lower frequency one, (frame or image pulses). These components are applied to the corresponding time bases to assure perfect synchronization of the receiver.

Suppression of the time base

But is it necessary to maintain the 2 time bases in the receiver? We believe they are no longer indispensable in such a system as this.

As we have noted above, the frequency-modulation channel transmits, not quasi-instantaneous pulses, but voltages which have the actual form of those produced by the time bases of the transmitter. It is therefore possible, after separating and amplifying them, to apply them directly to the deflecting elements of the receiver's cathode-ray tube. (The drawing shows a tube with electrostatic deflection, but, of course, there is nothing against the use of electromagnetic deflection in such a system.)

Technicians know how often time bases are a cause of trouble. They will appreciate the advantages to be obtained by replacing them with simple amplifiers. If any irregularities should occur in the sweep circuits of the transmitter, they would be faithfully reproduced (in this system) so that no distortion whatever would result.

Finally, it is easy to imagine the application of the principle of velocity modulation to the system described. We know that it is possible to improve the contrast of the image by increasing the speed of the spot in the darker parts of the image and slowing it down in the brighter portions. Nothing prevents the use of these speed variations by applying a fraction of the photoelectric voltages of the transmitter to its line time base and to the reactance tube. The same speed variations in the horizontal sweep then would be reproduced faithfully in the receiver.

The principle of double modulation seems to have numerous applications in the field of television.

RADIO ELECTRONIC PATENTS

(Continued from page 96)

A crystal of the piezo-electric type is connected between grid and ground of the pentode or beam-power tube, and the cathode circuit is tuned to approximately the same frequency. Therefore oscillations are generated at the crystal frequency. The screen circuit is tuned to the 3rd harmonic, and this harmonic is transferred to the secondary of the transformer which is also tuned to the same harmonic.

This tuned transformer eliminates most of the fundamental voltage and applies a relatively pure wave to the suppressor to modulate the electron stream. The plate circuit is tuned to the 3rd harmonic of this frequency (which is the 9th harmonic of the crystal frequency). This high harmonic is found to be relatively strong in the output, because of the tube characteristic.

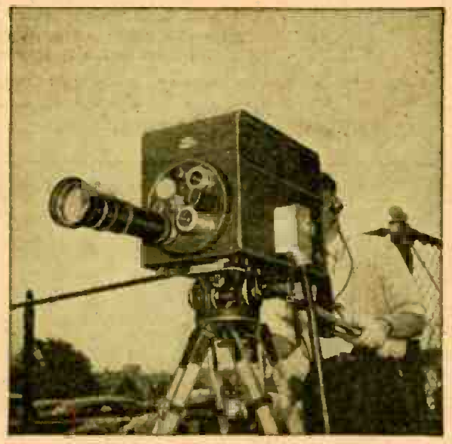
NATION-WIDE TELEVISION

(Continued from page 27)

once the performance is underway, there can be no interruption in the action. There can be no retakes. There can be no prompting. That means many more hours of rehearsing than actual time on the air. It all adds up to real money.

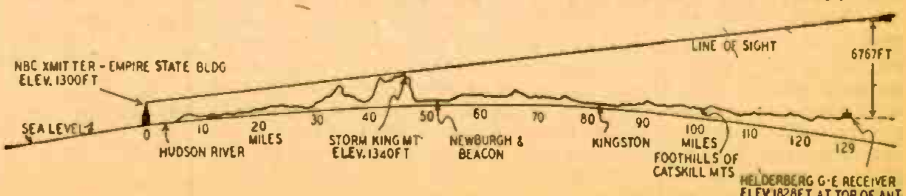
There has been a tendency during 1947 for some leading telecasters to subordinate their studio activities to outside pickups such as sports, news events, and "magazine" features. At least such programs "just happen" and can be televised as they are found. To be sure, sporting events often call for handsome payments for the television rights, but the popularity of televised sporting events is such that there is no dearth of sponsors to foot the bill.

From the metropolitan centers, then, must come most of the studio productions and the major sporting events as well as the big news events. This means a television network. Such a network can be either of the as-it-happens kind or of the recorded-on-film kind, just as in sound broadcasting there is the actual network and in addition the electrical transcription.



