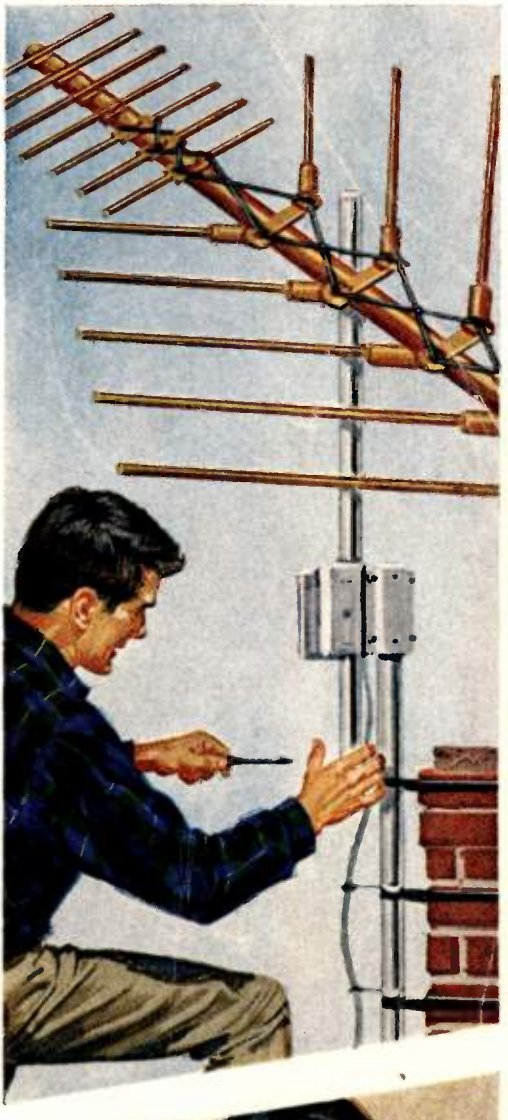
By the Editors of ELEMENTARY ELECTRONICS and SCIENCE AND ELECTRONICS

RADIO TV REPAIR



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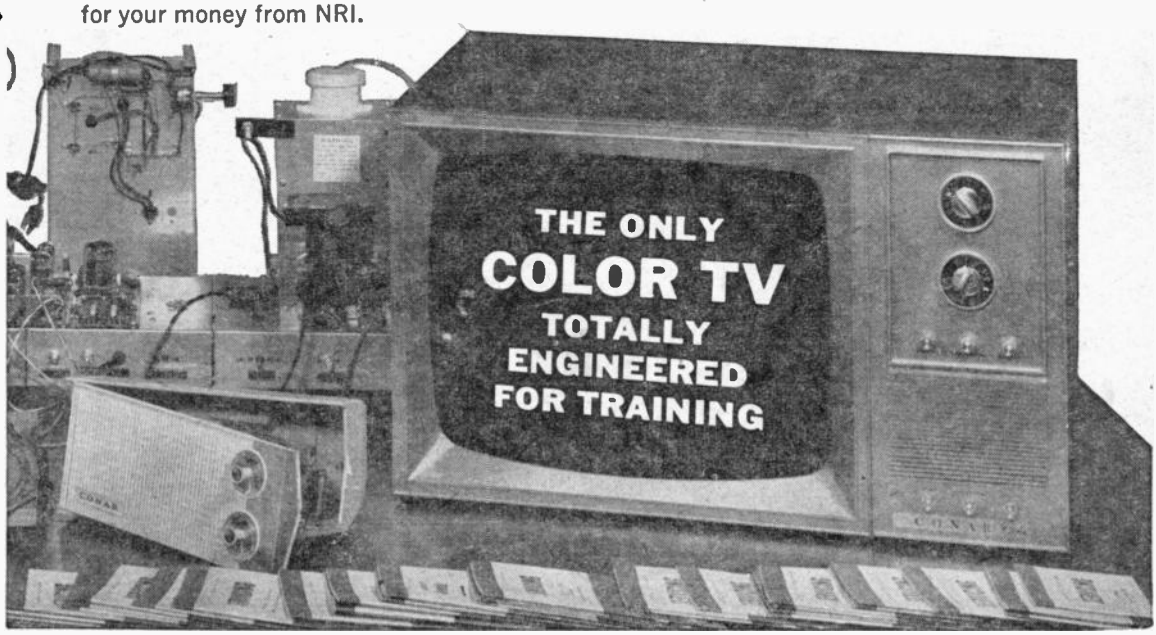

RADIO TV REPAIR

1970 EDITION

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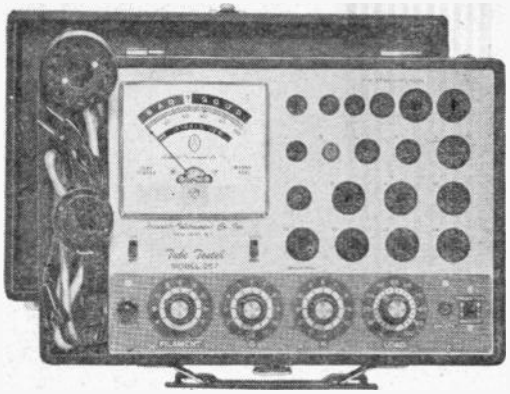

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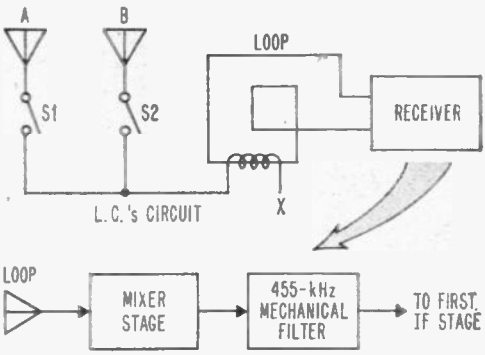
service shop tips

Whip and Peak

I have an antenna hook-up for BCB DX as shown. Antenna A is a whip; antenna B is homebrew. Whenever I connect these antennas, selectivity is decreased, but volume is increased. How can I improve selectivity without using a bandspread in the receiver?

—L. C., Auburndale, Mass.

Connect point X to ground. Add a 455-kHz



mechanical filter ahead of the IF stage as shown in the block diagram. Wiring instructions should come with the filter. You can probably get one from Lafayette Radio, 111 Jericho Tpke., Syossett. N.Y. 11791. But don't expect too much from such a patchwork setup.

Teutonic Efficiency

How can I improve the selectivity and sensitivity of my Grundig 2440U AM/FM, shortwave receiver? The AM and shortwave IF is 460 kHz and available selectivity filters are for 455 kHz.

—R. B., Cincinnati, Ohio

Your schematic reveals that your six-tube receiver has two RF stages and one IF stage and that one of the tubes is a tuning indicator. It looks like you have a cleverly designed receiver, but don't expect super-pro performance on shortwave with so few tubes. You can add a

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SERVICE SHOP TIPS

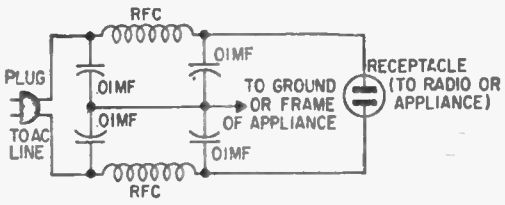
455-kHz IF filter at the output of the mixer if you return the IF transformers from 460 kHz to 455 kHz, but dial calibrations would then be off.

AC-Line Filtering

I need circuits for power line filters to cut out noise caused by neighbors' vacuum cleaners, etc. I get the noise on AC radios but not on transistor portables at the same locations.

—C. L. D., Homestead, Fla.

A noise filter circuit is shown in the diagram. The chokes can consist of bell wire wound for two or three inches on a half-inch diameter form. I have the same problem in my steel-

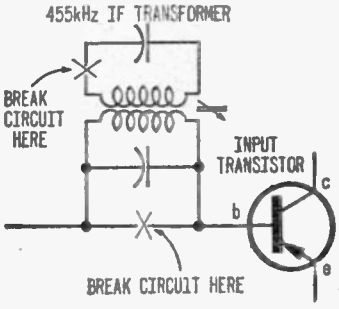


framed New York City apartment where radio signal pickup is poor and noise level is high. My transistor radios don't pick up the noise. You might try a Viking (830 Monroe Street, Hoboken, N. J.) Model 958 line filter ($12) designed for CATV system use, connected between a radio and an AC outlet. It is supposed to provide 60 dB of attenuation. Radio noise is best suppressed at the source.

Ham and Beacon

I recently bought a portable AM/FM/SW receiver of fairly good quality. On AM and SW every station is heterodyned by a CW beacon. I assume the beacon is operating around 455 kHz since it is received across the dial. Is there a simple remedy such as the addition of another tuned circuit in the loop antenna? I don't have any test equipment and only limited parts from other radios.

—Pfc. Salerno, Vietnam



It is possible that the interfering station is very close to you and is overloading the receiver's front end. You might try connecting a 455-kHz wave trap in series with the input to first transistor as shown in diagram. You can use a 455-kHz IF transformer. Adjust the active IF coil's slug until the interference is minimized.

Buzz Bomb

When I turn the volume all the way down on my Panasonic radio hum can be heard. What is the matter and how can it be fixed?

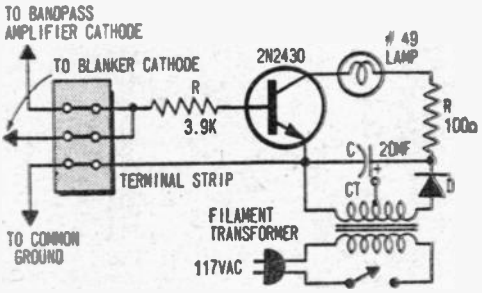
—J. S., N. Y., N. Y.

Offhand it sounds like a defective volume control. But, without knowing the model number, we can only guess. Why don't you try the Panasonic Service Center in New York City?

Color Tattler

How can I add color TV tuning indicator to a color TV set?

—D. R., Los Angeles, Calif.



It depends greatly upon the circuitry of your set. The diagram shows a color indicator circuit based on the one used in some Olympic models. If you make one as an outboard device, install the barrier terminal strip on the back of the TV receiver. The transistor is powered by a 6.3-volt filament transformer whose output is rectified by D and filtered by C. When the TV set is tuned to a color program, the bandpass amplifier and blanker cathode voltages rise because of the presence of the 3.58-MHz color burst. This provides forward bias on the transistor, causing the lamp to glow.

Salty TV

What kind of antenna can I use on my boat for a TV set? The built-in telescoping antenna is not adequate.

O. H., San Francisco, Calif.

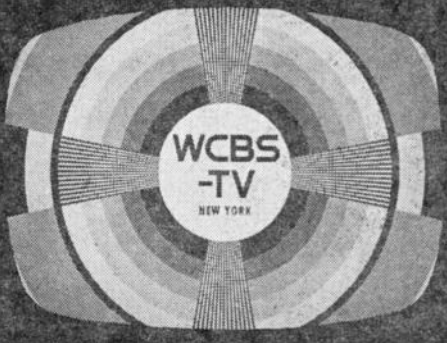
You can get a very compact marine TV antenna from JFD Electronics, 1462 62nd St., Brooklyn, N. Y. 11219, or almost any marina or TV store can order one for you. It has two removable, telescoping elements. You may have seen similar antennas on limousines. A long

(Continued on page 98)

21-SECOND TV CURE-ALL

By Homer L. Davidson

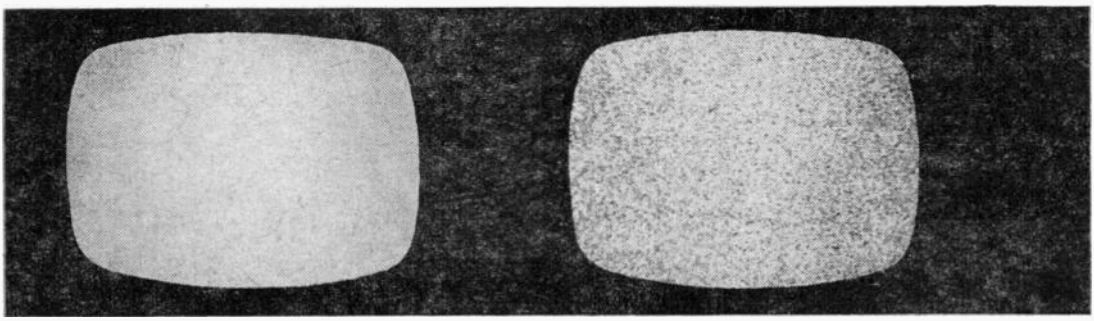
Nothing pleases like an AOK TV set (well, almost nothing, let's say), and nothing irks like a TV set on the fritz. Thing is, TVs have a way of telling you what—if anything—ails them with a message plain as the nose on your face. It's the image on the picture tube that tells the story; the problem lies in interpreting what it's trying to say. But that's easy—our 21-Second TV Cure-all includes 21 of the most frequently encountered TV ills, tells where the fault lies and how to go about correcting it. Let's start with the nicest story of all—a properly displayed test pattern on an AOK TV set.



1 Typical TV test pattern is transmitted perfectly round, perfectly centered, and with all wedges of equal length. Height and width have 3:4 ratio.

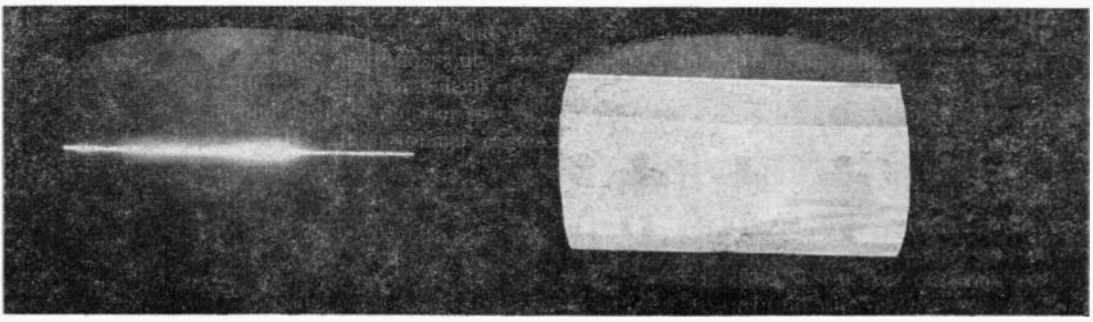
(Continued overleaf)

TV CURE-ALL



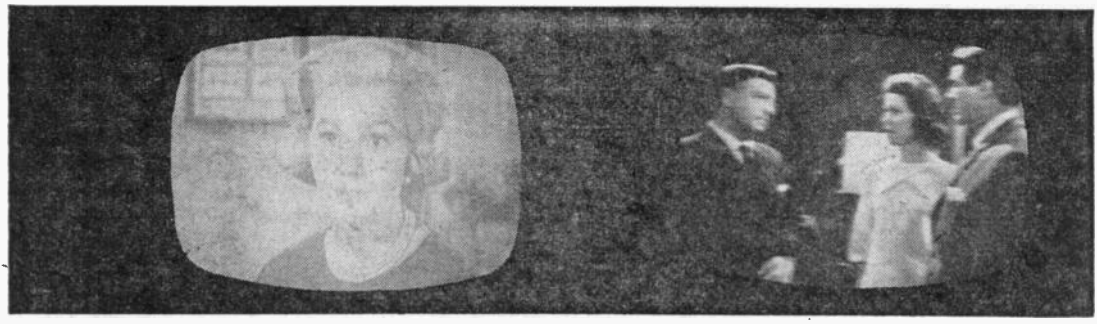
2 **WHITE ALL OVER.** OK, so your set isn't pouring forth with the beautiful TV test pattern shown on the preceding page. Let's say all you can see is a white screen with raster lines. There may be a tweeting sound or perhaps no sound at all coming from the speaker. First thing to check is the local oscillator tube. Next, check the first RF tube. If there's still no picture, check the IF and first video tubes. If you're still up the TV creek, check the IF tuner cable between tuner and chassis; a loose or poor soldered connection will result in no picture or an intermittent picture on the TV screen. As a last resort, check the AGC and second detector tube. And if yours is an older set, check even the sound output tube. Reason is that sets have been made where the sound tube actually furnished voltage to the tuner and IF stages.

3 **RUSH, RUSH, RUSH!** Here we have a TV screen with no picture, snowy screen, and a loud rushing sound issuing from the speaker. Switching the tuning selector from channel to channel has no effect whatever. And while the screen can be lightened or darkened, there's still no picture or intelligible sound. Thing to do is check the first RF amplifier tube in the tuner (most RF tubes are located at the rear of the tuner). If the oscillator tube in the tuner were defective, there would be no snow on the screen or rushing sound in the speaker. And since we have plenty of both in this picture, replacing the RF tube should do it. If not, check the antenna lead-in. Assuming this passes with flying colors, take a close look at the antenna matching coils on the top of the tuner next to the lead-in. These may be shorted or open.



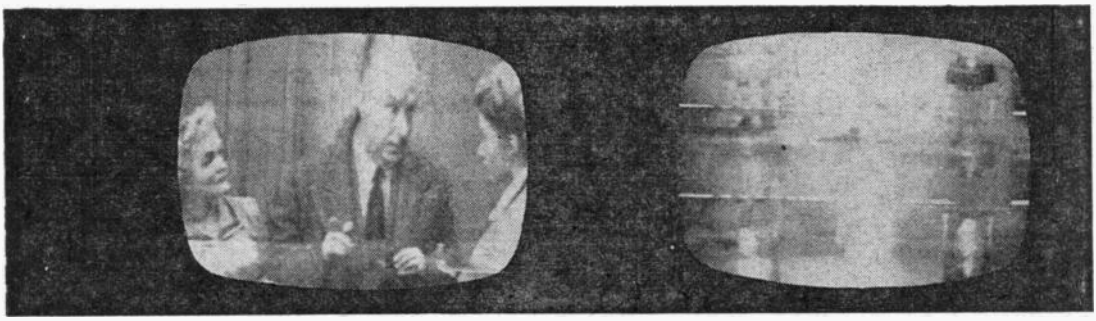
6 **LIKE A LASER BEAM.** A horizontal white line on the screen indicates lack of vertical sweep. First things to check are the vertical oscillator and vertical output tubes (dual-purpose tubes are often found in late-model TV receivers). Also check adjustment of vertical linearity height controls. Be sure to first turn the brightness control down so only a faint white line remains, however, since leaving a bright horizontal line on the screen can easily burn a line across the phosphor on the pic-tube face. If you're handy with a VOM, you may want to pull the TV chassis. This done, check voltages on the vertical oscillator and output tubes, then give the vertical output transformer a resistance test.

7 **SHORT AND SQUATTY.** Trouble here is plain and simple: insufficient vertical sweep. Best bet for locating culprits is to check both the vertical output and oscillator tubes, though you might start by checking the settings of the vertical linearity and height controls. A shorted or vertical transformer winding will cause the same trouble. Can't find the vertical output tube? Here's a quick rundown—in consoles: 6AQ5, 6BL7, 6CG7, 6CM6, 6CM7, 6CS7, 6CW5, 6CZ5, 6CY7, 6DE7, 6DR7, 6EA7, 6EM7, 6EW7, 6FD7, 6GE7, 6GL7, 6K6GT, 6KY8, 6S4, 6SL7, 6SN7, 6U8, 12AT7, 12AU7, 12AX7, 12BH7, 12BZ7, 12B4; and in portables: 5AQ5, 5CZ5, 5V6, 7AV7, 8CG7, 8CM7, 8CW5, 8CS7, 10CW5, 10DE7, 10DR7, 10EM7, 10GF7, 11CY7, 13DE7, 13DR7, 13FD7, 13GF7, 15KY8.



4 ALL WASHED UP. Even with the contrast control wide open, the best we can get out of this one is a light, washed-out picture. While local stations can be picked up, distant stations come in ever so faintly or not at all. The problem is likely a weak video or IF tube or perhaps the AGC control setting. In the event the picture has a slight trace of snow, check the RF tube or TV antenna. For the record, common video tubes for AC sets are 6AC7, 6AG5, 6AG7, 6AM8, 6AN8, 6AW5, 6AS8, 6AU8, 6AW8, 6AZ8, 6BA8, 6BH8, 6BK5, 6BK8, 6CB6, 6CH8, 6CL6, 6CL8, 6CV8, 6CX8, 6EB8, 6GN8, 6FH8, 6HL8, 6JV8, 6K6GT, 6KV8, 6LF8, 6U8, 6V6GT, 6W6GT, 12BH7, 12BY7, 12GH7; common video tubes in portables are 3BU8, 5AM8, 5AN8, 5AQ5, 5AS8, 5U8, 5V6, 8AU8, 8AW8, 8BA8A, 8BH8, 8CX8, 8EB8, 8GN8, 8JV8, 10GN8, 10HF8, 10JA8, 11KV8, 11LQ8, 12AT7, 12L6, 12W6, 16GK6, 25BK5.

5 LOOKS LIKE SNOW. A snowy picture can be caused by a weak RF or oscillator tube. First step is to replace the RF tube, and, if that doesn't pay off, replace the oscillator tube. Also, check the lead-in going to the TV tuner and try rotating the fine-tuning control to clear up the picture. If a lightning- or thunderstorm has been in the area, check for a burned or open antenna coil. Some coils are mounted on top of the tuner close to the lead-in cable; others are mounted within the TV tuner itself. Still another thing to check is the outside antenna for a broken lead-in wire. Then, too, wind or rotator may have turned the antenna in the wrong direction. And, last but not least, the antenna may actually have damaged elements.

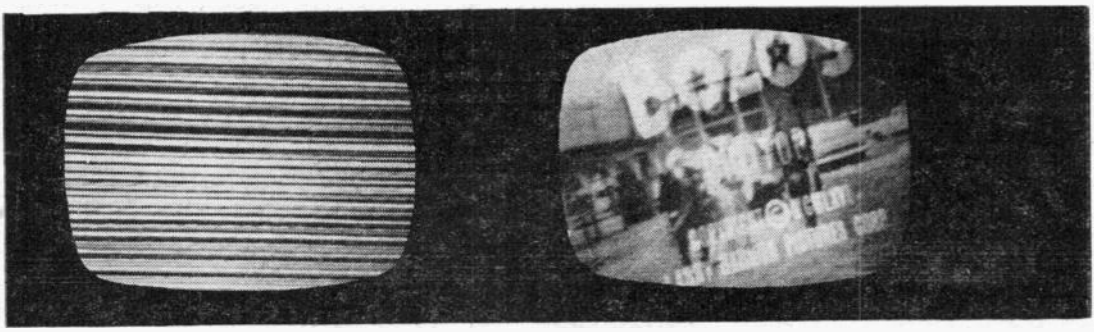


8 TALLER THAN TALL. A distortion of the sort pictured here would never be the case with a properly adjusted TV set, so it's obvious that this set's owner didn't take full advantage of the TV test pattern shown in case No. 1. If you go in for fun-house mirrors, you may also dig the TV equivalent. Lacking this rather rare proclivity, you'll no doubt want to adjust the set so it displays an image as faithful to the original as possible. The vertical linearity control is your tool in this case. And while you could try to alter its setting until heads here assumed reasonable proportions, you would be far better advised to make such adjustment with a test pattern. Also, remember that many sets incorporate not one but two controls affecting vertical linearity (the second is usually termed an auxiliary control), so both must be adjusted.

9 RUNNING UPHILL. Though a picture can roll both up and down, the site of the trouble is almost always the same: the vertical sync section. Best remedy is to replace both the vertical oscillator and sync tubes (often found in the one and same envelope). If this doesn't solve the problem, try adjusting both the vertical height and linearity control settings. In some TV sets, incorrect adjustment of these two controls will result in a rolling picture. Physically check the vertical hold control for possible loose or poorly soldered connections. Should the vertical hold control let the picture roll in one direction only, look for a defective resistor or capacitor in the plate circuit of the vertical oscillator tube. And should vertical fold-over occur only at the bottom of the TV screen, it's a safe bet that the trouble is the vertical output tube.

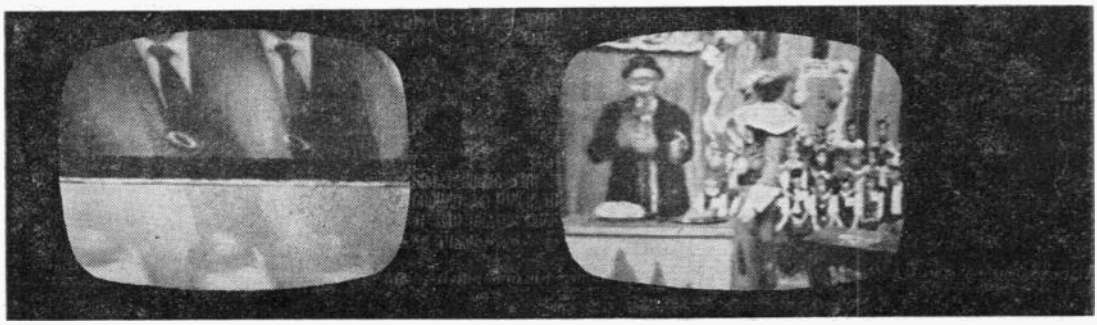
(Continued overleaf)

TV CURE-ALL



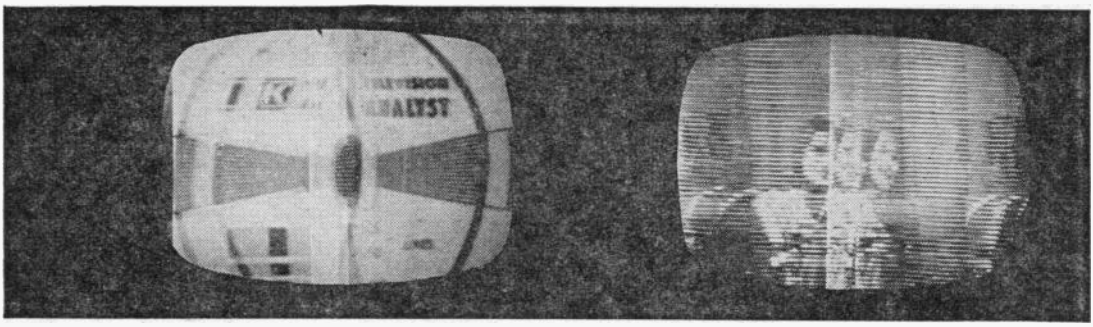
10 **THE LINES HAVE IT.** A screenful of black and white lines can be caused by a defective horizontal oscillator tube. First, check to see if the horizontal hold control is properly set. Once it is, check the horizontal oscillator frequency setting as well as the AFC and sync clipper tube. Since the AFC tube has been replaced by a dual-diode solid-state receiver in many of the newer sets, you may discover such a unit either plugged into a socket or soldered directly into the PC board. However, all is not lost—you can replace the soldered job by snipping off the three leads close to the body of the diodes, then forming small loops in new diode rectifier leads and soldering them to the ends of the leads you just snipped off. Bear in mind that there are two basic types of hookups: a series and a parallel.

