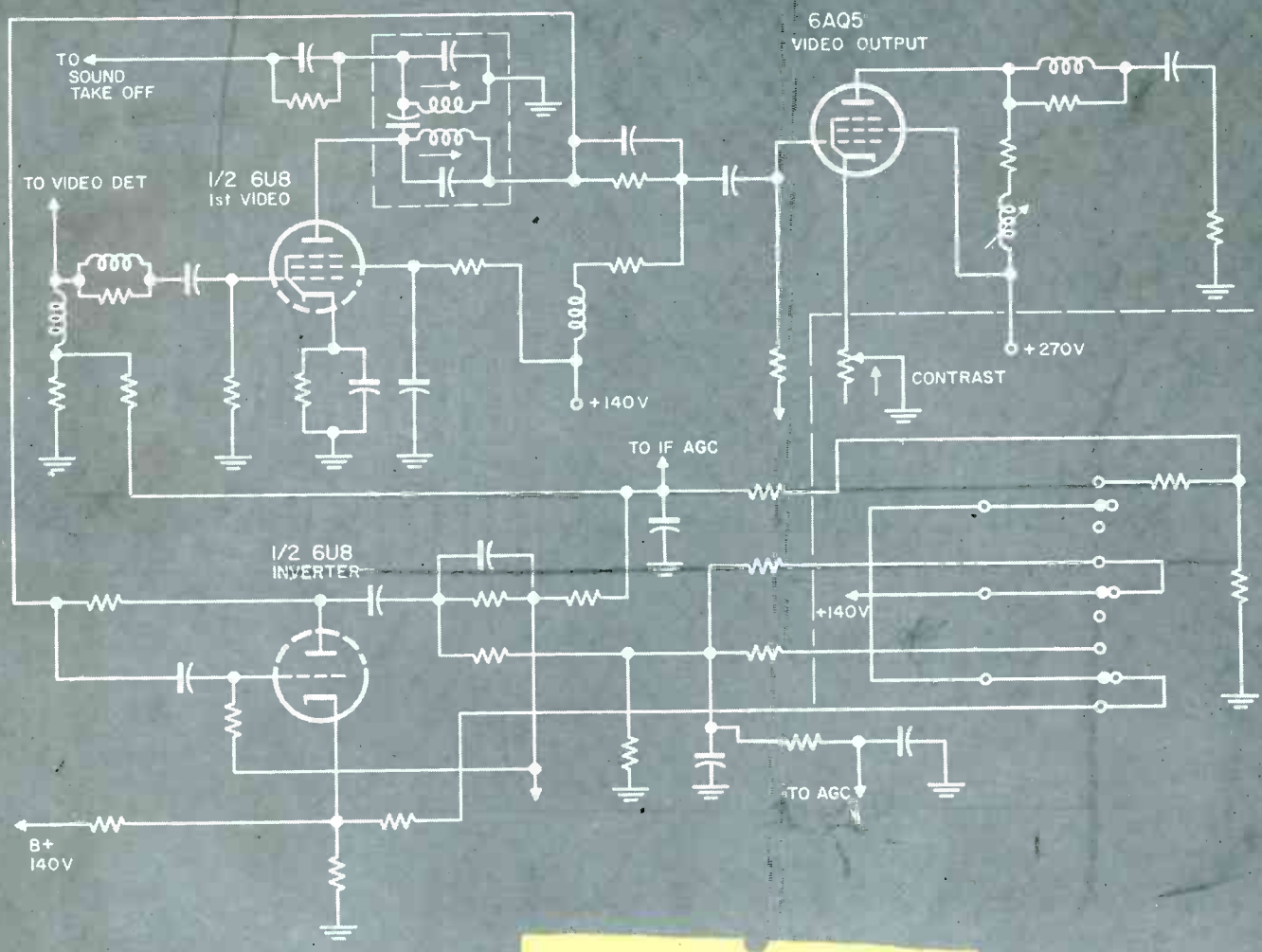
SEPTEMBER, 1956

SERVICE

THE TECHNICAL JOURNAL OF THE TELEVISION-RADIO TRADE



Two-stage video amplifier with a 6AQ5 power pentode in the final stage.

See circuit analysis, this issue

This combination of **CDR ROTORS**

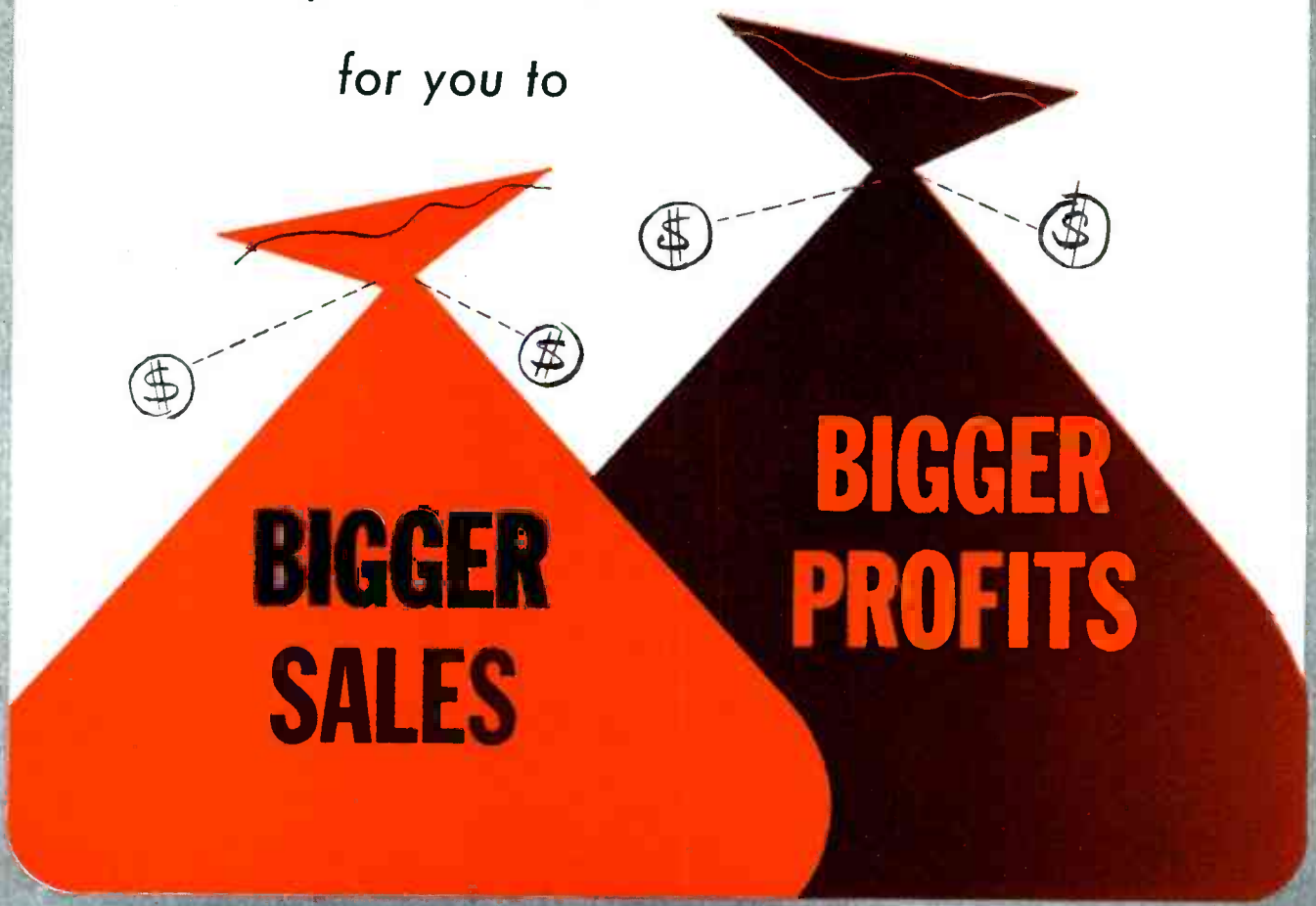
and the ***Biggest TV Spot Campaign***

in our history

PRE-SELLING *your customers*

opens the door

for you to



CORNELL-DUBILIER
SOUTH PLAINFIELD, N. J.

THE RADIART CORP.
CLEVELAND 13, OHIO

YOUR COMBINATION CDR TO BIGGER SALES

There's more in store for you . . . when you feature

CDR ROTORS

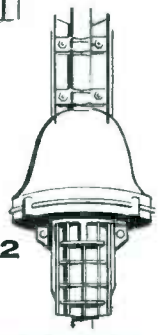
Proven the popular favorite

the complete line . . .

a model for every need!

AR-1

AR-2



AR-22

featuring

CDR AUTOMATIC Rotors

An outstanding group of rotors . . . three proven and tested models . . . ALL 40% SHARPER TUNING thanANY other automatic rotor. Handsome cabinet . . . dependable performance . . . proven and tested by thousands and thousands of satisfied users.

TR-12 a special combination value consisting of complete rotor, including thrust bearing. Handsome new modern cabinet with meter control dial, uses 4 wire cable.

TR-11 same as TR-12 without thrust bearing.

TR-4 the heavy duty rotor complete with handsome modern cabinet with METER control dial, uses 4 wire cable.

TR-2 the heavy duty rotor with plastic cabinet featuring "compass control" illuminated perfect pattern dial, uses 8 wire cable.

CORNELL-DUBILIER South Plainfield, N. J.

The **RADIART** Corporation, Cleveland 13, Ohio

Vol. 25 No. 9

SERVICE

SEPTEMBER, 1956

The Technical Journal of the Television-Radio Trade

Including SERVICE—*A Monthly Digest of Radio and Allied Maintenance*: RADIO MERCHANDISING and TELEVISION MERCHANDISING. Registered U. S. Patent Office.

COVER CIRCUIT

FEATURES

CIRCUIT DIAGRAMS

DEPARTMENTS

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1957 CROSLEY

TELEVISION'S EASIEST-TO-SERVICE CHASSIS

drastically reduces repair time — *even in the shop!*

"This new CROSLEY TV can be serviced in half the time of ordinary sets!"

—says ED HELLER, Owner,
Heller Radio & Television;
President of Master TV
Servicemen's Assoc., Cincinnati, Ohio

"If my men serviced these new Crosley sets exclusively," says Mr. Heller, "they could increase calls handled in the home by 90%!" Yes, Crosley once again takes TV leadership in producing a chassis that's so easy to service, you'll be recommending it every chance you get. It gives you an opportunity to give better, faster and less expensive service—at greater profit per call! It greatly reduces repair time in the shop.

Many of the major repairs required on a TV set —even the replacement of the picture tube—can now be done in the home while the chassis is in the cabinet. Here's a true "Serviceman's Set," specially designed to make your job easier and much more profitable.

Check the advantages described below, and see for yourself why Crosley is

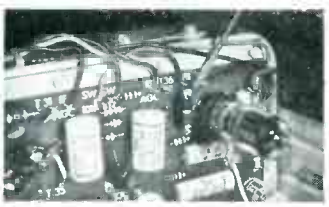
KNOWN FOR THE NEWEST . . . RESPECTED FOR THE BEST!

Special Reasons Why You'll Prefer 1957 Crosley TV

- Printed circuit board is translucent! Just place light behind it to trace circuitry.
- Even filter capacitors and selenium rectifiers can be replaced without removing chassis!
- Transformers and chokes are screwed on—not riveted. Easy to service or replace!
- Special Crosley funnel-guide helps find oscillator adjustment. Cuts down probing time!

Test points are labeled and easily available from the rear without removing chassis. Quick circuit analysis and trouble-shooting make for simplified servicing.

95% of all parts replaced without removing chassis, without touching a chassis bolt. Provision is even made for changing the power supply parts easily.



Find tube blowouts with a screwdriver. Open heater tubes are a cinch to locate with the marked special test points. All receiving tubes easily replaced.

Picture tube comes out with the chassis. The tube mounting is a part of the chassis assembly for quick handling. Replacement and set-up are quicker and easier.

Two great brand names from one single source

crosley and **bendix**
HOME APPLIANCES

DIVISIONS OF **AVCO** MANUFACTURING CORP., CINCINNATI 25, OHIO

CHANNEL MASTER

Explodes a Spectacular Campaign of

NATIONAL CONSUMER MAGAZINE ADVERTISING

THE FIRST PROGRAM OF ITS KIND IN TV ANTENNA HISTORY

2-Page Spreads . . . Full-Page Ads . . . Full-Color Ads . . .

reaching into millions of American homes on the pages of these outstanding magazines:

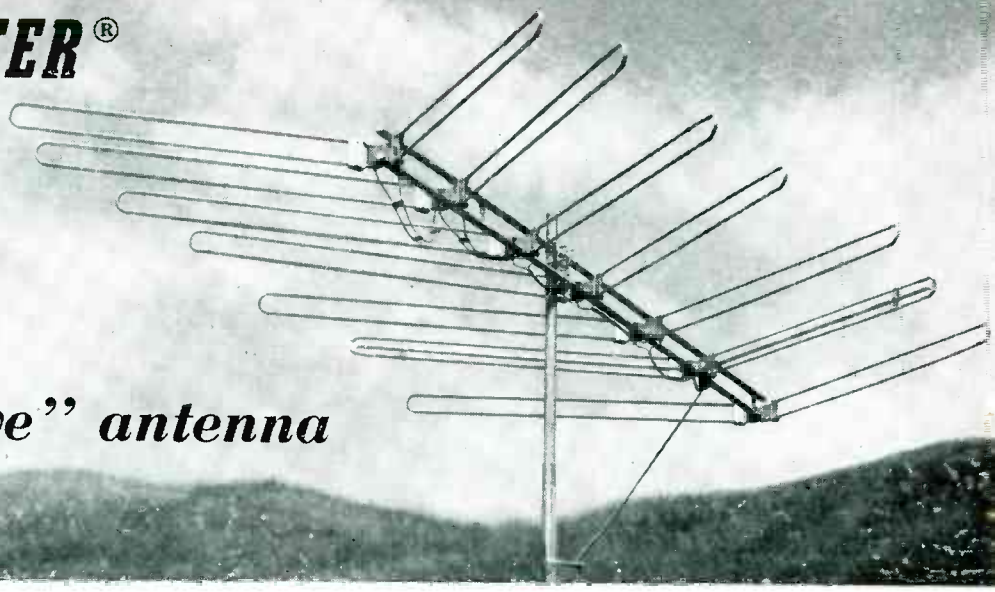
CHANNEL MASTER REVOLUTIONIZES ANTENNA MERCHANDISING! With large-scale national advertising and traffic-building local promotions, Channel Master now places TV antennas on the *same retail level as traffic appliances*. It's actually a NEW WAY for you to sell antennas — and sell *more* of them. Climb aboard the Channel Master brandwagon and tie in with these profit-making promotions. Get details from your Channel Master distributor.

NEW MARKETS . . . NEW CUSTOMERS . . . FOR THESE 2 GREAT NEW ANTENNAS

CHANNEL MASTER®

T-W

the world's first "Travelling Wave" antenna



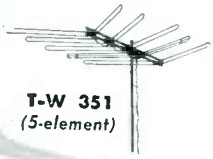
WHAT THE "TRAVELLING WAVE" PRINCIPLE MEANS—

- ideal phase relationships on *all* channels
- optimum impedance matching on *all* channels
- equal flow of current in all dipoles on *all* channels
- fullest use of transmitted energy on *all* channels

IN SHORT — FABULOUS PERFORMANCE ON ALL CHANNELS

SENSATIONAL 3- AND 5-ELEMENT MODELS!

Amazing T-W performance for suburban and near-fringe areas, too! Wonderfully compact and rugged!



T-W 351 *(5-element)*

T-W 352 *(3-element)*

revolutionary new design provides picture quality never before possible

After two years of research—a completely new kind of VHF antenna, operating on revolutionary new electronic principles. The T-W is Channel Master's greatest antenna achievement.

ALL THREE — IN ONE ALL-CHANNEL ANTENNA

1 *HIGHEST GAINS*

Most powerful all-channel antenna ever developed. A single-bay T-W 350 (7-element) actually OUTPERFORMS—

any wide-spaced 5-element Yagi on each low band channel.

any stacked 10-element Yagi on each high band channel.

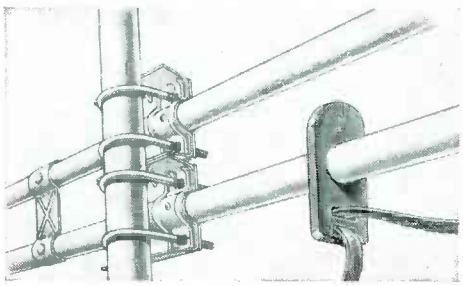
2 *TOP FRONT-TO-BACK RATIOS*

Low Band:
Better than 10:1 on every channel. HIGHER THAN ANY 10-ELEMENT SINGLE CHANNEL YAGI ON ALL CHANNELS!

High Band:
From 5:1 to 12:1. HIGHEST RATIOS OF ANY SINGLE ALL CHANNEL ANTENNA.

3 *GREATEST MECHANICAL STRENGTH*

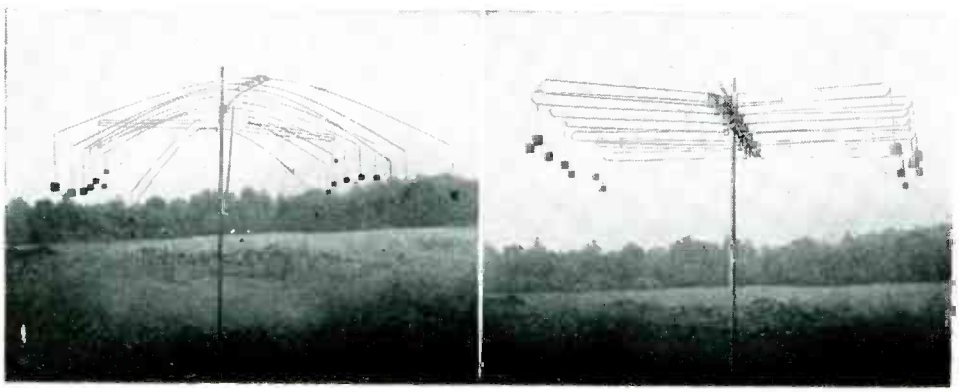
The most rugged antenna ever built. "Twin Truss" design amplifies the strength of every component. And new mechanical features add still greater durability . . .



"Twin Booms" . . . *Two full-length crossarms—really rugged and rigid.*

2 "Super-Nests" *One heavy-duty mast clamp on each crossboom . A TOTAL OF 4 U-BOLTS! Antenna cannot move.*

"Line-Lok" . . . . . *Twinlead can't possibly tear away from terminals.*



PROOF OF THE SUPERIORITY OF "TWIN-TRUSS" CONSTRUCTION

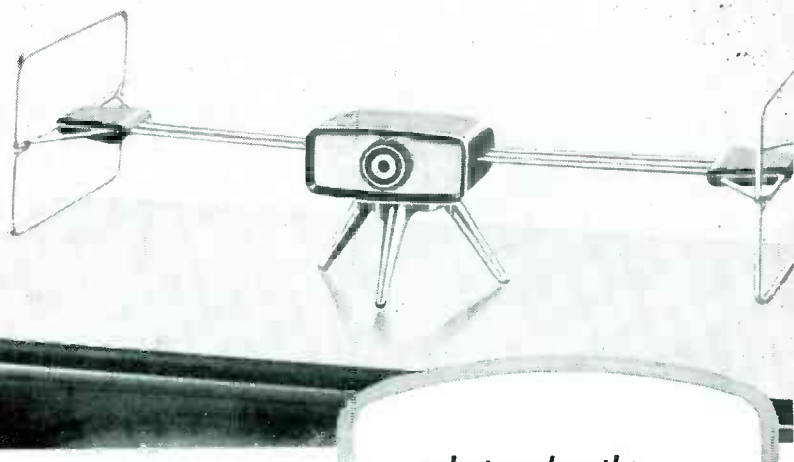
Look at the dramatic result when equal weights are hung on a T-W and a standard 10-element Yagi!

Write for complete technical literature.

®-Trade Mark Reg. U.S. Pat. Off.

CHANNEL MASTER® "Showman"

new "Metro-Dyne" tuning obsoletes "Rabbit-Ears"



the first basic indoor antenna improvement in over 10 years

Channel Master sets an exciting new trend in TV antennas with the Showman. In appearance (so important in the sale of indoor antennas) the Showman is in a dazzling class by itself. Yet, it's a complex electronic instrument—the most powerful indoor antenna yet developed by modern science!

The SHOWMAN is perfect for color reception, tops for black-and-white. And, it provides excellent FM reception, too!

ACTUALLY TUNES OUT "GHOSTS" AND "SNOW"!
MORE EFFECTIVE THAN ANY OTHER INDOOR ANTENNA!

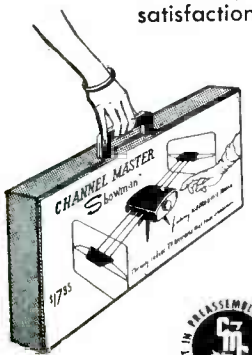
With ordinary indoor antennas

With the Showman

Metropolitan areas, where indoor antennas are most frequently used, are often subject to the most severe "ghosting" problems. Only the SHOWMAN, with its sensational new Metro-Dyne tuning, can overcome this difficulty. You'll be amazed at the job it does on all kinds of interference. Test it for yourself! Demonstrate it for your customers!

Channel Master stands squarely behind every SHOWMAN you sell. An unconditional money-back guarantee assures your customer of complete satisfaction.

UNCONDITIONAL MONEY-BACK GUARANTEE



"High fashion" packaging. Attractive, convenient. Ideal for display.

Available in three "decor designs"— to blend with any setting.

Mahogany and Gold	Blond and Gold	Ebony and Silver
model no. 3900	*model no. 3901*	*model no. 3902*

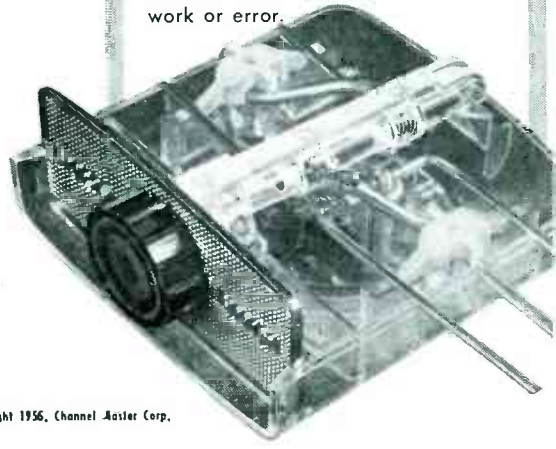
what makes the "Showman" different?

FABULOUS "METRO-DYNE" TUNING!

The Metro-Dyne 12-Channel "Variable Inductance" Tuner

Ordinary switch-type antennas work by connecting various element into different combinations. METRO-DYNE tuning, on the other hand, is "variable inductance" tuning, using the same tuning principles as any TV set. It is the first broad band antenna which can be tuned to a specific channel so that it exhibits the band width characteristics of a single-channel Yagi. This selectivity cuts down tremendously on "electronic noise" and interference. A built-in auto transformer maintains a constant 300 ohm impedance match.

EASY OPERATION: the Showman is calibrated by channels. Just turn it to the same channel number as the TV set. No arms to adjust; no guesswork or error.



CHANNEL MASTER CORP. ELLENVILLE, N. Y.

the world's largest manufacturer of television antennas and accessories

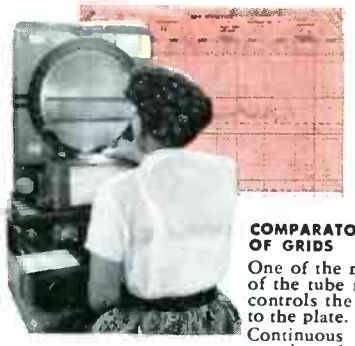
RAYTHEON TUBES

are the best you can buy...