Orthicon camera for small telecasters—can be used both for outside pickup and studio work.

Already the beginnings of the television network of tomorrow have been made. The A. T. & T. co-axial cable between New York and Washington, with Philadelphia and Baltimore along the way, already is being used for network purposes, mainly by NBC and Du Mont. Such co-axial cables are being extended in the Middle Atlantic, South, and Mid-West States. Nevertheless, many gaps still remain to be closed before coast-to-coast telecasting can be even approximated. Meanwhile, several organizations seeking less costly means of piping syndicated television programs have turned to ultra-high-frequency radio relaying, notably G-E and Philco, while the Bell System is supplementing its co-axial lines with radio relays. The NBC-G-E tieup between New York and the Schenectady-Albany area is made in 4 radio-relay jumps—from the Empire State Building to Mount Beacon to Round Top (in the Catskills) to Helderberg Mountain (near Schenectady) and



Earth contour and line of sight along General Electric's New York-Schenectady relay route.

then into the main G-E transmitter, the radio relaying transmitters being strictly automatic or nonattended. It may be that these relay transmitters may serve local telecasting stations along the route in the future, branching out the network. Philco in Philadelphia has been retransmitting WNBT (New York) programs by means of relay transmitters.

In the matter of television networks, however, there is a time factor quite as well as distance. The important news event doesn't wait upon the convenience of the television audience. Most news events occur during the day, yet television audiences gather in the evening. Consequently, such news events must be recorded on special film, and telecast at such times as meet with the convenience and pleasure of the television audience. Much of the syndicated program material is bound to be handled by special television films from here on. Please note that word "special." Already television is developing its own film-recording technique. Leading telecasters have their own film camera crews. Most of the films are of the 16-mm size, for it has been found that this small film does just about as well as the more cumbersome and costly 35-mm theater film.

Means are available for filming programs directly off the monitor screens. Such recordings have heretofore been used mainly "for the files," or for studying program techniques and performances in considerable detail. They are now good enough to be used for syndicating purposes. Thus telecasts originating in metropolitan studios or remote pickups may be available to affiliates of a group or network within a matter of hours or days.

So much for the big-city stuff which the smaller telecaster will want to handle. There never will be a scarcity of local programs. Certainly the football game between the local high school team and that in the adjoining town always carries greater weight than a big-league game. The telecaster will want to cover such local happenings either by direct telecasting or by 16-mm film recordings for transmission during evening hours. Prominent citizens will appear before camera and mike in the studio. Amateur players will jump at the chance of being televised. The local television station will be to the community what its local newspaper has ever been—the local pride and joy.

So again the writer points out that eventually it will be immaterial whether you live in New York or Pumpkin Center so far as satisfactory television entertainment is concerned. In due course television must become nation-wide. That dream is well along toward realization.

TELEVISION AND FM ANTENNAS

(Continued from page 126)

somewhere between 2 and 3, it is considered a fair value.

The Tricraft Products Co.'s antenna, developed in conjunction with the Belmont Radio Corp., uses 2 dipoles (see Fig. 15) to cover the 2 TV bands and also FM. It is matched by a 300-ohm line. A relatively thin dipole, (which is a half-wave long at 70 mc) is placed near a relatively thicker dipole cut to a half wave at 128 mc. The short, thick dipole is connected at its ends through inductive rings to the approximate midpoints of the thin, long dipole section.

In the lower television band the antenna acts like a broad-band folded dipole tuned to approximately 65 mc, with the thin member resonant at about this frequency, and the short heavy antenna end loaded by the inductive rings at its ends. In the higher TV band, the long thin dipole is 1½ wavelengths in the center of the band, and the short member is end-fed by means of the inductive rings connecting it to the long member, so that the currents flow approximately in phase in the 2 dipoles.

All elements of the antenna are securely grounded to the support member, which permits grounding it to ensure lightning protection.

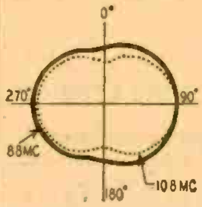


Fig. 13.