11 **TILT!** A tilted picture can be caused by only one thing: a loose mounting screw on the deflection yoke assembly. In other words, the deflection yoke has turned on the neck of the picture tube, which can easily happen if the mounting bolt on the deflection yoke is the least bit loose. Most older TV sets have a wing nut at the top of the yoke assembly; newer ones generally have a metal yoke band with a ¼-in. cinch-nut tightener. In the latter case, the metal band fits over the plastic tabs of the yoke assembly and snugs against the neck of the picture tube. In both instances, the procedure is exactly the same: you first set the yoke level with the frame of a picture at the top of the TV screen, then adjust this picture into position with the vertical hold control. You then recheck the level, and lock the yoke in place.



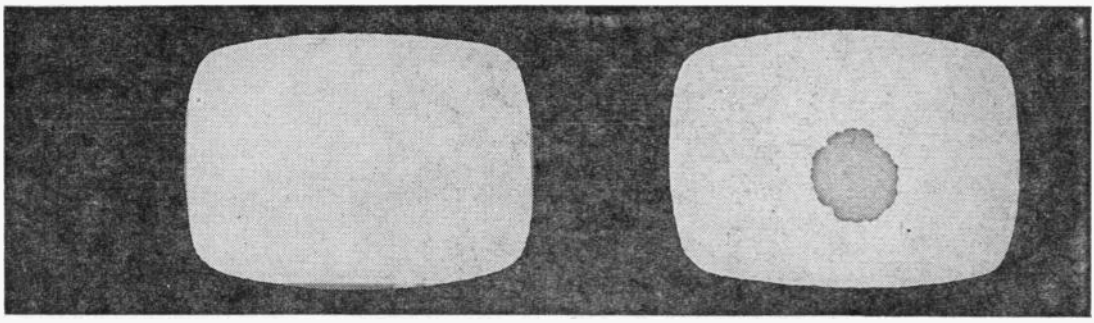
14 **BOTTOMS UP!** Any TV picture running sideways or up-and-down is sure indication that sync trouble is at hand. Check both the horizontal and vertical sync tubes, bearing in mind that these tubes may be in two separate envelopes or, conversely, snug as a bug in a rug in but a single vacuum bottle. Can't find the sync tubes? In consoles, the most probable types are 6AL8, 6AM8, 6AN8, 6AU6, 6AU8, 6AX8, 6HZ8, 6BE6, 6BH8, 6BU8, 6BY6, 6CG7, 6CH8, 6CS6, 6CQ8, 6CU8, 6CX8, 6EA8, 6EB8, 6GN8, 6GW8, 6GY6, 6HF8, 6JV8, 6KA8, 6LC8, 6SN7, 6U8, 12AU7, 12AX7, 12BZ7; and in portables, 3BU8, 3BY6, 3CS6, 3GS8, 4BU8, 4CS6, 4GS8, 4HS8, 5AM8, 5AN8, 5EA8, 5U8, 7AU7, 8AU8, 8AW8, 8CG7, 8CN7, 8CX8, 8EB8, 8GN8, 8JV8, 8KA8, 8LC8, 9AU7, 10GN8, 10HF8, 10JA8, 11KV8, 11LQ8, 12AT7, 12AU7, 12BH7, 12SN7.

15 **SQUEEZED AND SQUASHED.** Bigger-than-life objects on an advertised-in-Life TV are normally the result of a defect in the low-voltage power supply. In older consoles, you can suspect a rectifier tube of some description; in later model sets and portables, you can expect to find a selenium rectifier or a silicon diode in its place. Pinpointing a defective solid-state job with a voltmeter is a pretty simple task: with the lead between the positive terminal and chassis ground, a half-wave rectifier should produce a voltage of 125 to 150 VDC. And given a full-wave job or a voltage-doubler, output should be something on the order of 225 to 260 VDC. Should this approach prove fruitless, you might also check for improper setting of the tube positioning magnet on the rear of the deflection yoke (it can also produce roughly the same symptoms).



12 **CHRISTMAS IS HERE!** An extreme condition known as the Christmas tree effect, this problem stems from a horizontal oscillator tube or a horizontal output tube. (It generally takes the form of a vertical white bar somewhere on the screen.) Also worth checking are the horizontal drive and horizontal frequency controls. First, make sure that the horizontal drive trimmer isn't more than ½-turn from its tight-up position. Next, set the horizontal hold control to its center-rotation position, then adjust the horizontal frequency slug within the horizontal oscillator coil with a plastic adjustment tool. Turn the slug until the fine horizontal lines become wider and then plop into a full picture (if the slug is turned too far, the lines will slant in the opposite direction). Once this looks satisfactory, try rotating the station selector to see if the picture stays in view.

13 **FOLDED GRILLE.** Looking much like the dented grille of a brand-spanking new chrome-plated gas-eating chariot, this condition can result from the very same ills that were responsible for the problems in photo 12. The demon may be the horizontal oscillator tube. Again, it may be the dual-diode AFC rectifier, so if replacing the horizontal oscillator tube doesn't help, the next thing to tackle is the AFC diodes. Should a shorted or leaky dual-diode rectifier be the defective component, you'll generally hear a high-pitched whistle or peeping sound from the speaker. In this case, your course of action is to replace those lousy diodes as outlined previously, turn on the set, and search for a folded grille that hopefully will be no more.

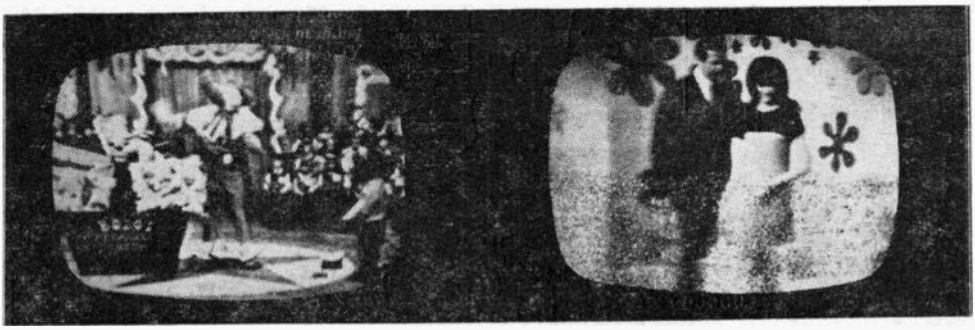


16 **WIGGLE WORM.** Though a trifle hard to show photographically, wiggles on a TV screen are ordinarily due to a 60- or 120-Hz component in the low-voltage power supply. They normally evidence themselves by causing the image to wobble back and forth; oftentimes, there will also be one or two dark stripes across the screen. First thing to suspect is an electrolytic capacitor in the doubler circuits. To remedy the situation, simply bridge a 100-μF, 450-V electrolytic capacitor across the suspect. Should things improve, replace the tired and testy old job with a brand-new one, having the exact capacity and voltage ratings. Also worth knowing is the fact that a defective input filter capacitor in AC/DC portables can even result in no picture, no sound, or no raster!

17 **SPOTTED SCREEN.** The trouble shown above started with a spot the size of a pin head, which, within two weeks, had grown to be big as an orange. Wha hoppen? Simple! The phosphor on the pic-tube was burning off. And the only remedy is replacement of the pic tube itself. Thing to watch for here, with older TVs at least, is incorrect setting of the ion trap (newer TVs are devoid of this device). The ion trap should always be set as close as possible to the picture-tube pin base so as to produce the greatest possible brightness. Sitll another way to ruin a pic tube is to operate a set having a defective vertical oscillator tube. As pointed out in case No. 6, the single horizontal white line across the screen will produce devastating destruction in short order, unless the brightness control is turned way, way down.

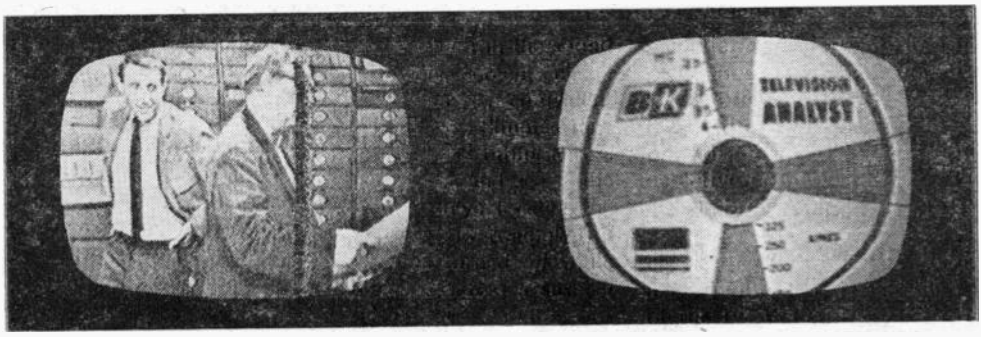
(Continued overleaf)

TV CURE-ALL



18 **BLURRY, FUZZY, AND DIM.** TV pic tubes that come on with all the speed of a turtle in Tipperary are probably tired as a fleet-footed floozy after an 8000-meter race. For like all tubes, boob tubes begin their journey to tube burying ground the first time they're turned on. Eventually, images are blurred and fuzzy, even though brightness and contrast controls are wide open; closeups of faces reveal extreme white and blotchy areas even though such blemishes aren't present in the flesh. Tube brighteners or a special process called charging can stave off the inevitable for a time, but stalling for time is only delaying the inevitable. Best bet is to do the thing you'll eventually have to do—replace the picture tube.

19 **ROAR! ROAR! ROAR!** Though images of this sort make for anything but pleasurable viewing, there's really little you can do to relieve the situation. The particular form of TV interference (TVI) shown here was caused by a defective power transformer somewhere on the same power line; roughly half the picture is covered with dots and dashes, and there is a good deal of picture tearing. Since there are so many causes of TVI—police radio, CB equipment, hams, even radio-TV stations—pinpointing the culprit may take some time. Installing a TVI trap in series with the antenna lead-in sometimes helps. And anything you can do to increase signal strength at the receiver itself is also worth trying. Among the various steps in this direction are installing a narrow-band (yagi) antenna; raising the antenna in height; and using shielded lead-in cable between antenna and TV set.



20 **STRING OF ROPE.** A vertical weaving line down the TV screen is generally evidence of Barkhausen, snivets, or RF oscillation (Barkhausen and snivet lines predominate on VHF channels). First step is to replace the horizontal output tube, which, though it may check out OK in a tube tester, may still be oscillating and causing interference. In many cases, this same type of oscillation will become more pronounced on weak or distant stations. Dressing the antenna leads away from the high-voltage cage should help. Should there be a white vertical line present on the screen, the horizontal drive control should be backed off until the line disappears. In extreme conditions, it may also be necessary to replace the horizontal output and oscillator tubes.

21 **TEST PATTERNS, AGAIN!** Having examined case after case of typical TV ills, we're back again to the faithful test pattern. The reason is easy to explain: nothing else tells you half as much about a TV set's performance—good or bad. When you come right down to it, there are dozens of TV test patterns, since each station transmits its own particular version (the one shown in case No. 1 is that transmitted by New York's WCBS-TV; the one above is that produced by the B&K Television Analyst). But regardless of which pattern you have at your disposal, you can use it to determine whether your set is properly adjusted for aspect ratio, linearity, and contrast; and how it stacks up in terms of line count, line resolution, and low-frequency phase shift. In short, TV happiness is a properly displayed test pattern!

Color sync has been the cause of many a good man's cop-out, but take heart! Here's what to do

WHEN COLOR WON'T STAY PUT

By Len Buckwalter, K1ODH

Of all the troubles that attack the color TV screen, running hue is one of the easiest to spot. It produces a number of weird patterns, but there's always one revealing symptom—color seems to separate from the black-and-white image. The monochrome picture keeps operating normally while color washes in waves across the screen. Stripes can drift horizontally, vertically, or diagonally. They might rush by at dizzying speed or float lazily to and fro. Worse yet, width of roaming color stripes often varies from narrow to broad.

This classic symptom—separation of color from the black-and-white picture—is strong evidence that the problem is "lack of color sync" (synchronization). A similar effect in a black-and-white receiver is uncontrolled vertical rolling, or a slashing of the image into horizonal lines. In those troubles, the receiver's vertical and horizontal stages are not in step with signals transmitted by the TV station. When color sync is lost, the receiver also fails to mesh with transmitted signals.

Sync-ing Fast. There's good reason why the color set must latch onto the transmitting station. When today's color system was approved, the FCC decided color must not interfere with regular black-and-white reception. To fulfill the requirement, engineers created a vehicle to carry color in a manner the black-and-white set would ignore. They came up with the "color subcarrier." When color voltages from the studio camera are modulated onto a frequency of 3.58 MHz, the color subcarrier, it was found they would drop into "holes" already existing in the black-and-white signal. Now color and monochrome receivers could co-exist in a compatible system.

But the color receiver must have special circuits to recover the subcarrier. Reason is that color *modulation* is transmitted, but the subcarrier remains behind. (Color modulation exists just above and below 3.58 MHz.) This system proves technically economical. Since the subcarrier is killed at the transmitting end (after it's done its job of creating color modulation frequencies), it simply

COLOR WON'T STAY

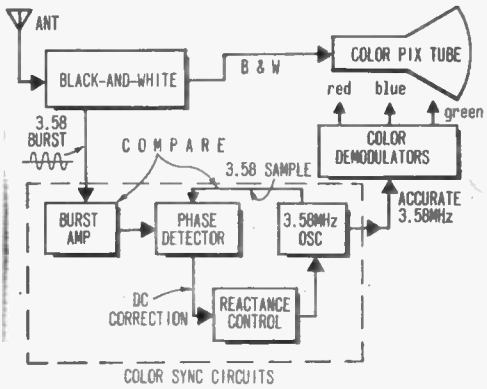


Fig. 1. Color sync circuits are enclosed in dotted line. To maintain correct color on screen, both frequency and phase of 3.58-MHz Oscillator is locked-on to station signal.

isn't present to interfere with black-and-white reception. The color receiver, however, must create a *local* subcarrier to serve as a key for decoding, or demodulating, the original color signal generated at the studio.

Just Like CW. This action can be compared to tuning a ham or shortwave receiver for code reception. Code enters the receiver as a radio-frequency signal which can't be fed directly to the speaker. So the receiver provides a local radio signal (from a BFO, or beat-frequency oscillator) and the resulting mixture creates an audio tone. In the color receiver, the subcarrier reconstructs the original camera signals so they can be fed to the picture tube.

Because of incredible accuracy needed for good color, the color circuits have a few refinements.

For one thing, the station transmits only a tiny sampling of the 3.58 subcarrier. Since it's about 8 cycles long, it's aptly called the "burst." So brief is the signal that it can be squeezed in during the time the screen is dark for a fraction of a second at the end of each horizontal scanning line. The burst, though, is long enough to inform the receiver of the correct subcarrier frequency. This is the initial step in synchronizing color between transmitter and receiver.

As for that subcarrier, the color receiver generates its own on 3.58 MHz. It's done with a stable, crystal-controlled oscillator. Nevertheless, the oscillator can't approach the required accuracy, and the incoming burst is used to kick it on frequency.

Another element of the color sync system is a control "loop." As we'll see, this will tie the incoming burst—the reference—to the local crystal oscillator. Anything which disturbs this system causes running color, an aimless spilling of tints off the basic black-and-white image.

A Trip On AFPC. In Fig. 1 is a block diagram of major stages for color sync. This is the set's AFPC, or Automatic Frequency Phase Control system. As the name implies it controls both frequency and phase of the receiver's locally generated subcarrier. Actually, frequency and phase are mostly a matter of degree. When the oscillator is a few dozen cycles above or below 3.58 MHz the system may be considered controlling frequency.

But as the burst signal and oscillator start

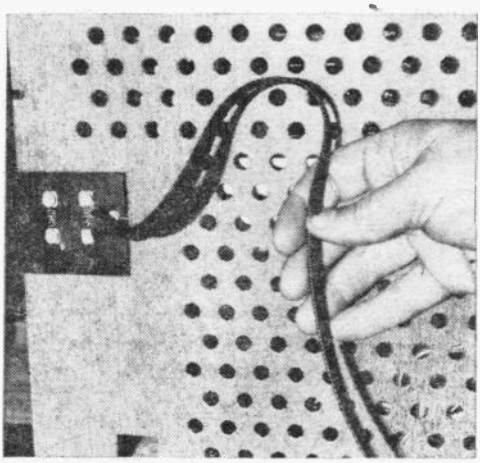


Fig. 2. Poor sync or runny color can sometimes be traced to a defective antenna or lead-in. Flat twin-lead exposed to the elements is especially subject to color-wrecking damage.

to get into step; the control system operates on the more precise level of phase; that is, both signals must begin at zero at exactly the same instant, then alternate through 360 degrees together. Unless locking action is total, picture hues may shift toward the green or purple end of the scale. Major functions of the color-sync section, blocked in Fig. 1, are as follows.

Burst Amp. An incoming colorcast travels through the conventional part of the receiver at upper left. Note that it is basically a black-and-white receiver that feeds

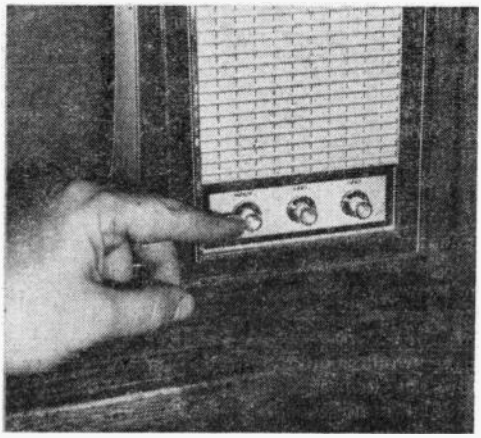


Fig. 3. Before tearing into the color TV to look for causes of poor color sync, make sure that all the controls are properly set—especially the horizontal hold control.

the specialized color circuits found below. Synchronizing action begins as an incoming burst signal reaches the Burst Amp. This is the rapid-fire group of cycles sent as a reference by the TV station and thus they become the reference for the complete control system. They are strengthened by the Burst Amplifier before proceeding further. Notice that the burst is next applied to the Phase Detector.

Phase Detector. An electronic comparison occurs here. The stage is designed to accept two signals, then produce one output voltage which encodes any differences between the original signals. The burst is one signal; the other is from the 3.58 MHz Oscillator.

3.58 MHz Oscillator. This crystal-controlled oscillator generates the local color subcarrier. As mentioned earlier, it is stable, but not accurate enough. A small portion of oscillator signal is sent to the Phase Detector as a 3.58 MHz sample. The Phase Detector is now receiving two signals for comparison and it produces an output (shown as the DC correction).

Reactance Control. This tube serves as an electronic tuning capacitor, much the same as the tuning capacitor used to tune any radio. Only it has no moving plates. Its capacity can be controlled by the DC correction voltage supplied by the Phase Detector. Further, the Reactance Tube is connected as a variable capacitor across the tuning circuits of the 3.58 MHz Oscillator.

To sum up the overall action of Fig. 1: an incoming burst signal is compared with the local 3.58 Oscillator at the outset. The Phase Detector senses error between the two, then operates the Reactance Control. Capacity changes then re-tune the 3.58 Oscillator until it is on the exact subcarrier frequency. Note that the oscillator produces a continuous signal, though it is being controlled by the burst.

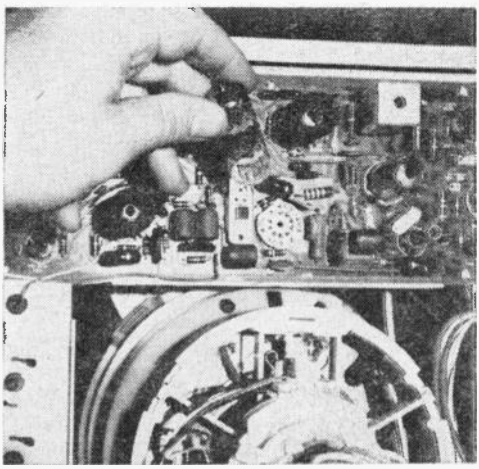


Fig. 5. Tubes account for most sync circuit troubles. They will usually all be found on the set's chroma board; checking by substitution is the easiest way to find a bad one. .

The 3.58 signal, now precisely correct, goes to the Color Demodulators which produce correct voltages for operating the picture tube guns. At this point, any loss of sync detaches color from the black-and-white image.

Manual Control. When color sync acts up, there are a couple of initial checks which will determine whether it's caused by something outside the chassis. We'll assume the set is receiving a normal black-and-white picture in order to rule out problems which might originate in other sections of the receiver. The antenna and lead-in (Fig. 2) are also considered to be in good condition and aren't deteriorating the color signal before it enters the receiver.

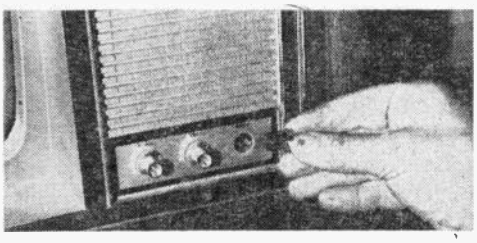


Fig. 4. Another adjustment that can affect color sync is the AGC. Here, control is located behind a front-panel knob, though usually it's on the rear apron. Set AGC as described in text.

COLOR WON'T STAY

Turn to a color program and carefully adjust the fine-tuning control. This is critical to stable color reception since it places the burst into correct position within the set's tuning circuits. If the burst is attenuated, it won't be available to control the crystal oscillator. Another adjustment that might

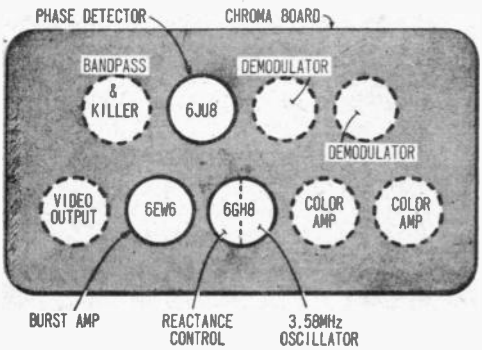


Fig. 6. On this typical chroma board, stages directly concerned with color sync are shown in solid circles. Poor sync is usually caused by one or more of these tubes being defective.

affect the burst signal is the horizontal hold control (Fig. 3).

Though these circuits occur in different sections of the receiver, there is some interaction. You may recall that a burst occurs at the end of every horizontal scanning line. To help keep the Burst Amplifier firing properly, it is locked into the set's horizontal scanning section. Mistuning of the horizontal hold control is apt to disturb the timing. For this reason, always set the horizontal hold

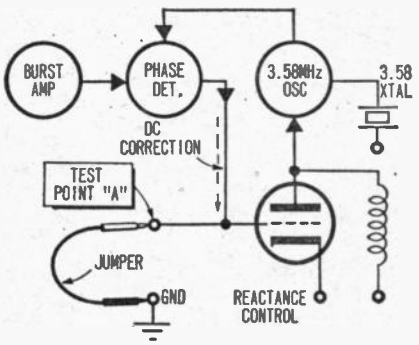


Fig. 7. If tubes are not the problem, shorting the grid of the reactance tube to ground may isolate trouble. Manufacturer's service literature may be needed to locate test point.

so the picture is centered on the screen. (You'll note the hold is able to shift the picture slightly left or right before the image breaks up.)

Consider The Killer. Another adjustment to check is the Color Killer. This circuit doesn't directly participate in color sync but it could have an effect. The "killer" is a stage which closes off the receiver's color stages during black-and-white reception to keep color from accidentally spilling through and disturbing the image.

If the killer is set at a critical point, it's possible for a part of the color signal to be wiped away, which could lead to unstable operation. Turn the control fully off to check if this is the sync problem. The correct setting is one that doesn't produce colored "confetti" on the screen when the set is tuned to an unused channel. Location of the killer control is usually along the rear

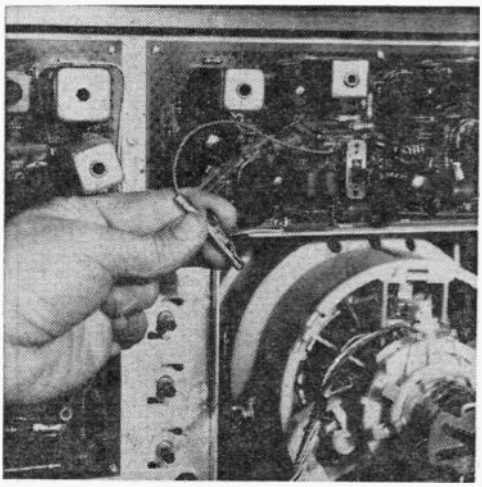


Fig. 8. If color sync improves when reactance tube grid is grounded, reactance and oscillator stages are probably alright. Be careful not to disturb yoke components while working on set.

chassis apron: on some sets it's accessible when one of the front-panel knobs is removed.

Finally, check the AGC (automatic gain control) adjustment if the set has one (Fig. 4). Should AGC be set too high (thereby severely reducing gain of the receiver's front-end), there could be partial clipping of the color signal. The usual adjustment for AGC is done while viewing the strongest local channel. The control is turned until the picture starts tearing or turns negative, which indicates overload. Then the control is re-

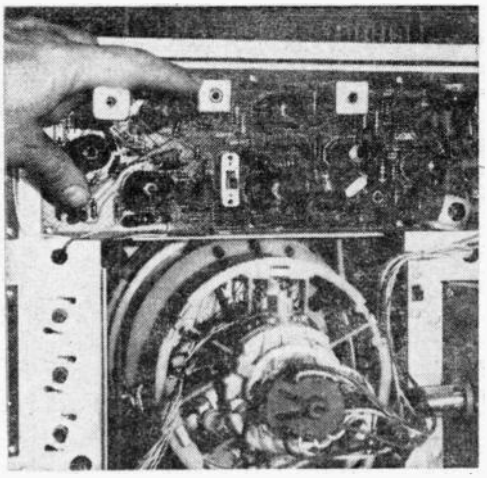


Fig. 9. Alignment of transformers in the color section should not be disturbed since realignment is complicated. However, transformer windings can readily be checked for continuity.

One useful test point indicates whether the fault is in the Burst Amp and Phase Detector stages or the Reactance Control and 3.58 Oscillator stages. If the simplified diagram in Fig. 7 is traced, it is seen that a test point (A) occurs in the grid of the Reactance Control tube. This is the stage that acts like a variable capacitor across the oscillator and continuously adjusts frequency with a DC correction voltage.

The test point enables you to ground the DC correction voltage and observe certain effects. Watch the color picture when you ground the test point with a clip lead to the chassis (Fig. 8). If it improves color sync—color stops moving through the picture—it's a good sign the Reactance Control and oscillator stages are not at fault.