HERE'S WHY

INSTRON WIRE TESTING

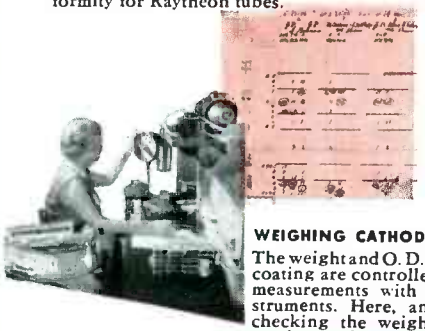
Testing of grid lateral and filament wire on the Instron Tester for specified physical properties as tensile strength, yield point, breaking point and proportional limit insures better tube quality and uniformity for Raytheon tubes.



COMPARATOR INSPECTION OF GRIDS

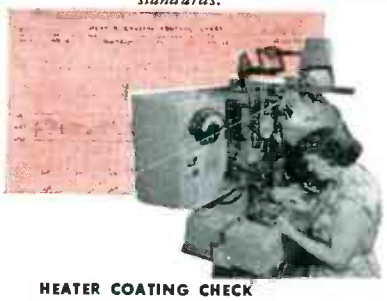
One of the most critical parts of the tube is the grid which controls the flow of electrons to the plate.

Continuous comparator inspection of critical parts such as the above grid (magnified 20x) *supplies information for better quality control and guards against deviations from Raytheon's high quality standards.*



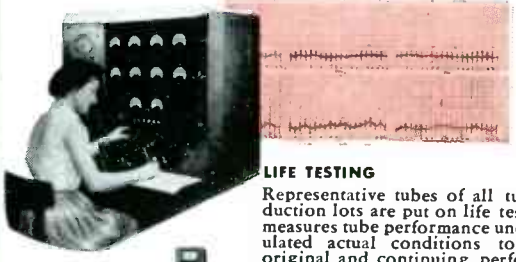
WEIGHING CATHODE COATING

The weight and O. D. of the cathode coating are controlled by periodic measurements with precision instruments. Here, an operator is checking the weight of cathode coating at the operation.



HEATER COATING CHECK

Heater wire must have uniform and closely toleranced coating thickness to insure short and uniform warm-up-time and durability. Raytheon makes continuous inspections of the heater wire coating to make certain of uniformity.



LIFE TESTING

Representative tubes of all tube production lots are put on life test which measures tube performance under simulated actual conditions to ensure original and continuing performance of Raytheon tubes.

ENGINEER CHECKS DESIGN CHARACTERISTICS

Behind all these quality activities stands a large group of experienced, capable engineers whose sole concern is maintaining and developing Raytheon tube quality performance. This engineer is measuring tube design characteristics with the purpose of developing a tube for a customer with special applications.

1ST FINISHED TUBE TEST

All Raytheon tubes undergo a rigid 100% First Test where they must pass strict requirements on both physical and electrical characteristics.

These girls are testing tubes for excessive noise and microphonics, inoperative tubes, specified electrical characteristics and physical appearance.

These and many other vital tests and checks add up to

UNIFORMITY OF CHARACTERISTICS THROUGH RIGID QUALITY CONTROL

RAYTHEON MANUFACTURING COMPANY

Receiving and Cathode Ray Tube Operations

Newton, Mass. • Chicago, Ill. • Atlanta, Ga. • Los Angeles, Calif.

Raytheon makes all these: { Receiving and Picture Tubes, Reliable Subminiature and Miniature Tubes, Semiconductor Diodes and Transistors, Nucleonic Tubes, Microwave Tubes.

SERVICE

The Technical Journal of the Television-Radio Trade

Service Is BIG Business

THE SERVICE BUSINESS is now ringing up cash registers at an estimated rate of well over $2-billion a year (for labor, parts and accessories), and offering more than 120-million call opportunities to provide service. And the potentials are climbing daily.

Based on the present TV set count of over 40-million in homes, and an average need for servicing of about 1½ calls per year, over 60-million opportunities to repair and install TV replacements, adding up to over a $1-billion income, are on tap. To these figures nearly another $1-billion can be added to cover the cost of new and replacement antenna installations, and radio, audio, 2-way and electronic equipment maintenance and repair.

IN THE TV ANTENNA business, sales are soaring up to over $250-million for over 20-million antennas that have been blown down, become corroded or suffered other damages, and at least 5-million more needed for new chassis.

THE MILLION RECORD player attachments, phonos and phono combinations installed since the beginning of the year, the additional million installations expected before the year is out, plus the 10-million older units in use, represent another husky repair market, totaling at least $25-million for new and replacement components and accessories.

RECEIVING AND PICTURE TUBE replacement needs are also hitting new highs. According to a study completed only a few weeks ago, the latest yearly national replacement sales estimate for receiving tubes is 170,000,000 and 5,300,000 for picture tubes.

During the next twelve months, a total of nearly 70-million tubes is expected to be sold in New York, Pennsylvania, Illinois, California, New Jersey and Ohio. Over 3-million unit sales are in view for Florida, Georgia, Minnesota, North Carolina and Wisconsin. Substantial replacement sales are also anticipated in the smaller states; well over 1-million unit sales are scheduled for Maine, Mississippi, Colorado, Arkansas, Oregon and West Virginia. And in Montana, Vermont, North and South Dakota, New Mexico, New Hampshire, Idaho, Delaware and Arizona, tube sales of at least a half-million per state are expected.

THE COLOR BREAKTHROUGH the Fall and Winter months will bring, will also contribute healthy sums to the installation-repair package.

In the last two months of '55, more color sets were sold than in the previous 10 months combined. There are now nearly 150,000 color chassis in the field, and another 100,000 are expected to be added before the year is out. This quantity should be *tripled* within the next twelve months, production estimates of leading color set makers indicate.

The growing interest in color has been sparked by the tremendous increase in programming. A 500 per cent boost in color programs is now on the books. In the fourth quarter of this year, nighttime color programming will total between 120 and 130 hours, as against 22½ for the fourth quarter a year ago. Network heads have also announced that the daytime schedules of color shows will be stepped up. In some localities, as in Chicago's WNBQ, the bulk of the TV broadcasts are already in color.

THE COLOR PROSPECTS have given birth to many dynamic educational drives designed to sell color and develop markets for the Service Man.

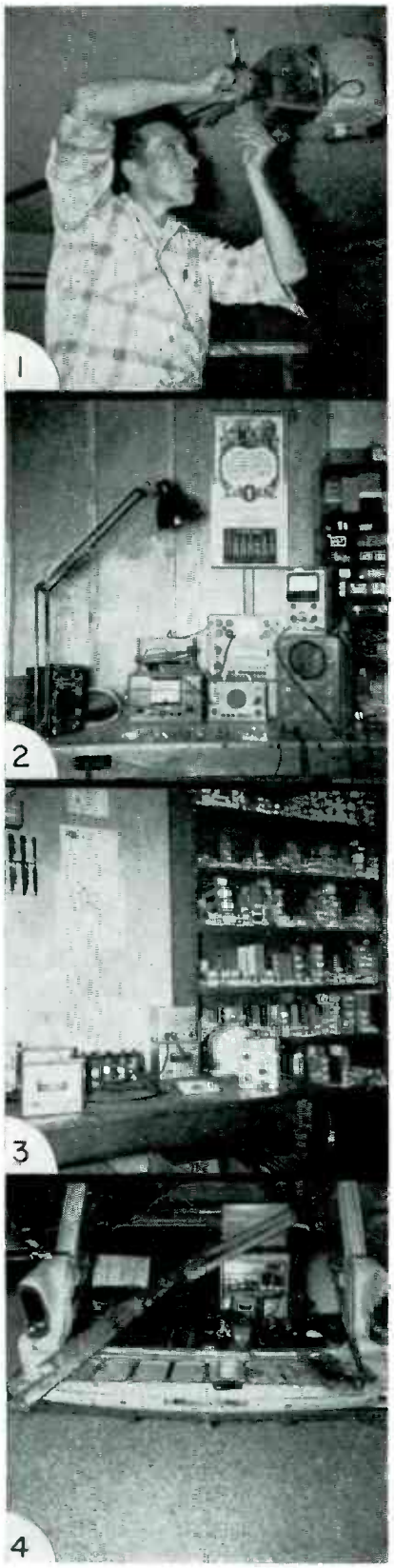
Make Way For Color, the theme of one drive, features a novel slide film that will be exhibited at meetings from coast to coast. The film, explaining the differences between black and white and color, points out that tube replacements and convergence adjustments will demand most of the Service Man's attention.

In a commentary on the tube-replacement picture in color, the film notes that we can expect to find (as an average) about four tubes burning out yearly in the color set, or twice as many as in the black and white models.

Another vital fact underlined in the color drives is the need for complete sets of instruments that will not only take care of installations, but all repair calls in the field or on the bench.

THE SERVICE BUSINESS has certainly set an extraordinary growth record, and as all statistics show, there's just no ceiling to the expansion possibilities that are ahead.—L.W.

GARAGE-DOOR OPENER



WE SPECIALIZE in the installation, repair and maintenance of radio remote-control systems associated with garage-door operators.

Located in Joliet, Illinois, about 40 miles southwest of Chicago, our shop is housed in a duplex garage facing a street. We chose a garage site for its promotional value and because it makes an ideal arrangement for on-the-spot demonstration of remote-control door operators.

In view of the unusual construction and operation of the door openers, it has been found necessary to develop and build a number of special installation jigs. For operator installation, we use a jig made up of two-by-four in an inverted *T* arrangement, with another two-by-four slotted to slide up or down on this *T*. The resultant arrangement allows one man to install an operator-door mechanism. The jig is positioned under the track at the motor end raised and locked into position. This allows freedom of movement for permanent mounting and simplifies installation.

We have examined and tested many makes of door-operators so that we might know how they work and thus be better able to install and repair them. As a result of these studies, we have learned that in the high-frequency band control type units, the transmitter and receiver are variably tuned. In most cases, the receiver employs a super-regenerative circuit, and a choice of key frequencies is available. Basically, in tuning, a meter is placed in the relay circuit with the receiver tuned to a region of no-meter kicks. Then the transmitter is tuned to the receiver on this spot. Sensitivity of this arrangement is very good. However, because of the super-sensitive inherent characteristic of this type of receiver, various troubles loom.

In a case of two car transmitters operating with one receiver, it is sometimes difficult to achieve equal

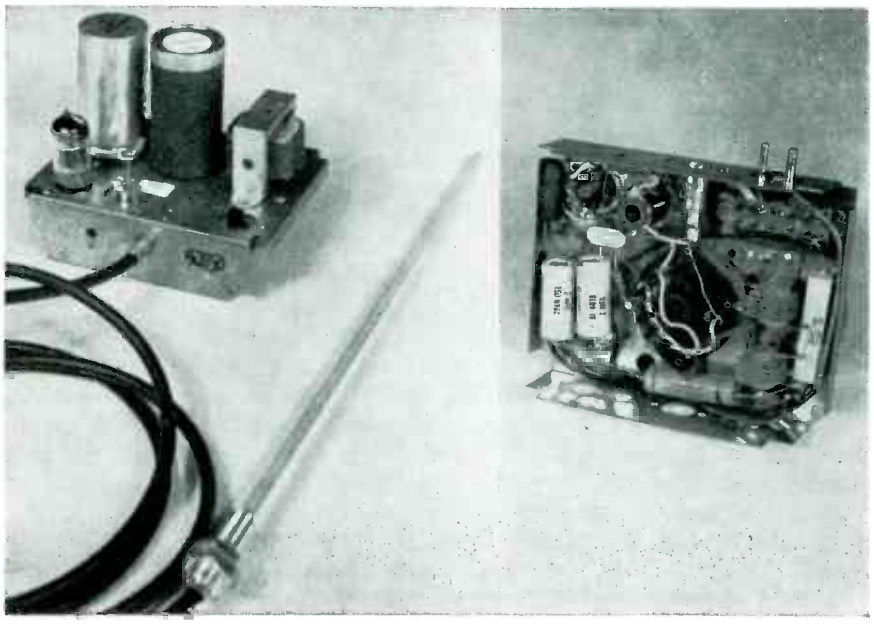
Left: Figs. 1-4

1: THE INSTALLATION of the remote-control receiver door-operator in the garage.

2: TEST BENCH in shop specializing in garage-control work. Test equipment employed includes a 'scope, signal generator, capacitor checker, vtvm, tube tester, regulated power input and battery eliminator.

3: ANOTHER VIEW of shop showing inventory of stock required for electronic operator installation and repair: Electric motor belts, drive chain, vibrators, selenium rectifiers, diode detectors, etc. Plug-in channel coils, transmitters, receivers, antennas, operators, not shown.

4: PARTS AND TOOLS carried in car for door-opener jobs: Jig, vise, level, hacksaw, power drill, 25' tape, antenna, lag bolts, spare tubes, transmitter-receiver, operator, ladder on top of wagon on a carrier.



RIGHT: TONE MODULATED transmitter of door-opener remote control with a 12AU7A. A triode section of tube serves as crystal-controlled rf oscillator which is plate modulated by second triode section functioning as a tone oscillator in conjunction with a plug-in tuned circuit. (Perma-Power RC201)

Installation and Servicing

by JOHN B. SEVEC
John B. Electronics

results from both transmitters. Since no crystal control is employed, we have found that after an operation sequence of several weeks, some drift occurs and retuning becomes necessary. Another disadvantage is the radiation caused by the receiver. This results in false openings, especially when other units of the same type are operating in the neighborhood.

We have found these units susceptible to *rf* from planes, amateur radio, atmospheric and man-made noise. The FCC now specifies that receivers in this classification shall be certified with a seal stating in effect that no *rf* radiation obtains. This has been met by some with shielding and the addition of an isolation stage.

Another control device, known as an induction field type, employs a resonant relay, which in turn is used to actuate an auxiliary relay or thyratron. In response to energy at the resonant frequency, the contacts vibrate, closing the controlled circuit.

This system has posed some problems, too; primarily the troubles have been due to mechanical vibration imparted by the operator itself or heavy vehicle rumble in the vicinity causing adverse operation of the door. The units are shock mounted and therefore critical if any departure occurs from its original mount. No field repair should be attempted on this unit.

At present, we are using an operator featuring a transmitter crystal controlled at 27.25 mc, with various plug-in coils allowing ten-channel audio key frequencies.

Since many cars now have a 12-volt system, the hot connection, if made to the coil, must be on the ignition lead side of a dropping resistor which is in series with the coil. If this is overlooked, subnormal input voltage results.

The system we now use employs an antenna mounted beneath the car and behind the bumper. This gives a range of about 6′ to 300′ with a sensitivity adjustmnet on the receiver.

Where, in some special case, extended range is desired, you may find the geometric placement of the antenna at a disadvantage. In this case,

(*Continued on page* 56)

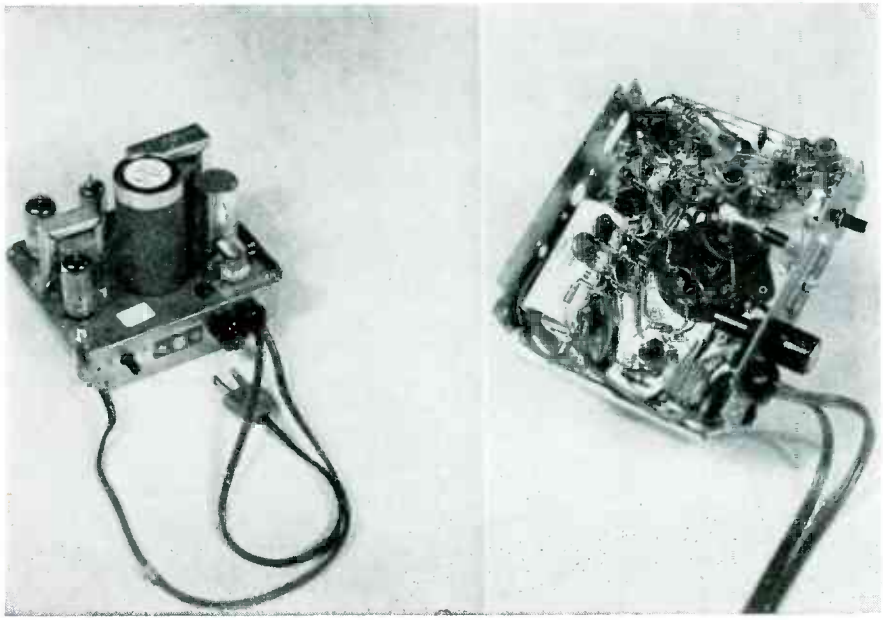
Right: Figs. 5-8

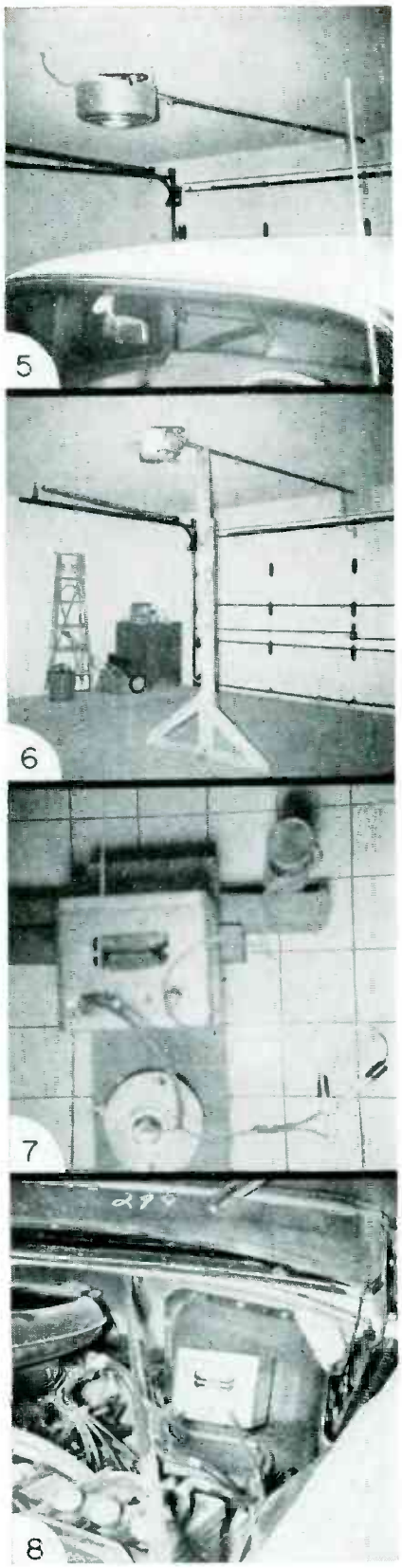
5: TYPICAL GARAGE-door installation in garage.

6: JIG IN POSITION under operator that facilitates installation of ceiling unit.

7: TEST SETUP with light which allows operation from transmitting car to be seen at a distance, and enables range of receivers and transmitters to be checked under actual field conditions.

8: TRANSMITTER INSTALLATION mounted on car's firewall.





LEFT: REMOTE DOOR-OPENER receiver which uses three tubes (6BA6, 12AU7A and 2D21), germanium diode (1N64) for signal detection, a pair of selenium diodes (1S1) in tone selector network and selenium rectifier (H50B) in power supply. (Perma-Power RC201)

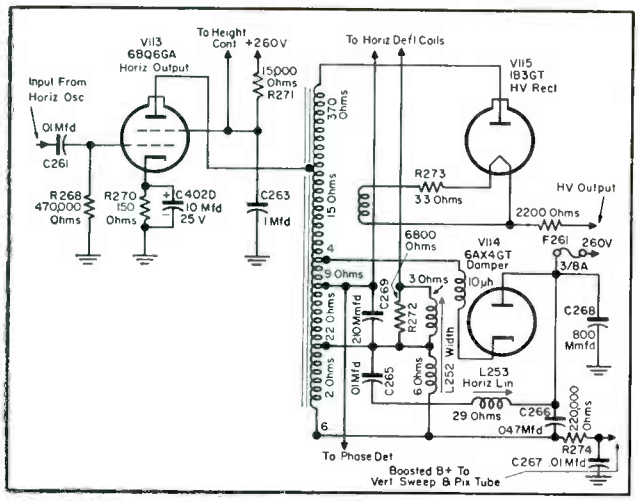


FIG. 1: FUSED HV line in TV chassis (G.E. model 21T26).

Blown Fuses In TV

How To Track Down Fuse Problems Caused By Complete or Intermittent Breakdown of Components

by CYRUS GLICKSTEIN*

A BLOWN FUSE in a TV set often is caused by a surge of current, resulting from a momentary increase in line voltage or an instantaneous arc in a component, which does no permanent damage either to the part or to the rest of the circuit. This problem is solved simply by replacing the fuse. There are, however, many instances where the blown fuse is caused by a complete or intermittent breakdown of some other circuit component. Then the fun begins.

Tracking down the defective part is not a simple matter, when the replacement fuse blows as soon as power is turned on. Even worse, the replacement fuse may not blow immediately, but a little later (after the Service Man has left the home, naturally) if the fault is intermittent.

Fuses are commonly inserted at one or more of the following points in TV receivers:

(*a*)—High-voltage (Fig. 1); (*b*)—B+ supply (Fig. 2); (*c*)—Filament line (Fig. 3); and (*d*)—*ac* line (Fig. 4).

The high-voltage fuse is commonly connected between the damper tube and either the low-voltage B+ line or the boosted B+ line. High-voltage fuse values range from ⅛ to ⅜ amp; a typical value is ¼ amp.

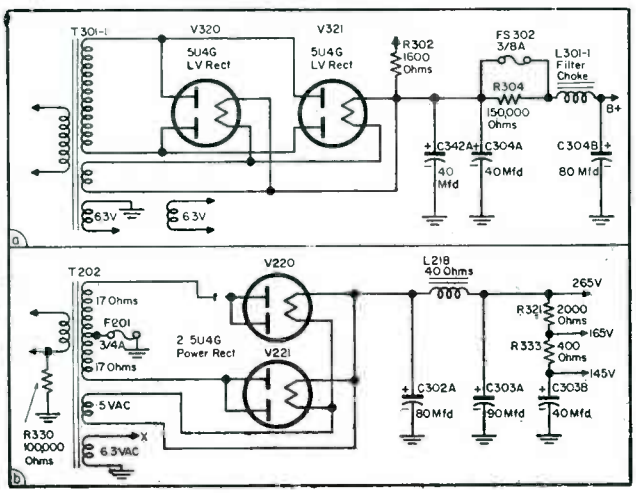
B+ fuses are usually connected in the B+ line, though they are sometimes found between the center tap of the power transformer high-voltage winding and ground; their values range from ⅜ to 2.5 amps. A 1.6 amp fuse is commonly employed in transformerless supplies, when a fusible resistor is not used.

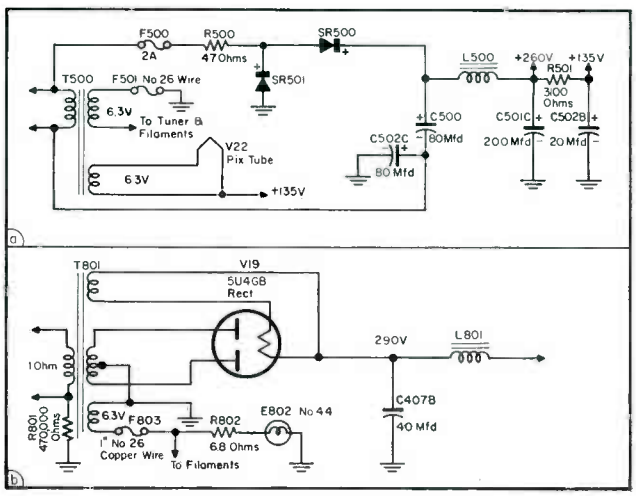
Line fuses are generally found only in sets with power transformers. These fuses are usually located between the *on-off* switch and either the primary of the transformer or the *ac* line-cord. Depending upon the size of the receiver (number of stages), line fuses vary from 2 to 5 amps; a common value is 3.2 amps.

Filament fuses are in series with the secondary of the filament transformer or filament winding of the power transformer. This type of fuse usually consists of about one inch of No. 26 wire and is not found in many models.