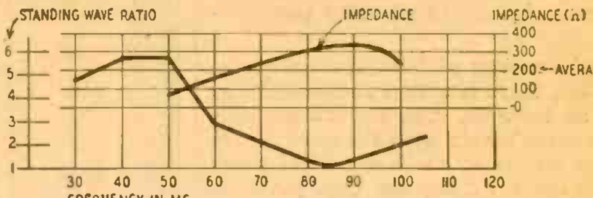


Fig. 14—Antenna impedance vs frequency. Mismatch may cause ghosts.

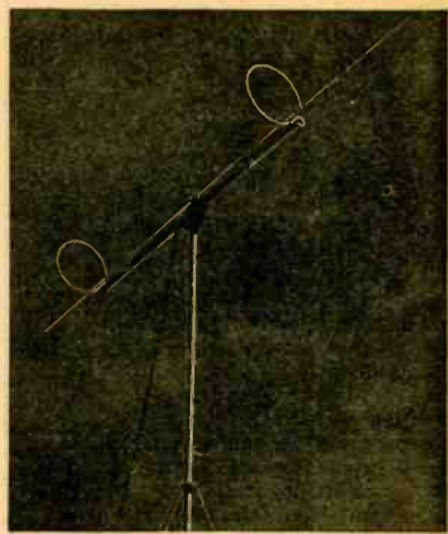


Fig. 15—Interesting-looking two-band antenna.

BRITISH TELEVISERS

(Continued from page 44)

first a.f. plus pentode output type. Almost its only departure from the normal is the use of 725 kc as the intermediate frequency.

On the television side, the 4 r.f. stages are the tuned-plate, tuned-grid variety (except that the grid of the second r.f. amplifier is untuned) illustrated in Fig. 7, so arranged that the circuits form capacitance-coupled bypass filters. The preset tuning is done by movable brass cores. The video amplifier and its associated circuits, seen in Fig. 8, have some original features. At the plate of the video amplifier the vision signal is positive, *i.e.*, the picture-painting voltage variations are positive swings and those forming the synchronization pulses negative. The plate output of this tube (V1 in Fig. 8) is applied direct to the grid of the cathode-ray tube. A second output, this time of negative form, is developed across the cathode resistor and applied to the plate of limiter diode V2. In the output of this tube the sync pulses are positive. The sorting out of short line-sync and long frame-sync pulses is done by feeding them to the grid of the thyratron of the line time base through a differentiating circuit and to that of the frame time base through an integrating circuit. Another diode limiter is connected between the grid and cathode of the cathode-ray tube. It is adjusted by a preset control to prevent the input from exceeding the peak white level. Auto ignition interference is thus kept below the level at which it could cause white splashes.

An interesting set in the higher-priced class is the Sobell T.107 which costs $684. In this case the purchase

(Continued on page 141)

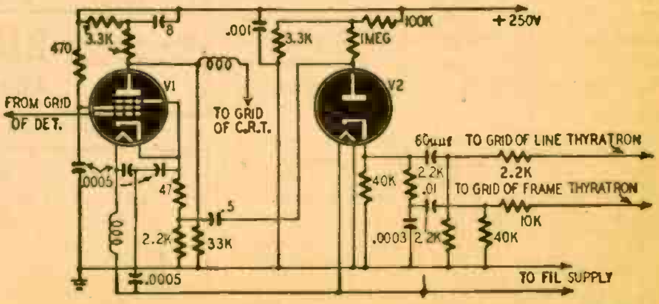


Fig. 8—Video signals come from plate, sync signals from cathode.

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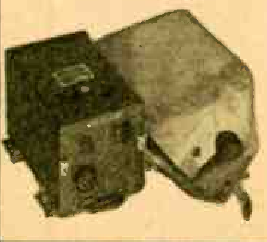

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RADIO SET AND SERVICE REVIEW

(*Continued from page 48*)

have wide-band vertical amplifiers, an input calibrating source, and a low-capacitance probe.