No Reactance Volts. During this test, you removed the action of the Burst Amplifier and Phase Detector from the circuit. Further, in grounding the test point, you

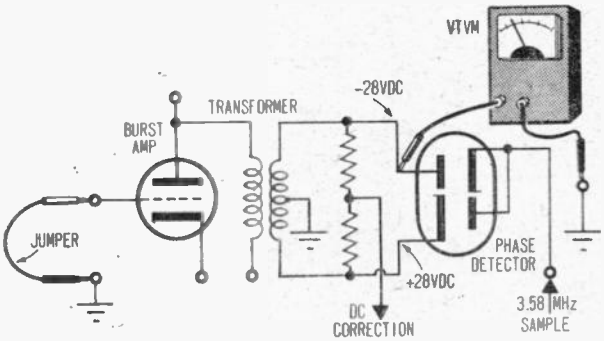


Fig. 10. To determine if Burst Amp and Phase Detector are working properly, ground the Burst Amp grid as shown, then measure the voltages (with a VTVM) on the transformer side of the diode. The actual voltages will vary from set to set, but should be equal and of opposite polarity.

tarded slightly until a normal image is obtained. If these preliminaries don't cure a case of color instability, the back cover of the set is removed for the next step.

Troublesome Tubes. As in most other circuits, tubes account for the bulk of color-sync faults. You can locate tubes (Fig. 5) associated with color sync by examining the set's chroma (or color) board. It's usually a subchassis or printed circuit that bears most circuitry for processing color signals. The layout of a color board used in a recent Westinghouse receiver is shown in Fig. 6. When color sync acts up, check those tubes by substituting known good ones before probing more deeply into the set.

Manufacturers often provide convenient test points on a color chassis to help pinpoint troublespots. Thus, it's a good idea to obtain the service literature for a particular set if you wish to probe further into a color sync problem.

placed zero volts on the grid of the Reactance Control stage, a voltage which is about right during normal reception. If color sync improves, you have proved that both reactance and oscillator stages are capable of approximately normal operation.

We say "approximate" since color may

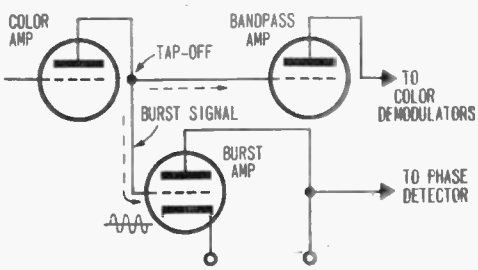


Fig. 11. The next circuit to have a close look at is the Burst Amp. If Phase Detector voltages are incorrect, perhaps the burst signal is being interrupted between Color and Burst Amp. The only way to find out is with a scope.

COLOR WON'T STAY

not lock completely in place, but possibly drift slowly across the screen. If you get this action, shift suspicion to the burst and detector stages. Measure tube-socket values of voltage and resistance to find the faulty component. Leaky capacitors are frequently the trouble, followed by resistors which have changed value (rarely will a 3.58 crystal go bad). Alignment of various coils or transformers in this section (Fig. 9) shouldn't be touched unless you've exhausted all other test possibilities.

Slap In The Phase. One shortcut helps tell whether Phase Detector or Burst Amp is at fault. In Fig. 10 is a simplified schematic of these stages, as used in an RCA color chassis. During operation, the Burst Amp is boosting the received burst signal and applying it to the Phase Detector. Here the signal is split in the transformer leading to a tube with a pair of detector diodes. At the same time, a 3.58 MHz Sample is applied to the other side of the diodes. This circuit com-

(Continued on page 102)

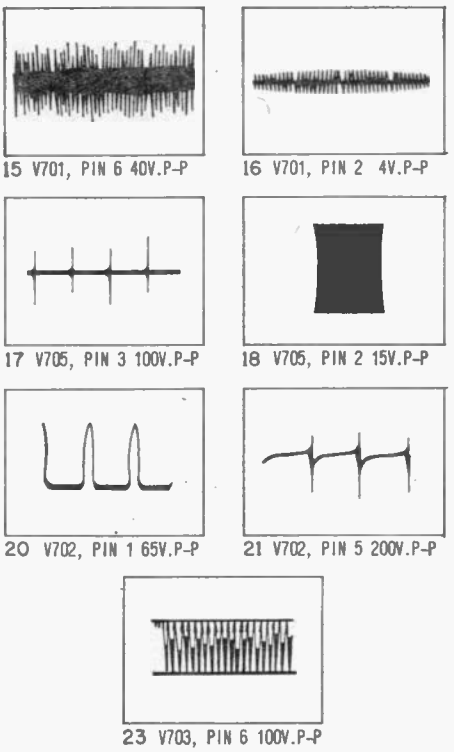
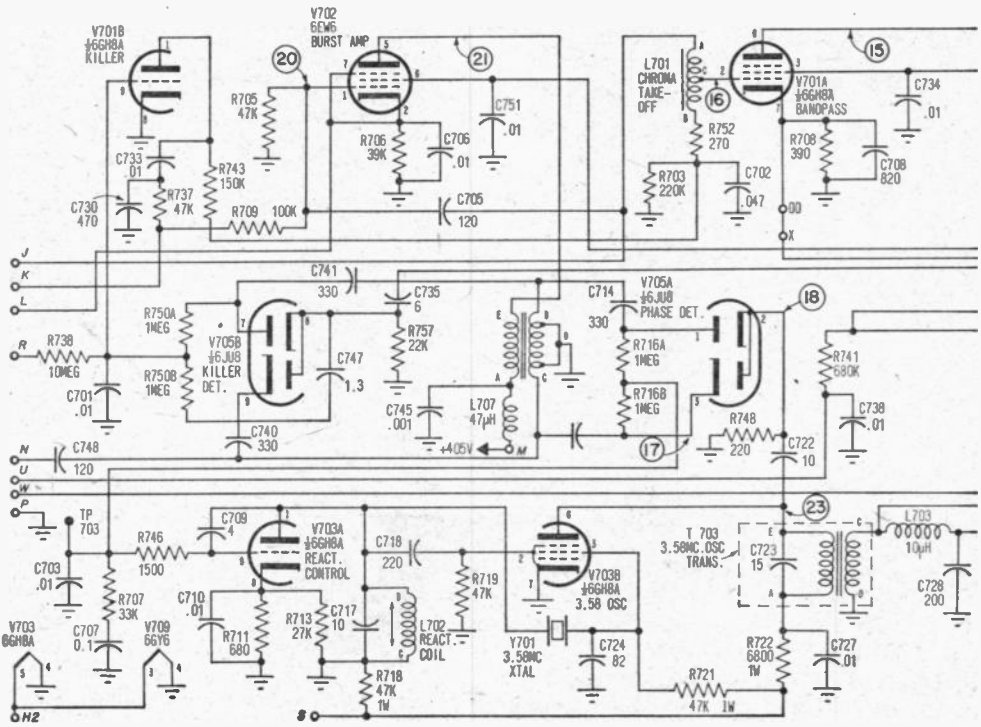
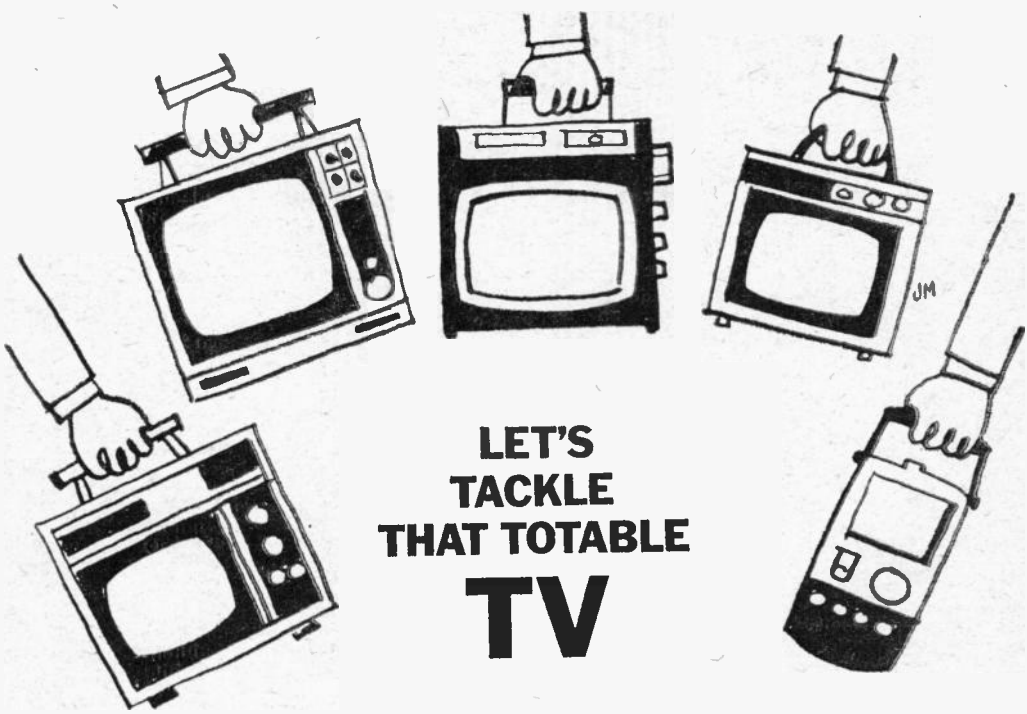


Fig. 12. Typical service literature provides waveforms at different circuit points so that burst and other signals can readily be traced through various stages with an oscilloscope.





LET'S TACKLE THAT TOTABLE TV

By Homer L. Davidson

Fixing that portable takes a knowing hand; here a pro lends his!

When that portable TV is on the blink, you've got two choices: figure on spending a bundle having it fixed, or doing it yourself. Of course, doing it yourself can be a problem even if you've had experience with big-brother console. That's because size considerations makes for design and construction differences. But take heart —the most common problems of a portable TV are often the easiest to repair. And with a few items of test gear and a little know-how you can tackle that misbehaving portable with confidence.

No Nothing. This symptom is the easiest trouble of all to correct. Let's take a look at the block diagram in Fig. 1. We see that practically every stage gets power from the low-voltage power supply. Let's begin right here.

Roll up your sleeves and pull the TV back cover off. First, see if the portable is an AC/DC or power-transformer type. The AC/DC portable TV receiver does not have a power transformer like the one shown in Fig. 2. All filaments in the AC/DC portable are hooked in series. In the power-transformer variety, the transformer supplies 6.3 VAC to all tubes in a parallel circuit.

Now check the circuit breaker on the rear apron of the TV chassis. In most late-model sets, it's in the form of a small protruding red rod. Push this and the circuit breaker will reset. If this was the problem, the filaments should begin lighting. Often a tube in the sweep circuit, such as the damper tube, will arc over, kicking out the circuit breaker. If the tube starts arcing when the circuit breaker is reset, replace the tube.

Fused Fuse. Take a look and see if all tubes light up. If they don't, check for a defective fuse. Some portable receivers have a circuit breaker and a low-ampere fuse in the AC line. Check the continuity of the fuse with an ohmmeter. Just looking at the fuse may not tell the tale. OK, the fuse is blown, so in goes another one. In some cases, only the type designed for the set will plug into the fuse holder.

Look at the schematic of your set and see if the fuse in the low-voltage power supply is like the hookup in Fig. 3. Here is a 2-A fuse protecting the overload that may occur in the low-voltage power supply if

associated circuitry suddenly shorts out.

What makes the fuse blow in the low-voltage power supply? Check for a shorted selenium or silicon diode rectifier. Then go to the filter capacitors and check for other possible defective components that can be shorted causing an overload in the B+ line.

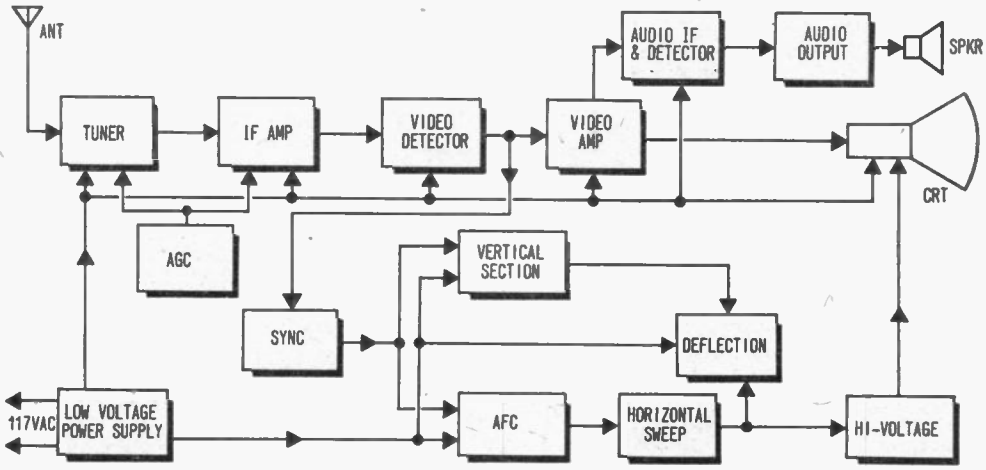


Fig. 1. Block diagram of standard TV set is useful when attempting to track down power supply troubles.

You can make a quick check of silicon diodes with the low-ohms scale of the VOM. Remove one end of the suspected diode, then place the ohmmeter leads across the diode rectifier. You should have a 5- to 15-ohm reading in one direction. Now reverse the ohmmeter leads. Does the ohmmeter still read 5 to 15 ohms? If so, the diode is shorted. A very high resistance reading should be noted with reversed ohmmeter leads. Very rarely do silicon diodes go open; they usually short out.

Smelly Selenium. Selenium rectifiers will have a resistance reading from 20 to 25 ohms in one direction and over 3000 in the other. You can easily spot a defective selenium rectifier by its pungent smell. Also, black burned spots form on the selenium side of a defective rectifier of this type.

Let's say, for instance, the fuse is good but there's still no output voltage from the low-voltage supply. In this same circuit (Fig. 3), check to see if the 3-ohm resistor is open.

A voltage-doubler circuit used in series string portable TVs (transformerless) is shown in Fig. 4. Here the fuse is a 0.4-amp type at the output of the power supply. After checking the fuse, go directly to plug-in resistor, R113 and see if it has burned open.

Now check the front-to-back resistance of SR101 and SR102, the two silicon diodes. Remember to always cut one lead loose for accurate measurement. If they're OK, then check the voltage-doubler capacitor, C111. These capacitors will dry out after several years of use. A white substance may have leaked out at the bottom of the filter, indicating the capacitor is defective.

To check the capacitor, shunt a new one across it. If that cures the problem, replace the defective capacitor.

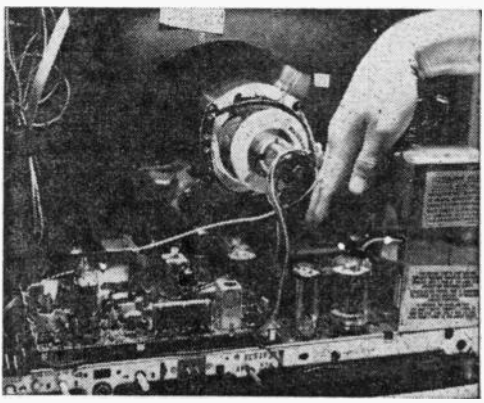


Fig. 2. Hand points to power transformer in transformer type set. The absence of this or similar transformer indicates TV set is of the series string variety, which the majority of low-cost portables are.

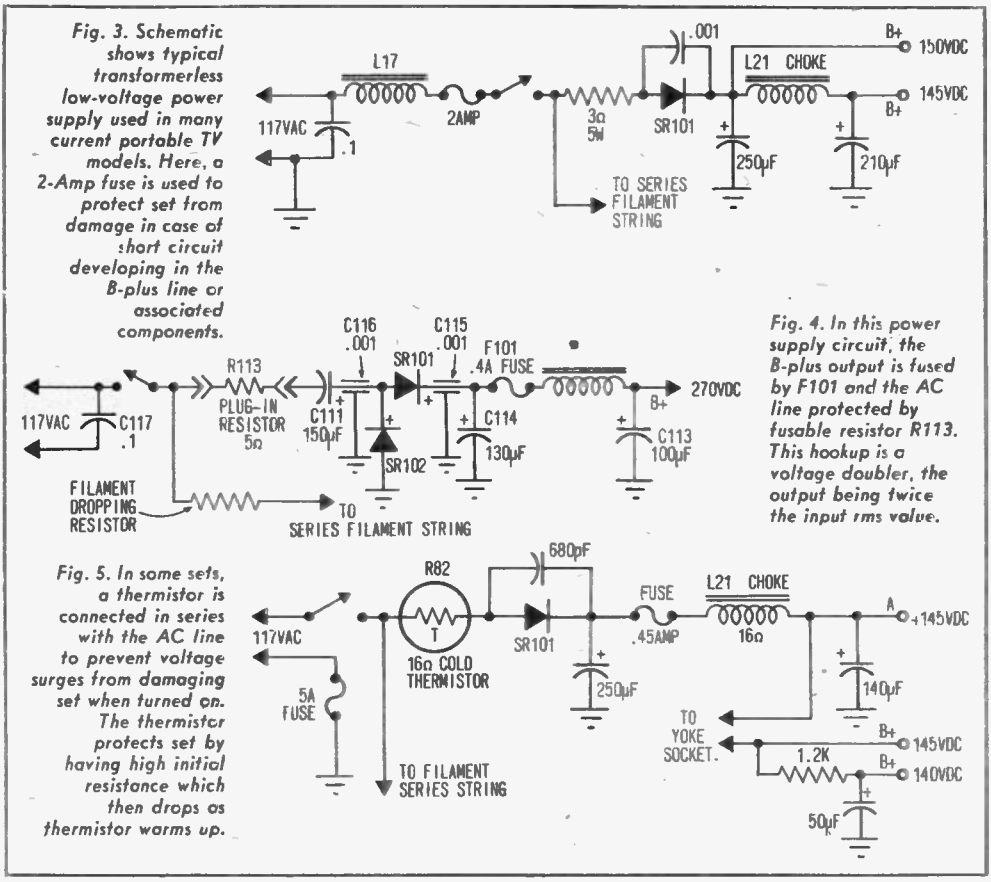


Fig. 3. Schematic shows typical transformerless low-voltage power supply used in many current portable TV models. Here, a 2-Amp fuse is used to protect set from damage in case of short circuit developing in the B-plus line or associated components.

Fig. 4. In this power supply circuit, the B-plus output is fused by F101 and the AC line protected by fusable resistor R113. This hookup is a voltage doubler, the output being twice the input rms value.

Fig. 5. In some sets, a thermistor is connected in series with the AC line to prevent voltage surges from damaging set when turned on. The thermistor protects set by having high initial resistance which then drops as thermistor warms up.

Hummm . . . If there's hum in the sound or dark bars across the screen, check the filter capacitor in your set equivalent to C113 and C114 in Fig. 4. Shunt a new capacitor of at least 450-VDC rating across the suspected filter capacitor and see if the hum disappears—if so, you've located the fault. When checking the power supply, always have the AC switch turned *off* while clipping the test capacitor across a suspect filter capacitor.

In Fig. 5 is another low-voltage power supply using a silicon diode as rectifier. Notice the thermistor resistor ahead of the diode. This resistor protects the series-string tubes by preventing surge voltage from being applied to cold tubes.

After several years' usage, the wires soldered to each side of the thermistor can pop off or come loose, leaving a high-resistance or open-current path. The results are intermittent or no output from the low-voltage power supply.

A low-voltage power supply circuit using a power transformer is shown in Fig. 6. The secondary winding is wired up for full-wave rectification with two silicon diodes in each leg. Notice the circuit breaker in the center leg of the transformer. In case heavy current drain in the B+ results because of defective components or a short circuit, the circuit breaker will kick out.

No H.V.? When this type of set is dead, check the B+ output supply voltage with a DC voltmeter. Also check the resistance of the two silicon diodes. Generally, when one is found defective, both silicon diodes in that leg should be replaced. If the circuit breaker keeps kicking out after it's been reset a few seconds, short across the terminals with an alligator clip. Occasionally, the circuit breaker will become defective and will not hold under the ordinary power load and will have to be replaced.

The second winding on the power transformer is the heater circuit. Tubes in transformer-type portable sets usually all operate on 6.3 VAC. This particular heater winding (hot side) has a 1-in. piece of #28 fuse wire so that in case of a filament or

pilot lamp short circuit, the wire will open, protecting the transformer winding from overload. If the filaments don't light, check for an open fuse wire—if OK, check for an open transformer winding with an ohmmeter and one transformer lead disconnected.

When the tubes are dark in a series-string set, all tubes will have to be checked for an open filament because if one goes out, none will light. So with a tube filament checker as shown in Fig. 7 or with an ohmmeter, check filament continuity.

Continuity Check. We know that one of these tubes, or possibly two, may have an open heater element. Take one tube out at a time and check it for continuity. Start with the horizontal output tube, damper, and sound output tube, in that order. These tubes run hot and are most likely to have a defective filament.

When checking filament continuity with an ohmmeter, switch to a low-ohm scale and place the probes across the heater terminals. The larger the heater voltage required by the tube, the greater the filament resistance measured should be. See Fig. 8 for a filament resistance chart.

In case the problem hasn't been found after checking tube continuity, bring out the AC voltmeter (see Fig. 9). Switch the voltmeter to the 150-VAC scale. Place the voltmeter probes across the *on/off* switch—it could be open. If this checks out OK, put one voltmeter lead to the *on/off* switch and trace the heater wires starting at the grounded side (Fig. 10).

Most tuner tubes are located at the grounded side of the series filament string. Quickest way to eliminate a possible defective tube socket or broken heater wire in the tuner is to clip a shunt wire from the brown heater wire going from the tuner to the chassis ground. If the problem is in the tuner, the other series string of tubes will light up when the set is turned on. If so, you have isolated the heater trouble to the tuner section.

Mostly Series. Remember that most portable receivers are of the series heater variety. When one tube goes out, the whole string is open like a cheap string of Christmas tree lights.

Fig. 11 shows a typical power transformer heater circuit with all tubes wired in parallel. In this type, one or two tubes may not light up indicating they are dead or their heater wiring defective. If all the tubes are dead in a power-transformer TV set, check for defective power transformer, broken heater wires, or open fuse wire.

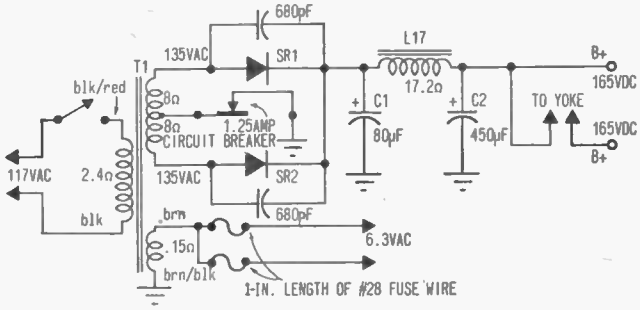


Fig. 6. Transformer power supply is used in better portable TVs. Typically, a circuit breaker is used in either AC line or in B-plus circuit as shown here. Full-wave rectification is provided by the use of two silicon diodes in this configuration, or in some cases, a bridge circuit employing four diodes. Typical DC-ohms values shown on transformer windings and choke lets them be easily tested with an ohmmeter.

When the picture tube has a raster, but there is no sound or picture, the trouble is probably in the tuner. The tuner is just behind the station selector knob. Substitute or check the RF and oscillator tube. If substituting tubes here doesn't produce picture or

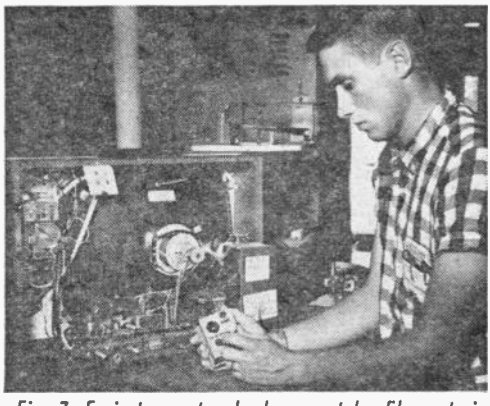


Fig. 7. Easiest way to check many tube filaments in a series-string TV is with simple continuity tester. What happens in this type of set is that when one filament burns out, none of the tubes will light up.

TUBE HEATER RATINGS

VOLTAGE (VOLTS)	3	6	12	17	25	35	50
RESISTANCE (OHMS)	1–1½	2–5	3–12	5–12	10–20	30–50	50–60

Fig. 8. If a continuity tester isn't available, tube filaments can be checked with an ohmmeter. Listed above is the approximate resistance value for tubes of various voltage ratings, e.g., 12BQ6 is 3—12.

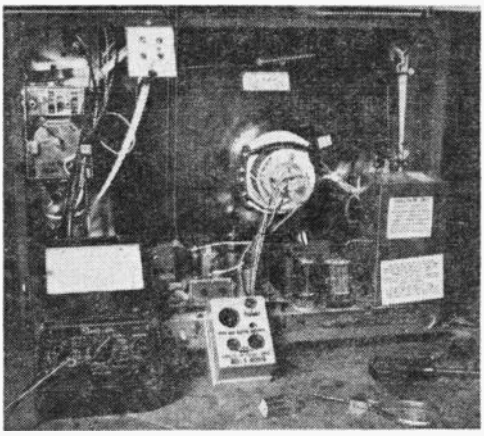


Fig. 9. If all tube filaments check out good, test the AC power switch with an AC voltmeter. If switch is good, no voltage should be indicated when on, 117 VAC should be indicated when off.

No Picture — Raster — Good Sound. When there is sound, a good raster, but no picture, the trouble is likely to be in the video circuits. Most portable TV sound circuits are connected to the beginning of the video circuit, so the problem will be somewhere after this point. Substituting or checking the video amplifier tubes will usually solve this problem.

The cause of excessive picture smear and tearing can usually be found in the video amp circuits. Open peaking coils in the video output circuit will result in a smeary picture—see Fig. 12. An open or leaky coupling capacitor from video amp to CRT can also cause picture smear.

Another possibility is a shorted picture tube. Simply tap near the end of the CRT, but *gently*, while watching the picture in a hand mirror. If the fault comes and goes while you're tapping, replacement of the CRT is the answer.