Practically all receivers with transformerless B+ supplies using selenium rectifiers have some type of B+ fusing. The most common variety is a 7.5-ohm fusible resistor. This resistor is connected between the selenium rectifiers and the *ac* line to provide fusing and at the same time to limit surge currents through the rectifiers. A few models use thermal cutouts at approximately the same point; a thermal cutout is a bimetallic strip which opens on overload and which is

FIGS. 2-3: CIRCUITS BELOW (Fig. 2) show B supply lines in transformer-type power supplies. Diagram in a shows fuse in B+ lead; in b fuse has been installed in B— lead. (Hallicrafters D1400D and DuMont RA-340/341). **At right, below (Fig. 3) are illustrated filament-circuit fuse lines. In a we have a fuse in the filament-transformer secondary circuit;** Sylvania 1-533-1. **The fused filament winding of a power transformer is shown in** b; Motorola TS-533.





reset by pushing a button provided for this purpose on the rear apron.

Line fuses are generally found only in transformer-type sets. Filament fuses are used in those chassis that use either a power or a filament transformer. B+ supply and high-voltage fuses are found in either transformer-type or series-filament type sets.

Some models have more than one fuse. Sets with a filament fuse usually have in addition a high-voltage or B+ supply fuse. Other sets may have any two of the four main types. Most sets with fuses, however, have only one. There are a number of receivers that do not carry any fusing.

The symptoms due to a blown fuse vary, depending on the type of fuse which blows. In any of the following cases, one of the first checks should be for a blown fuse: If the symptoms are no raster, no pix and no sound and none of the filaments light up, one should check for an open line or filament fuse. If the symptoms are no raster, no pix and no sound and the filaments light, one should check for an open B+ supply fuse. If the symptoms are blank screen and normal sound, one should check for an open *hv* fuse.

Home Servicing Steps

To save time in home servicing, the following procedure is recommended for all types of blown fuses:

(*a*) The initial assumption should be that the blown fuse has been caused by a momentary current surge, rather than a component failure, unless some indication of damage is noted, or a breakdown is suspected on the basis of experience or the manufacturer's service bulletins.

(*b*) With the set off, the fuse should be replaced with another fuse *of the same rating.* (If the open fuse is a fusible resistor, it will then be necessary to follow other troubleshooting methods; these are explained in another section of this report.

(*c*) The set should then be turned on.

(1) If the replacement fuse blows immediately, this indicates that there is trouble in the receiver rather than a surge.

(2) If the set operates normally with the replacement fuse, then it is necessary to find out if the fuse has blown previously within a recent period. If so, there may be an intermittent breakdown in the set or the fuse is operating too close to its rating to take normal current surges. One should note if the old fuse is fast blow or slow blow and the fuse rating should be checked against the range of common values mentioned. If the old fuse was a fast-blow type, it should be replaced with a slow-blow fuse of the same or slightly higher rating. However, unless the old current rating is obviously low, the capacity should not be increased. In any event, the capacity should not be increased by more than 20%, unless the setup is specifically suggested in a manufacturer's field service bulletin for a given model.

(3) If the set operates normally with the replacement fuse, and a slow-blow type with adequate current capacity was used originally, one must then check further for the possibility of an intermittent breakdown. With the set on, the tubes should be tapped (especially the *heavy-duty* low-voltage rectifier, sound output, horizontal output and damper tubes) with an insulated rod. In transformer-type sets, it is important to make a further check for the possible intermittent by removing the sound-output tube; this raises both low-voltage and boosted B+ somewhat. A borderline component will tend to break down because of the higher voltage. (In shop servicing, the same type of test can be performed on a series-filament set by using a *variac* to raise the input voltage to about 125 *v.*) In any event, the set should be allowed to operate for at least 10-15 minutes before leaving the home to check if the replacement fuse blows.

Blown Fuse Replacements

When a blown fuse is replaced and the replacement fuse blows, the specific procedure to follow next varies, depending on the type of fuse (line, B+ supply, etc.). In making further checks at this stage of troubleshooting, some prefer to pull the chassis and make detailed resistance checks around the circuit before inserting a second replacement fuse. Others find that they can often localize the fault

(*Continued on page* 40)

*Author of *Repairing Television Receivers*; John F. Rider Publisher, Inc.

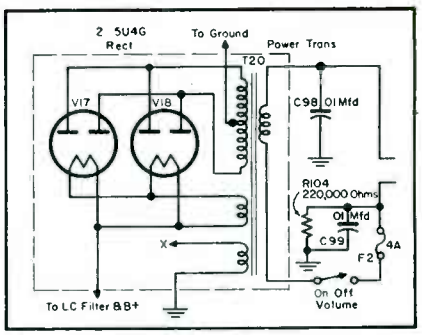


FIG. 4: AN AC-LINE fuse circuit. (Sentinel 1U-1202)

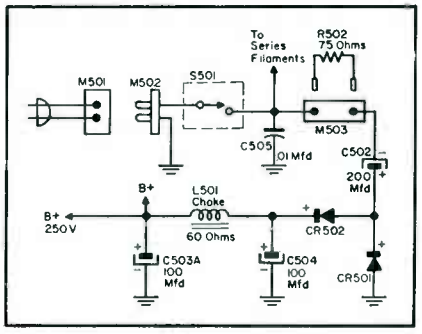


FIG. 5: LV B+ TRANSFORMERLESS supply with selenium rectifiers fused by a fusible resistor; series filaments are not fused by the resistor. (Admiral 17XP3)

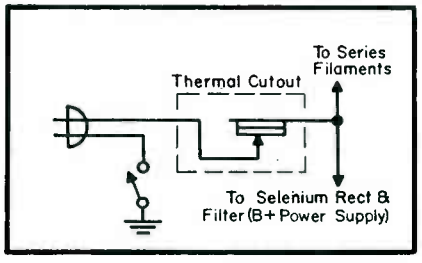
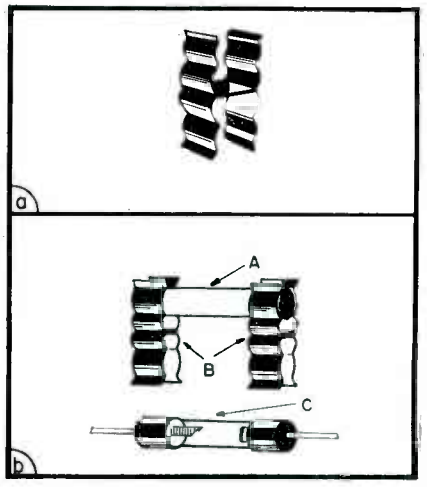


FIG. 6: THERMAL CUTOUT used as a line fuse in a series-filament receiver. Both the B+ supply and series filaments are fused by the cutout protective unit.



(Right)

FIG. 7: METHOD that can be used to replace pigtail fuse, using dual fuse clips and replacement fuse without pigtails. No soldering is required in this operation. The fuse clip is shown in a; installation method in b. The replacement fuse is installed as noted at A; the blown pigtail fuse can remain in the circuit and the open side of the fuse clip clamped over it as shown in B and C.

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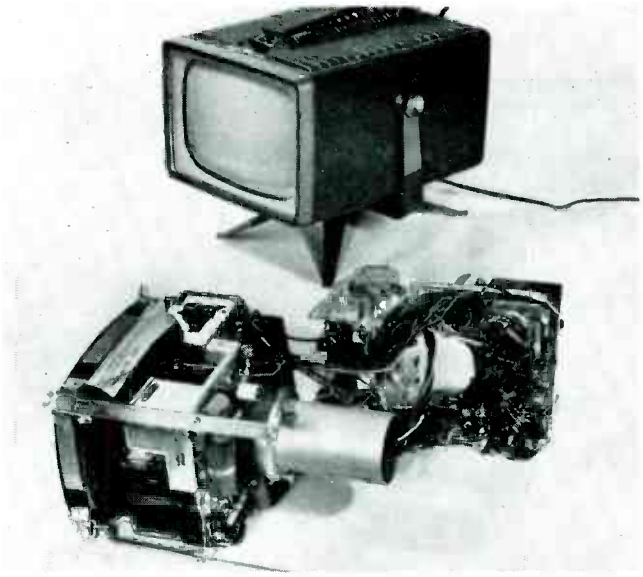
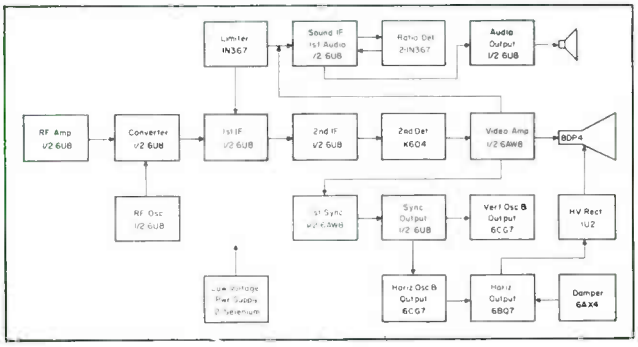


FIG. 1 (left): EXTERNAL AND INTERNAL views of RCA portable (model 8PT7030) which utilizes an 8½ picture tube providing 36 square inches of viewable picture.

FIG. 2: BLOCK DIAGRAM of portable showing tube complement.



11-Tube 90° 8½-Inch RCA Portable TV

by W. W. COOK, *Technical Training, RCA Service Company, Inc.*

THE DEBUT OF THE TV portable, the television counterpart of the personal radio, within the first decade of large scale television broadcasting, is another example of the tremendous pace of television development. Progress which required 20 years in the radio field has been telescoped into 10 years of television.

As in the case of radio, a high standard of performance had to be specified even though the receiver components had to be compacted into a package much smaller than was thought practical or possible just a short time ago. Just how this has been made possible is best understood by considering the technical and constructional features of these unique receivers.

The portable[1], diagrammed in Fig. 4 (*p. 16*) which features an 8½" (90° with electrostatic focus) rectangular picture tube, is housed in a case that is only 10½" x 9¼" x 12⅞" and weighs approximately 22 pounds without a stand.

The receiver utilizes 11 tubes including a picture tube (8DP4) and four crystal diodes, which serve as second detector, sound *if* limiter and ratio detector. The receiver uses the usual number of tube functions, except in the case of the picture *if*, where only two pentode tube functions are employed.

Normal *if* gain is present; however, the *if* bandwidth is somewhat narrower. This is allowable since the size of the picture tube is a determining factor on the resolution perceptible by the human eye.

The receiver is constructed on three separate chassis sub-assemblies. Two of the sub-assemblies are vertical chassis, through which the picture tube is inserted. The third assembly is the *rf* tuner.

Circuit Description

An incremental inductance tuner[2] used in this receiver, has two pentode-triodes (6U8) as *rf* amplifier, converter, *rf* oscillator and first picture *if* amplifier.

The antenna input circuit is conventional and includes an antenna matching transformer, two *if* traps, AM rejection and an FM trap. The output of this circuit feeds the *rf* amplifier which is connected as a grounded-grid amplifier. An *agc* bias voltage is applied to the *rf* grounded grid through a 22,000-ohm decoupling resistor.

The *rf* amplifier plate voltage is obtained from the cathode of the first *if*

(*Continued on page 16*)

[1]*RCA models 8PT7030/7031/7032* 7034. [2]KRK 55A.

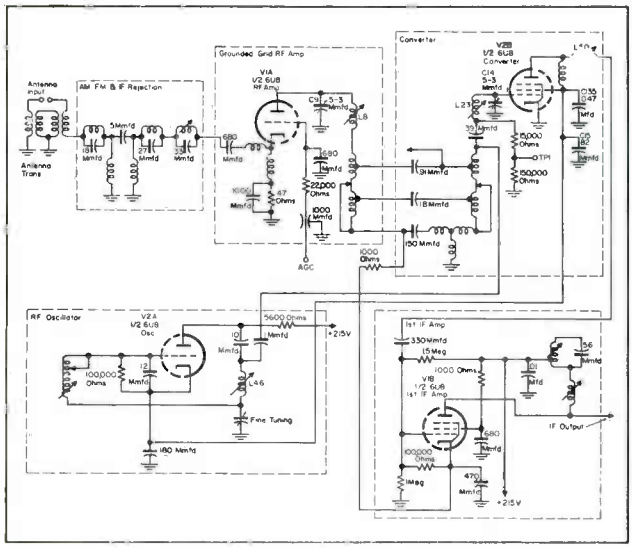
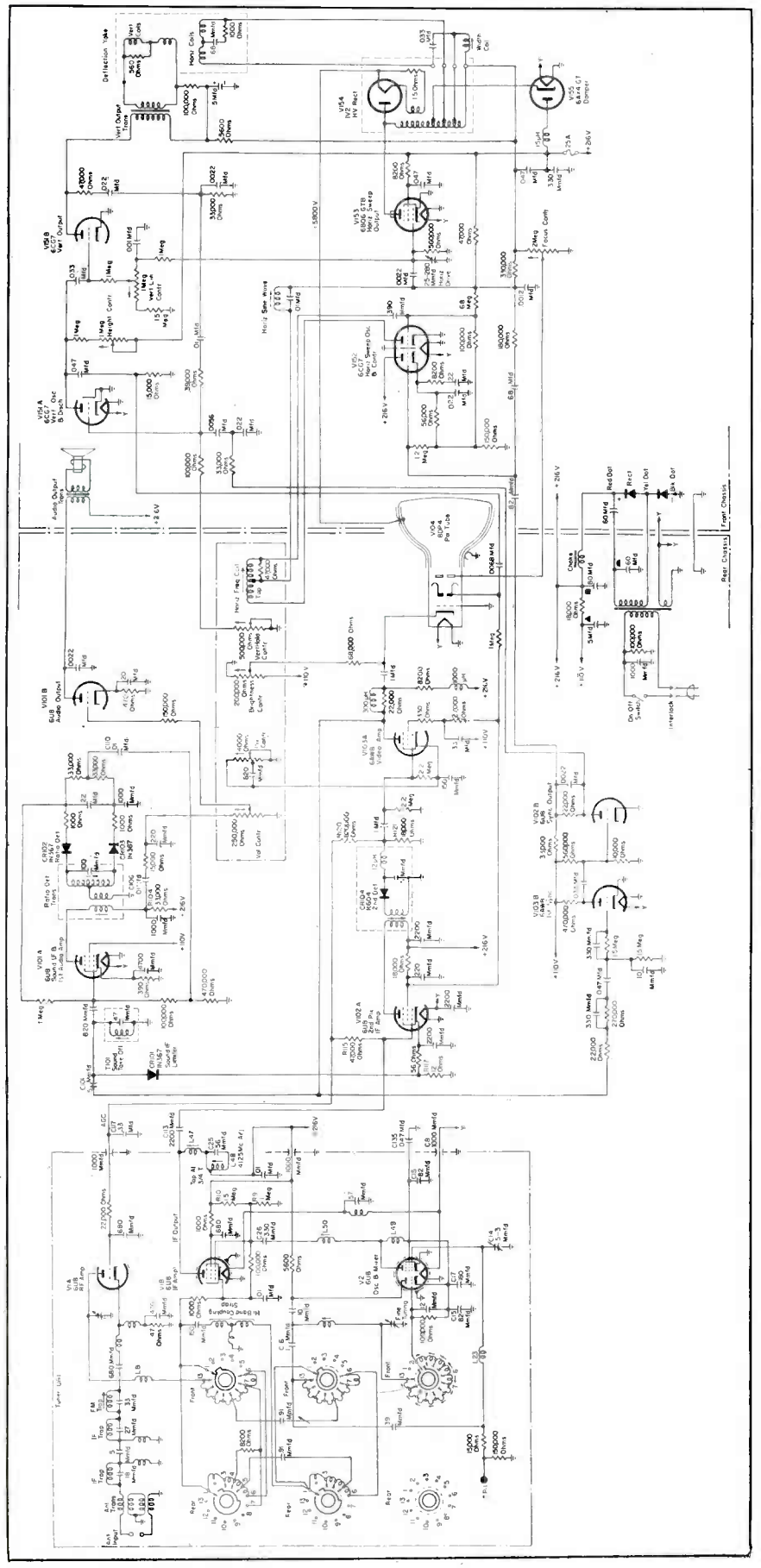


FIG. 3. CIRCUIT (simplified) **of the rf tuner used in RCA personal portable chassis.**

[See Page 16 for Complete Diagram]

8½" Portable TV

(*Continued from page* 15)



amplifier. A 1000-ohm resistor (R_4) decouples the two stages from interaction.

Plate tuning for the *rf* amplifier is accomplished on channel *13* by means of L_8 and on channel *8* by means of a .5 to 3-mmfd variable capacitor (C_8). The low channels are individually tuned by *knifing* the coils for the proper response.

The output of the *rf* amplifier is capacitively and inductively coupled to the grid circuit of the converter stage. Converter grid tuning is accomplished by means of L_{23} and a .5 to 3-mmfd variable (C_{14}) on channels *13* and *8*, respectively. Low-channel tunning is also accomplished by *knifing* the individual coils. The *rf* oscillator is of conventional design and the oscillator voltage is coupled to the converter grid by means of a 1-mmfd capacitor (C_{16}). The converter obtains its plate voltage from the cathode of the oscillator.

The *if* output of the converter is coupled to the grid of the first *if* amplifier by means of L_{50} and a 330-mmfd capacitor (C_{20}) (first picture *if* transformer) which form a series resonant circuit. L_{49} serves as the converter plate load impedance. Effective decoupling between the oscillator and converter is maintained by the use of 82 and 180-mmfd and .047-mfd capacitors (C_{15}, C_{17} and C_{135}).

The output of the first *if* stage is developed across L_{47} (the second picture *if* transformer) and is then coupled to the grid of the second *if*. A parallel-resonant trap (L_{48} *and* C_{25}, a 56-mmfd capacitor) is associated with L_{47}, which provides the desired accompanying sound rejection (41.25 mc).

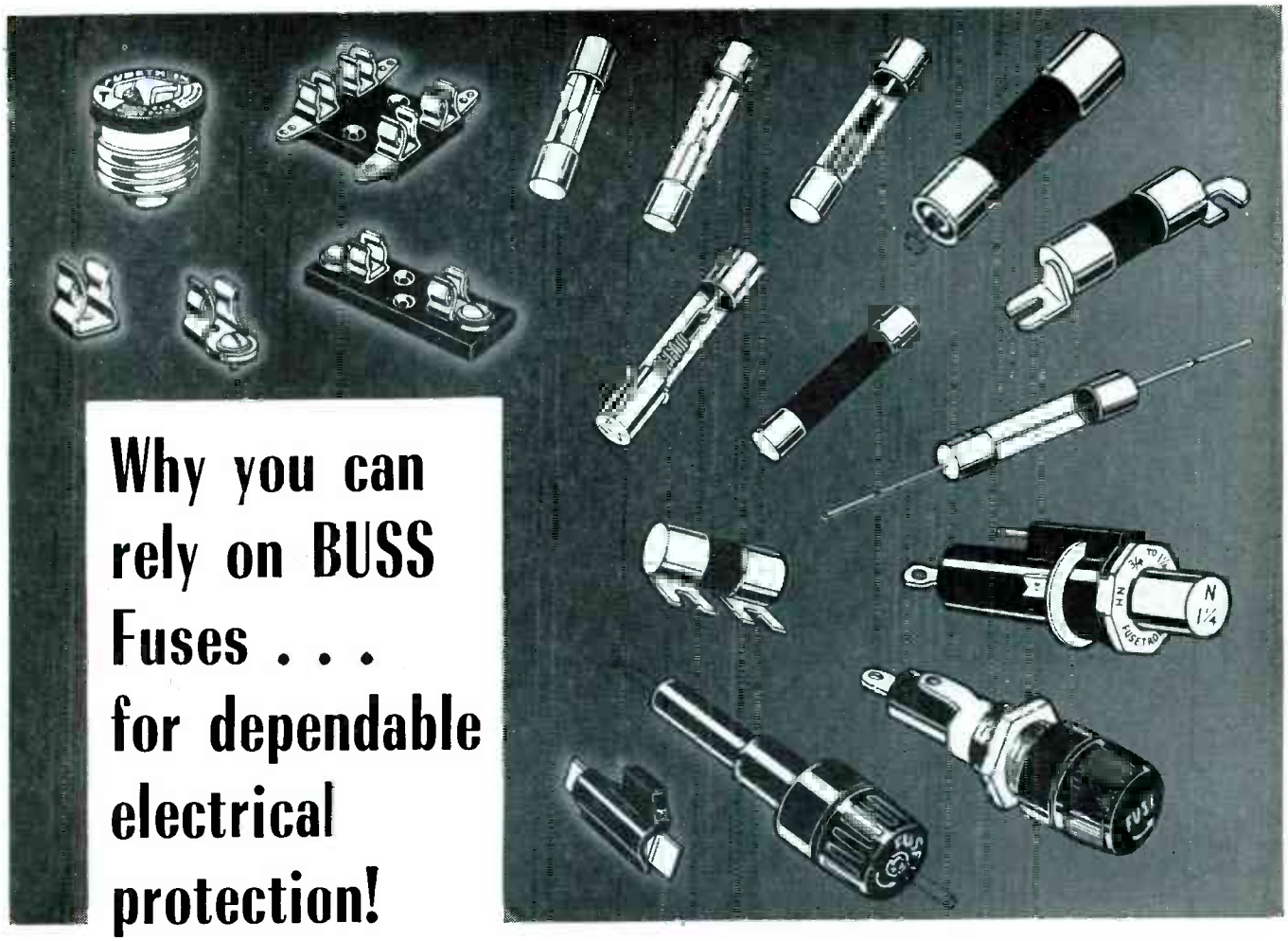
The grid voltage of this stage is held to a fixed potential by means of a (1 and 1.5-megohm) voltage divider, R_9 and R_{10}. Since *agc* is applied to the *rf* amplifier, age action is accomplished in the first *if* amplifier, due to its cathode voltage varying as the plate voltage of the *rf* amplifier varies.

The output of the tuner is coupled to the grid of the second pix *if* through a 2200-mmfd capacitor (C_{113}). *Agc* is applied to this grid through a 47,000-ohm resistor, R_{115}. Bias voltage for the sound *if* limiter is provided by a 12-ohm resistor (R_{117}) in the cathode of this stage.

The third pix *if* transformer drives

(*Continued on page* 63)

FIG. 4: CIRCUIT DIAGRAM of RCA 8PT-7030 portable series.



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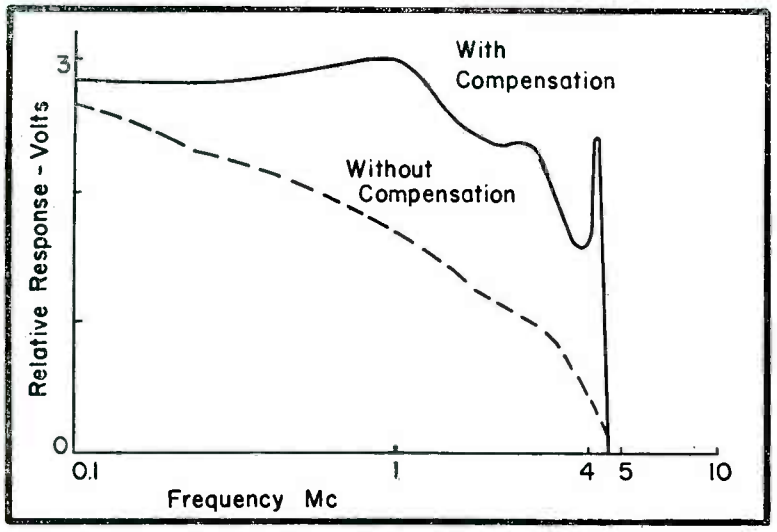
[See Front Cover]

2-Stage Printed-Wiring



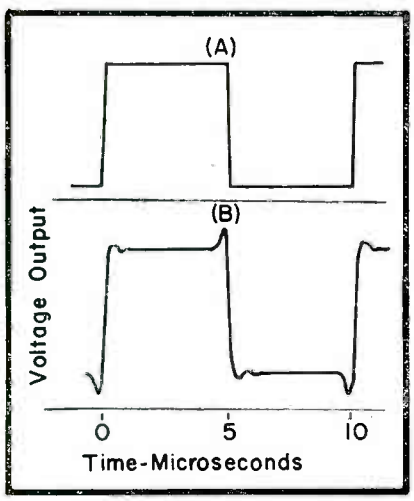
FREQUENCY RESPONSE of first video stage.