When complete alignment is required, it can be performed most conveniently in the following order: 1. video i.f. traps; 2. video i.f. transformers; 3. sound discriminator; 4. sound i.f. transformers; 5, 6. r.f. and converter lines; 7. oscillator line; 8. converter grid trap; 9. retouch video i.f. transformers; 10. sensitivity check. Complete step-by-step alignment procedure is given in the manufacturer's booklet. It is complex, requiring 52 separate steps, and the manufacturer's instructions should be studied carefully before starting the work and referred to constantly during the process of alignment.

REVERSIBLE TELEVISION

(*Continued from page 92*)

endorsement, signature, etc.

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Department stores—between customer and stockroom, to pick out items not in stock at counter, etc. A customer in a special booth—provided for this purpose—can "shop" via television, ordering a long list of merchandise from stockrooms in a minimum of time.

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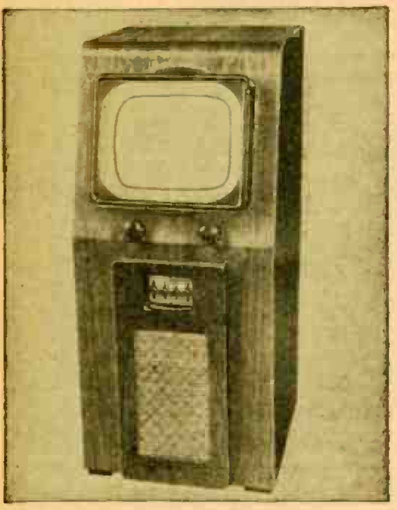
BRITISH TELEVISERS
(Continued from page 138)

price includes complete maintenance and servicing for two years by the makers. The set is an all-wave radio and televiser contained in a console cabinet. When it is in use as a radio receiver, the cathode-ray tube is concealed by a sliding ground-glass panel, on which appears the illuminated tuning scale of whatever wave band is selected by the wave-change switch. The tuning indicator is a spot of light traveling over the scale. On raising this panel and pushing it back into the cabinet, the screen of the 12-inch tube is exposed. The picture is 10 x 8 inches. Like several other British televisers, the Sobell has single-side-band operation on the television channel. This facilitates the separation of sound on 41.5 mc from


The Sobell T-107 is one of the better televisers.

television on 45 mc and makes for increased stage gain because of the narrower band width. A noteworthy feature is the use of what the makers term a "spotter" stage. The video amplifier feeds positive picture impulses direct to the grid of the cathode-ray tube. Its output is also connected to the cathode of the tube through a diode so biased that it does not conduct on normal signals. When a peak due to auto ignition interference occurs, the diode conducts and delivers a "whiff" of positive potential to the cathode, thus making the cathode-ray tube grid negative with respect to it. The electron beam is dammed back for an instant, with the result that a small black spot is produced on the screen. This is less noticeable and certainly far less offensive to the eye than a large defocused white splotch.

The only set to use projection methods for obtaining a large image is the HMV 1852. In this a 4-inch cathode-ray tube with 25,000 volts on the second anode is employed in conjunction with a modified form of the Schmidt system.

The electrostatic cathode-ray tube, seen in many of the televisers of former years, is never used today. The Cossor and Ferranti sets strike out on a line of their own by using permanent magnets with adjustable shunts for focusing the electromagnetic tube.

RADIO SCHOOL DIRECTORY

(Continued)

BOOK REVIEWS

THE FUTURE OF TELEVISION, by Orrin E. Dunlap, Jr. Published by Harpper & Brothers. Stiff cloth covers, 6 x 8½ inches, 194 pages. Price $3.00.

The author, one of the country's pioneer authorities on radio and television, uses present-day facts to deduce the probabilities of television's future. Prediction as such is rejected in favor of showing the nontechnical reader just what the situation is at present and what trends have led to it, then letting him produce the lines into the future on his own personal chart.

The development of television as an industry is first traced, showing the effect of business competition, increasing technical knowledge, and government regulation on its growth. Home television brings the author nearer to pure prediction than any of the other chapters. The ultimate type of multiple-dwelling antenna is discussed, as well as television's effect on the televiewer's ordinary radio-listening habits.

Television's probable effect on the movies and theater, the outlook for sound broadcasting, news and sports events, and television as an educational medium are discussed.

The final chapters, a history of television, are especially interesting, particularly the appendix, which is in chronological form.