No Sound—Good Picture. When everything is fine but the sound is missing, go directly to the sound amplifier section and check the sound tubes, starting with the output tube—see Fig. 13. A defect here can cause no sound, extreme distortion, or excessive hum. If a tube is not at fault, check

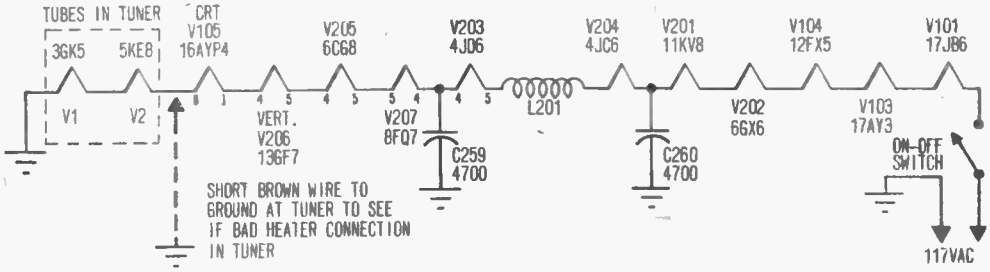


Fig. 10. Typical series-string hookup can be quickly traced with AC voltmeter to locate break in circuit.

sound, check the IF and video output tube. Always replace these tubes if any element indicates shorted on a tube tester.

If the problem persists, try pulling the AGC (automatic gain control) tube out of its socket (with the set on) and see if the picture or sound returns for a split second. If so, your set has AGC troubles. A defective AGC tube can cut off both picture and sound. Another method for checking AGC is to turn to a weak TV station. The picture and sound may appear on a weak signal but can be blocked by AGC action on a strong TV station.

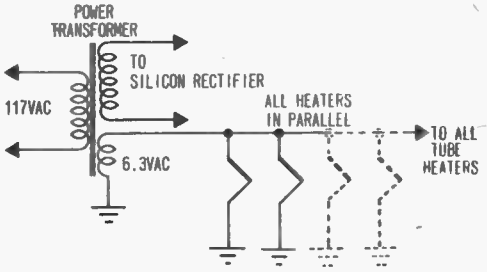


Fig. 11. In transformer type set, one or two filaments may not light up indicating tube or associated heater wiring is defective. If no tubes light up in this type of set, check the power transformer, fuses in AC or filament line or circuit breaker, and AC switch.

THAT TOTABLE TV

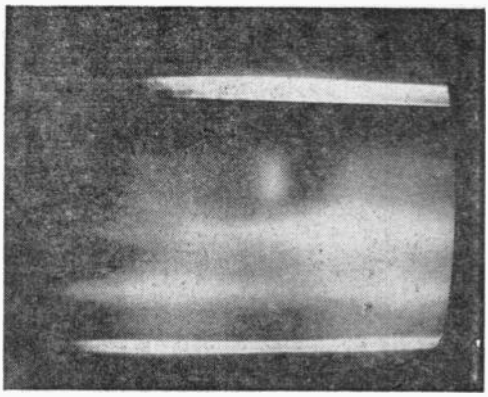
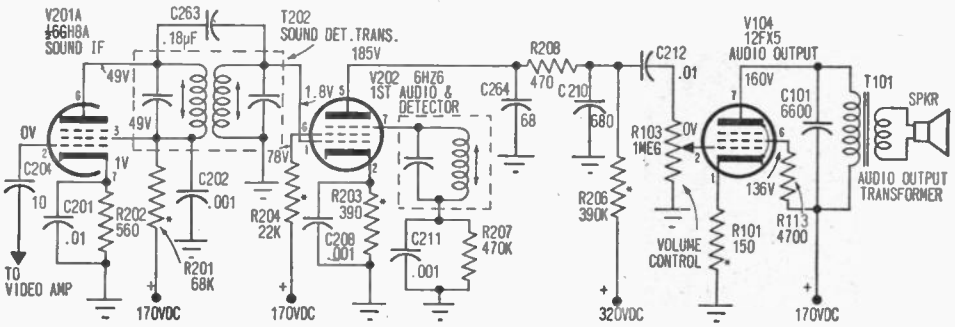


Fig. 12. Picture smear with complete loss of detail is caused by defects in either the video amplifier circuit or a shorted picture tube. Easy way to check picture tube is to tap it gently on the base and neck while watching picture in mirror.

Fig. 13. The audio circuitry in your portable TV will look very much like this. If poor, distorted or weak sound is the problem, start by checking these tubes or their counterparts in your set. The next thing to check is the speaker (see text).



the speaker and cable connections. Also check for a defective output transformer. This can easily be accomplished with an ohmmeter continuity check. Distorted sound can be caused by the cone resting on the center pole piece, in which case the speaker must be replaced. Small holes poked into the speaker cone can be repaired with glue.

Intermittent sound can be caused by a cracked PC board. Push and move the small parts on the PC board with an *insulated* tool while the set is on. Intermittent IF and detector coils may have cold solder connections inside the metal can.

Black Screen—Good Sound. Here we probably have a horizontal sweep problem (but be sure it is not just the brightness control turned all the way down). Be extremely careful when working in this section as LETHAL voltages exist. Keep the set turned *off* unless stated otherwise. The CRT capacitively stores up to a 20,000-volt charge

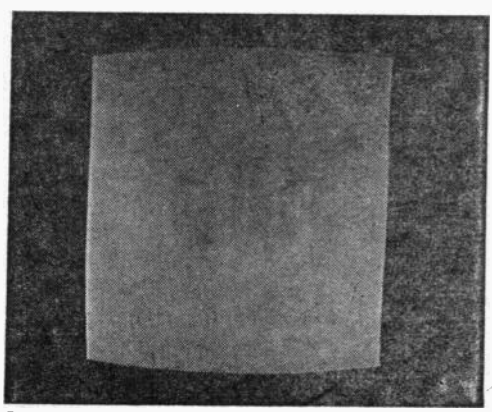


Fig. 14. Insufficient width is caused by the horizontal sweep voltage being low. This problem is most often traced to a weak or defective horizontal output or damper tube, but can also be low B-plus voltage.

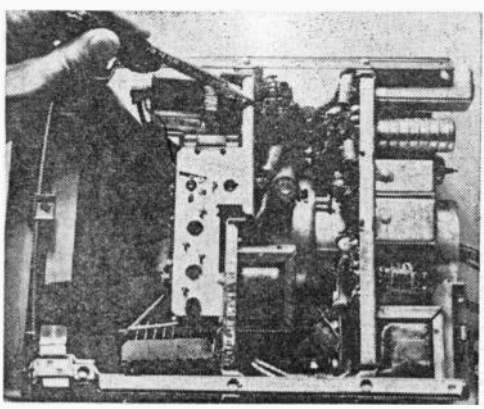


Fig. 15. If tubes are not the cause of a narrow raster, circuit components associated with the horizontal and damper tubes are likely candidates. The pencil points to the horizontal output tube circuit.

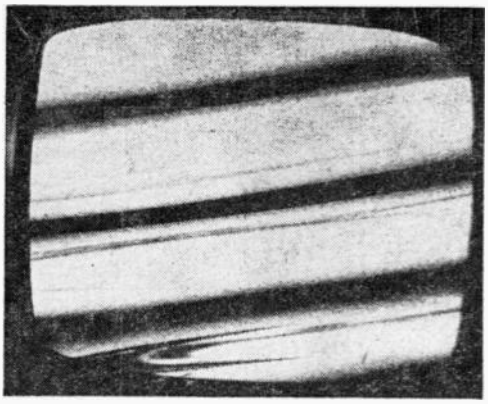


Fig. 16. When the horizontal won't lock in, check the horizontal oscillator and output tubes. If alright, try adjusting the horizontal frequency coil slug, usually on rear skirt of set.

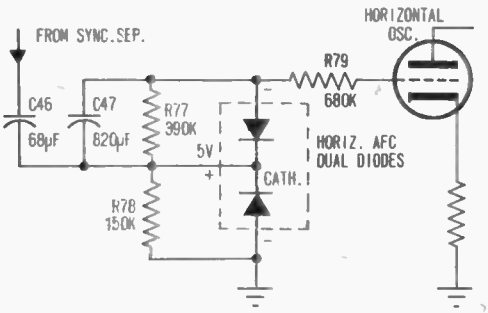
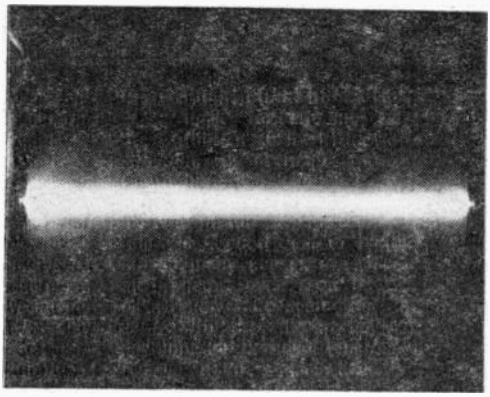


Fig. 17. If horizontal still can't be locked in, the next thing to check is the AFC (automatic frequency control) diodes. They are usually in the form of a single common-cathode three-lead package.

Fig. 18. A single bright horizontal line usually means the vertical oscillator or output tube is defective. Also try adjusting the vertical height and linearity controls (see text).



so do not touch the high voltage nipple—even with the set *off*. As a further precaution, keep one hand *behind* your back, away from the ground or chassis, working with the other. This will keep possible shock from being dangerous.

First off, check the horizontal output, damper, and horizontal oscillator tube, in that order, with the set *off*. Then check the high-voltage rectifier tube after shorting all exposed high-voltage cage connections to ground to assure everything is discharged.

Look closely for a burned spot on the flyback transformer indicating it is defective and may have to be replaced. Then take a small, *well-insulated* screwdriver blade, slip the blade under the horizontal output cap while the set is *on* and draw a small arc from the plate terminal. If no arc appears, there is probably insufficient drive voltage to the horizontal output tube. Take a voltage reading at the grid pin; it should be from −5 to −25 VDC.

All of these checks can be made from the top of the chassis. Never measure the cap, or plate, voltage on a horizontal output tube. You can easily wrap the meter hand around the stop terminal. To measure the grid drive voltage, pull the plate cap off the horizontal output with the set *off* and then turn set *on*. If the voltage is normal, the horizontal oscillator section is performing. The trouble must be between the horizontal output tube to the CRT.

Careful Now. With the set off, carefully pull the cap off the high voltage rectifier tube with a pair of insulated long-nose pliers.

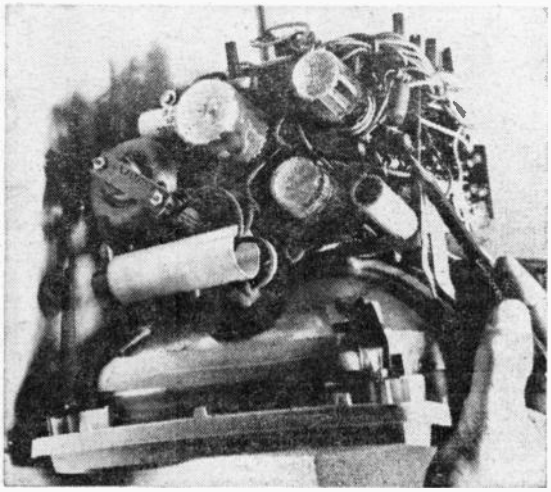


Fig. 19. The vertical oscillator circuit can also cause the absence of vertical sweep. The pencil points to the oscillator feedback coupling capacitor, one possible suspect; also check the vertical transformer.

THAT TOTABLE TV

Turn the set *on*, let it warm up, and then arc the screwdriver blade to the terminal inside of the high voltage cap. A good hot arc can be drawn up to half an inch long, if the horizontal sweep section is working properly. Turn the set *off* and replace the tube cap.

To see if the high voltage is being applied to the CRT, short the high voltage nipple on the CRT to chassis ground with a long, *well-insulated* screwdriver. Be extremely careful here. Placing the metal screwdriver

Fig. 20. A snowy picture with little contrast and weak detail is often caused by a weak RF amplifier tube in the tuner. This symptom can also mean a broken lead-in wire, shorted antenna, or open antenna coils.

to the ground and sliding it to the high-voltage anode connection should produce a sharp high-voltage arc.

If not, shut down the TV. Short the picture tube high-voltage cap to chassis ground. Also discharge the CRT by using two large screwdrivers, one on the anode connection and the other to black CRT coating. Snap

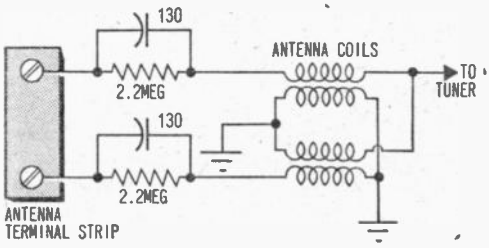


Fig. 21. The antenna coils are usually hooked up in this way. The capacitor/resistor network is designed to prevent lightning from damaging tuner. Check that capacitors, resistors and coils haven't been damaged.

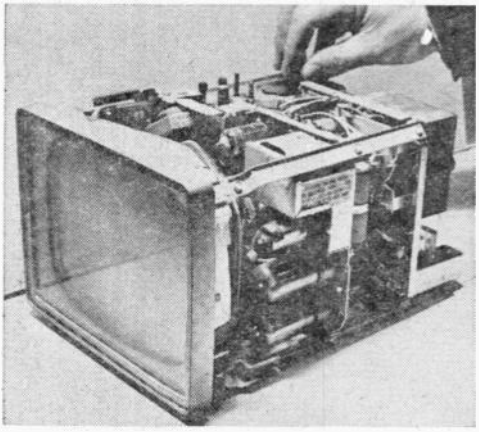


Fig. 22. If the picture jumps around every time you touch the channel selector, the tuner probably needs cleaning. Get a good spray lube and spray it on the contacts while briskly rotating the selector knob.

out the high-voltage cable and fire up the receiver. Arc the high-voltage cable to chassis and a sharp-high-voltage arc should occur. In case there is plenty of high voltage, the picture tube is probably defective.

Sides Pulled In. Insufficient horizontal width indicates insufficient high voltage on the CRT. The trouble can be a weak horizontal output, damper, oscillator tube, or all three. Don't overlook the possibility of a weak low-voltage rectifier tube that supplies power to the horizontal sweep stages. Check the setting of the horizontal linearity or width coil, as shown in Fig. 14.

The screen-grid resistor and bypass capacitor of the horizontal output tube are likely components to check if insufficient width is

(Continued on page 99)

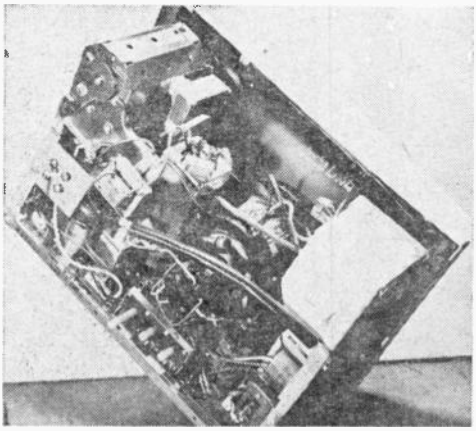


Fig. 23. Attempts at reducing overall size of portable TV sets have resulted in very crowded chassis layouts. This makes the portable a great deal more difficult to work on and care must be used not to damage set.

The Thinking Man's Answer to TV Servicing

By ROBERT F. LEWIS

TVs can be a cinch to service, but only if you first take careful aim and mix a little method with your madness

■ When it comes to do-it-yourself TV servicing, do you use the "shotgun" method to locate bad tubes? If you're the average, nontechnical, television set owner you probably do, since you couldn't be expected to know exactly where the target is. What do I mean by the "shotgun" method? Well, here's how it works:

Your TV set is acting up. So you pull out all or most of the tubes, cart them down to the corner drug store or supermarket, and run them through the do-it-yourself tube checker. You find two or three that show a "bad" or "questionable" reading, so you buy some new ones. When you get home and plug in the new tubes, you may find that you still haven't cured the sickness. Even if you have, there's a good chance you've replaced some tubes needlessly, since a questionable tube-checker reading doesn't always indicate a bad tube.

First Step Forward. What can you do to avoid this unnecessary expense? Here are some tips that may save you considerable cash and frustration the next time you tackle the one-eyed monster!

First, unless you have some technical knowledge of television, you shouldn't ordinarily attempt to carry servicing beyond the tube-changing point. You don't have to be an engineer or technician just to change a TV tube, but it does help to have a little familiarity with the inner workings of your set. This isn't as complicated as you might think; you can learn enough about it in the time it will take you to read this article.

Second, most TV receivers have, pasted somewhere inside the cabinet, a tube location diagram. This gives you a wealth of information; it tells you the type and location of each tube, plus the kind of job it does.

Now, with these two pieces of knowledge at hand, you should be able to direct most of your troubleshooting efforts to smaller sections of your set—to zero in on the exact tube or tubes ruining your viewing. You shouldn't have to use the expensive scattergun approach.

Before we go any further, let's agree to concern ourselves only with black-and-white TV. Unless you have considerable servicing know-how, it's best to leave most color TV repairs, even tube changing, to a competent repairman, since many of the circuits in color TV sets require critical adjustment for proper color rendition.

A Little Theory. What is a television picture composed of? If you look at any newspaper photograph—called a "halftone" illustration—through a magnifying glass you will

TV SERVICING

see that it is made up of rows of fine black dots. In the light areas of the picture the dots are very small, leaving considerable white space between. In the darker areas the black dots are larger, leaving less white space. At a distance your eye sees the whole mass as a complete picture, since it can't distinguish between the individual dots.

Now, turn on your TV set and tune it to some channel where no picture is being transmitted. Look closely at the screen. See how the picture is made up of a series of horizontal lines of light? These lines are actually traced on the screen by a rapidly moving spot of light produced when a sweeping electron beam inside the picture tube strikes the screen. The spot travels across the screen, starting at the upper left-hand corner and working down to the lower right-hand corner, in the manner shown in Fig. 1. For

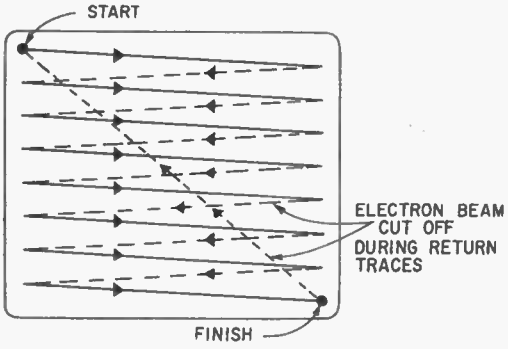


Fig. 1. Simplified diagram of TV raster does not show complicated interlacing.

the sake of clarity, we have shown the lines much farther apart than they really are on your TV screen. There are actually over 400 of these lines on the screen.

When the spot gets to the lower right-hand corner, it returns almost instantly to the starting point and repeats the trace. This screen "painting" process is repeated at such a rapid rate that your eye cannot detect the movement of the spot, but sees the screen as though it were continuously lighted. The technical name for the lighted screen is the "raster." Keep this term in mind. We'll use it again later.

At the Studio. Now, if we were to break up the horizontal lines into dots of varying brightness, we would have all of the necessary elements for a picture, as we saw in the newspaper illustration. In practice, this is essentially what is done. The light and dark portions of a TV picture are produced by simply varying the intensity of the electron

TV TROUBLESHOOTING CHART

Symptom	Possible Source of Trouble
No picture, sound or raster	Low-voltage rectifier. Filament burned out in one tube of series-connected string. Fuse.
Picture dim, does not fill screen. Sound weak.	Low-voltage rectifier.
Picture and sound weak or dead. Raster OK.	RF amplifier, oscillator, mixer, video IF amplifier, video amplifier.
Picture dead or has low contrast. Raster OK. Sound may be dead in some sets.	Video amplifier.
No sound. Picture OK.	Sound IF amplifiers, ratio detector, audio amplifiers.
Picture does not fill screen vertically. Cannot be corrected with **height** control.	Vertical oscillator and vertical output, low-voltage rectifier.
Picture rolls vertically. Cannot be stabilized with **vertical hold** control.	Vertical oscillator, sync separator, sync amplifier.
Picture does not fill screen horizontally. May also be dim.	Horizontal oscillator, horizontal output, damper, low-voltage rectifier.
Picture flops over sideways and rolls vertically.	Sync separator, sync amplifier.
Picture flops over sideways. Cannot be stabilized with **horizontal hold** control.	Horizontal oscillator, sync separator, sync amplifier.
Picture dim but raster fills screen. Sound OK. Sync OK. Cannot be brightened with **brightness** control. Image sometimes "blooms" around edges when **brightness** control is turned up.	High voltage rectifier, damper, picture tube.
Picture does not fill screen either horizontally or vertically.	Low-voltage rectifier.
Picture contrast fades up and down, excessively.	AGC, RF and IF amplifier tubes.

beam as it paints the screen. The signals that produce this variation originate in the camera in the TV studio. The image "seen" by the camera is swept by an electron beam in the same manner we have just described for the receiver picture tube. But instead of painting a scene, the camera breaks the image it sees into bits, like the dots in the newspaper illustration. These bits are sent out in sequence by the TV station, received by your TV set, and reassembled on the picture tube screen in exactly the same order and position. To create the illusion of a complete picture, these bits are broken down and reassembled at an incredibly rapid rate, several million per second. Other signals transmitted by the TV station synchronize the picture tube in your set with the studio TV station synchronize the picture tube in your set with the studio TV camera so that both will begin "painting" at exactly the same instant. The third signal transmitted by the station is the sound or "audio" signal. If the picture is in color, additional color-information signals are transmitted. Sounds fantastic, doesn't it?

same as, or similar to, those indicated on our diagram. In some cases you'll notice that a single tube does several jobs, possibly in completely unrelated sections. This is because many tubes contain two or three sets of elements in one envelope, a space-saving trick.

Sound, picture, and synchronizing signals from the TV station arrive via your receiving antenna and are all processed in the *RF amplifier, mixer, oscillator*, and *video IF amplifier* tubes.

These signals continue on to the *video detector* and *video amplifier* tubes where they are further processed. The picture signal is extracted and applied to the picture tube where it controls the variations between dark and light on the screen.

The synchronizing signals are routed through the *sync amplifier* and *sync separator* tubes, then applied as locking signals to the *vertical oscillator* and *horizontal oscillator* tubes.

The sound signal is separated at this point and passed through the *sound IF amplifiers*,

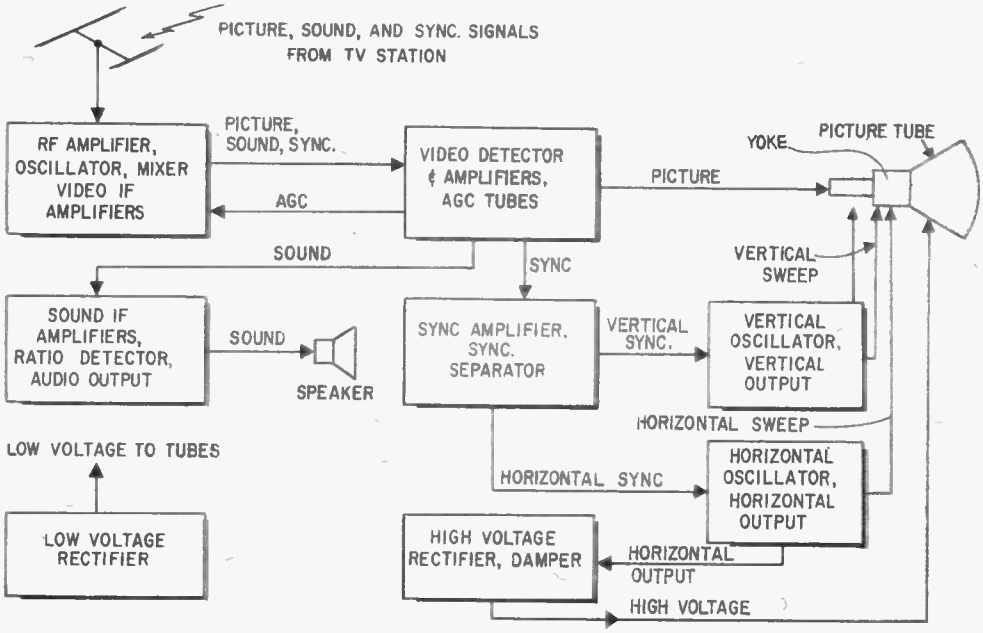


Fig. 2. Block diagram of TV circuitry is just about the same for all black & white TV sets.

Around the Block. Now, let's take a look into your TV set. Fig. 2 is a simplified block diagram showing the electronic-tube circuits in a *typical* black-and-white television set. Let's trace the routing of signals through the diagram. As we do this, refer to the tube location diagram in your own set and see if you can find tubes whose functions are the

ratio detector, and *audio amplifier* or *output* tubes, then to the loudspeaker.

Another circuit is the AGC or automatic gain control.

The purpose of the AGC tubes is to minimize fading or fluctuations in the picture contrast that may occur when the incoming TV signals vary in intensity. This often hap-

TV SERVICING

pens when an airplane is flying overhead.

The *vertical oscillator* and *vertical output* tubes control the vertical sweeping of the electron beam in the picture tube. The horizontal sweeping of the beam is controlled by the *horizontal oscillator* and *horizontal output* tubes.

Every picture tube requires a potential of somewhere between 10,000 and 25,000 volts for its operation. This voltage is generated by the *horizontal oscillator, horizontal output, high voltage rectifier,* and *horizontal damper* tubes. Very little *current* is developed in most high-voltage systems, so it is generally not dangerous to human life; although if you get a jolt from it, it can be startling and uncomfortable—something like getting a shock from an automobile ignition system.

Finally, the *low voltage rectifier* tube supplies all of the lower voltages to the other tubes in your TV set. In the more recent models, a metallic rectifier is used instead of a tube for this purpose.

Zeroing In. Now that you have more than a nodding acquaintance with your TV set, how can you use this newly gained knowledge? Here's an example, a typical troubleshooting situation:

Let's assume that your picture tube screen is brilliantly lighted and that the raster completely fills the screen. Yet there is no sound and no picture. Looking at our block diagram, you can see that the sections that are common to both picture and sound are the ones that include the *RF amplifier, mixer, oscillator, video IF amplifiers, video detector,* and *video amplifier* tubes. So you proceed to check these tubes. Forget the others.

Another common TV complaint is vertical "rolling." The image keeps slipping up or down and cannot be stabilized by adjusting the *vertical hold* control. This symptom indicates that your TV set is not synchronized with the camera at the TV station. It is likely to be caused by a faulty *vertical oscillator tube,* or perhaps by a weak *sync amplifier* or *sync separator.* This narrows your search down to two or three tubes; no need to use the "shotgun" system. Our troubleshooting chart directs you to source of still more symptoms in a malfunctioning set.

Picture Tubes. The TV picture tube generally gives long life if properly installed and adjusted. Loss of electron emission due to old age is a common problem, however, and is indicated by a gradual dimming of the picture that cannot be restored by adjusting the brightness control or by replacing small tubes. The life of a picture tube that shows aging can often be extended by installing a *picture tube brightener.* However, you should not use a brightener on a perfectly good picture tube, since it increases the heater voltage and may reduce the life of the tube or even burn it out.