IN DESIGNING any receiver, certain performance requirements must be met. The specifications spelled out for the video amplifier[1] of our new line of TV sets[2] called for a two stage unit that would deliver sufficient drive to get the maximum amount of contrast available in the picture tube with a linear gamma characteristic, and a picture resolution capable of reproducing the detail available in good quality studio transmission. So that the overall gain of the receiver could, in the fringe area, take every advantage of the low noise figure of the tuner used in these models, the amplifier also had to have two to three times the video gain of the average video amplifier.

The highlight brightness obtainable from a picture tube is determined by the high voltage and beam current available to zero grid bias. However, the beam current available at zero bias is also a function of the screen or first anode voltage of the picture tube. Therefore, by increasing this voltage, it is possible to gain in highlight brightness and at the same time improve the focus quality of the beam. But, increasing the first anode voltage increases the cutoff voltage of the control grid of the picture tube; hence, a proportional increase in drive is required to drive the black level to zero beam current.

The first anode voltage of the picture tube in our chassis[1] has been increased by approximately 50% over that of the average set, and the available video drive has been upped by a corresponding percentage.

To obtain the required video drive and maintain good gamma or shading characteristic and high resolution in the picture a 6AQ5 power pentode was chosen for the final stage of the video amplifier. This type tube was chosen for three reasons: (*1*) The available plate voltage swing between zero bias and grid voltage cutoff is greater than can be obtained in a triode; (2) the grid-to-plate capacity is much lower than a triode; and (3) a pentode as a power tube has higher G_m than a triode. A power pentode is effective because large excursions of current are required to deliver the required video drive voltage across the relatively low value of plate load.



OVERALL TRANSIENT RESPONSE of video-amplifier. Plot in a shows overall transient or square-wave response of modulated antenna signal. In b is illustrated the extended frequency range and sharp corners of the transient response obtained because of the use of lower inductance peaking coils.

Low grid-to-plate capacity is more important than a casual observation would indicate. Where the amplifier tube is working into a resistance amplifier, the effective input capacity of the tube is increased by an amount equal to the gain of the stage, multiplied by the grid-to-plate capacity. This capacity could amount to as much as 20 or 30 mmfd in the case of a triode, as compared to 2 or 3 mmfd for a pentode.

A two-stage video amplifier was chosen to provide adequate over-all receiver gain for the fringe area, and sufficient gain to amplify the level at the second detector to that required to deliver the ultimate available contrast at the picture tube. A two-stage amplifier, it was also found, permits placing the contrast control in the cathode of the last video amplifier, where the synchronizing signals and transient response or picture quality are independent of the contrast setting.

Circuitry Analysis

In the special circuit developed, the sync information is taken off at the plate of the first video amplifier ahead of the second video amplifier, where it is unaffected by the contrast control. By using a cathode type of contrast control, a low-impedance control can be used, so that the stray circuit capacities across the control have little or no effect on the transient response. Here the choice of a pentode again plays an important part because the reflected grid-to-plate capacity is very low. Hence, the magnitude of this capacity, which varies with the gain of the stage, as the contrast setting is varied, has little or no effect on the transient response.

The second detector level must be maintained relatively low to prevent overload in the last *if* stage and to permit the use of a high *agc* loop gain that is required to hold constant *if* gain and guard against overload at high signal levels. This means high gain in the first video stage to provide the necessary grid swing for the power stage. A high G_m pentode (½

[1]Using the Decatron circuit.
[2]*Philco* 7L70.

Decatron Video System

by E.C.. FREELAND
Engineer, Television Division
Philco Corporation

With 6AQ5 Power Pentode In Output and 6U8 as First Video Amplifier and Inverter

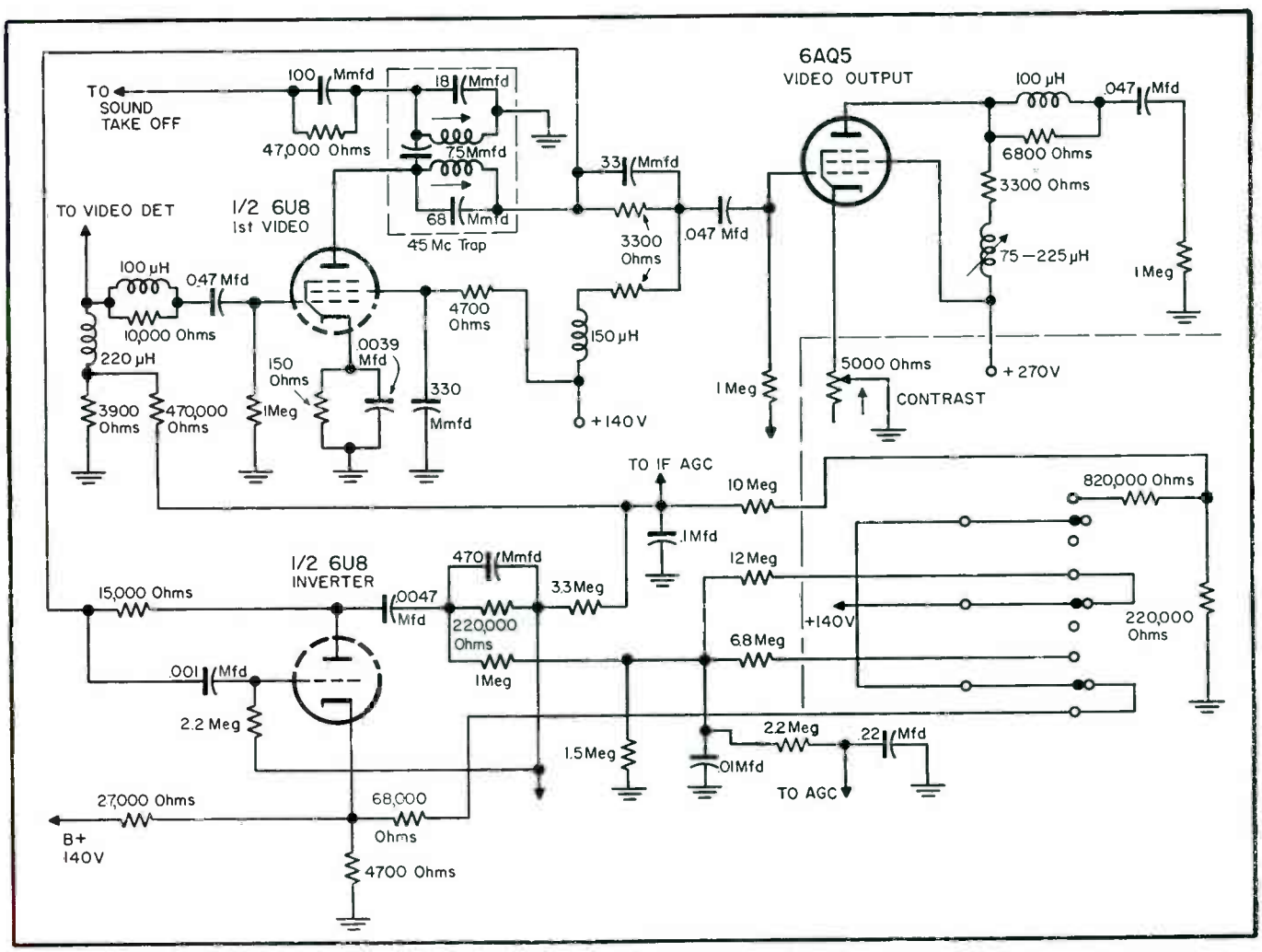
6U8) was chosen for this function. The dual tube was selected so that the triode section could be employed as a noise inverter. The noise inverter is closely related with the video amplifier, in that its input energy comes from the video amplifier and its output energy is again fed back into the video amplifier in reverse phase. The use of the 6U8, therefore, makes for a compact layout on a printed-wiring panel (used in this chassis series), which results in low circuit capacities and contributes to the gain bandwidth of the amplifier.

The use of a pentode with high G_m and low grid-to-plate capacity in the first video stage not only contributes to picture resolution, but also boosts the available sound gain. The low reflected grid-to-plate capacity makes it possible to use a low value of series peaking coil in the grid of this stage, without losing picture resolution. The value of this peaking coil was chosen so as to resonate approximately the input capacity of the tube at 4.5 mc. A high-impedance parallel-resonant trap is used in the plate circuit of this stage; this has been found to be a most effective means of trapping out the 4.5-mc sound beat from the picture channel and at the same time functions as a part of a broad-band double-tuned sound take-off transformer.

The grid of the second video stage is tapped half way down on the video plate load to provide the proper portioning of the noise inverter and video voltages. The output capacity of the noise inverter and input capacity of the sync separator are in parallel and load the video amplifier through a 15-000-ohm plate load of the noise inverter. This puts a step function in the frequency response, which must

(*Continued on page* 60)

CIRCUIT DIAGRAM of the Philco decatron **video system which features use of a 6AQ5 power pentode in the final video-amplifier stage.**



Magnetic Recording

Tape Types . . . Cures for Physical-Electronic Tape Defects

by WILLIAM H. WOGLOM and LAWRENCE KNEES

Quality Control Manager *Service Manager*

Reeves Soundcraft Corp.

IN SELECTING TAPE for magnetic recorders, it is necessary to consider tape gage.

The thinner gage tapes afford more recording footage per reel, but are not as strong as standard gage. It is therefore important that tensions in a machine using thin gage tape be correctly adjusted, to avoid tape damage.

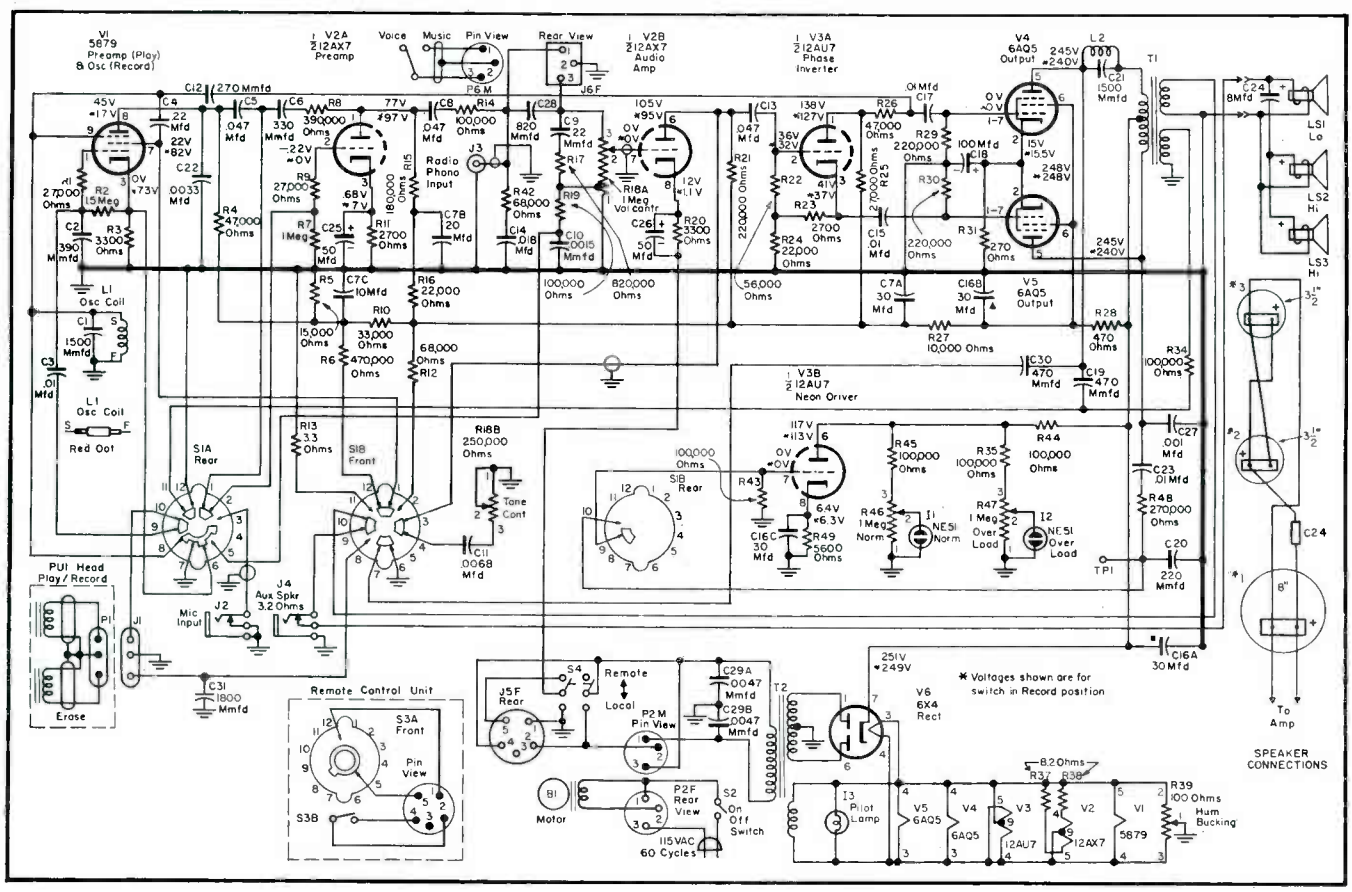
In recorder repair, Service Men must be alert to various problems in recording and reproduction which are caused by the tape itself, rather than the recorder, to avoid useless work on a recorder which is blameless. If a complaint of either squeal or static is received, the tape should immediately be suspect and before any work is done on the recorder, the tape should be replaced by a roll known to be free of these defects. Although great strides have been made by tape manufacturers to rid their products of these faults, and they are much less common than formerly, it is possible that tape with such defects still exists. Intermittent pops and bangs can also be caused by the tape. Here again, the tape should be replaced with a roll known to be good, before the recorder is worked on.

If a lack of high-frequency response is noted, again it may save the Service Man a good deal of time if he assures himself that the tape is not the cause, before working on the machine. Good high-frequency response is dependent on good head contact. It would be well to check tape adhesion; if it is poor large amounts of oxide could be building up on the heads, causing the tape to be removed from the heads just enough to lose the highs.

It is also necessary for a tape to be flat, both vertically and longitudinally, if good high-frequency response is to be had. Should a tape not be flat across its width, or *cupped*, either the edges or the middle of the tape will stand away from the head, depending upon which way it is cupped. This will cause a serious loss of high frequencies, especially in half-track recording. This effect will be less noticeable in the thinner base tapes, which generally maintain better head

(*Continued on page 61*)

COMPLETE CIRCUIT DIAGRAM of RCA 7-TRC-1 tape recorder-playback and remote control system.



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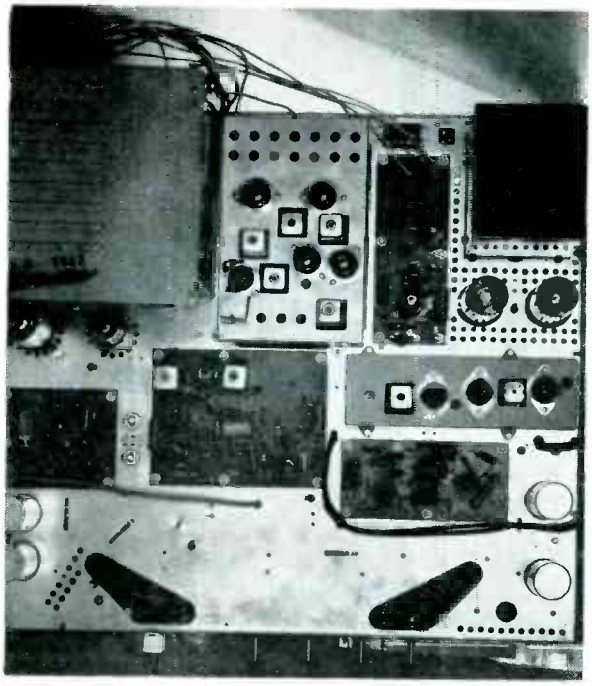


21-Inch COLOR-TV Chassis Featuring Printed-Wiring Boards

by J. A. MAY and W. H. FULROTH

Commercial Service, TV Service Clinic, RCA Service Company, Inc.

LEFT: TOP CHASSIS view of RCA CTC5 color chassis.

THE RCA 21-inch color-TV line receivers recently introduced incorporates 10 models, equipped for *vhf* reception only, or optionally, for *uhf-vhf*.

In all models the tuner unit is mounted separately from the main receiver chassis. The receiver chassis are mounted horizontally with cables extending to the tuner unit, and the volume and brightness controls. The volume and brightness control unit is attached to the tuner mounting bracket and is removable separately.

For the convenience of the Service Man there is a special bracket, built into the main receiver chassis, for attachment of the tuner, when both units are removed from the cabinet.

New circuitry in one line of models[1] includes separate second detectors for picture *if* and sound *if*. All models feature the intercarrier-type sound system which places the sound *if* 920 kc from the color subcarrier; sound *if* at 4.5 mc, color subcarrier at 3.58 mc. The use of dual second detectors, it has been found, makes it possible to obtain attenuated sound for application to the output of the picture second detector without impairment of sound gain. This attenuation minimizes the possibility of the 920-kc beat appearing as an interference pattern in the picture when viewing a color picture.

Another advance includes the use of printed-wiring boards that comprise approximately 80% of the circuitry in the receivers.[2]

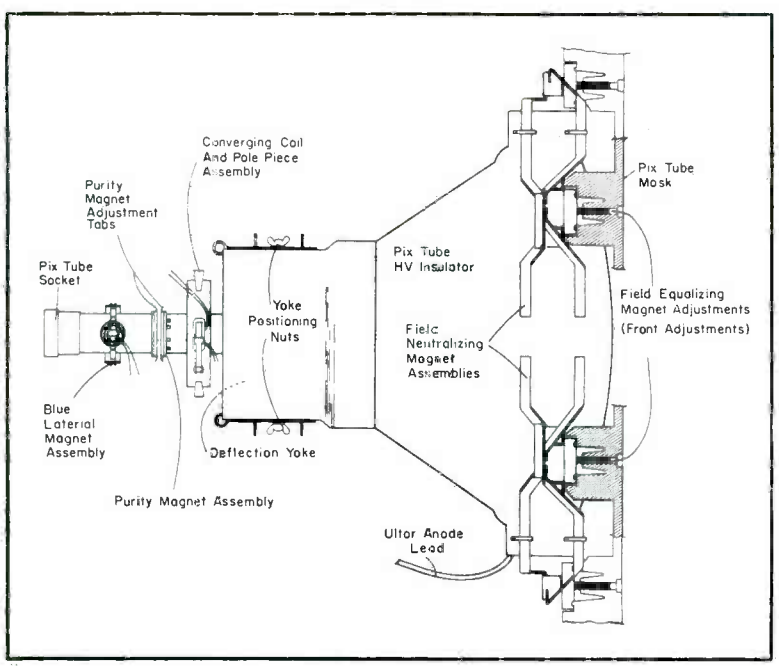
Each board is mounted flush with the chassis and has the components and convenient test points located on the top side of the boards.

In the new models the top of the cabinet is not removable as it was in previous RCA color receivers. Because of this, a new feature has been incorporated; all grey scale adjustments and all convergence adjustments except the blue-lateral beam positioning magnet have been made accessible at the front of the receiver when the control box cover is removed. This means that for all normal service adjustments, except during initial purity setup adjustments, where it may be necessary to properly position the deflection yoke, convergence yoke or purity magnet from the rear of the receiver, the rear cover of the receiver need not be removed.

The 21-inch color tube used in these new models has a high-voltage

(*Continued on page 62*)

MASK, PICTURE TUBE, high-voltage insulator and color picture-tube accessories.

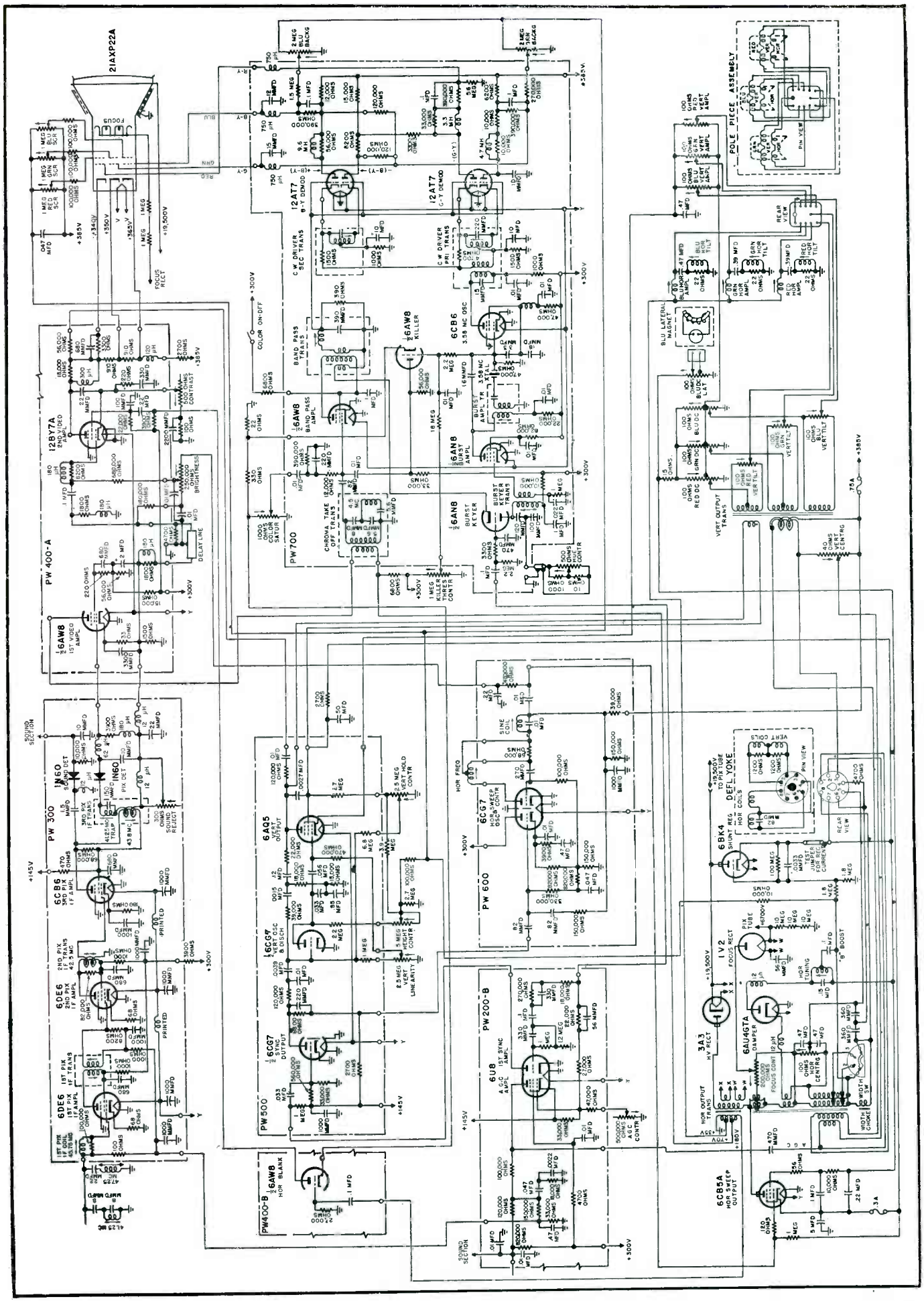


[1] *The* ***Special*** *series.*

[2] *In the* ***Special*** *and* ***Super*** *models (**CTC5**), there are six boards; in the* ***DeLuxe*** *series (**CTC5N**), there are five boards.*

▶ Right ▶

COMPLETE diagram of RCA CTC5 color-TV chassis.