TELEVISION, Volumes III and IV, edited by Alfred N. Goldsmith, Arthur F. Van Dyck, Robert S. Burnap, Edward T. Dickey and George M. K. Baker. Published by RCA Review. Paper or cloth covers, 6 x 9¼ inches. Volume III, 486 pages, Volume IV, 510 pages. Price, per volume, paper, $1.50, cloth, $2.50.

These books are the first post-war publications in the Technical Book Series published by RCA Review. Each is a compilation of television papers and other material that have appeared in publications of the I.R.E., the Society of Motion Picture Engineers, McGraw-Hill publications, the Optical Society of America, the American Academy of Political and Social Science, the RCA Review and other papers on the subject that have not been published in other publications.

Volume III covers the progress and development of television from 1938 to 1941. Its material is presented in four sections: Pickup, Transmission, Reception and General. In some instances, the original material was summarized or condensed; not, however, in such a way as to detract from the value of the articles.

Volume IV is prepared along the lines of Volume III and contains slightly more material. This book describes television progress from 1942 to 1946. Color television and military television have been added to the material covered.

A television bibliography, listing nearly 300 technical papers on television and related subjects that have appeared in one or more of 30 publications, will be of particular interest to those doing television research.—*R. F. S.*

Advertising Index

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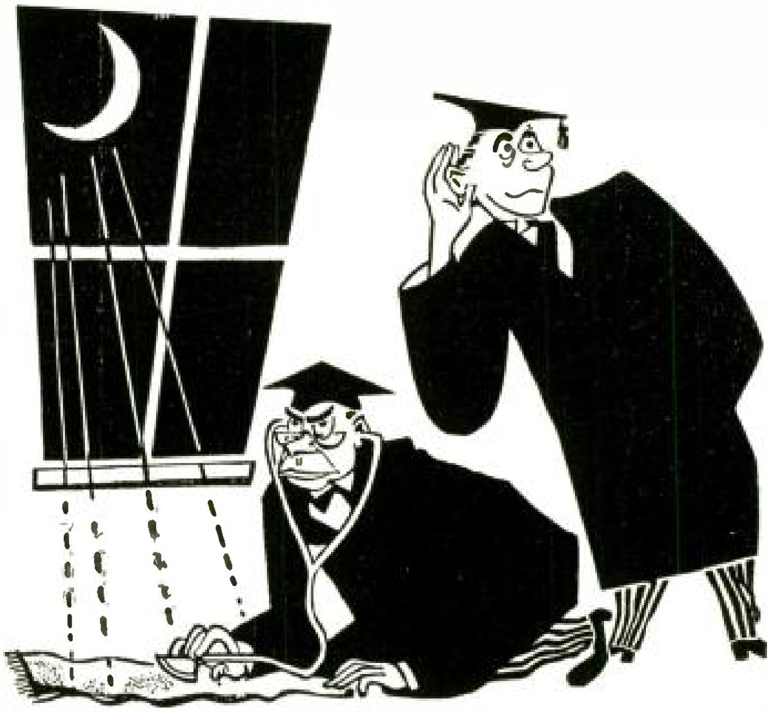
Quiet as a Moonbeam Falling on Velvet



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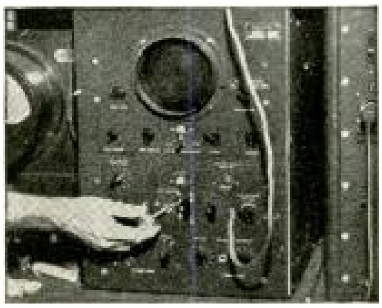