If you are going to use a picture tube brightener, first determine if your TV set has *series* or *parallel* connected tubes; then buy the corresponding type of brightener. If all of the tubes in your set (except the high voltage rectifier and picture tube) begin with the number 6 or 12, the tubes are probably parallel connected. If the tube designations start with various numbers other than 6 or 12, series connection is most probable.

Pulling Tubes. Here are a few tips to keep in mind when replacing the small tubes in your TV set.

1. Be sure to turn off the receiver and disconnect the power plug before working inside the cabinet.

2. Wait for the tubes to cool enough to handle before trying to pull them out.

3. Discharge the stored high voltage from the picture tube by connecting one end of a *well-insulated* wire to the TV set chassis and touching the other end of the wire to the high-voltage terminal which connects to the side of the picture tube envelope. You'll probably have to slip the wire under the edge of the rubber insulator to make contact with the high-voltage terminal.

4. When you replace a tube, be sure that the new one is the correct type number as marked on the tube location diagram. Don't switch tubes around just because they look alike, unless they have the same number.

5. Be careful not to bend the pins on miniature tubes. Be sure the pins are straight before attempting to insert tubes in sockets.

6. If you doubt some of the readings you get on a do-it-yourself tube tester, recheck the tubes on another machine before investing in a new tube.

If your diagnosis fails to turn up a faulty tube because the trouble lies deeper, then you'd better turn the job over to your serviceman. However, if you're successful, you can sit back and bask in the glow of your TV set and the cash savings you've made! ■

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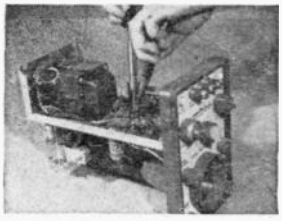

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CB FIX-IT SPECIAL

11 STEPS TO WALKIE-TALKIE REPAIR

by Homer L. Davidson

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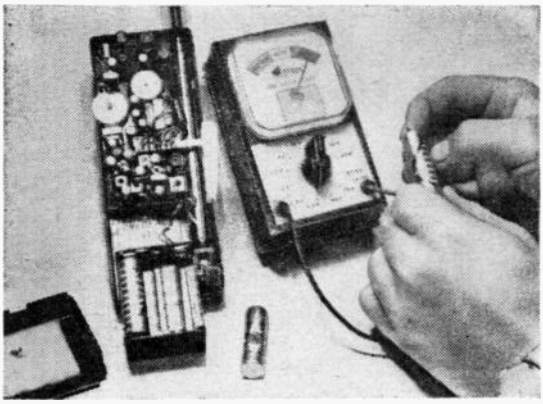
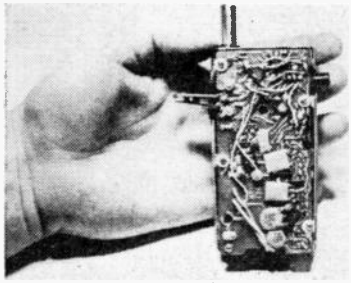
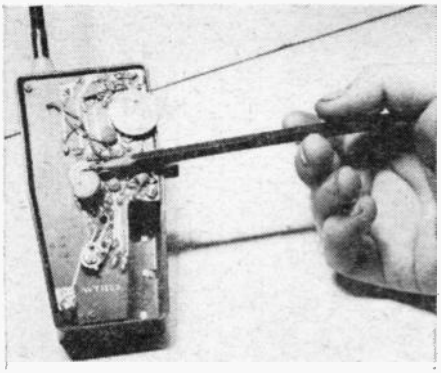


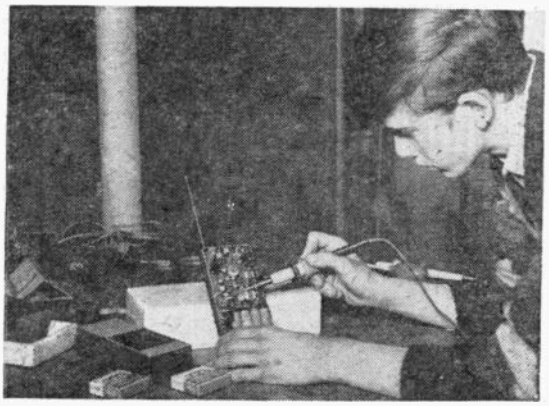
1 Check those small dry cells first! If you don't have a battery tester, check voltage with the "talk" button depressed. If one or more dry cells are low, replace all. Be sure dry cell contact surfaces are shiny bright or else you lose volts.



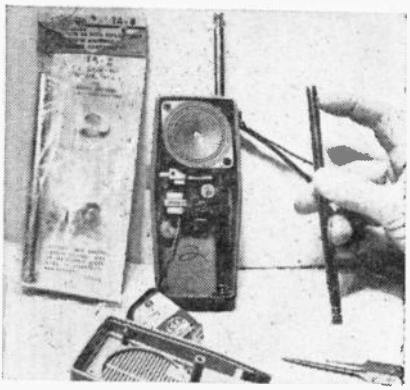
4 If you can't turn your walkie-talkie on and the batteries are good, then you got switch trouble. The on-off switches in most portables are flimsy and break easily. Use an alligator clip across the switch connections—if this works, a new switch is needed.



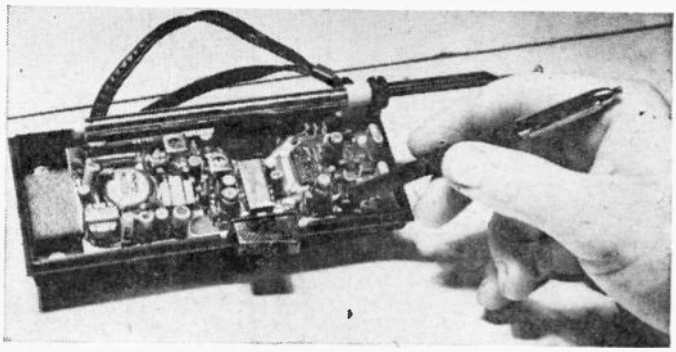
5 If your unit will not go on the air, then it's time to push, poke, and pull to detect loose components, snapped wires, etc. Poor or marginal connections are responsible for most transmitter problems. Better go back to Step 2 and do some careful inspecting and soldering.



2 One big headache common to battery equipment is loose battery leads. Use a small-tip, low-wattage solder iron while making repairs. Apply enough heat to make a good solder joint and stop. Nose around for other loose connections or cold solder joints in the printed circuit board. Check switch connections, too!

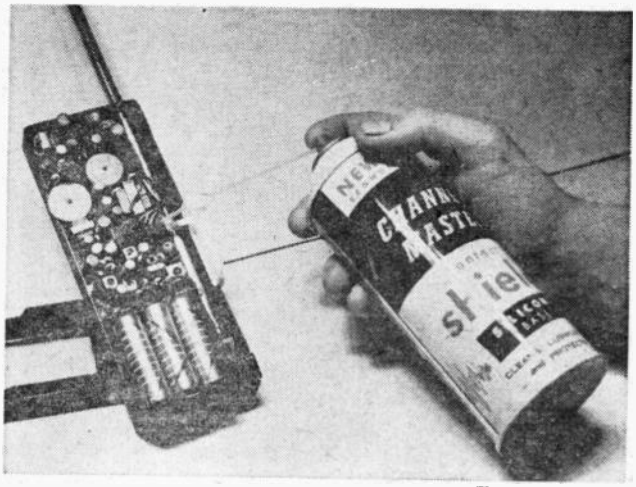


3 Walkie-talkie antennas usually break with time because of the abuse they take. Don't toss out the unit because its sky hook snapped. Multi-section antennas are available at most parts suppliers and can be installed in your unit. Be sure to select an antenna that comes close in length to the original. A longer antenna does not mean better reception or more signal out—it may mean poorer operation because of detuning.



6 No reception? In superhet models this means trouble in unit's front end as a rule. Check antenna coil for broken leads or loose connections. Travel from antenna to audio section touching transistor leads as you go. As soon as buzz comes from speaker, you know trouble is in previous transistor stage. Check for physical defects and damage before yanking out any transistors.

7 One good way to get rid of bugs is to spray them dead with electronic Raid. Push-to-talk switches cause a lot of trouble because of dirty contacts. It's not the switch's fault. The unit's low cost prevents use of hermetically-sealed switches, so dirt and dust will louse up the contacts. Use one of the many contact cleaners currently on the market place. A short spray and a dozen switch pushes should clean up any trouble in your rig.



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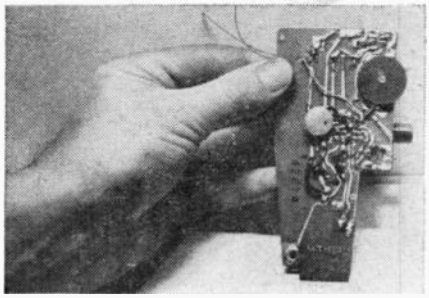
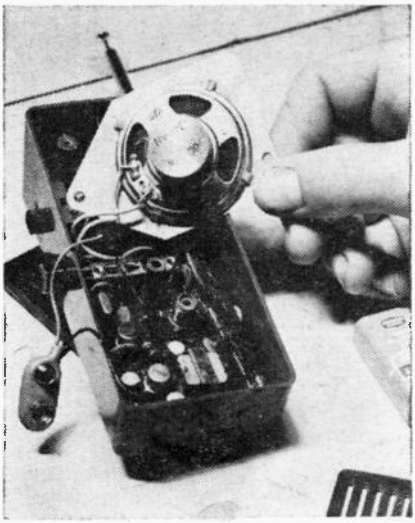
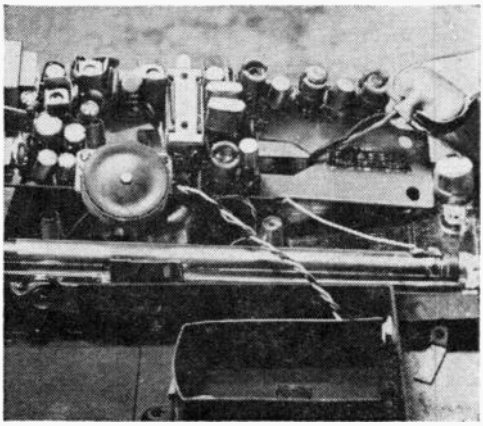
WALKIE-TALKIE



8 Let's face it, you drop a walkie-talkie and you have to pay the price. In this case it means removing the printed circuit board and patching it up if necessary, not to mention the epoxy work needed on the case.

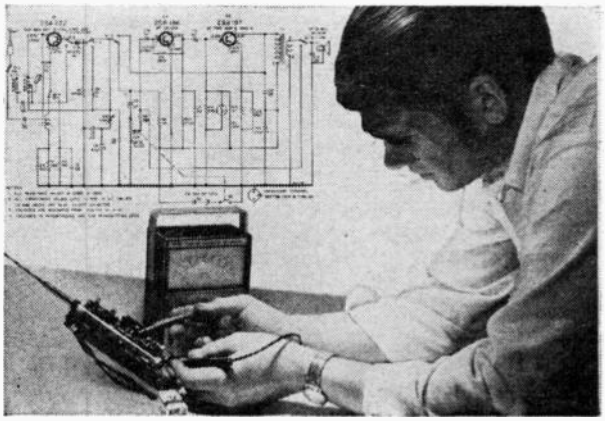


9 The sound from walkie-talkies is never hi-fi, but it can get worse with time because dirt, dust, humidity, and what-not tear, jam, warp, etc., the speaker cone. A quick test is to listen to the receiver at low volume—if it still sounds bad, it's time for a new speaker. Most jobs are 8-10 ohm units available from electronic supply houses. Pick a PM speaker replacement with the exact dimensions as the original.



10 If your receiver looks like it was salvaged from a vacuum cleaner bag, it's due for a thorough cleaning. Here's where old-fashioned GI spit and polish will pay off. Use Q-tips and water-color brushes to wipe and brush away the gook. You'll be surprised at the defects that can be uncovered this way.

11 If the first ten steps do not get your walkie-talkie on the air, you're in for some dog work. Most rigs come supplied with schematic diagrams—use them to pinpoint troubles. Make resistance measurements and continuity checks. Use the lowest scale setting when possible and likewise for voltage checks. If a transistor tester is available, check each transistor. It's a good idea to compare measurements against your other unit if you own a pair. It's up to you now, we ran out of space.



SOLDERING IRON + KNOW-HOW = HOT RECEIVER

Here's how I turned an inexpensive set into a real go-getter—*R. E. Schemel*

Newly arrived in the U.S., I went straight to the local ham radio shop with the firm intention of buying a multiband transistor radio. My purpose: to tune in those distant shortwave broadcasts from home. I looked around the shop, but, seeing nothing in the price range that a two-month stay here would justify, I wandered over to the sales section. To my delight, there was the grooviest little communications receiver you ever saw—a Lafayette HA-226. And—wait for it!—it was going for the lower-than-low special sales price of $13.88!

Reckoning it to be a cheap import with little or no performance, I asked for a demonstration. Truth be known, I firmly expected a stern reply that for the price did I really expect a demonstration as well? Instead, a courteous salesman connected a shielded antenna lead and pointed out that the radio was perfect, adequate for SW broadcasts, but not exactly a piece of high-class communications equipment.

I played with it for a few moments. It seemed to pull in SW broadcasts quite well except on the highest frequency range, something I put down to bad conditions. I hurriedly said I would take it before the salesman changed his mind about the price. At the checkout, the girl saw the price and shouted to the salesman with a note of astonishment in her voice, "You shouldn't have, Jack!" I beat it out of that shop so fast that I forgot to ask for the instruction book.

When I got the baby back to the motel, with a reel of wire for an antenna (and that cost me all of a dollar, compared with $13.88 for the radio!), it worked really well on two of the shortwave bands, but not on the 12-30 MHz range. I put this down to the shielding of the motel room, and thought nothing more about it.

Zeroing the S. After a while, I noticed that the S-meter was altering its zero position from range to range, but I resisted an almighty temptation to fiddle inside. However, I did take off the covers, and found a solid type of chassis construction that augered well for future modifications. None of this printed-circuit stuff to inhibit one's enthusiasm in this little radio!

A few days later, we moved into an apartment, and by this time curiosity had got the better of me. I took off the bottom lid and saw what the trouble was. The supply for grids 2 and 4 of the 6BE6 convertor was run from the same dropper resistor as the screen grid of the 6BA6 IF amplifier. As the oscillator section drew differing currents on the different wave-bands, the 6BA6 screen grid varied in voltage, and this caused the cathode current to vary.

Shorting the dropper resistor proved the point. Therefore, purloining a soldering iron and the necessary parts, I made the modification shown in Fig. 1. This cured the problem completely, and now the S-meter stayed firmly at zero on all bands.

In the interim, I had determined that this set was a real goer, defi-

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nitely better than the average domestic type of radio. It really pulled in stations on the three lower frequency bands, but that 12-30 MHz band remained sullenly silent. I still explained it away with bad conditions. But one fine day it clicked—stations on the 31-Meter band were strong on Range C (4.3-12 MHz), but couldn't even be heard on the bottom end of Range D (12-30 MHz)!

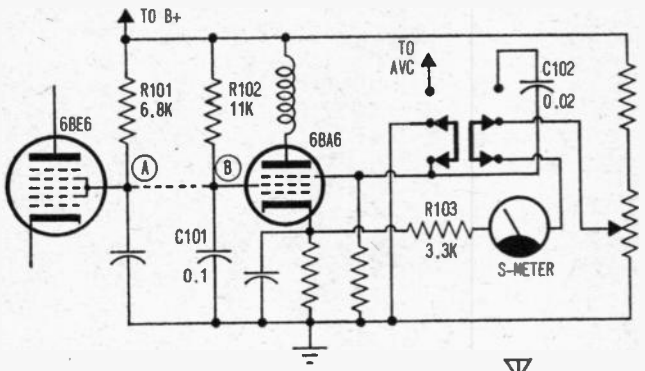
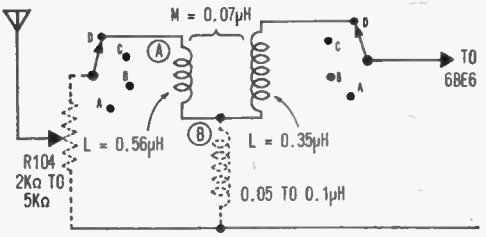


Fig. 1. Common dropper resistor for grids 2 and 4 of 6BE6 convertor and screen of 6BA6 IF was first circuit shortcoming uncovered in Lafayette HA-226. Author removed jumper between points A and B, tossed in R101 and R102 as shown, and sat back to appreciate an S-meter that no longer varied between bands.

Fig. 2. Long (4-in.) ground wire on Band D coil proved second problem with HA-226. Text tells how author handled this one.



Six for a Quarter. I checked the 6BE6 at a local drug store; it wasn't that. Something just had to be wrong with the radio. Surely not on a new one like this? Perhaps it could be a bad antenna system? Lengthening it, shortening it, using the drainpipes, nothing seemed to help. OK, I concluded triumphantly, the receiver input impedance must be wrong for these antennas; so I made a quarter-wave line (this gives a low input impedance when terminated by a high one, and vice versa) by twisting some #22 plastic-covered wire togther. Presto! Here was an improvement of maybe 6 to 9 dB.

Was this it? Not really, for after a couple of days' listening I found stations could still be heard on Range C that just couldn't be found on Range D. Something just had to be wrong with that receiver! So, after studying the receiver layout, the following solution came up.

Fig. 2 shows the effective circuit of the antenna tuning on Range D. I found that the ground wire, common to both the coupling and antenna coils on Range D, ran about 4 in. before finally reaching the chassis. I figured its inductance was between 0.05 and 0.1 *u*H. I also figured that the mutual inductance between the two-turn coupling coil and the five-turn tuning coil was of this order. If the phase of the coupling coil was wrong, it would cancel against the ground lead inductance, and there would be no signal pick-up in the main coil.

To prove my idea, I took the antenna to point B instead of point A. I was right! Signal strength increased considerably, maybe as much as 10 dB. So, I ran separate ground leads from the two tags on the Range D coil to the tag located immediately below them on the other side of the chassis; this cured the problem completely. The old ground path was disconnected to leave a connection for the other three antenna coils.

Grounds and Leads. For a few days I was satisfied, but then my fingers became itchy once more. That Range D could still take a lot of improvement. Everyday, the other three ranges seemed to get better, and for a 3-tube radio, we were really pulling those DX stations in. Could a good ground provide the answer? Some chrome-plated bars conveniently doing nothing in the forest near the apartment were brought into use.

Fortunately, the apartment was on terrace level, and the ground was still wet from the winter rain and snow. So with quite a lot of improvization, under cover of darkness with an eye to objecting neighbors, those bars were driven deep. After all that there was just a small improvement, so a good ground obviously wasn't the answer. So on to the next modification!

The 6BE6 is a cathode-coupled oscillator type of frequency changer. To obtain good conversion conductance, the RF cathode-to-ground voltage should be a small fraction of the grid voltage. At low frequencies it's easy to achieve this by tapping well down the coil. However, on Band D this makes for a very small number of turns, and on this receiver the ratio of the main oscillator-to-tickler windings was about 2:5. To make matters a lot worse, the lead from the cathode of the 6BE6 to the four different oscillator coils is about 4-in. long.

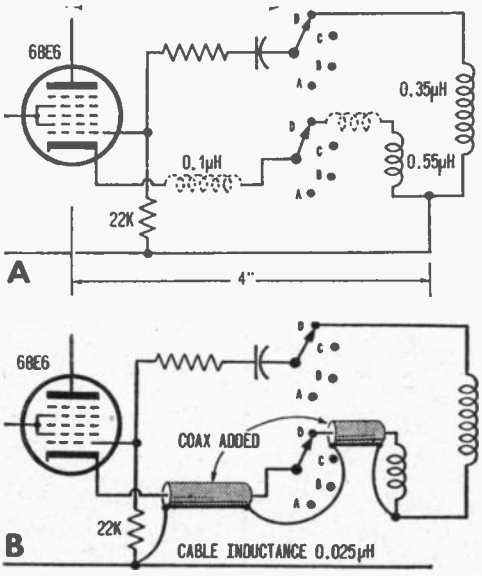


Fig. 3. Though modification detailed in Fig. 2 proved helpful, self-inductance of 6BE6 cathode lead to Band D coil was much too high for good conversion efficiency (schematic labeled A above shows effective circuit—lead, shown dotted, was calculated to have inductance of approximately 0.1 uH). Installing length of coax (schematic B) dropped inductance to 0.025 uH.

The self-inductance of this wire is about 0.1 *u*H, and the effective circuit is shown in Fig. 3a. The effect of the lead inductance is to make the cathode voltage 'way above the expected value, and nearer in potential to the grid. Overall, the conversion conductance falls off rapidly as the cathod-grid potential decreases.

What was done to cure the problem is shown in Fig. 3b. I ran a 50-ohm cable, grounded only at the tube socket on the lug adjacent to pin 1, right up to the range switch and on to the tags on the Range D oscillator coil, grounding the coil only via the outer shield of the coax. The calculated inductance of a 4-in. run of 50-ohm coax is only 0.025 *u*H.

Now things really started working! But, by the latest modification, the oscillator tuning had gone astray. And on realigning it, it was noticed that the receiver worked much better when the local oscillator was tuned lower than signal frequency, rather than higher, as it was originally. I noted that on Range D the designers hadn't bothered to incorporate a padder, and figured that we might as well align with the oscillator set low.

With all these modifications, that high-frequency range was working really well. In fact, there was little difference between the top end of Range C and the bottom end of Range D.

Razor Gen. Realignment presented a small problem with no instruments available, so what I did was to screw in the oscillator coil slug until WWV was heard on 15 and 25 MHz. I checked for WWV at 14.1 and 15.9 MHz; these corresponding to the possible image frequencies. If the oscillator was set correctly, the image of WWV was found at 15.9 MHz on the dial. The process was repeated at 25 and 25.9 MHz, and this time the oscillator trimmer capacitor was altered. If you have another receiver, you could use this same procedure to set oscillator frequencies at 14.55 and 24.55 MHz.

I also checked the antenna circuit alignment, and this really was a problem—moving anything in that front end pulled the local oscillator, so using a local station was no use at all. In the end an electric razor (the AC/DC type with contacts) came to the rescue as a broad-band interference generator. There were two tuning positions for the antenna tuning slug and the trimmer capacitor, and these corresponded to the two possible tuning frequencies above and below the local oscillator. I aligned for maximum noise on the higher of the two frequencies at 13 MHz, using the coil slug (slug in the further out of the two positions) and repeated this at 26 MHz using the trimmer capacitor (set to the minimum capacity of the two positions).

Q And BFO. Well, that wasn't the end of the story. I settled in for SW broadcast listening, and realized that the stability of my little receiver wasn't bad at all—it might even be good for sideband. However, the BFO didn't work properly. In the CW mode, the 6BA6 suppressor grid is not firmly grounded, and the tube works as a dynatron oscillator.

(Continued on page 98)

HOW TO BE A P.A. PATSY...

Public-address systems never seem to work quite as intended, and electronics buffs are frequently expected to perform major miracles with them. The following tips should help the miracle-worker.

Ten minutes to starting time. The Royal Grand Potentate has come all the way from Crows Canyon for the annual lodge banquet, and you know what a reputation he has for laying 'em in the aisles. The MC makes a perfunctory check of the public address system with the *one-two-three* testing routine. *Nothing happens!*

Normally stable as the Rock of Gibraltar, the MC is suddenly reduced to panting panic as he hammers the mike and hollers for the manager. And then his eye lights up with the hope of desperation as he spots you, the lodge electronics hobbyist, at a forward table. Suddenly it's *your* tub of transistors.

Enter Thinking. You make sure the mike's own switch is *on*, and you work it back and forth to clear the contacts. You gently tap the microphone after tightening the cable connector on the mike head, and you finally determine the system is truly a corpse. The connector at the other end of the cable is firmly snapped into the audio wall socket. A harried scan of the room discloses the amplifier on a shelf at the rear. The red pilot light shows the AC is OK. The mike volume control and master gain pots are set near mid-range so up to here, all systems are go.

You gently slide the amplifier around and see no unattached wires hanging loose and no stray strands shorting the loudspeaker-connection screws. Turning *off* the power briefly, you tighten the screws with your nail file or pocket knife and firmly seat the two mike connectors.

Two mike connectors? You dash to the other microphone—the one for the guest speaker—and *Eureka!* It works! So while a hastily recruited lodge brother talks into the good mike, you identify the defective channel at the amplifier by disengaging the mike cable connectors one at a time and noting when the signal stops. Then putting your finger on that channel's now-exposed single (Amphenol) or triple (Cannon) mike input terminals on the amplifier, you get a satisfying buzz from the speakers.

So you now know the amplifier channel is good and the mike or its cable is bad.

by Eugene F. Coriell,
Lt. Col. USAF-Ret.

By this time, the assistant manager has arrived. In no time at all, he sets up a spare mike and waves good luck as he hastily departs to answer a paging call.

Pause Smiling. You heave a mighty sigh. The MC looks ten years younger as he confidently repeats his test routine—and promptly ages again as the system howls into feedback. As the guest speaker enters, the MC tosses the ball of wax back to you. So what now, Marconi?

Feedback, hmmm. Maybe in checking over the amplifier connections, you accidentally advanced the mike pot? No, it's OK but you drop it a bit. No dice. Another slight drop, and now the howl is gone, and so is the needed volume. Could the tone control have been jostled down into the bass region where feedback is most likely?

Nope, it's right in the middle of the range. Then your eye falls on the MC's replacement microphone and you notice it looks a bit different from the original. In fact, it's a non-directional unit and it's picking up some of the loudspeaker output that was blocked out by the original directional mike.

So you mentally tick off possible solutions as the guest speaker is being escorted up the aisle toward the head table. You could turn down the gain to reduce system sensitivity and have the MC buddy up to the mike to compensate. Or you could raise the mike higher on its stand and angle it downward, hoping for a little instant directionality.

But wait a minute. Here comes the assistant manager again and he's carrying the original mike. Beaming, he puts it back on the MC's stand and explains he soldered a broken connection in the connector receptacle. And gratefully you hear the clear, ringing tones from the loudspeakers, "Ladies and gentlemen . . ."

Act II. In show business, they'd call this happy solution a contrived ending. But now let's put the shoe on the other foot in a situation where any contriving may be strictly up to you. Let's say that, well in advance, your lodge had the good sense to make you their sound liaison man with the hotel. So

PA Patsy

you approach the manager via the public-relations route and explain that the lodge has asked you to offer cooperation in meeting the sound needs of the meeting. Since this has probably never happened before, you have thereby earned a good question-and-answer session with one of his aides, perhaps the hotel engineer.

For your particular table and seating arrangements, where will the mikes be plugged in and what types are available? Where is the amplifier located and what are the normal ranges of the gain and tone pots? Can the mikes be seen from the amplifier location? Where are the speakers to be located? Sometimes they are fixed in place, with some or all hidden in the ceiling.