THIS MONTH IN SERVICE

CRASH PROGRAM TO EXPAND UHF UNDER WAY--The first industry conference to develop a high-speed ultrahigh research program that will revitalize the highbands has been called by the FCC. . . . The agenda for this special session calls for the setup of a TV allocation and research committee of industry experts to work closely with the Commission. . . . Basic objectives of this new development group are to determine the feasibility of transferring TV to the ultrahighs, and technical principles and channel allocations involved in any changes. . . . In the proposed probe, receivers will receive headline attention. The committee will evaluate comparative potential performance and costs of veryhigh and ultrahigh black-and-white and color sets; antenna, transmission line and other pickup-accessory low and high-band requirements will also be analyzed. Detailed, too, will be design specifications for circuits and tubes. . . . An intensive field testing study program is also scheduled. Determined will be the uniform methods that will be required to measure field intensity and appraise the quality of TV service on all bands. Measurements and observations are expected to cover reception in canyon type and average type cities, prairie area locations, as well as sites in mountainous terrain.

WIDER ANGLE PIX TUBES AHEAD FOR SMALLER PORTABLES -- The new crop of TV receivers are going to be smaller and yet still offer the same size picture screens prevailing today. This prediction, made recently by the prexy of RETMA, was based on the forthcoming production of picture tubes with angles of 110° (as against 90° tubes now in use), that will shorten the depth of a receiver by four or five inches. Using such a tube, it was said, a 14-inch portable will be about 25% shorter. . . . Others commenting on the trend said that we may even have 120° picture tubes that will reduce further the overall depth of portables. The only disadvantage in the wider-angle tubes, it was pointed out, is increased distortion at the edges. Circuits are now being designed to overcome this objection. . . . Reviewing the growth of the portable market, industry specialists have pointed out that whereas in the first six months of '55 only 50,000 sets in the 15-inch or smaller sizes were made, over 300,000 were produced during the first six months of this year.

ADVANCED COLOR SCHOOL CREATED BY NEW YORK SET MANUFACTURER -- A new school offering a 40-hour tuition-free course in the theory, mathematics and practical aspects of color TV servicing is now in full swing in Syracuse, N. Y., under the sponsorship of a set maker. The school is being operated on a year-round basis. . . . Text books and local transportation to and from the school are also being supplied on a free basis. . . . To gain admission to the school, Service Men are required to apply to their distributors. There is no written entry examination, but students are given a quiz before the actual classes start to determine their familiarity with black and white television. . . . Test questions ask for such information as: The basic principle employed in horizontal automatic-frequency control. . . . Video polarity of signals fed to the picture tube cathodes. . . . If detector diode-video amplifier coupler circuits (showing series and shunt peaking). . . . Differentiator and integrator circuitry characteristics. . . . Nature of the transmitted rf signal envelope. . . . Rf tuner, as well as 45-mc if response.

HUGE FOUR-FLOOR SOUND SYSTEM AT COLISEUM IN NEW YORK -- Four separate sound systems for each of the building's four exhibition floors, that can be used individually or on a building-wide scale, are now in operation in the New York Coliseum. . . . Sixteen microphone circuits and facilities for amplifying four different program sources are provided on each floor. In addition to microphone originations, the program sources include AM and FM radio, a turntable for phono records and a wire line input for remote program pickup. Other features of the sound system include availability of 280 watts of power to each floor, and 60° radial-type horns spaced among 12 and 15-inch loudspeakers.

DO-IT-YOURSELF TUBE TEST WONDER HITS NEW YORK -- A miracle gimmick to check tubes, without even using a tester, has been announced. The designers say that they have found the answer for tube tests with a magic chart equipped with a few simple patterns. It's only necessary to turn a dial, we are told, and a slide rule index pinpoints the tube or tubes that may need replacing. "Replacing a tube is as easy as replacing a light bulb," the official announcement declares. And to rub it in, the manufacturers say that anyone can now do their own troubleshooting easily and quickly without any previous knowledge of electronics or circuitry. Presto!

ON SEPTEMBER 1ST, JFD ANNOUNCED TO THEIR DISTRIBUTORS A SPECTACULAR NEW NCB* COLORTENNA® PROFIT-PACKAGE FOR YOU, THE SERVICE DEALER.

This publication went to press before its completion.

The NCB* COLORTENNA® PROFIT-PACKAGE is now available at your JFD antenna distributor. It will be well worth your while to see it before stocking up on any antennas.

2-Way Railroad-Radio Service: Field-Shop Procedures . . . Test Equipment . . . How To Get Into The Field

by LEO SANDS

THE STEAM LOCOMOTIVE presents many electrical and physical problems in 2-way operations, and as a result most railroads have not installed radio systems on steam engine equipment. Instead, they have waited until the steamers were replaced with diesel power.

The typical iron horse is provided with a steam-turbine driven *dc* generator delivering 32 volts *dc* for operation of a headlight. When a radio setup is installed, the generator must usually be replaced by a bigger one of adequate capacity.

The radio equipment must be mounted in a weatherproof case generally on the top of the tender. Cables provide connections to the handset, loudspeaker and control box in the cab. The antenna is mounted on the roof of the cab or on the tender near the radio equipment. However, because of vibration, noise, smoke and water, radio installations on steam locomotives leave much to be desired.

Radio on a diesel-electric road engine is an entirely different story. The cab of a modern locomotive is a quiet, comfortable place to ride. Thus the equipment takes less punishment. The handset can be placed within easy reach of the engineman or the fireman or both. The radio equipment is usually placed in the nose of the locomotive or behind the cab in the engine compartment.

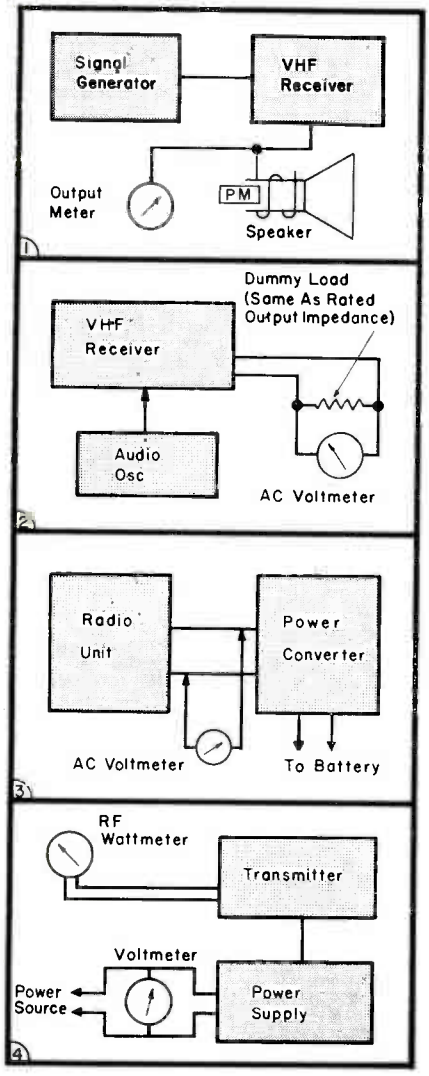
Most diesel-electric locomotives are equipped with 64-volt starting batteries which are also used for powering radio equipment; some have 72 or 110-volt batteries.‡ In older installations, a *dc* to *ac* inverter is used in conjunction with *ac* operated radio equipment. Some railroads still prefer this method.

Four-unit locomotives usually have two cabs, one at each end. When radio is installed, both cabs can be provided with independent radio systems or only one radio system may be installed which is operable from either cab. The latter requires extensive wiring and multi-conductor connectors between locomotive units. Even though the connectors are husky, they are subject to damage when the locomotive units are separated and someone forgets to disconnect the radio wiring. The main disadvantage of providing only one radio system for each locomotive is that when the engine is separated into two separate two-unit locomotives, one or neither have radio, depending upon the nature of the installation.

The voltage delivered to the radio apparatus or the input of the *dc* to *ac* inverter varies in locomotives, as it does in cabooses and for the same reason; it must if battery charging is to be effected. Thus the variation, if directly affecting the radio equipment, can cause changes in performance. However, in the case of both caboose and locomotive installations, the overall radio communications system must be so designed that with the radio equipment operating at its lowest ebb, communication should be adequate.

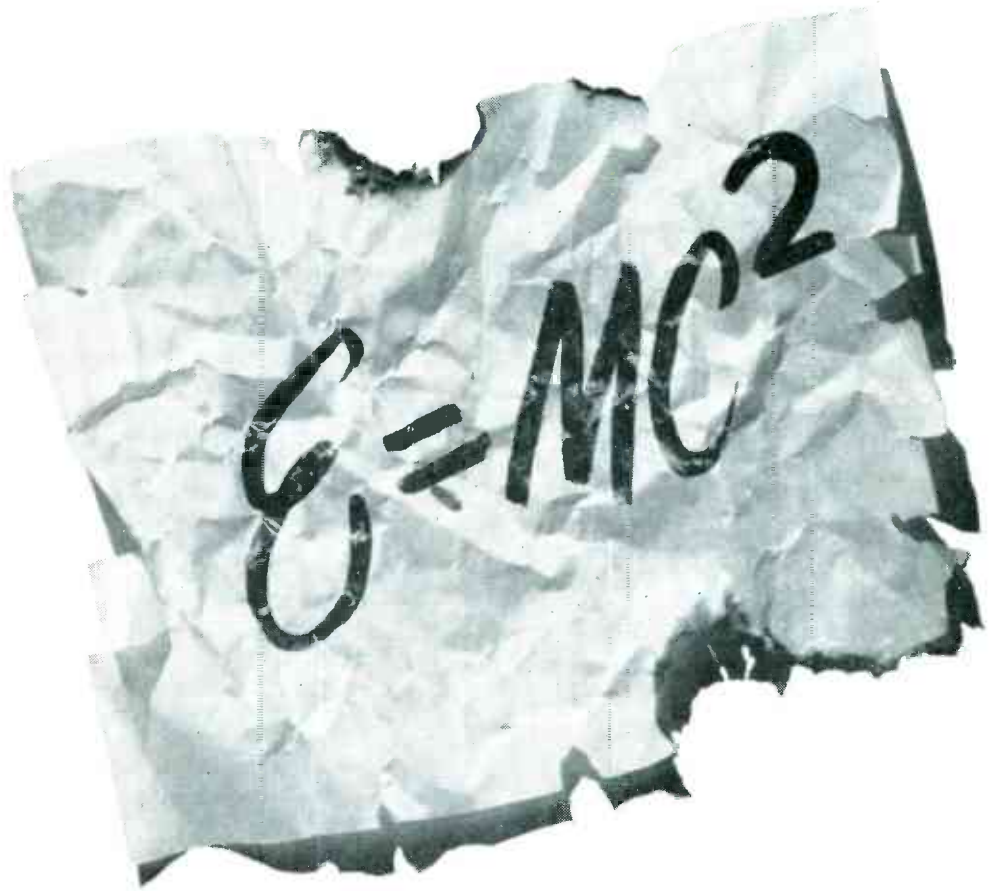
If radio is to be of any value to a railroad, it must be dependable and

(*Continued on page 57*)



FIGS. 1-4: TEST LAYOUTS for railroad-radio tube, audio, power and transmitter checks. To test tubes, the setup diagrammed in Fig. 1 is used. A low-output (unmodulated) signal from the generator is fed to the receiver; it must be low so that the receiver noise as indicated by the output meter is reduced 20 db, or voltage drops to about 4 one-tenth. By replacing tubes one at a time and repeaking trimmers, improvement will be noted when the signal input can be reduced to maintain 20-db quieting. Fig. 2 illustrates audio-output test technique. Here an audio signal (1000 cps) is applied at the input of the audio amp and output voltage noted: Watts=Voltage²/ Impedance. Thus, if the voltmeter reads 5 volts and the load is 8 ohms, a 3.1-watt dissipation would obtain in the resistor shown. A power source check is detailed in Fig. 3. On rolling stock the power source may be checked with an ac voltmeter (when ac is provided with the radio set to receive and then to transmit). Voltage should not exceed 120 or drop below 110 volts. If more variation obtains, converter or battery source must be checked. To check the transmitter output an r-f wattmeter should be used, as indicated in Fig. 4. Input voltage should also be measured, and if possible the input voltage should be varied over the range encountered on trains.

‡Bendix and Motorola both provide railroad radio equipment which will operate directly from a 64-volt *dc* source.



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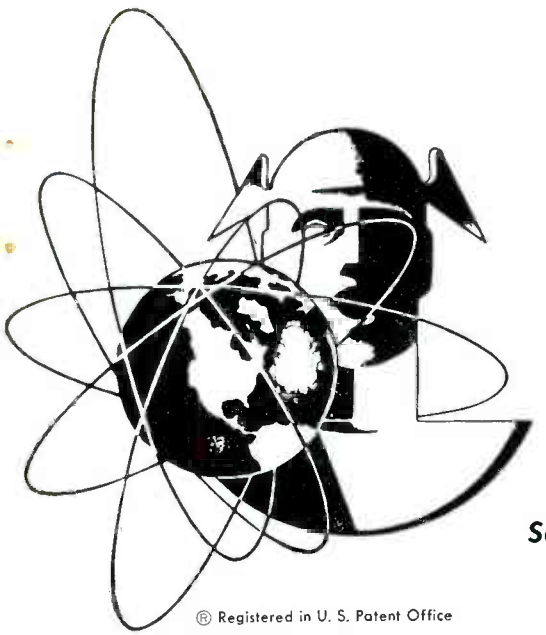

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Horizontal Amplifier Tube Tests in the Plant

by ELMER H. NIEHAUS

Standard Products Application Engineering
Receiving Tube Department, General Electric Company

IN MOST RECEIVERS, the cathode of the horizontal amplifier is tied directly to ground. Small amounts of heater to cathode leakage in these receivers would not be noticeable. However, to assure satisfactory operation in all receivers, tubes with excessive heater cathode leakage must be rejected.

To eliminate disturbances in the picture, the horizontal amplifier tube is tested for arcs and for microphonics. The *arc test* is performed with maximum rated voltages on the tube and a sensitive indicator rejects even those tubes with extremely small arcs. An arc in a tube results in the loss of a portion of one or more trace lines, while the effect of microphonics is to cause displacement, to right or left, of one or more trace lines.

The *microphonics test* is performed by connecting the output of the tube to a sensitive amplifier. During the test the tube is tapped by an automatic tube tapper and any output is indicated by a meter at the amplifier output.

Another type of picture disturbance which has been troublesome is called the *snivet*. The *snivet* is actually an *rf* radiation that occurs at the same point or points of each scan line. The radiation is picked up by the tuner and is amplified through the receiver, resulting in one or more black lines of varied widths, usually near the right hand edge of the picture. Frequently, the lines go together, forming oval shaped disturbances due to 60-cycle hum modulation. It has been found that tubes which exhibit a discontinuity in plate current, usually located at a point just below the knee of the zero bias plate current curve, will produce *snivets*. This discontinuity is a place on the curve where there is a change in plate current, with no change in plate voltage. It would be represented on the curve by a vertical slope at some point on the plate current curve. The *snivet* producing discontinuities can be detected by reducing the plate voltage slowly and watching for a sudden drop in plate current.

Tests are also performed for unwanted tube currents, such as gas current, emission current from the control grid, emission current from the screen grid and emission current from the plate. If the level of these currents is too high, tube life is significantly reduced. Each of these tests is performed by different methods with rejection levels consistent with the requirements for efficient tube operation in a receiver.

Tests to Guarantee Satisfactory Tube Life: A sample of tubes from each production lot must pass prescribed life tests before that production lot can be placed in the warehouse for shipment to customers. The regular life test is conducted with the tube operating at maximum conditions of current, voltage and dissipation for a minimum of 500 hours. At the end of the 300 hours the tubes must pass the tests previously described. Another life test is run simultaneously with elevated voltages for a shorter period of time. On this life test particular attention is given to the unwanted emission currents which would shorten tube life.

‡*First report on tests performed in the tube factory appeared in August, 1956, issue of* SERVICE.

CATALOGS — BOOKS

SPRAGUE PRODUCTS CO., 231 Marshall St., North Adams, Mass., has published a 63-page 5½" x 8⅜" pocket size *TV Replacement Capacitor Manual* (K-102). Covers 6589 different TV sets made by 88 manufacturers. Tables are broken down into two sections: Electrolytic section, with each manufacturer listed alphabetically, and Sprague replacement capacitors described and cross referenced to original part numbers; and ceramic section which also lists sets alphabetically by make, but Sprague replacements are grouped according to the section in the TV set in which they are used. Copies are available free from Sprague distributors or by mailing 10c direct to Sprague.

* * *

HOWARD W. SAMS & CO., INC., 2201 E. 46 St., Indianapolis 5, Ind., has published a 12-chapter book, *TV Servicing Guide*, by Leslie D. Deane and Calvin C. Young, Jr. Chapters are subdivided according to symptoms that result from failure within that particular section of the receiver. Trouble symptoms are illustrated by photos of picture-tube screen; possible causes for each symptom are listed. In each chapter are troubleshooting procedures and servicing hints. Priced at $2.00.

* * *

AEROVOX CORP., New Bedford, Mass., has prepared a 20-page guide on ceramic plate assemblies, including circuit diagrams, constants, functions and a cross reference section. Also included is a 10-page section of replacement information with manufacturers part numbers and correct Aerovox equivalent.

* * *

HARRY G. CISIN, Amagansett, New York, has published bulletin *S-11* describing an assortment of TV and radio service books. Included are books for novices as well as experts, tube location guides, tube substitution guides, color TV, picture guides to TV troubles and rapid diagnosis of TV faults.

* * *

PERMA POWER CO., 4727 N. Damen Ave., Chicago, Ill., has released a distributor catalog describing and illustrating TV tube *briteners*, voltage regulators, radio-controlled garage door openers, battery eliminators and a line of electronic accessories.

* * *

SHURE BROTHERS, INC., 222 Hartrey Avenue, Evanston, Ill., have published general catalog '56 (with technical data) covering microphones, microphone cartridges, microphone accessories, phono pickup cartridges and magnetic recording heads.

* * *

AIRCRAFT-MARINE PRODUCTS, INC., Harrisburg, Pa., has published a booklet, *The Adventures of Grandpa Champ*, which dramatizes some of the dangers in improperly handled electrical wiring around the home.

PERSONNEL

MIKE REMUND has been named vice president in charge of sales of Jensen Industries, Inc., 7333 W. Harrison St., Forest Park, Ill.


Remund


Clements

WALTER CLEMENTS has been promoted to the position of jobber sales manager of Littelfuse, Inc., Des Plaines, Ill.

° ° °

MILTON SCHINDLER, administrative assistant to Ben Snyder, president of Snyder Manufacturing Co., has been promoted to director of west coast sales. He will headquarter at the Snyder west coast offices and warehouse in Los Angeles.


Schindler


McDonald

SAMUEL J. MCDONALD has been named eastern regional manager, distributor sales, of the electronic product sales department of Sylvania Electric Products, Inc.

° ° °

M. P. FIELDMAN is now vice president in charge of sales at Raypar, Inc., 7800 West Addison St., Chicago 34, Ill.


Fieldman


Huser

WILLIAM A. HUSER has been appointed ad manager of Potter and Brumfield, Inc., Princeton, Ind.

° ° °

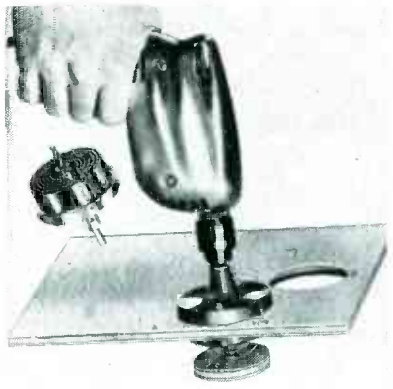
KENNETH C. KLEIDON has been named to a newly-created post of national color television manager for Hycon Electronics, Inc., Pasadena, Calif. Kleidon, formerly director of technical publications, color television training and assistant director of sales engineering for the radio and TV division of Raytheon, will conduct color television symposiums in cities across the nation for Hycon.

BENCH-FIELD TOOLS

CIRCULAR SAW

A circular saw, *Arco Hole-Saw*, featuring an automatic slug ejector which pops out sawed discs, has been developed by Arrow Metal Products Co., 140 W. Broadway, New York 13, N. Y.

Saw, powered by any electric drill, drill press, lathe or motor, cuts holes from 1" to 2½" in diameter in wood, wallboard, plastics, and sheet metal. Two models are available: *650* cuts 1", 1¼", 1½", 1¾", 2", 2¼" and 2½" holes through any ¾" stock; *600* cuts 1", 1½", 2" and 2½" holes. Both models include ¼" drill bit.

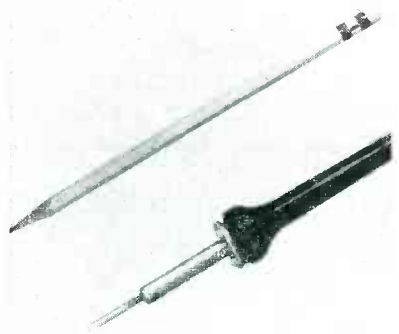


° ° °

PW SOLDERING IRON

A soldering iron, *Pencil*, for work on printed-wiring circuits and regular radio and TV circuits, has been announced by Wall Manufacturing Co., Grove City, Pa.

Iron weighs 1 ounce, has a ⅛" tip and is 7½" long. Tip temperature is controlled by thermostatic action. Comes with copper or *Walloy* tips; also in ¼" tip size.



° ° °

PRINTED WIRING PLIERS

Printed wiring pliers, featuring compound leverage for cutting and one operation cutting and crimping, are being manufactured by Utica Drop Forge and Tool Corp., Utica 4, New York.

Tool crimps as it cuts to prevent the cut wire from sliding back through the ole of the printed wiring board.

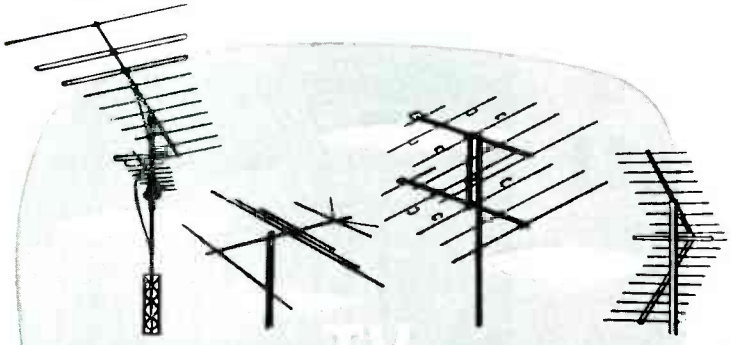
PORTABLE TERMINAL TOOL REPAIR KIT

A portable repair kit, made of crackle-finish lightweight metal, partitioned for *A-MP* terminals, connectors and the *Champ* or *Super-Champ* tool, has been announced by American Pamcor, Inc., Havertown, Pa. Kit features partition design and terminal tool and connector identification.

Also announced by A-MP is a line of junior *Faston* flag-type terminals with insulation support.

Fastons accommodate wire sizes 22-14; insulated and non-insulated support types accommodating wire sizes 22-14 are also available.

Design-Application Report on Variable-Inductance Tuned Indoor Antenna‡



UHF-VHF TV ANTENNA DIGEST

DESIGN • APPLICATION • INSTALLATION • SERVICE

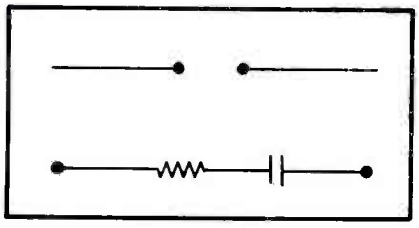
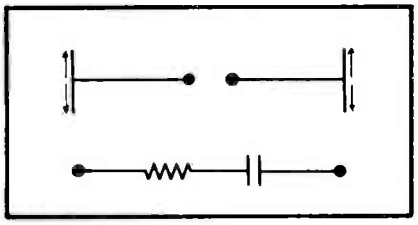


FIG. 1: SHORT low-band dipole (much less than ½ wavelength) which has a radiation resistance of approximately 3 ohms; this appears at feed points as a highly capacitive reactance.

FIG. 2: ELECTRICAL CIRCUIT for capacitive condition in antenna. Current in hats is equal and opposite; therefore, there is no radiation from the hats themselves. Radiation resistance at feed points raised to approximately 30 ohms is still highly capacitive; see p. 49 for detailed analysis.