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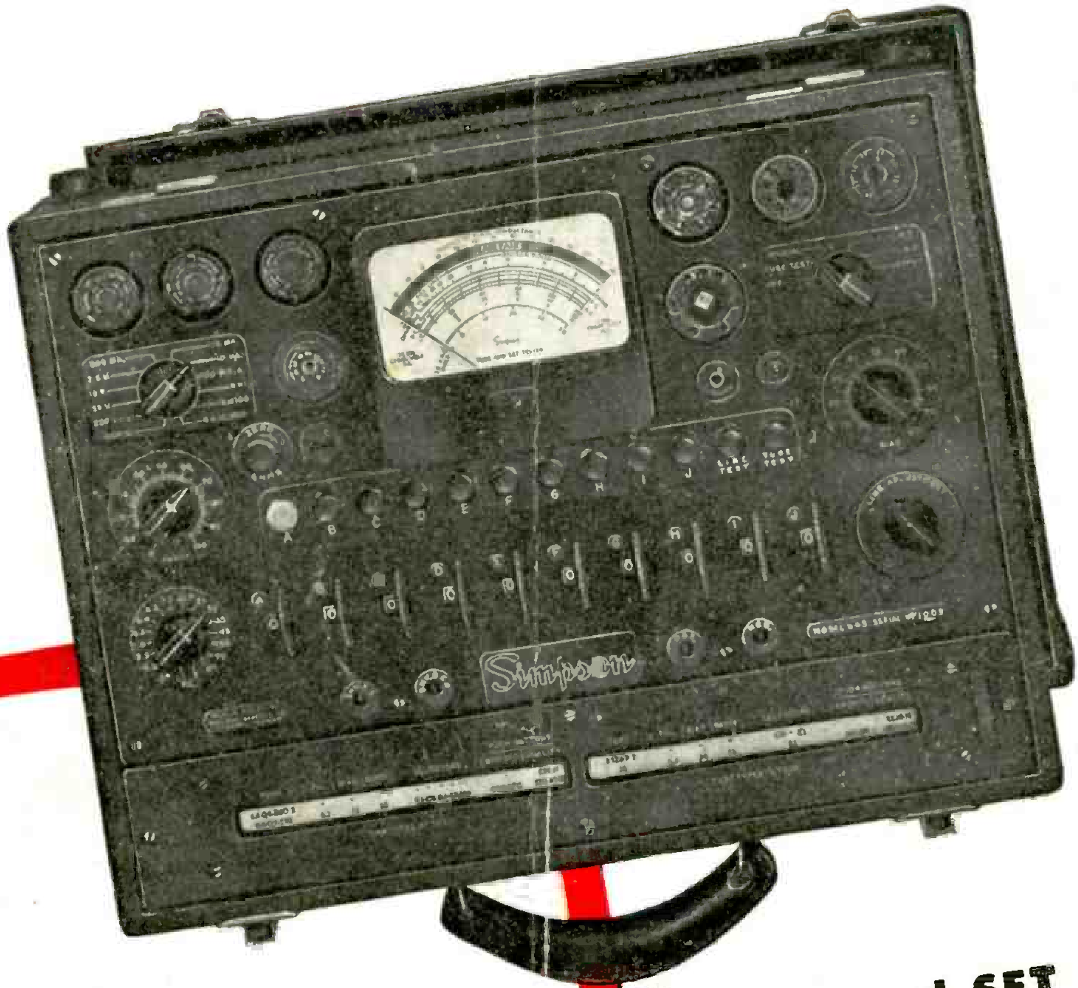

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Model 445 is housed in a durable, easy-to-carry case. Its panel is of heavy molded bakelite with all letters and figures recessed and filled in white for easy reading.

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TUBE and SET TESTER ...

with the famous Simpson "No Backlash" Roll Chart

RANGES

Volts (20,000 ohms per volt D.C., 1000 ohms per volt A.C.): 0-2.5, 10, 50, 250, 1000, 5000.

Milliamperes (D.C.): 0-10, 100, 500.

Microamperes (D.C.): 0-100.

Decibels (5 ranges): —10 to +52 DB.

Output (A.C. volts): 2.5, 10, 50, 250, 1000, 5000.

Ohms: 0-2000 (12 ohms center)
0-200,000 (1200 ohms center)
0-20 megohms (120,000 ohms center)

SIZE: 16" x 12½" x 6¾". WEIGHT: 9 LBS.

SHIPPING WEIGHT: 12 LBS.

Dealer's Net Price **$110.00**

SIMPSON ELECTRIC COMPANY

5200-5218 West Kinzie Street, Chicago 44, Illinois

In Canada, Bach-Simpson Ltd., London, Ont.

Simpson

INSTRUMENTS THAT STAY ACCURATE