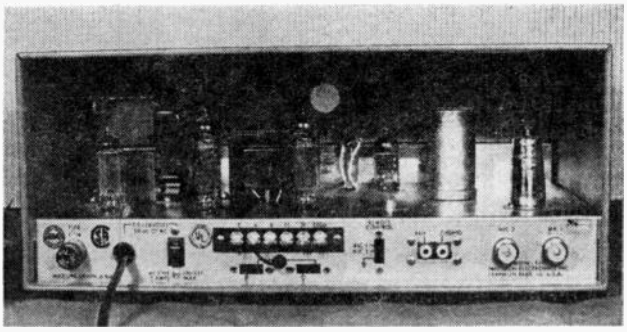
What is the range of movement of any speakers that can be relocated if necessary to reduce feedback or fill in dead spots? And you ask to have the hotel paging system disconnected so that Maizie at the switchboard can't come booming in over the climax of the guest speaker's best joke.

Dress Rehearsal. You then diplomatically ask to try out the system with the types of mikes you want, placed where you want them. You ask for the directional type as feedback insurance, and this includes the audience traveling mike. With the mastergain and tone-control pots set at mid-range, you note down the position of each mike pot for maximum volume before feedback occurs.

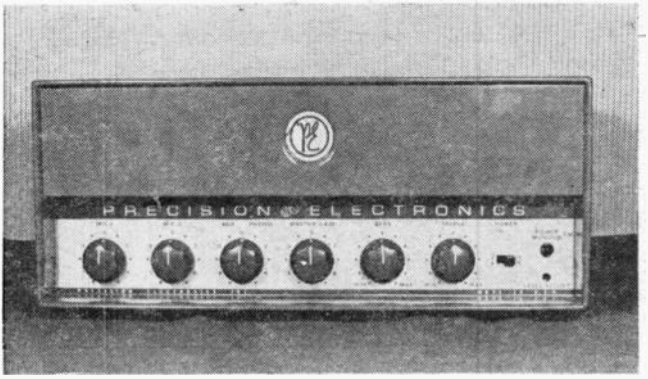
All mikes are *on* for this test. If this volume is adequate in the empty room, you figure there should be no howl problem with a full house, since an audience absorbs sound. Any additional volume needed then is obtained by carefully inching up the master gain without disturbing the individual mike pots.

Listening critically, you note the absence of hum but detect some crackling when using one of the mikes. With the hotel man nodding assent, you note that the cable is snug in the mike head and that tapping the instrument causes no crackling. But flexing the cable as you walk toward its wall receptacle, you suddenly come to a point that really makes the system bark.

Too many hotel dish carts have been rolled over that cable, and your guide notes the need for a new one. The other table mike seems to cause pops, particularly if you get too close to it. Sadly you agree replacement is in order.

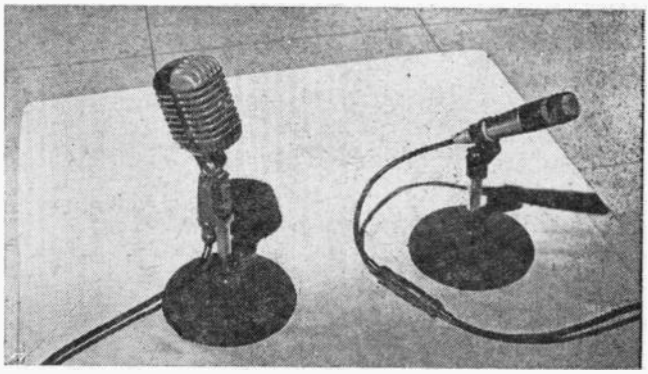


Rear of S20 reveals two mike inputs of Amphenol type at far right, remote control connector at right of speaker terminals. Latter is for pots to control mike volume.



Typical of public-address amplifiers is Precision Electronics' Model S20. Power Monitor (extreme right) is neon lamp which flickers when pots are set for desired output.

Trying out the traveling audience mike, you notice it causes howling when carried under any of the ceiling speakers. You learn that, unlike some installations, these speakers have no cut-off switches. This means that you'll want the mike man practically pushing the microphone into the users' faces

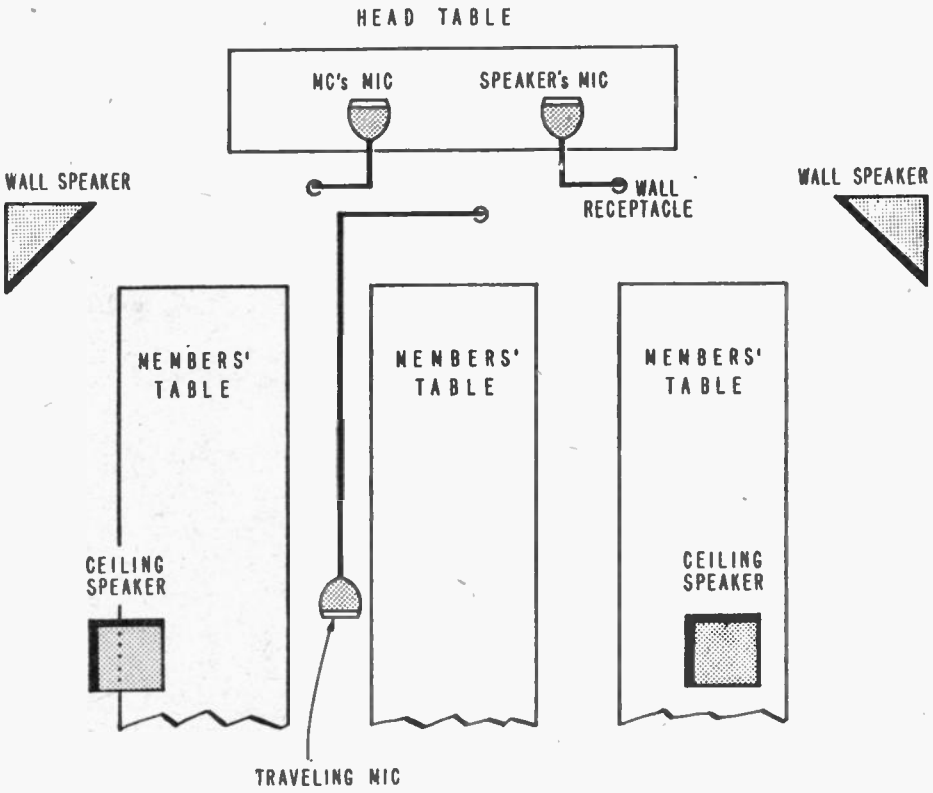


Two directional mikes in Shure's Unidyne series. Left, Model 55S accepts cable plug-in connector on threaded collar; right, Model 545 has cable-mounted connector.

to permit minimum gain setting to discourage feedback. And this reminds you to have someone assigned to that mike, and also an operator at the amplifier you'll maintain liaison with as the sound scout. Here you recall there may be a union and you make your arrangements with the hotel man accordingly.

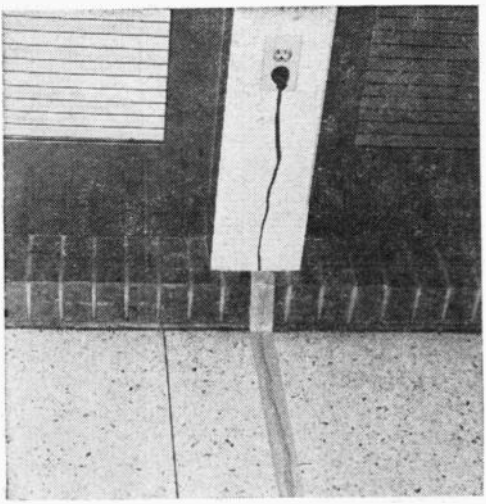
A Show For Sure. And now you foresightedly consider what to do if trouble occurs on the big night. If the hotel furnishes an operator (this is unlikely in smaller establishments), you're in his hands. If the lodge is graciously permitted to handle the amplifier, any fast fix needed is likely to be your baby—if only because the emphasis is on *fast*.

If the system conks out completely, maybe some wise guy pulled the AC plug or a mike connector. Or maybe the amplifier innocently blew a fuse. If the fuse isn't plainly visible, you ask the hotel man for its location, along with a spare fuse which you tape to the amplifier. The fuse has been known



Ideal public-address setup for banquet hall looks something like this, with wall and ceiling speakers aimed well away from mikes. Properly set up and tested ahead of time, PA system should give no trouble when it's call on to deliver its all-important goods.

PA Patsy

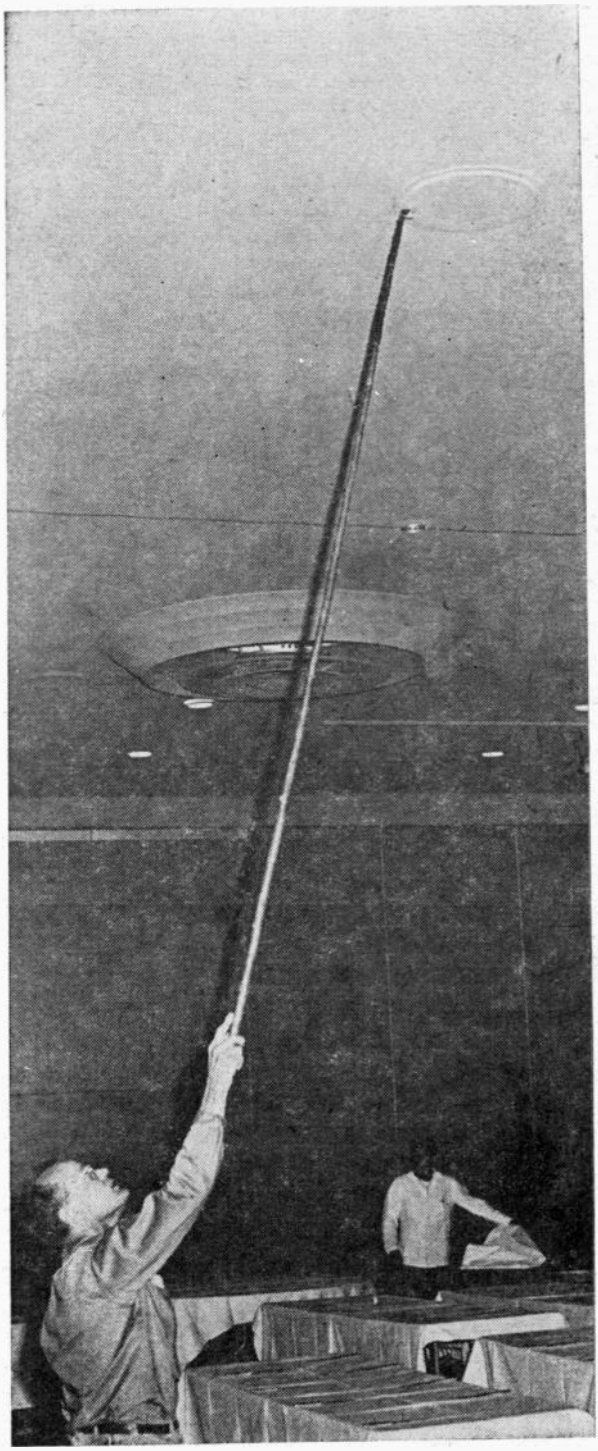


Leaving exposed cables and cords around banquet hall is asking for trouble. Best bet is to tape down all floor cables—those for microphones and speakers —as well as all AC line cords with painters' masking tape to avoid possible accidents.

to be hidden in the body of the AC plug.

And what if that old devil Hum should loudly assert his dominion? You'll promptly try reversing the AC plug in the wall socket, and make sure the pot on any unused channel—including a phono input—is all the way *off*. You'll make sure any grounding wire to the amplifier chassis is tight. If these tricks don't work and the hum is bad enough to warrant the interruption, you'll kill each mike pot in succession. If this points up a bad channel, you'll plug into a spare channel if any, or commandeer the traveling mike. Or you'll turn down the gain on the offending channel and ask the speaker to talk closer to the mike to improve the signal-to-hum ratio. But if the trouble is not in one of the mike channels, you'll rap the amplifier smartly—just in case—and/or turn down the tone control to minimum bass and ride out the storm.

And on banquet night, you'll firmly tape all exposed cables to the floor and all table mike cables to the table legs, using 3-in. painter's masking tape. Thus do you prevent mikes, members, and MCs from becoming accident statistics. And thus does your overall planning assure the Royal Grand Potentate will truly lay 'em in the aisles—because the sound system will lay no eggs. ■



Individual ceiling speakers in some halls are equipped with cut-off switches to control feedback. Reached with what hotel employees refer to as sky-hooks, switches can save the day for the PA patsy.

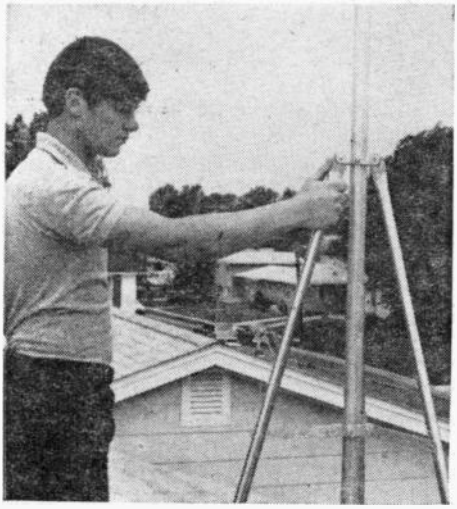
ERECTING A ROOFTOP TOWER

By Homer L. Davidson

Forget about masts, guy wires, and dizzying heights —a rooftop TV antenna will take less time, require less money, and give plenty of zonk!

Do you really want to climb Mount Everest to get good TV reception? Are you waiting for the moment when your mast gets the shakes and comes toppling down during a storm that was never supposed to show up?

If *you* get the wim-wams thinking about all the complications that might come up when erecting a mile-high TV antenna—or if you've already been through the mill—this guide to erecting a rooftop antenna should give you courage. Actually, it's not as bad as it first seems. If you're willing to sacrifice some height to gain a goof-proof installation, not only will you sleep better at night and feel better in your pocket book, but your neighbors will appreciate a job well done.



We've come up with some groovy photos that show a young fella going about his work. As you can see, he's got a sturdy roof (good shingles and joists), a few tools, and the roof mounting antenna. That's it.

With screwdriver, pliers, and crescent wrench in hand, all you do is select the right tower for your particular receiving area. This depends on the kind of signals you wish to receive (uhf, vhf, FM, etc.), distance from the transmitter, and the obstructions in between. Your local TV shop will probably give you some advice on just what you need.

Here To Stay. A rooftop tower has many advantages over a mast. It's easier to install, it has a much better appearance, it's more secure, and you eliminate vibrating guy wires that run endlessly from the

TV Tower

mast to your house. Very few rooftop antennas blow over during severe storms, so they prevent additional damage to your roof. Should the boom or any of the elements be damaged they can be reached with no trouble at all.

Only a few holes are needed to install the tower on your roof. Before you get started, check and make sure that your antenna will be no higher than other installations in your neighborhood. If necessary, check the local city ordinance for TV antenna installations. Some cities have very exact requirements and even a permit fee. Better to be safe now than sorry later.

Small TV towers come in lengths of 18, 30, and 36 in., as well as 5- and 10-ft. lengths. While they are sturdy and cost little, a tower mounted on a 1½- to 2-story home should provide adequate reception even in a fringe area. If you're really out in the cold, a hi-gain Yagi-type antenna will help to put you in the ball park.

Selecting a Sight. Once on the roof, select a likely spot for a three-legged tower. We'll help you out by recommending dead center on the roof peak (you get a ground-plane effect this way that will reduce local RF interference somewhat); just count the total number of shingles and divide by two to reach *Ground Zero*. Mounting the antenna to one side of the roof is possible, but less effective.

Make sure you're clear of tree limbs, etc., and in the line of sight of some TV stations. At all cost, keep away from power lines of any description.

In extreme fringe areas you can mount the tower on the highest part of your roof. But if you've got more than 10 ft. of antenna skyward (extending above the tower), it will have to be guyed properly. Under normal circumstances, however, guy wires shouldn't be necessary. A good rule of thumb is: a 5-ft. mast extended out of a 30- to 36-in. tower; a 10-ft. mast extended out of a 5- to 10-ft. tower.

If you're mounting the tower on a flat surface (with no peak), simply center it by using the roof corners as a guide. A friend can hold the boom at the approximate dead center while you take sightings from alternate corners.

Mounting Boom. Before securing the three-legged tower, check that all three legs are located *over* a roof joist (i.e., supporting beam). The towers have adjustable legs so this is possible. You can locate the joist by taking a hammer and tapping lightly over the surface of the roof. The first solid thump indicates you've got a beam where you need it.

Temporarily place the legs of the tower on the corresponding joists. Place the two adjoining legs (i.e., the two that form the base of the triangle) in the direction where winds are excessive. It's usually north winds or northwesterlies that cause most problems, but it pays to make sure for your particular area.

Level the tower before securing (lagging) it to the joists. A carpenter's level will prove to be a worthwhile investment, but should one be lacking, place the boom on the tower anyway and sight it against house outlines and other reference points. When using a level, level the tower in two opposite directions with the boom installed.

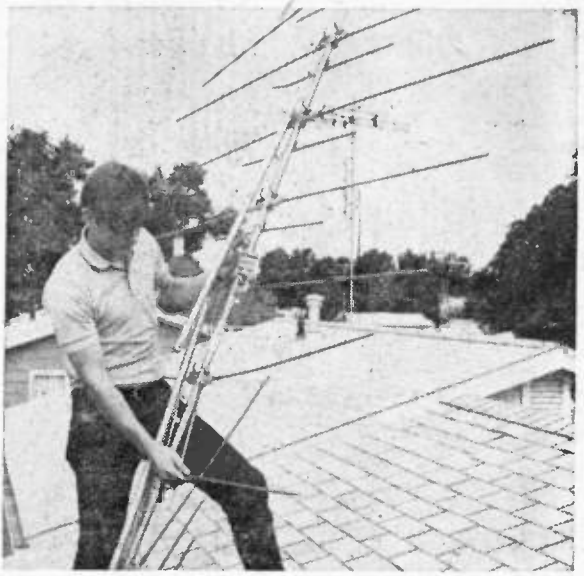
Now you can secure the legs to the joists using the supplied screws. Be sure to place at least two screws in the base of each supporting leg. If they don't go directly into the joist you will have to sound out the joist's location again. Probably a shift of ¼ in. is all that will be needed. Make sure that all screws are flush with the roof surface and as tight as possible.

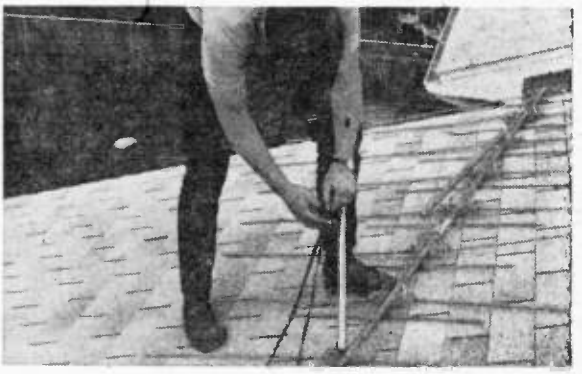
Antenna Up and Away. Remove the antenna from the packing carton and prepare it for mounting. Most TV antennas can be unfolded in a second and the antenna rods will lock into position. Simply push or pull the elements into the correct configuration and clip them into place. You'll find it easier to assemble the antenna on the roof, but take care not to damage shingles while you're working. Wherever you work, leave plenty of space for the job.

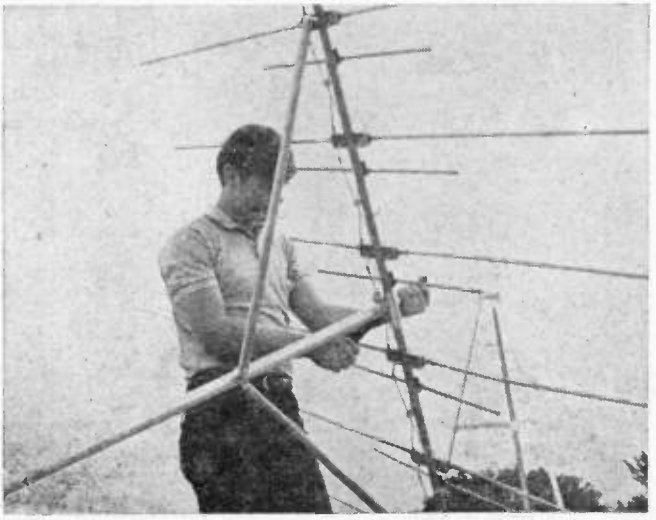
To connect the 300-ohm lead-in wire to the assembled antenna, use either small eyelet connectors or form an eyelet with the bare wire. Place the lead under a lock washer, tighten the connection, and place some electrical tape over the antenna terminals. This will insulate the antenna connections from erosion due to wind and moisture.

If the antenna has a fairly long boom, two brace supports should be used to support it. Place a standoff on the front support brace while the antenna is still being prepared for mounting.

Two Types. In this installation a uhf *bow-tie* antenna will be mounted below the







Before securing tower to roof, place TV mast in position so that tower can be properly leveled (see photo on previous page). Once antenna has been installed, final leveling can be achieved with small set screws on support braces. At least two screws should be used to secure legs to joist. Carefully remove vhf antenna from carton, fold out all elements, check their configuration, and then lock them into place. Hook up lead-in cable to antenna, and with cable in place, mount a standoff on one arm brace to hold it in position. Now that antenna lead-in is installed, mount antenna to 5 or 10 ft. mast. Tighten all bolts and pull up brace supports so that antenna will be level.

all-channel vhf boom. Since the latter is the basic unit it is mounted first. *Remember*—many antennas combine elements for both uhf and vhf reception, so you'll only need the bow-tie (or equivalent) if you're in a fringe area or the uhf signals are not in the same plane with the vhf signals.

Choose the correct length of mast to install in the tower. This will depend on reception requirements (also, check rule of thumb already mentioned for tower measurements). Most likely it will be either a 5- or 10-ft. piece. Bolt the antenna to the mast, level the bay, and tighten the mounting bolts. Pull up the brace supports so the antenna is in a level line and snug up the "U" bolts on the brace. Try not to flatten out any of the aluminum pipe.

Once you've lowered the mast into the tower, you can raise or lower it to get best reception. Rotate it so that the smallest elements on the boom are pointing toward desired stations; in fringe areas this may simply mean *snow-free* reception.

Some receiving areas require a uhf translator antenna. This is usually a bow-tie having several "V" elements and a reflecting screen. Gain is sometimes as high as 12 dB at distances up to 50 miles. If a translator antenna isn't required (as mentioned before), you can forget about the next steps.

Unfold the uhf antenna's mounting elements and bolt them into place. Connect the polyethylene lead-in cable to the antenna terminals and feed it through standoffs down the front of the antenna (or back through the screen). Now mount the bow-tie on the mast with two clamps just below the vhf boom. Point the bows toward the station you want; reflector remains flush behind them.

Leading Question. The lead-in cables for both antennas are fed down the mast and tower by way of standoffs (one for each lead). Bring the cables down one leg of the tower, pull them tight, and rotate the twin lead until you have a spiral that's taut so it won't flap in the wind. Crimp the insulating washers in the standoffs to hold the spiral in place. If you've got coax, however, you can tape it to the mast (see section on rotators).

Check to see at what point your leads will come off the roof and start down to the set. Position two screw standoffs here, fasten down the two leads, and pull them tight. Keep on making a taut spiral with the twin lead as before.

Going across the roof, place a screw standoff every 4 ft. and keep the two leads taut as they are inserted. This should make for a neat installation.

Once the tower legs, screw standoffs, etc., are in place, use plastic roof cement to cover up all the screws for a weather-proof installation. Smear the stuff over any metal part that penetrates the roof's surface.

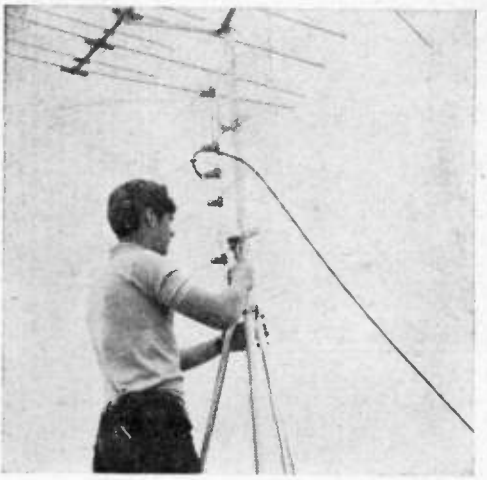
The antenna leads should now be brought down the side of the house. Place two screw standoffs just under the roof overhang and two more standoffs at the bottom where the leads will be fed into the house proper (through a window or the siding). Again, the leads should be taut, with more standoffs added wherever necessary. Try to keep the cables away from metal rain spouts, power lines, or other obstructions.

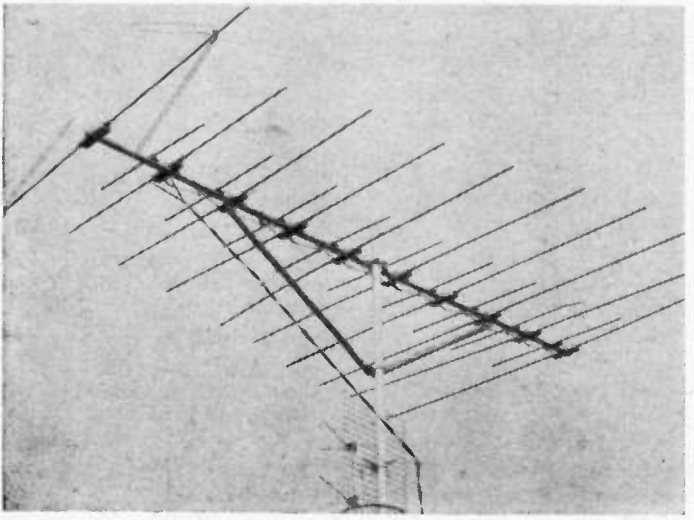
Rotating the Beam. If an antenna rotator is added to your installation it should be mounted *before* the vhf boom. Place the mast into the tower brace supports and mount the assembled rotator to this piece of pipe. If you use a 10-ft. tower, place the rotator on the tower mast as opposed to the antenna mast. This way it's easier to lower the vhf boom into the rotator assembly.

Connect the 4-, 5-, or 8-wire cable to the rotator. Make a note of the correct terminals for both ends of the cable. Terminal 1 on a flat 4- or 5-wire cable will be silver so start with it. Connect each wire to the rotator and tape the cable to the mounting bracket. The rotator's cable can be brought down either by taping it to the mast or using more standoffs.