IN THE EARLY DAYS of TV, indoor antenna models featured half-wave dipole design and were most commonly made with their two halves bent vertically in the shape of the letter V. In use, this type of antenna had to overcome many hurdles. Since the simple half-wave dipole presents only 72 ohms impedance, considerable mismatch obtains when it is connected to a 300-ohm line. Also, for maximum effectiveness, these dipoles should be oriented horizontally; and for the lower channels they must be fully extended. Technically, the lengths of each element should also be adjusted for each channel. It has been found that attempts to adjust the antenna for optimum reception have been hampered by the fact that the ele-

(*Continued on page* 49)

‡*Based on field notes prepared by* ***Channel Master*** *engineering department.*

FIG. 4 (RIGHT) : Use of autotransformer to step up 30-ohm impedance to provide match with 300-ohm transmission line.

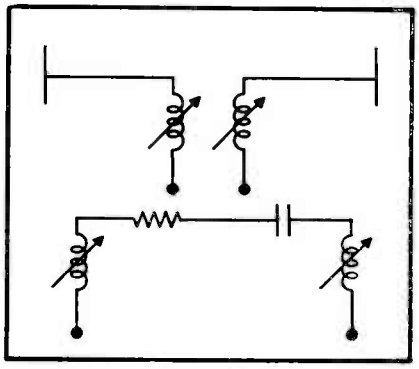
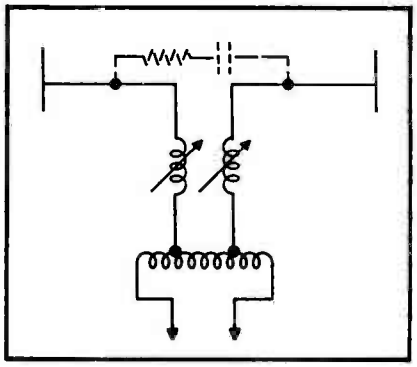
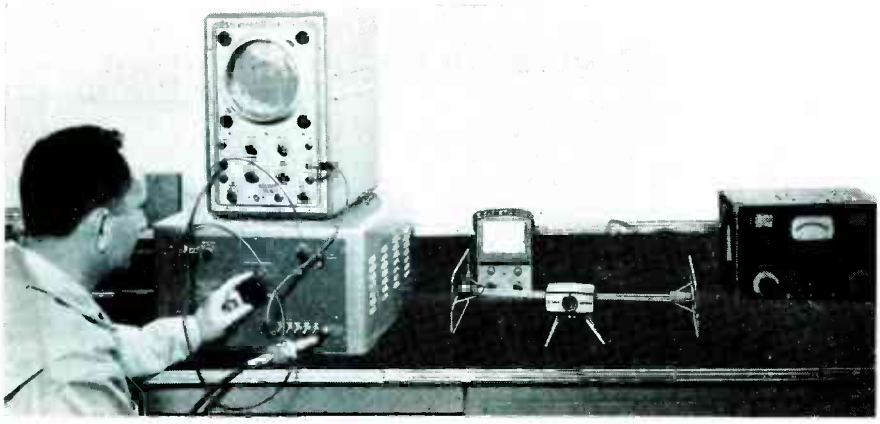
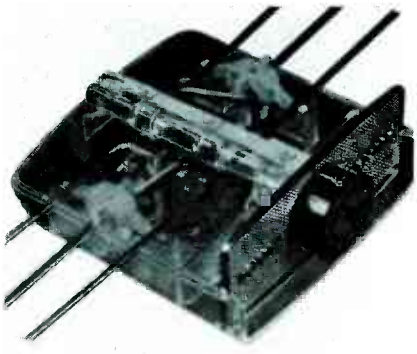


FIG. 3: CIRCUITRY illustrating use of variable series inductances added to feed points for tuning.





PROJECT ENGINEER JULIUS GREEN in Channel Master lab checking tuned indoor antenna at right.



CUTAWAY VIEW of the variable inductance tuner used in the indoor antenna.

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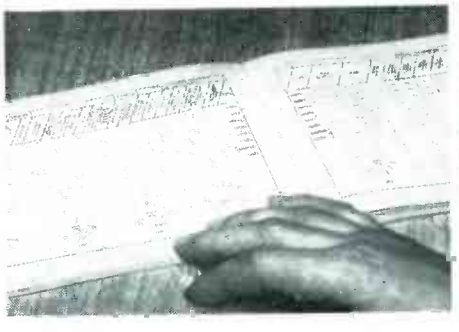

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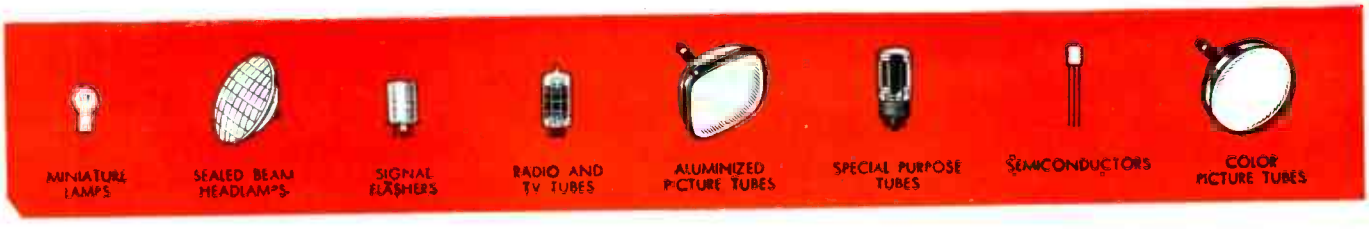

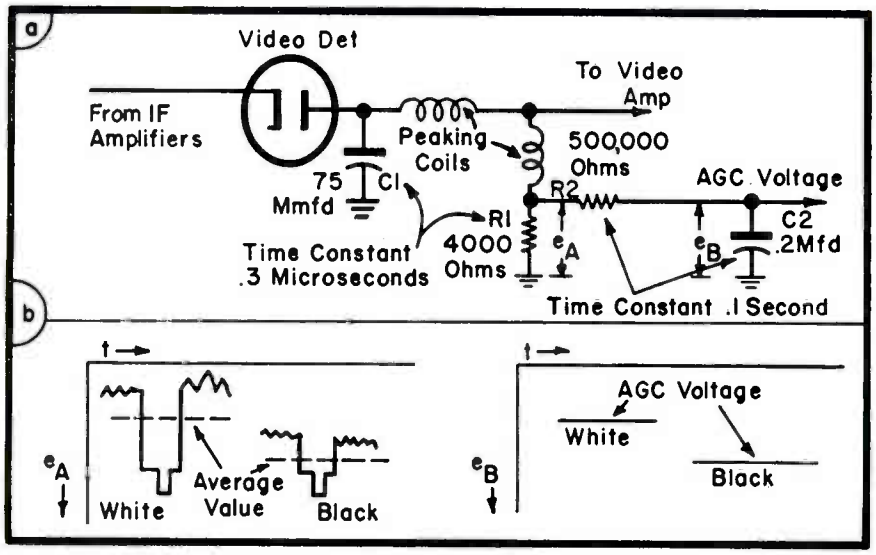

FIG. 1, LEFT: Simple average agc system.

Tubes and Circuits Used In AGC Systems *

by J. M. SHEEHE

Application Engineer
Electronic Tube Division
Westinghouse Electric Corp.

THE PEAK AGC system, described in last month's report, requires a separate diode. This tube can be eliminated, and a satisfactory *agc* system can still be designed; Fig. 1*a* shows such a system. Only two extra components (a resistor, R_2, and a capacitor C_2) are required. The remainder of the circuit is the ordinary video detector circuit with some peaking coils shown for completeness.

R_1 and C_1 compose the load circuit for the video detector. Their values are the same as in the previously described system. To obtain an *agc* voltage, an integrating network consisting of R_2 and C_2 is inserted between the video detector output and the grids of the *rf* and *if* tubes. This voltage is of the correct polarity, since negative detection is used. A long time constant is required for R_2 and C_2 to eliminate vertical sync suppression. This integrating network is both the charging and discharging load circuit. Since the charging-load circuit time constant is long, the voltage across C will never reach the peak value. Instead, it will tend to approach the average value and stay there. Therefore, only an average value of the video signal is obtained for the *agc* voltage. Since an average value is obtained, this value will change not only as the peak signal voltage changes, but also as the picture content varies. This is shown in *b* of Fig. 1.

The advantages of this type circuit are:

(*1*) Cheapness. Only two extra circuit components are required.

(*2*) Good noise immunity. The long charging time constant averages out the high noise spikes so that the *agc* circuit will not react appreciably to these noise spikes.

**Part 1 of this analysis appeared in August, 1956,* SERVICE.

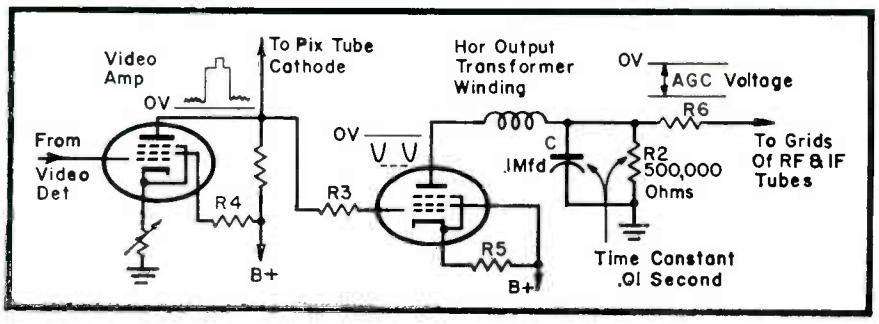

FIG. 2, LEFT: Circuit of keyed agc system.

Disadvantages of System

There are several disadvantages:

(*1*) Average detection is employed, so that the same peak signal value can give different *agc* voltage values, depending upon the picture content of the signal.

(*2*) A small *agc* voltage is obtained, it being much less than the peak signal available at the video detector. This makes the set more susceptible to overloading on strong signals than the simple peak detection system.

(*3*) There is a slow response to a change in the video signal because of the long time constant used; this will cause airplane flutter, etc.

This type system is being used today in many of the new inexpensive sets. It is satisfactory for fringe areas, where there is no danger of signal overload and where noise immunity is vital.

Keyed Agc Systems

An *agc* system, which overcomes the disadvantages of the previously described systems, has been devised. This system has excellent noise immunity, a relatively flat input signal versus detector output characteristic, a fast response and has a sufficiently large amount of *agc* voltage output available. It employs a pulse from the horizontal output transformer to key the *agc* tube into conduction, from whence the term keyed *agc* comes.

A simplified schematic of such a system is shown in Fig. 2. The output of the video output tube is fed to the grid of the *agc* tube; a pentode such as the 6AU6 is commonly used. The polarity of the video signal at this point is positive. There is no *dc* voltage applied to the plate. The plate voltage consists entirely of horizontal frequency pulses obtained from a winding of the horizontal-output transformer. These pulses can either be series or shunt fed to the plate. The winding is in series in the circuit shown. The *agc* tube is biased so that the tube will conduct only when the sync pulse is present. If either the

(*Continued on page 60*)

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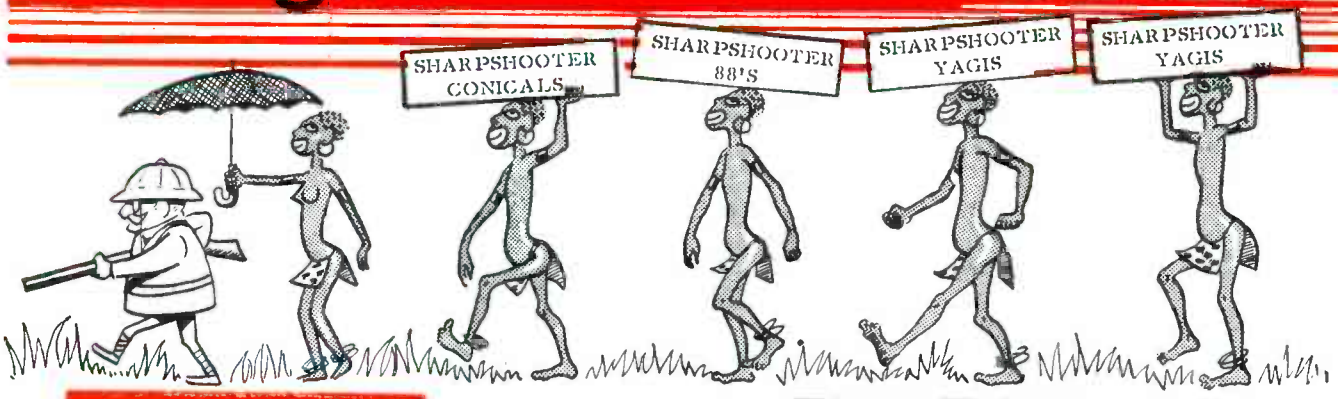

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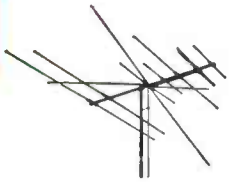

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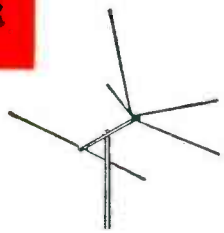

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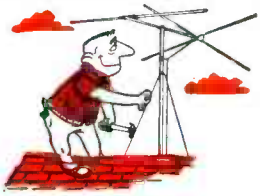

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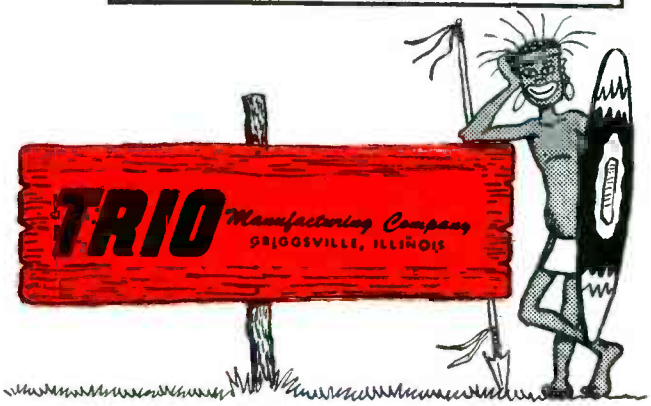

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Servicing Helps

Cures for IF Overloading and Vertical Rolling . . .

Checking Magnetic Tools

OVERLOADING of the *if* in the Bendix T14 chassis has been found to be due to the 1N60 crystal detector.

Overloading of this type normally takes place when switching from a weaker distant channel to a local strong signal. The crystal does not appear to respond to the sudden strong signal and, consequently, no *agc* is developed through the normal function of the 6AH6 video amplifier and 6AU6 *agc* amplifier. The receiver usually remains in this condition until the signal is disrupted or the set is tuned to another weaker channel. If this condition is encountered the crystal should be replaced.

Curbing Vertical Rolling[1]

VERTICAL ROLLING is often found to be an intermittent problem. With a setting of the vertical hold control and the use of a particular 6BL7 good lock may be obtained for a period, and rolling will begin. Resetting of the hold control may result in again stretching the locked-in period. Tube replacement, because of internal leakage, is generally indicated. Tubes that use gold-plated wire in the grid structures often resolve the problem, the wire reducing the leakage problems which can be a cause of instability.

When tube replacements do not cure the problem, the vertical sync pulses used for locking should be checked. Poor pulse clipping, poor video signal from the tuner or *if*, or a poorly-integrated vertical-sync pulse fed to the oscillator circuit, can cause vertical rolling.

In some instances, an open *agc* filter capacitor can cause loss of vertical sync pulses. Poor tuner or *if* tubes can cause similar trouble.

Tape Recorder Tools—Use Precautions

TOOLS USED in the vicinity of erase, record, and playback heads of tape recorders must not be magnetized.[2] If such a tool touches the magnetic structure of the head it can magnetize it. There is then the trouble of demagnetization which must be performed to restore the unit to normal operating condition.

For this reason, it is desirable to have some convenient way of checking all iron and steel tools employed in the vicinity of the heads. A pocket compass can be used as a quick and efficient check on the magnetic condition of all tools and implements. If either end of the compass needle is repelled when the tool is held near it, the tool is magnetized and should not be used in tape repair work.

Photographic Negatives as Shims

OLD PHOTOGRAPHIC negatives can be used to shim up small distances, such as the space between the flat on a shaft and the spring on a knob.

The negs can be cut into small strips and then the strips can be trimmed to length. More than one thickness can be employed if a greater thickness of shim is required.

The celluloid base of photo negatives is far less elastic or springy than paper or match sticks more commonly employed for such shims. It will not withstand the pressure of a motor driven device, but is ample in strength for channel selectors and other knobs on TV or radio chassis.

Ion-Trap Setting Checks

In servicing a television receiver for any type defect, it is good practice to check the setting and condition of the ion trap. If one finds that the ion trap no longer fits snug to the neck of the picture tube, a small piece of rubber should be placed under the clamps, or a piece of friction tape should be wrapped around the clamps to prevent the magnet from slipping from its optimum setting.

[1]From Motorola service notes.

[2]*Practical Considerations in Magnetic Recording*, SERVICE; August, 1956.

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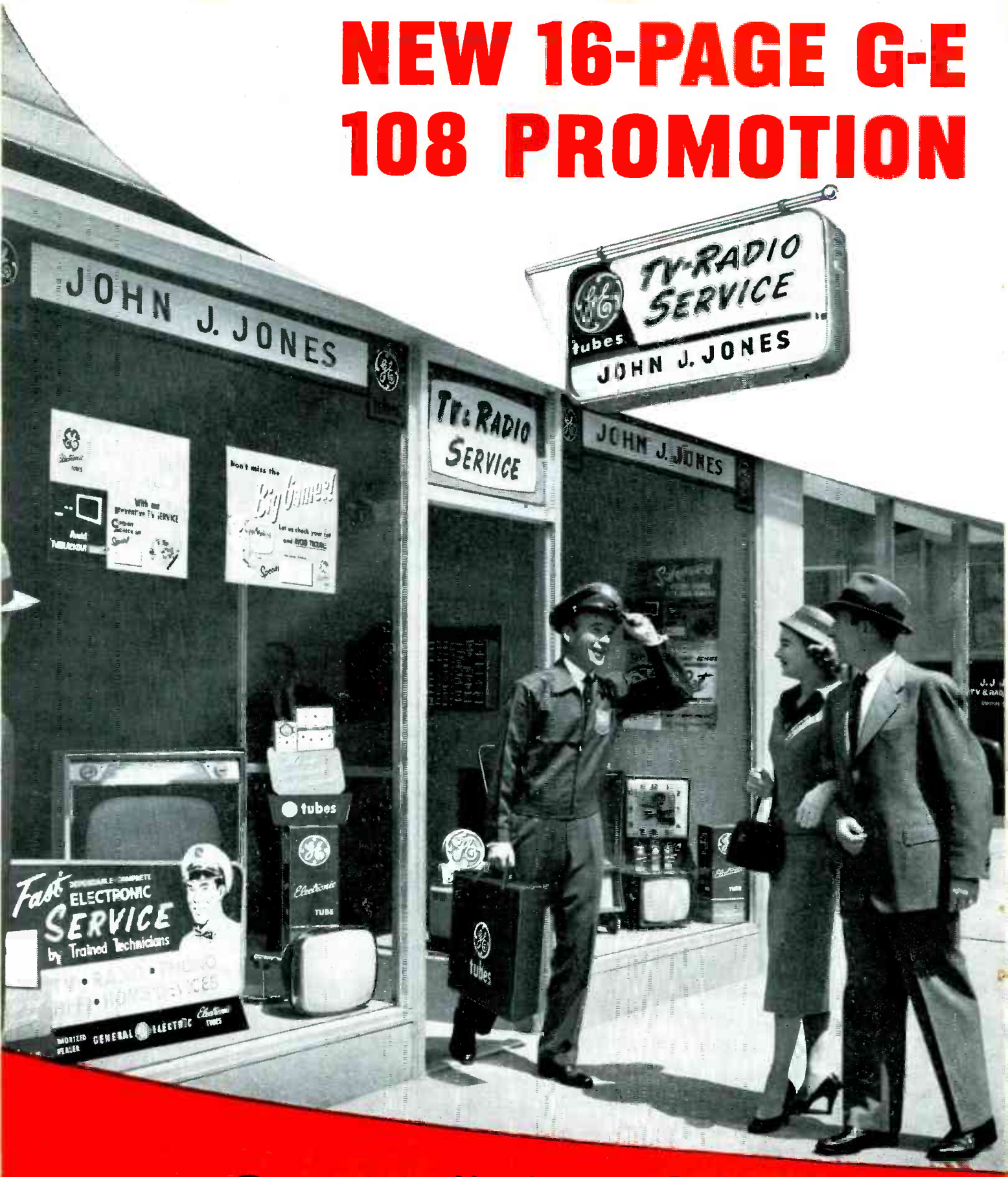

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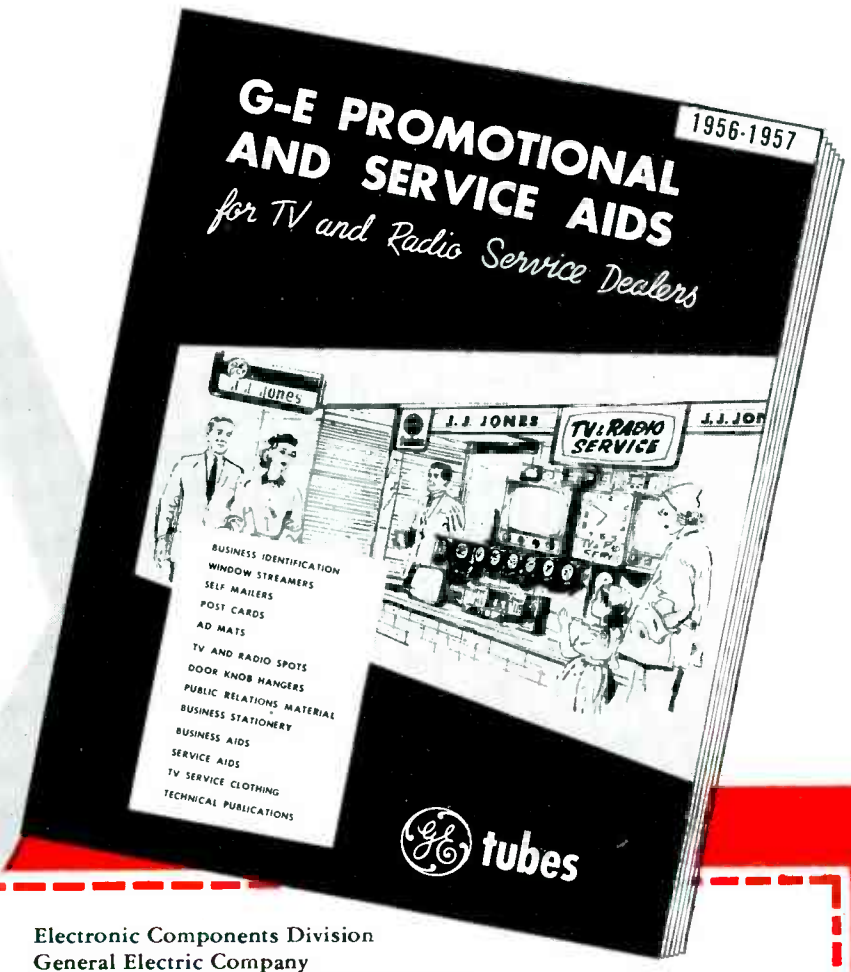

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Blown Fuses in TV
(*Continued from page* 13)

before pulling the chassis, especially if the trouble is a defective tube, by steps which may involve blowing one or two additional fuses. Time can be saved at the expense of the extra fuses. This is a matter of preference which the individual must decide for himself. The following suggested troubleshooting procedures make use of the second method wherever possible.

When a replacement *hv* fuse blows, the most likely possibilities of trouble are the horizontal output and damper tubes. In sets with power or filament transformers, these two tubes should be removed. Then, without replacing the tubes, the fuse should be replaced and the set turned on. If the fuse blows again, a shorted capacitor on one side of the fuse is indicated (C_{208}, Fig. 1: p. 12). If the fuse doesn't blow, both of these tubes should be replaced with new tubes and in addition the horizontal oscillator tube should be replaced. If, after replacing the tubes, the fuse doesn't blow, then one of the old tubes is defective. Each old tube can then be put back to determine which is defective. The fuse will open after the bad tube is put back. However, if the new fuse blows with the three new tubes in, then a voltage and resistance check should be made in the horizontal sweep circuit.

In some sets, the *hv* fuse also fuses the vertical oscillator or vertical output stages. In these models, new vertical sweep tubes should be substituted before making further voltage and resistance checks in the horizontal and vertical circuits.

Blown HV Fuse Causes

Common causes for blown *hv* fuses include gassy horizontal output tube; defective damper tube; shorted capacitors in the horizontal output or damper stage; defective horizontal output transformer or arcing in this transformer or its leads; defective yoke; shorted horizontal size or linearity coils (slugs may be turned in too far and possibly shorting one of the coil terminals to ground). In some cases, a defective horizontal-oscillator tube or other defect in the horizontal oscillator stage may cause a *hv* fuse to blow. This results from a lack of drive (horizontal input signal) to the horizontal output grid, which may cause excessive current through the tube and associated fused circuit.

Troubleshooting Blown B+ Supply Fuses

When a replacement B+ supply fuse blows, one should:

(*a*) Replace the fuse. (If a fusible resistor is used, see *b*.) Try a new rectifier tube, if a tube is used. If the new fuse does not blow, the original rectifier tube is evidently defective. If the replacement fuse blows with the new rectifier tube in the circuit, make a resistance check for a short in the B+ line.

(*b*) If a fusible resistor in the B+ line has opened (R_{502}; Fig. 5: p. 13), one should make a circuit check before replacing the resistor.

One should check to see if the selenium rectifiers appear defective; burn spots, discoloration, characteristic odor.

A resistance check of the selenium rectifiers should be made. Front-to-back resistance should be measured; then the ohmmeter prods should be reversed for a second resistance check. One reading should be considerably higher than the other. Two low resistance readings indicate a shorted rectifier. To get accurate readings, it is advisable to disconnect the wiring from one end of the rectifier.

The resistance of B+ to ground should be checked. A lower-than-normal reading indicates a defective B+ filter capacitor or other short in the B+ line.

If a fusible resistor is not available for replacement, a 7.5-ohm, 5-watt re-

(*Continued on page* 42)

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Blown Fuses in TV

(*Continued from page 40*)

sistor, in series with a 1.6 amp, 125-volt fuse, may be substituted.

Common causes for blown B+ supply fuses include leaky or shorted power supply filter capacitors; gassy rectifier tube (or defective selenium rectifier); shorted bypass capacitor in the B+ line; defective yoke; defective tubes causing B+ overload especially sound output, damper, and horizontal output tubes. (Set with B+ supply fuses usually do not have *hv* fuses.)

When a replacement line fuse blows, the rectifier tube should be removed, the fuse replaced and the set turned on again.

If the fuse blows again with the rectifier tube out, then the trouble is in the power transformer, the power transformer filament line, or between the power transformer primary and the fue (switch, etc.). To isolate further, it is neccessary to make a resistance check of the primary circuit, including the transformer, to determine if there is a short. (In many sets, the resistance of the power transformer primary is normally quite low; about 1 ohm.) If no short is found, one side of the filament line should be detached. With the rectifier tube still out, the fuse should be replaced and the power turned on. A blown fuse now points to a defective power transformer.

If the fuse does not blow with the rectifier tube out, a new rectifier tube should be tried. The old one may be defective (shorted plates). If the fuse blows with a new rectifier tube in the circuit, a defect in the B+ side of the rectifier is indicated. Further resistance checks should then be made in the B+ supply.

The most common causes for a blown-line fuse include a defective rectifier tube; defective power transformer; short in the transformer primary circuit; short in the B+ line; or short in the filament line. In some cases, a short in the B+ line may cause the *lv* rectifier filament to open before the line fuse is blown.

Troubleshooting Blown Filament Fuses

When a replacement filament fuse blows, the set should be turned off and the fuse replaced. As the first check, the tubes most likely to be defective should be removed before turning the set on again; the *rf* amplifier (if a cascode *rf* stage is used), audio output, and damper. These

(*Continued on page 61*)

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Phasing...Microphone Wiring...Low and Line-Impedance Runs

In Large Sound-System Installations

PHASING, as noted in previous reports, is a particularly important factor in the sound-system installation.

Most loudspeaker manufacturers phase their loudspeakers by marking the same terminal consistently positive or negative; thus by connecting all the positives together and all the negatives together, the loudspeakers are automatically in phase. In series connections, of course, a positive should be connected to a negative throughout the chain.

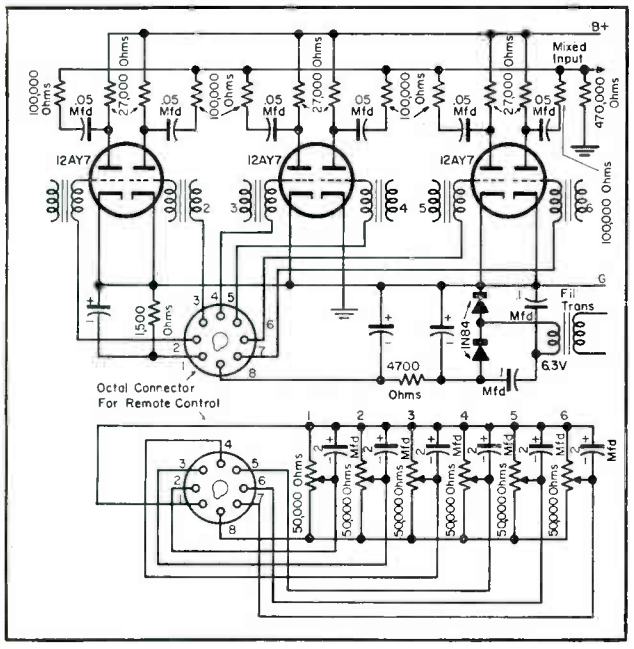
When, however, a 70-volt distribution system is used, you are not connecting directly to the voice coil and the transformer may well destroy your direct possibility of achieving such convenient phasing. It is a good idea to connect up the loudspeakers beforehand to be sure that all the commons of the primary side are connected together and the remaining side connected to the other terminal of the output. Then, by using a color-coded wiring system, phasing will be as simple an item as the direct voice-coil connection.

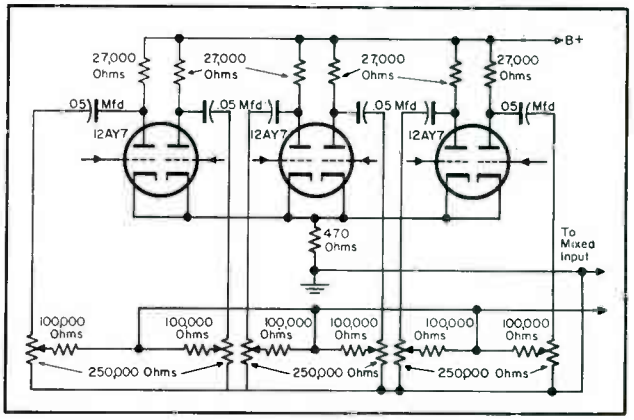
A simple check for the phasing of a pair of speakers is to *1*)—Stand them a few feet apart, *2*)—connect together, and *3*)—listen to program material played over the two loudspeakers, first connected one way and then in reversed position.

When correctly phased, and you are at an equal distance from both of the speakers, the sound should appear to come from a point midway between them; you should have a definite sense of sound source. When incorrectly connected, the sound will become confused; you will get the

(*Continued on page* 50)

*Jensen RT-20 **Jensen D-30





ABOVE: FOR MORE THAN TWO channels, it is necessary to use tubes to maintain level, using circuit illustrated here.

LEFT: IF REMOTE CONTROL OF mixing is desirable, use of dc controls is better than the installation of live audio lines at low level. This circuit shows a simple way of building up such a system. None of the 1 to 8 contacts can be grounded.

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COLOR-TV INTERLOCK CHEATER

A color-TV interlock cheater, *5650*, which is plugged into set to permit entry of a high-voltage probe through its shell, has been announced by General Cement Manufacturing Co., 400 S. Wyman St., Rockford, Ill.

Also available from G-C is a pix-tube rejuvenator, *Zipt 9264*, said to repair grid and cathode shorts without pulling chassis.

° ° °

TRANSISTORIZED RADIO BATTERIES

Three battery types, *VS304, VS305 and VS306*, designed for use in transistorized radio receivers have been added to the battery line of the RCA components division.

TV REMOTE CONTROL TUNER

A battery-operated TV remote-control tuner, *it*, that is attached to the channel selector shaft, has been introduced by Alliance Manufacturing Co. Inc., Lake Park Blvd., Alliance, O.

Unit is powered by a *dc* reversible motor which turns channel selector in either direction; works up to 20 feet away from set. Features finger-tip pressure controls.

PARTS... ACCESSORIES

DC TO AC POWER SUPPLIES

A line of electrical power supplies, *Powercons*, designed to convert the normal 6 or 12-*v dc* battery power supply to 110 *v* 60-cycle power, has been announced by the Powercon division, Cornell-Dubilier Electric Corp., South Plainfield, N. J. Can be installed under the dashboard or in a car's trunk compartment; they may then be wired to convenient outlet such as at the cigarette lighter socket. Range in size, weight, and capacity from light 20-watt units for operating electric shavers to 150-watt or 200-watt units for operation of larger devices. Several models have output voltage control built in.

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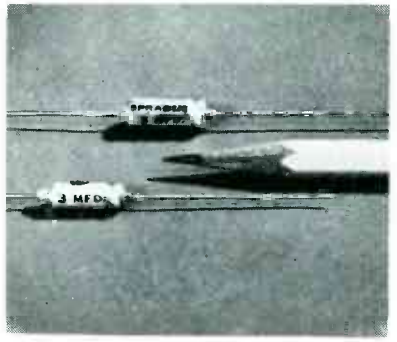
MINIATURE SEALED ALUMINUM ELECTROLYTICS

Small hermetically-sealed aluminum electrolytic capacitors *Littl-Lytics*, have been designed by the Sprague Products Company, 231 Marshall Street, North Adams, Mass.

Tiny capacitors, said to serve as replacements in such equipment as transistor radios, hearing aids, pocket-sized wire recorders, and other miniature electronic units, range in size from 3/16" diameter by 9/16" long to 3/8" diameter by 7/8" long. Values range from 1 to 200 mfd in voltages from 1 to 50 *vdc*.



TEN YEARS AGO IN SERVICE

THE FIRST NATIONAL conference on TV servicing, under the direction of *ye ed*, was held at the annual exhibition-meeting of the Television Broadcasters Association at the Waldorf-Astoria Hotel in N. Y. C. . . . Copies of the talks presented at the session were distributed among associations for use at clinics. . . . Two-way FM (*Motorola*) communication systems operating on 152.27 (receiving) and 157.53 mc (transmitting) were installed in Chicago taxis. . . . *Ted Smith* was named general sales manager of the engineering products department of *RCA*. . . . The first photo-diagram report on the installation of selenium disc rectifiers, based on information supplied by FTR, appeared in SERVICE.

Associations

TSDA, San Mateo, Calif.

AT A RECENT meeting of the Television Service Dealers Association of San Mateo County, Calif., Don Johnson of Westinghouse discussed and demonstrated the Westinghouse 22-inch glass rectangular color set, which was originally described in the June issue of SERVICE.

A highlight report of the meeting appeared in *TV Service*, the official journal of the association.

° ° °

IRTSA, Wisconsin

A NEW GROUP of officers was elected recently by the Indianhead Radio-TV Servicemen's Association, Inc., Eau St. Clair, Wisc. *Earl Kratch* was named president; *Upton St. Clair*, vice prexy; *Richard Presnel*, secretary; and *Vernon Christian*, treasurer.

Sherwood Stolp and *Earl Struve* were elected to the board of directors. *C. W. Stiemke* remains as corresponding secretary.

° ° °

RSA, Luzerne County, Pa.

THE TENTH annual clambake of the Radio Servicemen's Association of Luzerne County, Pa., was held a few weeks ago on Sgarlet Lake.

Formerly the meetings were held at Lily Lake.

° ° °

MTSE, Minneapolis, Minn.

THE FIRST service-engineering conclave of the Minnesota Television Service Engineers, Inc., Minneapolis, at the University of Minnesota, was an outstanding success, according to association prexy *John Hemak*.

Those at the meeting received certificates of attendance from University president *J. F. Morrell*.

The group will meet again next year at the University during a 3-day session on May 6, 7, 8.

° ° °

TVEC, Evansville, Ind.

THE TV ETHICS COMMITTEE of the Evansville (Ind.) Chamber of Commerce recently celebrated its third anniversary at a special meeting in Sterling, Indiana.

The group was praised by many business and professional members of the Chamber of Commerce for its activities in protecting the TV set owners and the self-policing program of the association membership which, it was said, insured honest and competent service and installation.

At third anniversary celebration meeting of TV Ethics Committee: Lee White, **secretary, and** John Buchman, **president.**

INSTRUMENTS

COLOR-TV VIDEO MULTIMARKER

An absorption-type *video multimarker* (*WG-295B*), designed especially for use in sweep alignment and troubleshooting of color-TV receivers, has been developed by the RCA components division. The instrument, it was said, provides seven simultaneous reference markers on a sweep-response curve at factory-set frequencies.

Markers at 4.1 and 3 mc provides facilities for checking video-amplifier and bandpass amplifier response curves, are in addition to the markers at .5, 1.5, 2.5, 3.58 and 4.5 mc supplied by the *WG-295A*. These are frequencies needed for checking Q and I filters, bandpass filter, color subcarrier circuitry and sound trap of color set.

° ° °

COLOR CONVERGENCE GENERATOR

A color-TV convergence and linearity generator (*model 250*), that provides white dot pattern, white line crosshatch and horizontal or vertical bars has been developed by Winston Electronics, Inc., 4312 Main St., Philadelphia 27, Pa.

Auto-lock counter chain with *afc* said to provide jitter-free patterns locked to the power line frequency. Standard 15,750-horizontal sync pulse and 60-vertical sync pulse, 30-frame 525-line interlaced raster with blanking of retrace lines makes unit also useful as a test pattern and sync generator.

TEST EQUIPMENT CALIBRATOR

A lab-type *test equipment calibrator* (*model 750*) with, it is said, accuracy of 1% or better in all of its voltage sections has been announced by the B&K Manufacturing Co., 3731 N. Southport Ave., Chicago 13, Ill.

Calibrator checks test equipment accuracy; reveals how far any instrument may be off.

Supplies 2, 5, 25, 100, and 300 *v dc*, and 5, 25, 100, and 300 *v ac*, to check voltage ranges. Provides 10, 100, 1,000. 10,000 and 100,000 ohms and 10 megohms to check resistance ranges. Supplies crystal oscillator capable of generating harmonic frequencies well over 300 mc. Plugging in proper crystal facilitates use as a marker generator in radio and TV receivers; helps to check calibration on AM signal generators, or check and align the audio *if* system of TV receivers.

Serves as a voltage calibrator for 'scopes in the measurement of peak-to-peak voltages of any unknown waveforms such as are found in TV receivers.

° ° °

TUBE TESTER

A tube tester (*model T72*) that provides 72 sockets to check over 300 TV and radio tubes including 600-mil and color tubes without, it is said, roll charts or multiple switching, has been placed on the market by the Anko Manufacturing Co., Inc., 5042 W. State St., Milwaukee 8, Wis.

Tests all sections of multi-section tubes. Dynamic-loaded test supplied by instrument, puts tubes under fully loaded conditions. Checks for shorts from any element to any adjacent element. Also affords special tests for gas, grid emission and grid shorts on one and two-section tubes. Ten spare sockets are provided for new tubes that cannot be tested on presently wired sockets.

TV Antennas

(*Continued from page* 32)

ments become loaded as the positions and sleeve lengths are changed.

To overcome these objections antenna manufacturers have designed many innovations in the basic V-shaped dipole configuration.

Recently, the lab of one antenna manufacturer announced the development of an indoor model[1] with a number of unique properties.

A feature of this antenna is its novel shape, with a flat length of twenty inches. This is considerably less than the desired length for a normal halfwave dipole causing its impedance to be almost entirely capacitive and its radiation resistance to be only 3 ohms. An electrical representation of this situation is shown in Fig. 1; p. 32. The electrical length of the antenna can be increased without increasing its physical length by end-loading. The *hats* at the end serve this purpose and increase the radiation resistance to about 30 ohms, but its impedance is still mostly capacitive; this condition is illustrated in Fig. 2; p. 32.

Since capacitive reactance can be tuned out with series inductance, this feature was included in the antenna via a variable inductance[2] which could be adjusted for each channel; this approach was found to provide a 30-ohm radiation resistance, as noted in Fig. 3; p. 32.

To provide an impedance step-up of 10:1 so that the antenna would appear as a 300-ohm impedance, an autotransformer was added; Fig. 4; p. 32.

This arrangement served to provide an antenna of short physical length that still could be tuned to even the lowest TV channel.

The use of the end-loading principle to increase the impedance was found to serve more than one useful purpose. It allowed the use of the 10:1 impedance ratio in the autotransformer instead of a 100:1 ratio; this would have been required if the antenna impedance was left at 3 ohms. End-loading also was found to control the antenna's Q, affording an increase in bandwidth and corresponding channel coverage.

In planning this indoor for low-band use, the center rod and *hats* at the ends (shown in Fig. 2) served as the basic elements. For high-band use, there were added two outside rods on each part of the antenna to form two *Us* to simulate a *fat* dipole. In view of the limited length of the antenna on the high bands it was found it would appear capacitive with a low impedance, were it not for the introduction of a tuning inductance. Therefore, the tuning mechanism used on the low band (in series) was adapted for the highs, but in shunt, to tune out the capacity. The equivalent circuit for the high band, including the auto-transformer to step up the impedance, is shown in Fig. 5.

[1]*The Showman, designed by Julius Green, Channel Master project engineer.*
[2]***Metro-Dyne** tuning*

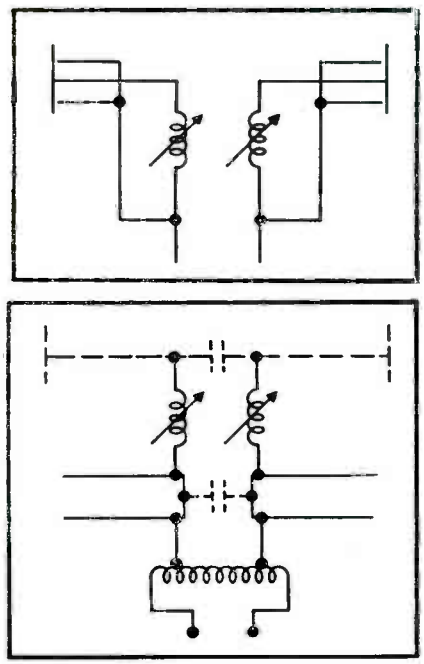


FIG. 5: CIRCUIT (top) illustrating high-band dipole; it is highly capacitive. Equivalent circuit (bottom) shows shunt compensation of high-band dipole; capacitive reactances of both the high and the low-band dipoles (dashed lines) can be tuned out. Impedance can then be stepped up by autotransformer as illustrated.

Audio

(Continued from page 44)

impression that the sound fills the room rather than coming from a definite point.

To phase up a whole batch of loudspeakers, one should be set aside as a reference. Then, each of the remaining loudspeakers can be compared with the original one. If necessary, the voice coils should be reconnected, so that all of them are in phase when the common side of the primary is connected to the same side of the amplifier output.

Having completed this test, and coded black and red, or red and white wire combinations are adopted for the wiring system, it will then be necessary to use only a black or white lead for the common and the red for the *live* side throughout the system, and you will automatically be phased.

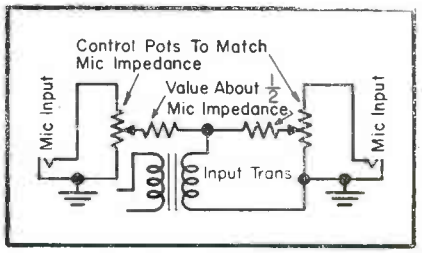
If these preparatory steps are not taken you will be faced with the problem of phasing on site. This will mean connecting and disconnecting each loudspeaker in turn and comparing the sound between individual pairs until you have the whole system phased; a very time-consuming process. It is much easier to make the test in the shop, where the speakers can be placed in position quite quickly and phasing checks made in quick succession.

Care should be taken in running the wires to the loudspeakers; they must not project into the audience area to present a safety hazard.

The possibility of sabotage must also be considered. Some people come to meetings just to spoil them in some way. It is much more convenient to cut the loudspeaker wire, if it is accessible, than to interrupt by heckling. So all the loudspeaker wiring should be placed out of harm's way.

In large sound installations, there are a number of special problems that must be resolved.

To illustrate, often the amplifier has to be at a considerable distance from



SIMPLE TWO-CHANNEL mixer for two microphones. This arrangement can also be used at high impedance, in which case the input transformer will be unnecessary.

INVERTER specially designed to operate tape recorders, record players and pa systems from auto dc supply. One model (ATR 6-RHF) operates on 6-v battery and delivers 100 watts continuous (125 watts intermittent). Another model (ATR 12-RHF), operating from 12-v battery, delivers 125 w continuous (150 w intermittent).

the microphone; this means the installation of relatively long lines.

On small installations, it is usually most convenient to use a high-impedance microphone, because this avoids the necessity of an input transformer on the amplifier. But long lengths of shielded cable can lead to excessive high-frequency loss or, if crystal type microphones are used, excessive attenuation of the entire signal.

Two impedances are favored by microphone manufacturers and public address groups. One may be described as a *low impedance* in the region of 25 to 50 ohms; the other is usually called a *line impedance* and may vary from a 150 to 600 ohms. The exact value is not usually very important, but the method of using the two groups does differ.

With low-impedance microphones it is possible to use the standard wiring for the microphone, because the low-impedance circuit is only likely to pick up crosstalk or hum by electromagnetic induction. Thus, tightly-twisted pairs can be used, either one side grounded or balanced, usually the former; *but* the leads must be kept reasonably well away from power lines or other sources of interference.

However, when low-impedance circuits are used on very long lines, say a mile or more, losses are often so serious that it becomes necessary to use a booster amplifier at the microphone end.

The 150 to 600-ohm variety of *line impedance* was originally introduced to make it possible to run distances up to a mile or more without serious

(*Continued on page 52*)

Audio

(*Continued from page* 51)

loss. This is, in fact, the region of optimum line impedance for audio transmission. However, lines at microphone level must be both balanced and screened for successful transmission over long distances. Thus twin shielded wire must be used with a center-tap input transformer, so that the line can be run balanced, by connecting the center tap to ground. The microphone output should not be grounded on either side; otherwise the balanced arrangement will be shorted out.

100′ To 200′ Run Requirements

For 100′ or 200′ runs, the 150-ohm impedance, which is becoming quite popular these days, is sufficiently low to be satisfactory connected single ended. As noted, the twin twisted or single shielded lead can usually be used at this impedance; the single shielded line is somewhat better, because higher impedances are up in the region where electrical pickup can be troublesome.

As all crystal or ceramic microphones are high impedance, these types are *not* recommended where long microphone connections are involved.

Mixing

Another large-installation situation that requires careful consideration is the mike junction point; often a number of microphones, at various points, must be connected into the same amplifier for use at different times during the program. Maybe a number of speakers distributed at different points on a platform have to talk, and instead of bringing each speaker to a central mike a number of mikes are grouped across the platform, so that each speaker can step up to his own microphone.

If all the microphones are connected into the same input, and are on simultaneously, the extraneous-noise pickup will be excessive and affect output. It is very desirable to use only the necessary microphones at one time. This requires some mixing arrangement, so that individual microphones can be faded in as desired.