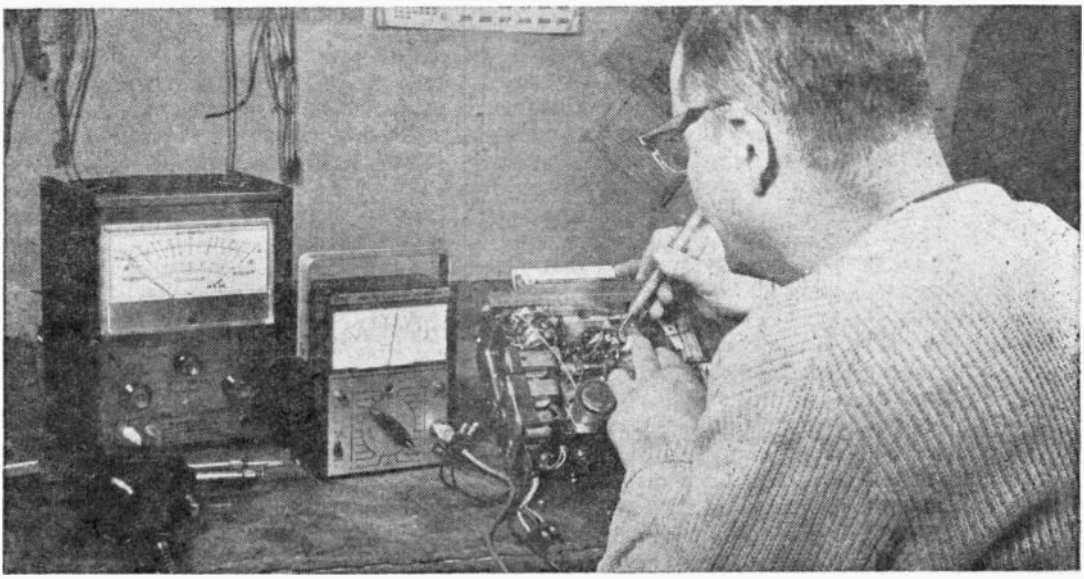
Be sure to leave a 1½- to 2-ft. loop in your antenna leads where they run past the rotator. This permits the antenna to turn a full 360 degrees without binding or pulling the leads out of position. Use a standoff above and below the rotator to hold the loop in position. These standoffs should be in position before you tape the rotator cable to the mast. This way you won't pierce these wires with one of the standoffs; this could ground the rotator's cable.

Check the correct direction for the rotator before leaving the antenna in one position. Rotator mechanisms have either a north or south starting position. When the antenna is in its correct starting position, bolt it into place. See if the antenna loop is free so it will rotate through a full 360 degrees. ■





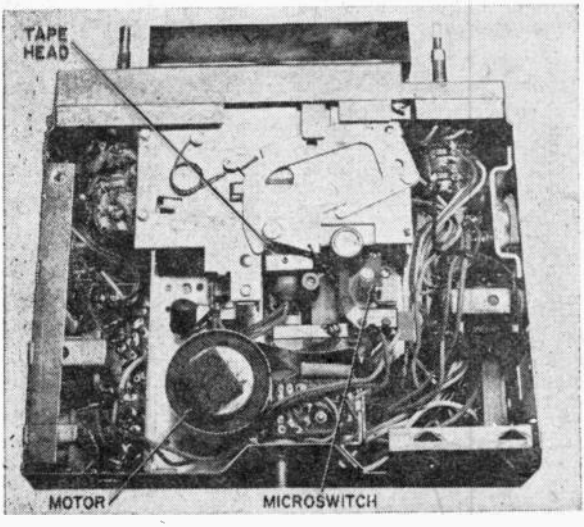
Remove uht antenna from carton (if needed—see text) and fold out all elements. Remember, if you're going to install a rotator it should be mounted before either the vht or uht arrays are bolted to tower's boom. Mount uht antenna below vht array and point bow ties towards desired TV stations. Now bring two lead-in cables down mast along one leg of tower. Standoffs should be used to keep leads in position. Loop of 1½ to 2 ft. is necessary to allow rotator to turn full 360 degrees. If you have no rotator, leads may be taut. Use plastic cement to cover all metal surfaces that penetrate roof's surface. At left, both antenna arrays have been mounted on boom and pointed towards major TV stations in area. Final leveling adjustment can now be made.



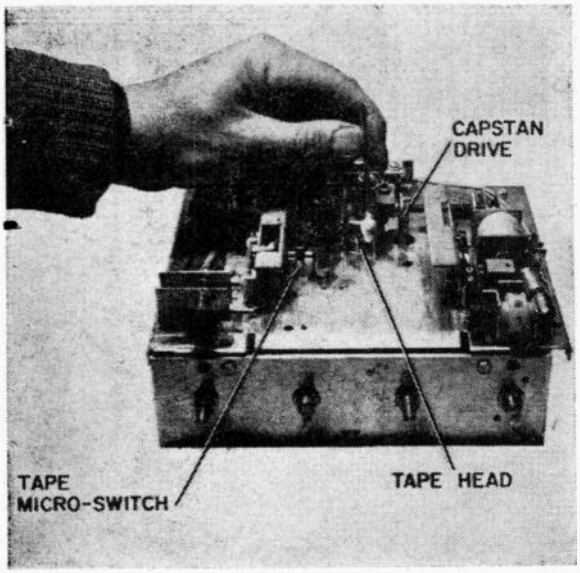
8 STEPS TO CAR

UNCLE SAM is spending millions to place men on the moon (rumor has it, in fact, that Rosemary's baby is scheduled for a moon landing, though nobody's saying just when). No one's denying that the Apollo missions are expensive and quite complicated electronically. Auto tape player repairs are expensive too, though unlike Apollo missions they needn't be—not if you fix your own.

In the Eight Steps you're about to see, you'll find meat enough to move you well along the way toward truly enjoyable music on the move. Only a few hand tools will be



1 Keep your eyes open as well as your mind when you remove the car tape player from under your dash, to the time you remove the chassis covers on your workbench. Very often a loose connection or screw can be fixed putting the player in tip top playing form. Once the covers are off, do some eyeball poking to turn up the trouble. Remember, most stereo tape player troubles are mechanical. Stop, think and try to isolate the trouble quickly before digging any deeper. And be sure not to misplace any hardware.



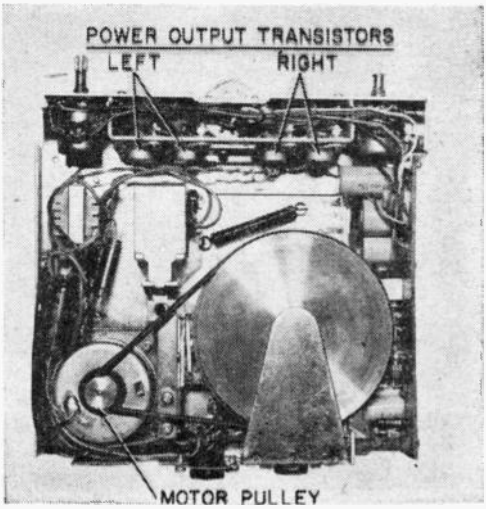
2 The most common trouble with auto tape machines is excessive dirt and dust. To ensure crisp tape reproduction, keep that tape head clean. A handy gadget to own is a tape head cleaning cartridge. At least once a week insert the cartridge to clean the head. At least once a year, or whenever playback reproduction is not up to par, do a thorough cleaning job. Clean tape head and tape guides with tape cleaning fluid. Apply fluid with a Q-tip. Denatured alcohol can be used. Also, remove tape oxide dust from head and motor capstan drive. Poke around and clean it all up. However, be sure not to throw any tape guides out of position.

by Homer L. Davidson

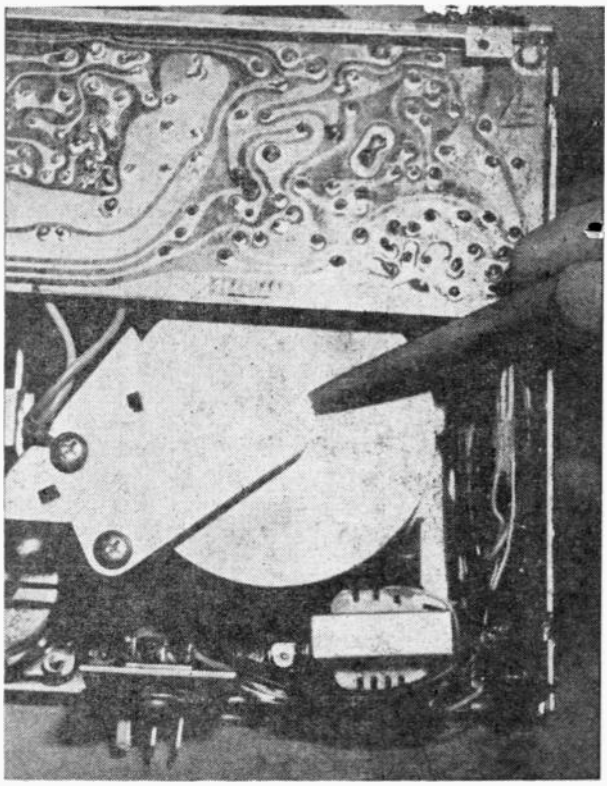
TAPE PLAYER REPAIR

needed for most repairs. Just remember to use a pencil-type soldering iron when working in solid-state circuit boards, and don't forget that adage about fools rushing in where angels wouldn't be caught dead. Takeyour time, take things easy, and think! If you have a signal tracer, VTVM, and/or transistor tester around the shop, by all means drag 'em out and put 'em to work—if you can find work for them. But since most tape player troubles are mechanical in nature, the bulk of the problem rests with you. Ready to take the time to stop, think, and try to isolate that trouble? Then read on.

3 In many cases, dirt and grease will collect on the motor drive pulley and nearby metal parts. Simply remove all dirt and grease with denatured alcohol. Also, check that capstan flywheel and clean it if necessary. A bright slick-looking flywheel indicates slippage between the drive belt and flywheel. Clean thoroughly. If at all possible, try to find a replacement drive belt. You may have to write to the manufacturer. Power output transistors are installed with hardware that can loosen, causing poor electrical connection. Also, if not seated tightly on their heatsink surface, the power output transistors can overheat and destroy themselves. Be sure they are secured in their sockets.

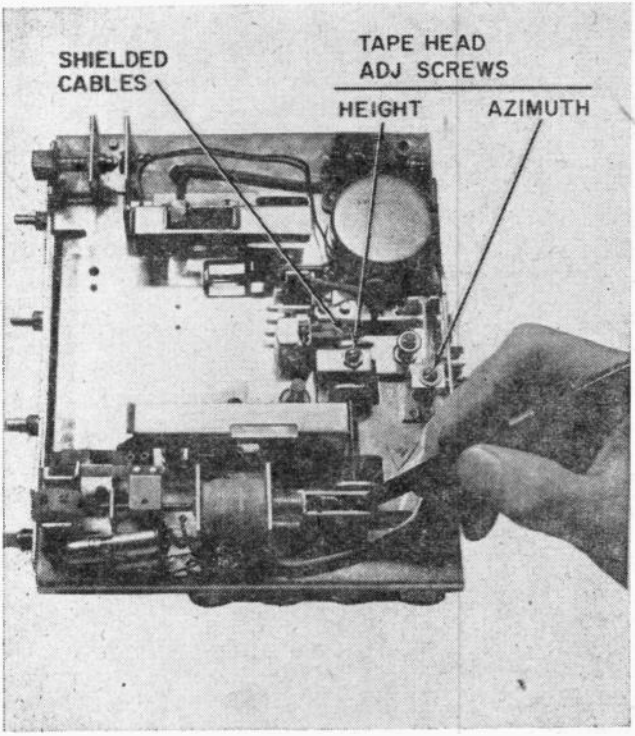


TAPE PLAYER REPAIR

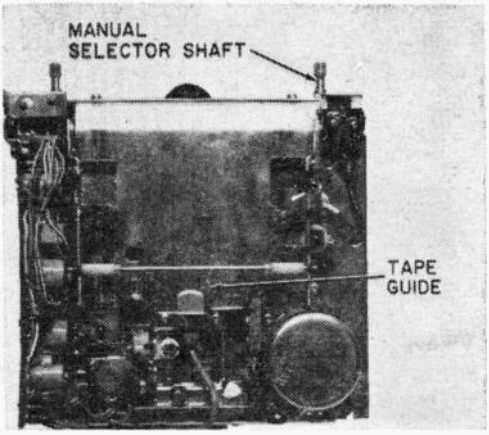


4 Excessive tape oxide dust within the flywheel bearing will cause slow and erratic tape speeds. Most capstan flywheels can be removed by pulling out a small keeper pin at the bottom bearing assembly. Now it will be easy to clean all bearing parts and surfaces nearby. Put a drop of oil into both bearings and re-assemble. Let the tape player run for a few minutes on the test bench and check for any oil that may work on the flywheel drive surface. Over lubrication may undo any good achieved.

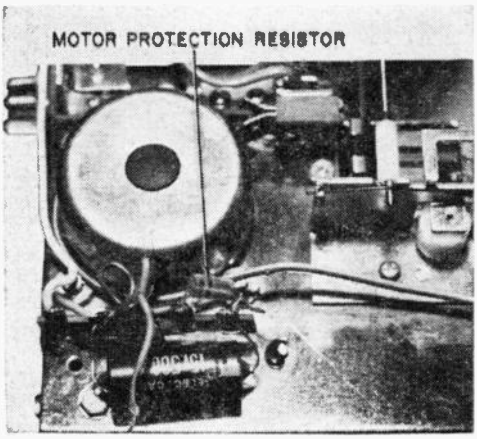
5 Does the tape refuse to change to another channel? Or perhaps, the solenoid is working and the channel indicator does not move? To find out what's up, connect power to the unit and listen to determine whether the solenoid is operating or not. A channel change can easily be heard while watching the ratchet. Determine whether the ratchet is turning over a small cam that lifts and lowers the tape head. Eyeballing it here will pin point simple mechanical problems that you can adjust to normal operation order. If the solenoid does not operate, it may be shorted out or have an open coil—call your VOM into action. If your playback is erratic or dead, check the shielded cables to the tape head. They can cause lots of trouble. If inspection does not pinpoint the cause of the trouble, you'll need the services of a signal tracer or injector. Be sure the volume control is set wide open.

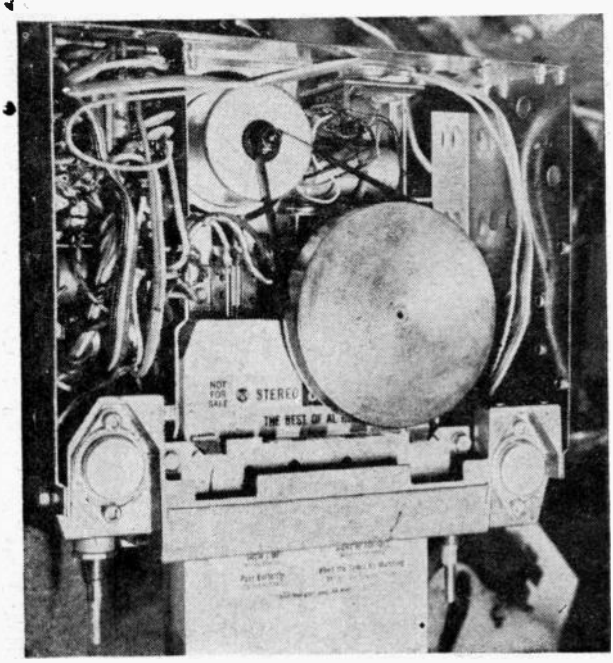


6 In case the stereo tape player will not manually change channels, suspect a dirty or broken manual change switch. Momentarily short the two contacts at the back of the change switch. If the solenoid is operating, the tape head will change positions. If not, trace out the wiring and look for a cold solder joint or break. If the switch is loose, it will promote frayed and broken wires. Try to determine cause of failure to prevent its recurrence.



7 Generally, when the tape becomes wound up into the capstan drive assembly, suspect a rough capstan drive or a poor cartridge. Do not allow the machine to run when jammed with tape. The motor will overheat. In this particular model, the motor protection resistor in series with the power supply burned out and was replaced. Most values are low—like 2.2 ohms. However, check the unit's schematic diagram to determine correct value and wattage. Of course, overheated motors often become defective and replacement is mandatory.



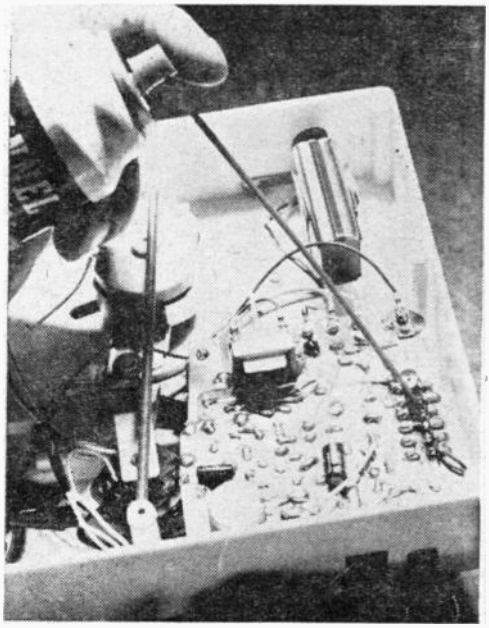


8 Before clamping the lid on a stereo tape player, give it a good bench preventative maintenance checkup. First, demagnetize the tape head. There are several inexpensive demagnetizers on the market. Second, use a test tape and check both amplifier channels and speakers for proper functioning. If you have the know how and manufacturer specs, check and align the tape head in azimuth and height. Next, install the machine under your dash, make power and speaker connections, snap in a tape cartridge. Now sit back and enjoy good stereo. ■

THOSE MINOR TAPE TROUBLES

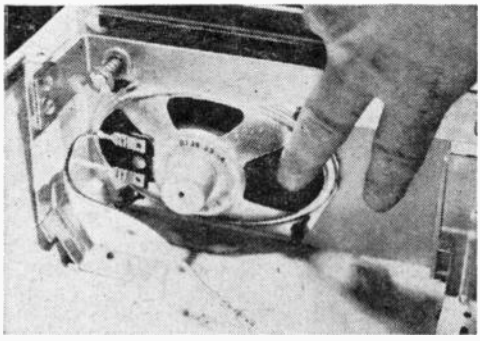
. . . and what you can do about them

By HOMER L. DAVIDSON

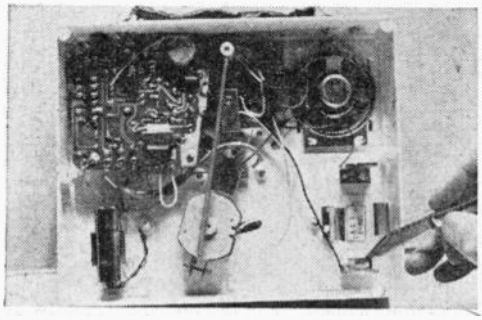


Oil has caused more tape troubles than it has cured, though it can be a godsend if used sparingly. But oil mechanical parts only.

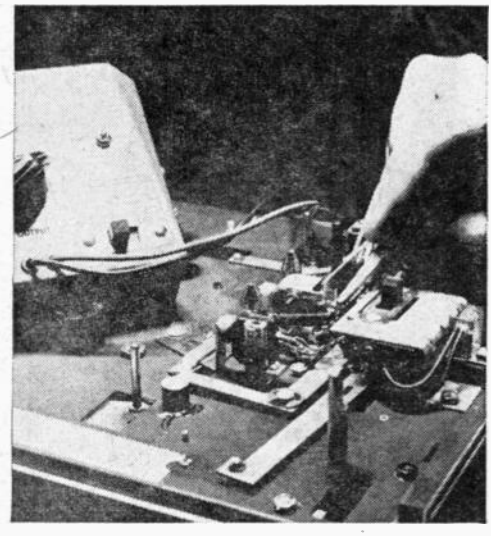
■ Ben Franklin wasn't thinking of tape-recorder repair when he observed that "a penny saved is a penny earned," but the fact is that you *can* cut service calls by making minor recorder repairs yourself. Our photos present a rogue's gallery of common tape-recorder ills, with the suggested remedy indicated in each case. A quick perusal will no doubt reveal what you have long suspected—that the answer to your tape troubles lies right in your own two hands. ■



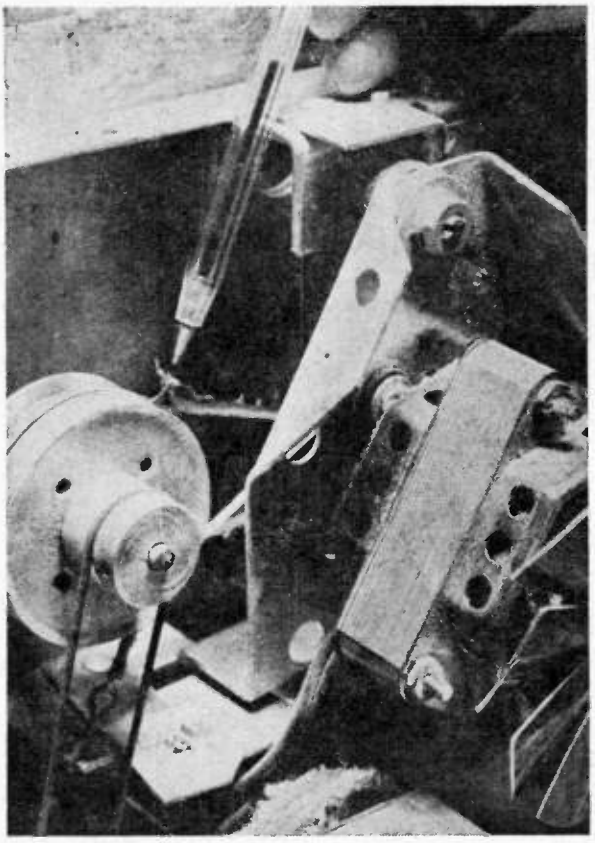
Speaker is often responsible for distorted sound, particularly if finger pressed against cone corrects trouble. Remedy is new speaker.



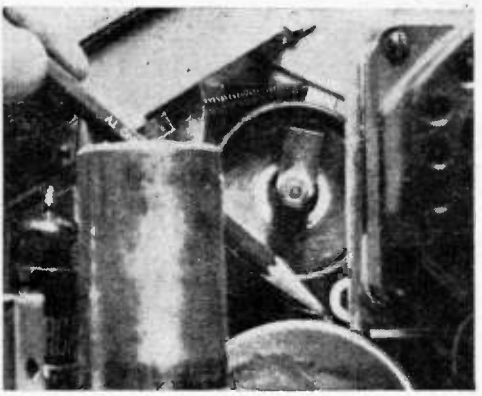
Batteries (if used) should be replaced often and removed whenever recorder is stored. Knife here points to corroded terminals.



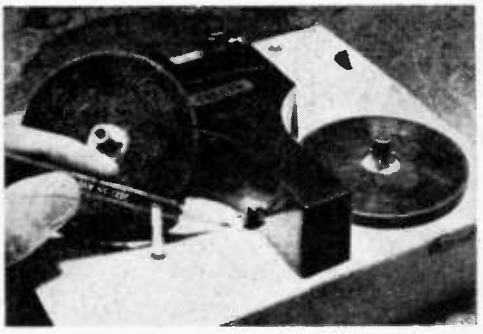
Tubes or transistors are chief reason for loss of record/play functions. Audio generator should quickly pinpoint defective one.



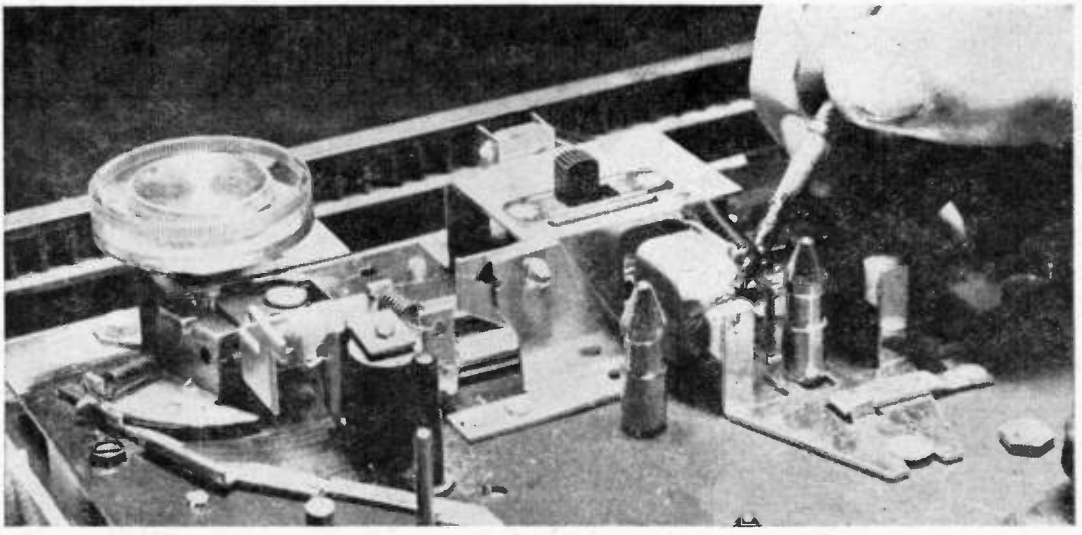
Drive belt may be culprit in recorder with too-slow tape speed. Clean belt with fluid; be certain idler pulley(s) are well oiled.



Capstan flywheel, if oily, can result in slippage, as can hardened rubber drive assembly. Remedies: clean flywheel, replace drive.



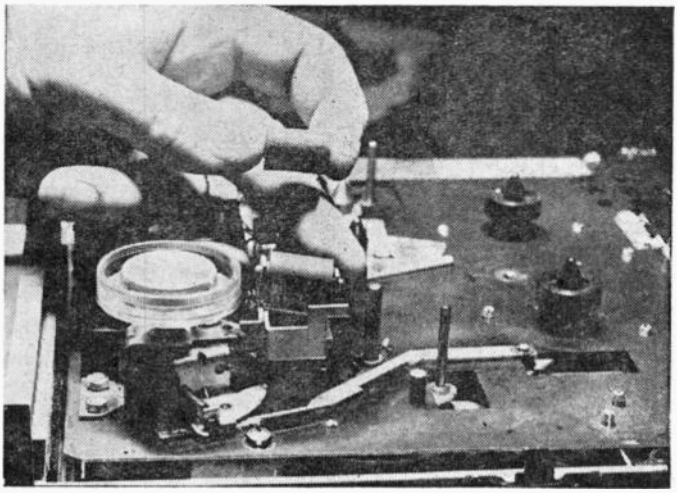
Tape guides and levers can slow tape, even stop recorder if bent or otherwise damaged. To fix, check and correct tape path.