If only two microphones are used, a parallel mixer can be connected right at the input to the amplifier. But even this will cause a loss of about 6 to 8 db in maximum gain from either individual microphone, so

it will not be successful unless this much spare gain is available in the first place.

Where four or five microphones have to be connected into the same circuit with a mixing arrangement, as much as 15 to 20 db loss can occur on each individual channel. Of course, additional gain can be provided to make up this loss; but, if it is provided after the mixing, the whole input circuit can become much more susceptible to pickup of extraneous signal, crosstalk and hum.

The best arrangement, therefore, is to provide each microphone input with a separate microphone amplifier stage. A 12AY7 amp is excellent for this purpose; it is low noise and has a medium gain. One half of a 12AY7 can be used for each microphone input; this will provide sufficient amplification to mix in the plate circuit of all the 12AY7s.

Six-Input Setup

With three 12AY7s, six inputs are possible. Filament and plate supply for the extra tubes can be obtained from the regular amplifier, after having ascertained that the filament winding is adequate for the purpose. Three 12AY7s connected to a 6.3-volt winding will take an additional .9 amp from the filament transformer.

This mixing circuit is at high impedance, to save stepping down and up again, and should be connected to the amplifier itself. It is not wise to try and make this remote from the amplifier.

If the refinement of a remote control is required, this can be achieved by using a variable bias on each tube;

(*Continued on page 54*)

Audio

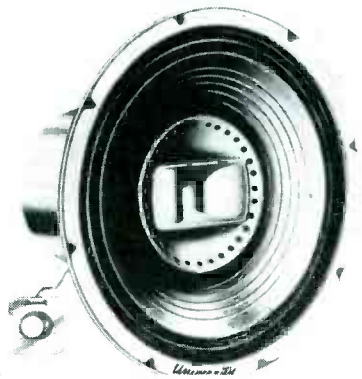
(*Continued from page 53*)

EXPLOSION-PROOF, U-L approved, pa loudspeakers made for paging and talk-back applications. Available with built-in line matching transformers. (Models HLE-1-30 and 1-42; Atlas Sound Corp., 1451 39 Street, Brooklyn 18, N. Y.)

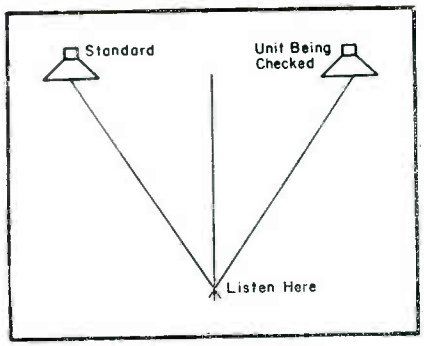
a negative supply can be obtained from a separate filament transformer, using a voltage-doubler circuit to get about 12-volts negative.

DC For Pots

With such a circuit plan, the potentiometers on the remote control unit only have to carry *dc*; the signal circuit goes straight into the amplifier and through the mixing tubes. This arrangement is very convenient where



UNITARY TYPE SPEAKER assemblies, containing two or three integrated radiators, for two- or three-way performance. Split range performance of two-way unit is said to be obtained through mechanical parameters designed into woofer and Diffusicone **sections to achieve mechano-acoustical crossover characteristics. In three-way unit a top-range compression diver-tweeter coupled to a** reciprocating flare **horn is added. Wide-angle horn is mounted through center of woofer assembly for exponential expansion. Tweeter is electrically meshed to two-way cone system through a built-in L/C dividing network.** (Diffaxial; University Loudspeakers, Inc., 80 S. Kensico Ave., White Plains, N. Y.)



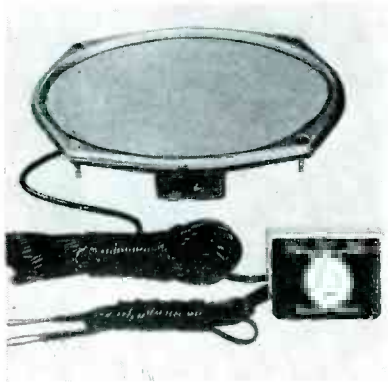
HOW TO LISTEN to two loudspeakers when making phasing checks.

it is desired to use controls remote from either amplifier or microphone.

The remote control can be connected with the amplifier by means of an octal plug and socket, so that the system can be made quite portable.

Tone Controls

A final feature that one should include in a large installation is a comprehensive tone control on the main amplifier. Most modern public-address amplifiers have this feature; but it is much more important in a large installation than a smaller one, because most large buildings have characteristic frequencies at which they reverberate and cause acoustic feedback. By careful adjustment of both high and low frequency tone controls the best overall response can be obtained in that particular building, compensating to some measure for the peculiarities of the building acoustics.



SWITCH HARNESS kits for auto rear seat speakers; seven models said to fit all cars from '49 through '56. Kits include a 3-position dial-type mounting switch and all necessary leads and instructions. (Rickay Manufacturing Co., 4319 W. 35th St., Cleveland 9, O.)

When . . .
You Change Your Address

▶ Be sure to notify the Subscription Department of SERVICE at 52 Vanderbilt Avenue, New York 17, N. Y., giving the old as well as the new address, enclose address labels from your last SERVICE copy, and do this at least four weeks in advance.

▶ The Post Office Department does not forward magazines unless you pay additional postage, and we cannot duplicate copies mailed to the old address.

▶ We ask your cooperation.

Garage Door Openers

(*Continued from page* 11)

a vertical mount on a fender or cowl is more satisfactory. To enable operation of a circuit posing a greater power demand, along with the door operation, an external relay will have to be added to the circuit.

Before an installation is ready, the leads from the receiver control leads must be left detached from the operator and a flashlight with two clip leads (in series with the bulb and batteries) hooked on. With the garage door open, the car's transmitter can be tested by observing the light each time the button is pressed. This will demonstrate range and directivity. The switch can be jumped with a lead (with light out) and the receiver antenna oriented. By placing the antenna in other directions or by adding a quarterwave length to the existing antenna, the light will go on signifying control from the car.

On all of the aforementioned control units, we have found the general type of troubles common to all electronic equipment, such as defects in vibrators, capacitors, resistors, selenium rectifiers and tubes.

It has been found that a tube in cutoff develops what is referred to as cathode-face resistance. This seems to be a function of the type of cathode material used. Consequently, premature failure in the relay circuit of the receiver results. We have met this problem by using premium tubes, specifically designed for computers, which lend themselves well in radio-control circuitry.

Service Call Procedures

On a typical service call over the phone customers are asked if the door operates with the garage button. If the answer is in the affirmative, the radio control is suspected. Our vehicle has a transmitter, and on reaching the customer's home, the key plug-in unit from his transmitter is used. If door operation is still lacking, the receiver is checked. With tubes lit up, fuse okeh, a substitute receiver is mounted; this change requires little time. We have found that this substitution method gives fast field service.

The future of radio control garage door openers is dependent on a design criteria that will overcome some of the shortcomings noted. Remarkable progress has already been made and many more developments will, we are sure, appear soon.

(*Continued from page* 26)

must be *available*. It is not as easy to make a piece of radio equipment which will function without frequent failures when it is subjected to heavy shock, weird types of vibrations, fumes, smoke, gases, and other unusual environmental conditions.

Once the hurdle of obtaining good equipment has been cleared, the railroad must install it properly and then must give it adequate maintenance. Stringent labor regulations on most railroads require that the installation of radio equipment must be performed only by properly classified railroad employees. Some railroads hire their own Service Men to maintain radio equipment. The Northern Pacific, for example, employs 9 people to maintain radio. However, many of the small railroads and a number of the big ones contract with independent service organizations to maintain some of their radio equipment in certain areas. The Walla Walla Valley Railroad and the South Shore Line farm out all of their radio maintenance; the New York Central in certain locations.

Service Men, whether employed by the railroad or outside contractors, seldom service the radio equipment while it is still on board rolling stock. Some roads require removal of the equipment by personnel employed in the railroad mechanical department. In some cases, Service Men are asked to come aboard to remove the set and replace it with a spare; Service Men are also called on to diagnose troubles which may be caused by the power supply, antenna system or control equipment.

Mobile communications units are removed and brought or shipped to a shop, where they are serviced and then stored as spares for later use. How often sets are replaced with spares on a routine basis depends upon the individual railroad. Some follow a 30-day cycle, others do not touch the sets for six months, unless a set fails in service before that time.

When a single unit type set is used, the entire assembly is, of course, exchanged. When three units sets are used, all three are usually replaced; in emergencies, however, when it is known which unit is ailing, only one unit need be replaced.

In the shop, the sets are thoroughly checked electrically and mechanically. Whole sets of tubes are rarely replaced at one time. In the rugged type of rail service to which 2-way

(*Continued on page* 58)

(*Continued from page 57*)

equipment is subjected, new tubes are more apt to fail than tubes which have been in service; aging racks are often used to permit tubes to be run-in before their installation in mobile units. When tubes are changed, particularly in the *rf* section of a receiver, realignment is generally necessary. If tubes are removed from a set for testing, they should be reinserted in the same sockets.

One large railroad reports that 63% of all radio failures are due to defective tubes and that types 6AK5, 6J6, 6BH6 and 2E26 fail far more frequently than other types. Vibrators have an average life of 21.5 months. Dynamotors have been found to require only routine maintenance.

Exact replacement parts are used for replacement. Wiring and placement of parts must not be altered lest what may be apparent small changes could produce major operating difficulties.

The law requires that all persons who make adjustments to radio transmitters must be properly licensed or must work under the direct supervision of a properly licensed operator. In the railroad radio service, the maintainer must possess either a first or second class radio-telephone operator's license.

Technical knowledge of electrical circuits, transmitters and receivers, plus familiarity with FCC rules and regulations is required. Written tests are administered at FCC regional offices.[1]

Test Equipment

Test equipment which has proved adequate for servicing home radio and TV sets may not be satisfactory for servicing railroad radio equipment. For example, an *rf* signal generator may be tunable through the 152-162 mc band, but if its output cannot be attenuated to less than one microvolt, it will not be satisfactory; railroad communications receivers can provide useful output with signals of one microvolt or less. Even if the signal generator-attenuator is calibrated down to one microvolt, the signal leakage around the attenuator and through the case may be far in excess of one microvolt.

Another must in the shop is a frequency and deviation meter.* The frequency meter must be a professional type acceptable to the

[1]There is no charge for an FCC license.

FCC. In making frequency measurements periodically, as required by the FCC regulations, the findings must be entered in the log. It is not satisfactory to state that the frequency checked within limits. Instead the exact frequency as indicated by the measuring device, must be recorded. Means must also be provided for checking the accuracy of the calibration of the frequency-measuring instrument. This can be done at a qualified laboratory or by the Service Man by making a comparison with standard frequency signals transmitted by the Bureau of Standards radio station WWV.

Shops should be provided with the proper wiring jigs so that the sets may be operated on a bench. The jig should provide a control system, microphone, loudspeaker and dummy antenna. Power must also be available for operation of mobile units in the shop. What kind of shop power supplies must be provided depends upon the equipment to be serviced; shops equipped to handle all types of railroad radio will need *dc* at 6, 12, 32, 64, 72, and 110 volts *dc* plus the usual *ac* power.

To get 6 or 12 volt power, rectifier power supplies are available. One with excellent regulation characteristics should be selected. A lot of time can be wasted if it is necessary to reset the voltage control every time the set being tested is transferred from *receive* to *transmit* and vice versa. A storage battery with a floating charger is a good reliable power source.

A rectifier power supply for furnishing 64 volts *dc*, the most popular value, is being developed specifically for shop testing of railroad radio units and power converters. Another solution is to use an *ac* to *dc* motor-generator set.

An *rf* wattmeter may be used in lieu of a dummy load. This is an expensive, but very handy instrument to have on hand. With it, the condition of transmitter tubes can be determined quickly. Tuning can be handled more accurately and quickly. Besides, it will often give a more accurate reading of power output, than the rating on the nameplate. This instrument is also valuable for detecting such faults as the decay of transmitting power after a short period of operation.

Getting Into the Field

To get into the railroad-radio servicing business, one should either get a full or part-time job with a railroad or a contract to handle servicing as an outsider. The superintendent of communications‡ usually makes the final decision in selecting either an employee of this type or an outside contractor. On very large railroads, contact is usually made at a lower echelon of management. The large railroads have regional communications supervisors, who, if they cannot make that type of decision, will know through what channels such inquiries should be routed.

There are 131 major railroads and about 3,000 of all types in the United States, so there are plenty of prospects. In addition, there are many industries which operate their own private railways. Radio maintenance work is generally performed in those areas where railroads have shop or yard facilities and at major terminals.

There is a greater opportunity now for the independent contractor because the rapid adoption of other new electronic devices by the railroads is overloading what technical manpower the railroads have available.

‡The name of the superintendent of communications of almost any railroad can be found in the Official Guide of the Railways that is available in almost every railroad ticket office. Such information also is available from either A. H. Grothmann or L. E. Kearny at the offices of the Association of American Railroads, 59 E. Van Buren St., Chicago.

*Several manufacturers including *Lampkin, James Knights, Motorola* and *West Coast Electronics* make these instruments.

Decatron Video System

(*Continued from page 19*)

be corrected for in-phase and amplitude response by the application of networks having the inverse characteristic of the step function.

Since the first stage employs a high G_m pentode, the required compensation can be obtained by using cathode and screen networks having an impedance of the inverse frequency characteristic. These networks have a rising frequency characteristic above the crossover point, and since the crossover point or time constant is the same as the 15,000-ohm load and its associated tube capacities, the result is flat frequency response within the desired pass band. A small part of this correction is also obtained from a 33-mmfd capacitor placed across a 3300-ohm resistor in the top half of the plate load of the first video amplifier.

The use of two pentodes has been found to result in lower circuit capacities as well as lower plate loads. This permits the use of lower inductance peaking coils, which in turn extends the frequency range and sharpens the corner of the transient response.

To insure further uniformity, the circuit employs a variable shunt peaking coil in the plate of the second video amplifier. This coil is adjusted on each set by a test operator to give the specified overshoot in the transient response. This slight overshoot sets off the blacks from the whites with a fine line of demarcation which gives depth and crispness to the picture. The low value of series-peaking coils achievable with this circuit has been found to make it possible to obtain this fine line of demarcation, by providing the high-frequency part of the response required to give a sharp corner to the transient response.

By combining a good transient response with high contrast, it has been possible to obtain pictures with extremely great depth and high resolution.

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AGC Systems

(*Continued from page 34*)

horizontal sync pulse is not applied to the grid, or the horizontal pulse from the output transformer is not applied to the plate, the *agc* tube will not conduct. When conductance does take place, the output of the *agc* tube appears across capacitor C_2, which charges up to the full amount of the amplified sync pulse. Phase reversal takes place in the tube, so that the output pulses extend in a negative direction as needed for *agc* voltage.

[Additional data on agc systems will appear in the third and concluding installment of this series, next month.]

Blown Fuses in TV

(*Continued from page 42*)

tubes have the greatest difference of potential between the filament and cathode, and are the most likely to have a filament-cathode or filament short, causing the filament fuse to open. However, any tube in the set may develop a short across the filament and thereby blow the fuse.

After removing the foregoing tubes the set should be turned on. If the new fuse doesn't blow, the old tubes should be reinstalled one by one until the fuse blows; the last tube put back is the defective one, and should be replaced by a new tube.

In the event the foregoing tubes are removed and the replacement fuse blows immediately, one or more of the remaining tubes is faulty. The rest of the tubes should be removed. The fuse can then be replaced and the tubes returned to their sockets one by one, until the defective tube is found. In rare instances, a shorted filament bypass capacitor or a short in the filament line wiring to the chassis is responsible for the blown fuse.

Types of Fuses

TV cartridge fuses have electrical ratings which refer to the opening time, current-carrying capacity, and voltage-breakdown value. With regard to opening time, fuses are either ordinary (fast blow) or slow blow. Fast-blowing fuses have a single link which opens quickly on overload. The drawback to this type of fuse is that it may open on a momentary surge of current which would not damage the circuit. Slow-blow fuses have two elements: a thermal cutout and a fuse link. These fuses do not open on momentary surges, but do open if the overload is sustained.

Fuse ratings for current-carrying capacity and voltage breakdown can be defined simply. The current rating indicates the maximum current the fuse can carry without opening. The voltage rating refers to the amount of voltage an open fuse can withstand safely without arcing over and breaking down. Most TV fuses are rated at 250 volts, though 125-volt fuses are used in some circuits.

It is important to replace blown fuses with new ones having the same ratings. As mentioned previously, exceptions should be made only when it is clear that the old rating does not allow adequately for current surges.

[A report on the C and N-type fuses, recently introduced, and replacement tips will appear in October, Service.]

Magnetic Recording

(*Continued from page 20*)

contact than the standard tape, because of their increased pliability.

If one edge of the tape has become stretched, either in manufacture or in subsequent handling, head contact will be poor. If a tape is suspected of stretched edge, about ten feet of the tape should be pulled out and the length of it sighted. If one edge droops below the other, this edge is longer, and will stand away from the heads. Should this condition exist, it would be well to determine whether the tape was stretched in manufacture, or if the customer's machine is stretching it. Tape can be stretched on a machine by incorrect holdback or takeup tensions, in either forward or rewind modes; a bad capstan bearing, which will cause the tape to run up on capstan thus stretching edge; or an oxide build-up on tape guides, especially on take-up side.

21-Inch Color-TV

(*Continued from page 22*)

resistor built into the neck portion of the tube. This has been found to permit the use of a conductive coating (applied to the exterior of the high voltage insulating boot) as the high-voltage filter capacitor.

A high-voltage insulating shield serves to support the deflection yoke and also to support the bell portion and the rear of the picture tube. An insert within the deflection yoke centers the neck of the tube in the deflection yoke.

By removal of only four nuts at the picture-tube mask, it is now possible to remove the picture tube, high-voltage insulating shield, deflection yoke, convergence yoke, and the purity magnet and blue lateral beam-positioning magnet as a unit.

As noted previously, two different tuner types are available in all three series of the receivers.

For *vhf* only, a switch-type tuner is used; this features a 6BQ7A dual triode as a driven grounded-grid *rf* amplifier coupled to the mixer, the pentode section of a 6X8. The triode section of the 6X8 is used as the local oscillator; the *if* output of the tuner is in the 41-mc range.

The *uhf-vhf tuner* assembly uses the same tube lineup as the *vhf* unit; however, when switched to the *uhf* position the 6X8 (triode) oscillator is switched off, the 6BQ7A becomes an *if* amplifier at 41 mc, and the pentode section of the 6X8 becomes another stage of 41 mc *if* amplification.

The *uhf* local oscillator uses a 6AF4A triode whose output is coupled, with the *rf* signal from the preselection circuits of the tuner, to a crystal-diode mixer. Output from the mixer feeds into the 6BQ7A which is used on the *vhf* positions as the *rf* amplifier.

In one line of chassis[3] the picture *if* amplifier consists of three stages using 6DE6s in the first two stages and a 6CB6 in the third stage.

The luminance channel, which performs the same functions as the video amplifiers in conventional black-and-white TV receivers, consists of two stages. The first video amplifier uses the pentode section of a 6AW8. The picture second detector output is applied between the grid and cathode of the first video stage. Output from the first video stage is taken from both the cathode and plate circuits. Luminance (the black-and-white signal) is coupled to the second video amplifier grid from the cathode circuit. Sync, *agc* voltage and chrominance information are derived from the plate circuit of this stage. A delay line between the first and second video amplifiers delays the luminance information so that it will arrive at the picture at the same time as the chrominance information.

[3]*Special and Super chassis.*

[A circuitry report on the remaining portion of the color chassis will appear in next month's issue of SERVICE.]

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8½" Portable TV

(*Continued from page 16*)

the crystal (CR_{301}) second detector. *Agc* is obtained by filtering the rectified *if* signal; the filter components are a 820,000-ohm resistor and a .33-mfd capacitor (R_{120} and C_{115}). This *agc* bias is applied to the combined *rf* amplifier and the first *if* amplifier and also to the second picture *if* amplifier.

The bandwidth of the *if* under normal signal conditions is approximately 2.1 mc. However, as the signal strength decreases, *agc* bias changes proportionately and the bandwidth decreases. This is due to the *Miller effect* and provides greater *if* gain for weak picture signals.

A single pentode is utilized as a video amplifier. Its output drives the cathode of the picture tube. The 4.5-mc sound *if* carrier is capacitively coupled to the grid of the sound *if* amplifier from this stage.

The 4.5-mc sound *if* carrier is coupled by means of a 5-mmfd capacitor (C_{101}) to the sound takeoff transformer (T_{101}). The sound *if* amplifier is a reflex circuit, since it serves both as an *if* and audio *amplifier*.

The ratio detector is comprised of two crystal diodes; CR_{102} and CR_{103}. The detected audio signal is coupled through a .01-mfd capacitor (C_{110}) to the grid of the sound *if* and first audio amplifier, a 6U8. The audio signal is developed across a 33,000-ohm resistor (R_{104}) and is coupled to the volume control by means of a .01-mfd capacitor (C_{106}). A filter network decouples the 4.5-mc signal from the audio prior to the volume control. A triode is used as an audio output stage. This tube function is part of the 6U8 so that the sound *if* and audio uses only one tube and three crystals.

The portable uses a synchroguide circuit with a 6BQ6 as a horizontal output to provide the relatively high deflection (90°) power required by the 8DP4.

TV-AUTO RADIO Tube Developments

PORTABLE-TV tubes for 450-mil series-string applications are now available as replacements.

One line, announced by Sylvania, includes 26 types.‡

Auto Radio Types

SEVEN NEW RECEIVING tubes,[1] designed for use in auto receivers in which transistors are used in the output stage and in which voltages for both tubes and transistors are obtained directly from a 12-*v* storage battery, have been developed for chassis that will be available in many models of '57 automobiles.

One is a pentagrid converter of the 7-pin miniature type (12AD6) intended for use as a combined mixer and oscillator tube. Two others (12AE6 and 12AJ6) are multiunit tubes of the 9-pin miniature type. Each contains two diodes and a medium-mu triode in one envelope, and is intended to perform the combined functions of AM detection, *af* amplification, and automatic volume control. The 12AE6 can also serve as a trigger tube in auto receivers utilizing automatic station-selection circuits.

For use as *rf* or *if* amplifiers, remote-cutoff pentodes (12AF6 and 12BL6) of the miniature type were designed.

For service as a combined AM detector and automatic volume-controlled audio amplifier, the tube engineers designed a 9-pin tube (12F8) containing two diodes and a remote-cut-off pentode in one envelope.

Driver Tubes

For driver applications, to supply high input power at low distortion to the transistor in the output stage, a high perveance 7-pin power tetrode (12K5) has been designed. This tube is also intended for use as the relay tube in receivers utilizing automatic station selector circuits.

‡Sylvania 450-mil series string tubes and their prototypes (italicized) are: 3AF4A (*6AF4A*), 4BC5 (*6BC5*), 4BN6 (*6BN6*), 4BU8 (*6BU8*), 4CB6 (*6CB6*), 4DT6 (*6DT6*), 5BQ7A (*6BQ7A*), 5BZ7 (*6BZ7*), 6AQ5A (*6AQ5*), 6BK7B (*6BK7A*), 6CL8 (*6CL8*), 6CM8 (*6CM8*), 6J6A (*6J6*), 6T8A (*6T8*), 6U8A (*6U8*), 8AU8 (*6AU8*), 8AW8A (*6AW8A*), 8BA8A (*6BA8A*), 8BH8 (*6BH8*), 8CG7 (*6CG7*), 8CM7 (*6CM7*), 8CN7 (*6CN7*), 8CS7 (*6CS7*), 9AU7 (*12AU7*), 17AV5GA (*6AV5GA*), 17AX4GT (*6AX4GT*), 17C5 (*5OC5*), and 17DQ6 (*6DQ6*).

[1]RCA.

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RECEIVING TUBES
RADIO CORPORATION OF AMERICA, HARRISON, N. J.

*RETMA REPORT for year of 1955