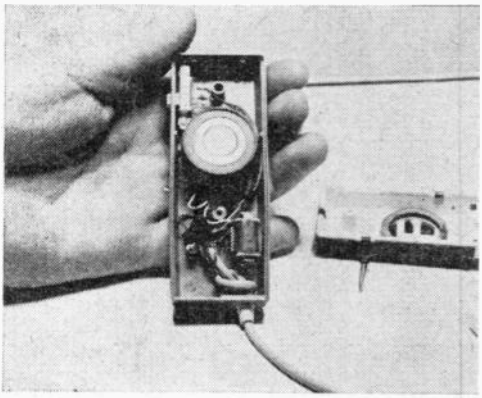
Record/play head holds key to proper operation of any recorder and can be source of weak, noisy, or distorted recordings. Use Q-tip moistened in head cleaner to remove dirt; use demagnetizer to remove residual magnetism and place head in neutral state. *(Turn page.)*

TAPE TROUBLES

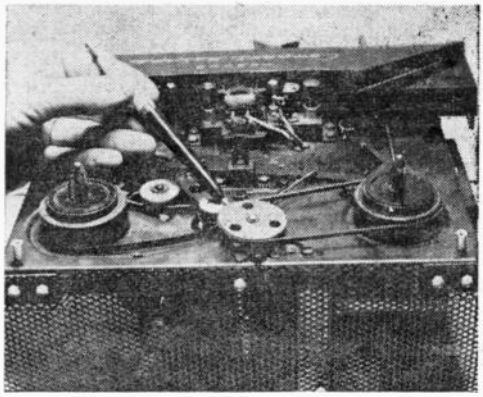
Continued



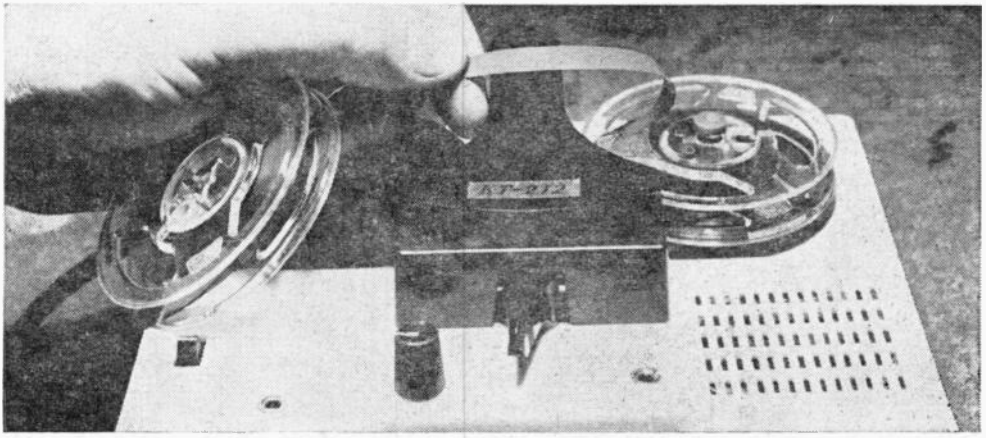
Rubber pressure roller can result in uneven tape motion, particularly if badly worn (as is roller being held by hand in photo). Since a worn roller cannot be repaired, an exact replacement must be secured from either the manufacturer or his agent.



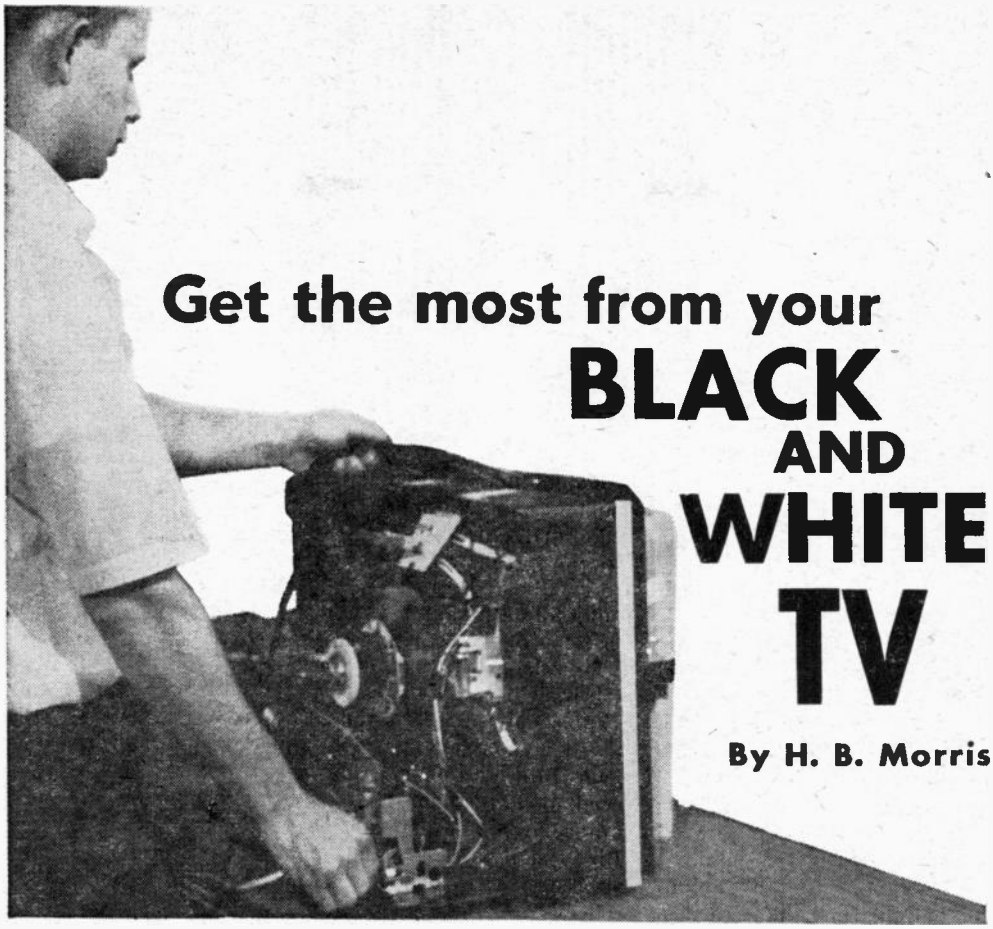
Mike cord can be explanation for intermittent recording, and mike can go completely dead if one or more wires in cable are broken. New cord or mike will solve problem.



Rewind drive wheel can prevent proper operation during rewind function if it is bent or otherwise defective. In portable units, batteries can also be to blame.



Tape itself holds clue to many a minor trouble. Dull side of tape must face heads if recorder is to function properly; tape must be fully erased if recording is to be clean and unblemished (virgin or bulk-erased tape being the best bet for good recordings).



Get the most from your BLACK AND WHITE TV

By H. B. Morris

■ You can bet an old fuse that TV sets have controls for mighty good reasons. Knobs in front let you scrimmage with the image until it agrees with your idea of a good picture. Further back are non-operating controls that need occasional touch-up. They'll shore up sagging tubes or aging components that can warp and shrink the picture.

Adjust controls and you'll delay the day the set needs tube replacement, maybe chassis repair. Best of all, controls keep the picture a pleasure to view, even on old sets. Why see fuzzy cowpokes wearing 40-gallon hats ride off into the black margin of a setting picture tube? Grip the pots, twist the tabs, and you'll be in Marlboro country!

You may argue that adjusting front controls is a matter of personal taste. True, but let's consider tricks that might improve your dialing technique—and reception. For though the main channel selector is nearly foolproof, other controls aren't so precise. Here's why.

Fine-Tuning. Anyone knows this one is turned for best picture and sound. Trouble is that best settings for sound and picture often don't agree, especially in weaker signal areas. Fine tuning must be a compromise. And the quickest way to find the best point is hunting for what's affectionately called "worms in the picture." Play around with the fine tuning control and you'll see that

B & W TV

turning it in one direction causes the picture to slowly fade. But turn it in the opposite direction and the screen should break into a mass of wriggles. Best adjustment of fine-tuning occurs if you back off *slightly* until the worms *just* disappear.

The slithery pattern is actually the sound carrier spilling into the picture. Use the tuning technique just described, and you can perfectly balance sound and picture as intended by the circuit designer. This method lets you capture good picture detail in the shortest possible time.

Vertical Hold. If the picture's not rolling, you say, that's proof the vertical hold control is properly adjusted (see Fig. 1). Sorry about that. Even if Flipper seems as stable as a snoozing Moby Dick, the control may not be perfectly adjusted. Thing is, TV pictures operate on *interlaced scanning*. It means the picture beam swings down and illuminates the screen on every other line (1, 3, 5, etc.). Then it repeats the scan for the missing (2, 4, 6) lines. This is a crafty trick to reduce flicker in the picture. But to do the job well, the set's vertical oscillator must perfectly lock to the station's sync signals. And that's where tuning technique can make or break it.

If you adjust the control carelessly the picture may stand still—but the sync signal may have to work hard to keep it there. The result could be "jitter" or "pairing."

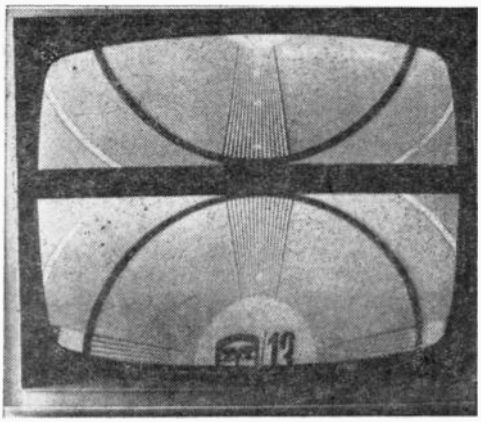


Fig. 1. Even if picture isn't rolling as above, vertical hold control may not be set properly.

Fine scanning lines on the screen bounce or run together, which, of course, steals sharpness from the image. You can avoid it by setting the vertical hold with this simple technique.

Turn the control until the picture starts rolling in a *downward* direction. Next, turn the knob *slowly* the opposite way until the image moves *upward*. Soon the frames begin to snap into place. When the picture's finally locked in, remove your hand from the knob. Always stop tuning on an *upward* roll of the picture. A close look at the screen should reveal well-separated, motionless scanning lines.

Horizontal Hold. There's much leeway in this adjustment, since TV horizontal circuits are semiautomatic. A grossly misadjusted control will produce slashing diagonal bars (Fig. 2). As the knob approaches correct setting, the number of bars diminishes

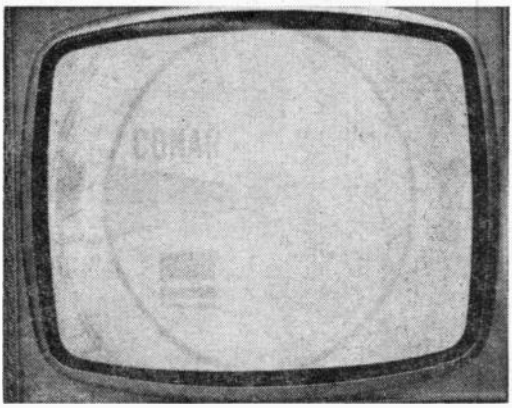


Fig. 4. Setting brightness control too high will cause a picture detail to wash out.

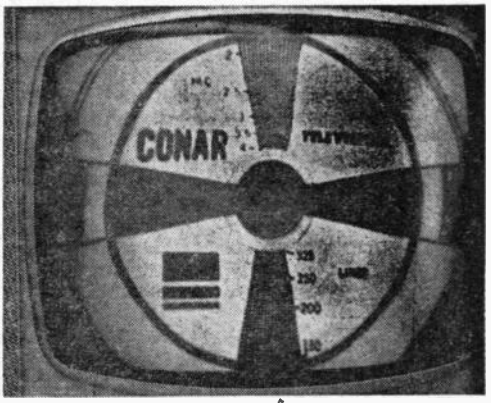


Fig. 5. Excessive contrast results in loss of picture detail and subtler gray shadings.

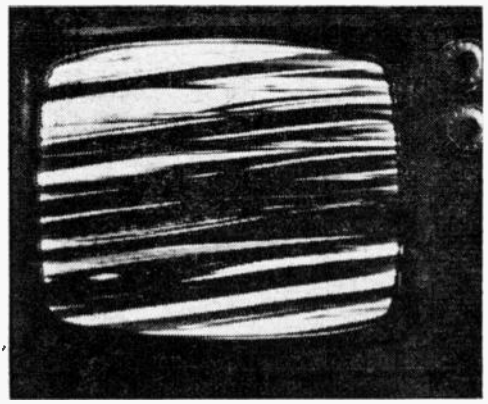


Fig. 2. Horizontal hold should be set so picture is stable after channel is changed.

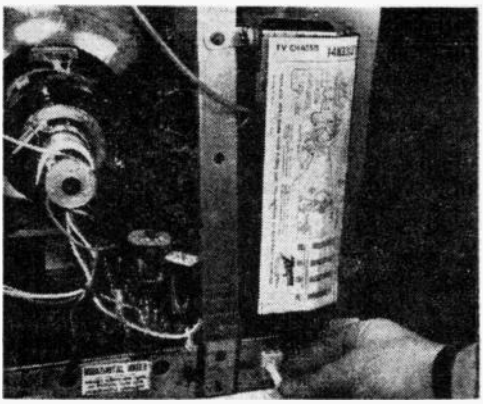


Fig. 3. Many late-model sets have horizontal-hold control located on the back of cabinet.

until the picture stands up straight. Yet there is margin for error.

First, be sure the setting is stable, quickly checked by flipping among all receivable channels. There should be no loss of horizontal sync—even temporarily—each time the main channel selector lands on a new channel. Check the picture for any distortion or whitish areas, especially at the left. This control may be located at the rear in some sets (see Fig. 3).

Contrast and Brightness. Little can be said about these controls since their effects are well known and settings mostly a matter of preference. Excessive brightness (Fig. 4) washes out the picture and may cause a few diagonal white lines to appear at the top of the screen. They're eliminated by slightly reducing brightness or increasing contrast. Pour on excessive contrast (Fig. 5), and the picture assumes a grainy texture of strong blacks and whites with loss of detail. Snowy reception is usually aggravated by too much contrast.

On some sets, excessive contrast might cause "sync clipping," which could cause a wavy unstable image (Fig. 6). If it happens when contrast is weak, chances are the set needs a tube or repair in the IF or front-end stages. The range of contrast is often determined by the set's AGC circuit (automatic gain control). If one is provided in your set, check its adjustment, as described in a later section.

That takes care of up-front, user-operated controls that let you trim picture and sound for daily viewing. For the next group of adjustments—non-operating controls that need only occasional attention—you'll have to penetrate more deeply into the set. Some are accessible through holes; others require removal of the back cover (Fig. 7).

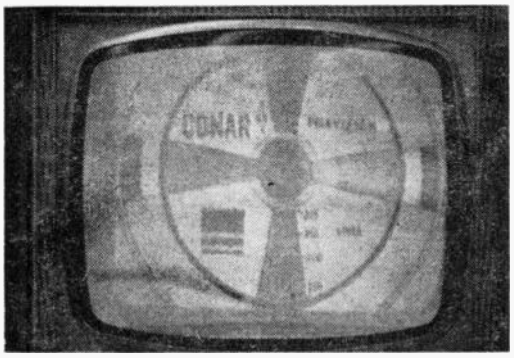


Fig. 6. Unstable picture with low contrast may indicate need for AGC control adjustment.

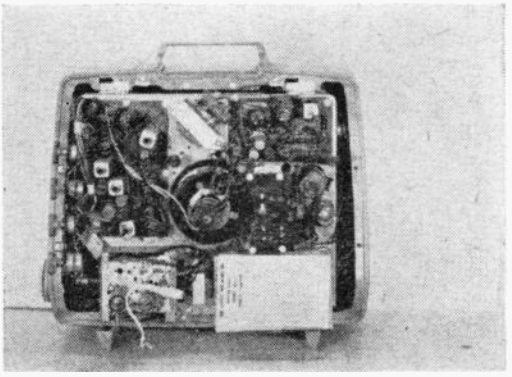


Fig. 7. Back of set may have to be removed for access to little-used controls.

B & W TV

If you can't locate a certain control there are several possibilities. One is that the manufacturer has completely omitted it (the horizontal width control is a casualty in some recent sets). Two, the control may not be readily apparent. An example is focus. Many sets eliminate a control and use adjustable metal strips on the picture-tube pins instead.

Since this and other controls may be difficult to find, you'll save time if you first obtain the service folder on your model. But before you touch anything inside the set, consider these precautions while you let the set warm up for 15 minutes.

The Shocking Truth. High voltages required to operate the various parts of a television receiver present an extremely dangerous shock hazard. To protect the user from dangerous shocks, most TV sets have an interlock switch or special line cord attached to the back cover. When the back cover is removed, the interlock switch opens or the line cord is disconnected, opening the power supply circuit. A caution label containing this information is affixed to the back cover of most TV sets.

To gain access to such controls as the ion trap magnet, deflection yoke, and on many TV sets, the positioning and focus controls, you must remove the back cover. This means that you will either have to detach the line cord from the back cover, or use a separate line cord (cheater cord) to connect the set to the power outlet. On sets using an interlock switch, you will also have to secure the switch in the closed position, possibly with masking or friction tape.

In making adjustments you will be working in close quarters, relatively near parts having high voltage. The following precautions should be observed when making adjustments inside the cabinet while the set is operating. (1) Do not adjust controls inside your set while standing on a concrete floor. (2) Make sure that there are no metal objects or wiring nearby through which you might make accidental contact to a good electrical ground. (3) Always keep one of your hands in your pocket when making your adjustments. This will prevent you from making a contact that could produce an unpleasant or dangerous shock. (4) Avoid contact with all parts having high voltage, especially the picture tube anode, or, in the case of a metal shell, the tube. (5) In general, stay way from all tubes to avoid burns. A burn caused by a hot tube, or an electrical shock, can result in cuts or bruises from striking other parts as your hand is withdrawn from the source of danger. (6) Use only moderate pressure to adjust any of the controls on the neck of the picture tube. Undue pressure or a jar can break the glass envelope causing the picture tube to explode.

If you follow these safety rules and use sound and careful judgment, you can safely and correctly adjust your television set.

Test Patterns. Many TV stations transmit a test pattern for short periods before and after their regularly scheduled programs. Test patterns are a valuable servicing aid in making rapid checks of the performance and adjustment of a TV receiver. If no test pat-

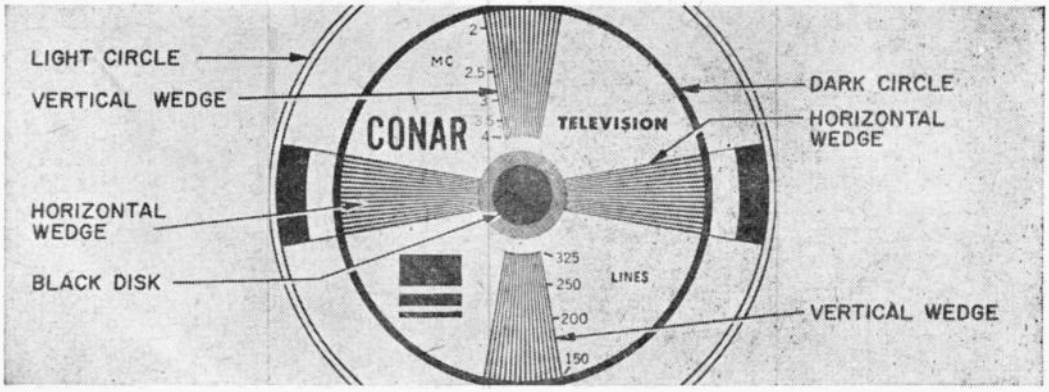


Fig. 8. Test pattern transmitted by most TV stations before and after regular programming is invaluable for adjusting set's controls. Important elements are labeled above.

tern is available at the time you adjust your set, you can use the actual picture to check the adjustment of the various controls.

A mirror placed in front of the set will enable you to observe the picture on the screen while you make adjustments from the rear of the set. Fig. 8 shows the appearance of a typical test pattern. Whenever the controls on any TV receiver are correctly adjusted, the test pattern should have the same general appearance as shown.

The elements of the test pattern are labeled in Fig. 8 and should conform to the following specifications. The light circle should appear just inside the edges of the mask when the horizontal and vertical size controls and the centering controls are properly adjusted. The dark circle and the edge of the black disc are perfectly round when the horizontal and vertical linearity controls are properly adjusted. Wedges are vertical and wedges are horizontal when the deflection yoke is properly positioned. The lines in the wedges are sharp and distinct when the focus control and ion trap magnet are properly adjusted. The concentric circles are of different shades from light gray to black, when the brightness, contrast, and AGC controls are properly adjusted. Let's consider how to adjust each control.

AGC (Automatic Gain Control). The AGC control when properly adjusted enables you to tune to different channels having various signal strengths without requiring you to readjust the contrast or volume controls each time you change channels. If the AGC control is improperly adjusted, a strong signal will cause the picture to have excessive contrast, and a hum will be heard in the audio. Often, the picture becomes completely distorted or it may even become completely negative.

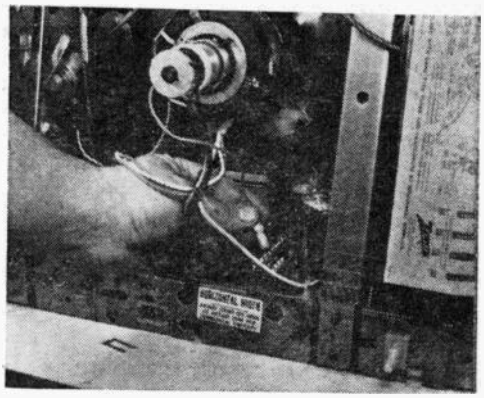


Fig. 10. One type of focusing arrangement is adjusted simply by selecting proper tap.

Fig. 9 shows this condition. To adjust the AGC control, tune the receiver to the strongest channel in the area and rotate the AGC control clockwise until you notice excessive picture contrast, buzzing sound, and pulling or tearing at the top of the picture. Then rotate the AGC control counterclockwise until the picture becomes normal once more.

What AGC actually does is allow your set to work well under a variety of conditions. For example, AGC will tend to hold contrast at a constant level even though signal strength varies markedly. (Without AGC, you might well be readjusting contrast for every channel you tune in!)

Focus Control. There are three types of focus controls in use on TV sets. One type uses a magnet located on the neck of the picture tube. This can be adjusted by a shaft

Fig. 9. Improper setting of AGC control causes variety of symptoms like one above.

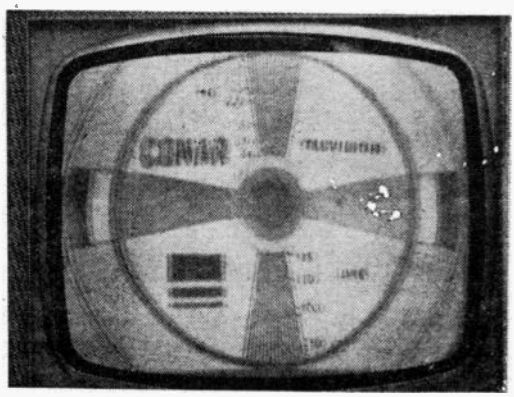


Fig. 11. Typical indication on screen when picture tube requires focusing adjustment.

B & W TV

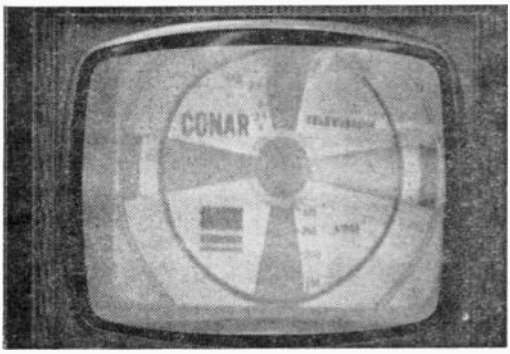


Fig. 12. Sets with sync stability control will require adjustment of this control when the condition in the photo is observed.

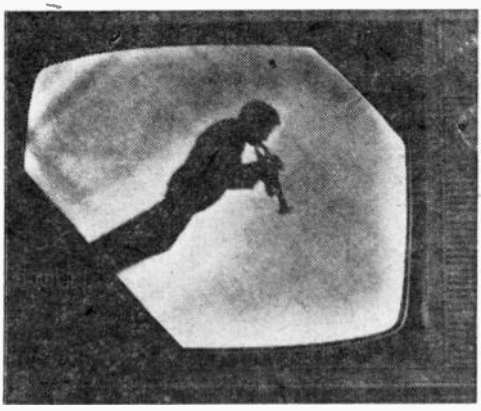


Fig. 13. Tilted picture occurs when yoke has rotated on picture tube neck, usually as a result of set being sharply jarred.

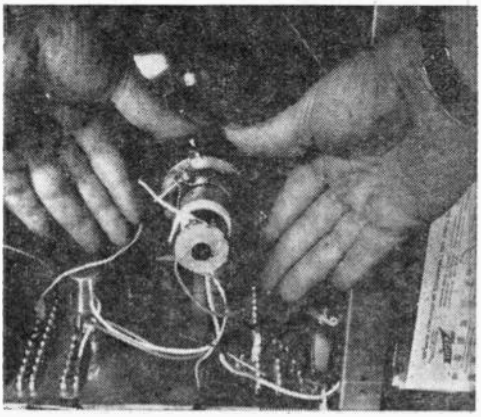


Fig. 14. To adjust yoke, loosen clamp screw, hold only insulated part, and rotate carefully.

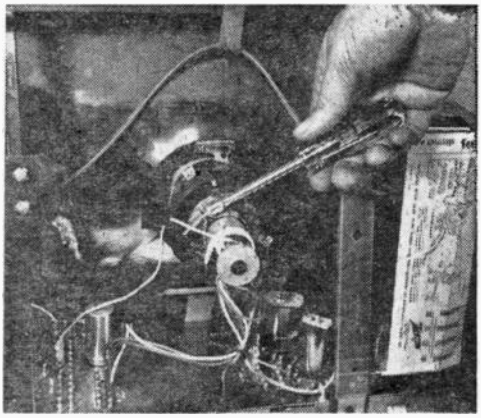


Fig. 15. When yoke is positioned, tighten clamp screw, being careful not to over-tighten.

extending from the back of the set, or you may find it necessary to adjust several screws to correctly position the focusing magnet.

A second type of focus control uses a control to electromagnetically focus the beam.

A third type focusing arrangement uses a series of taps or terminal connections to which the focusing electrode is attached to give the best possible focus (see Fig. 10). Fig. 11 shows the effect of an improperly adjusted focus control. Note the lack of definition in the image as compared with the normal test pattern. The focus control should be adjusted to give the sharpest, clearest picture possible.

Sync Stability Control. Fig. 12 shows the effect on the picture of improper adjustment of the sync stability control. Note the bending of the image in the top of the pattern. This control adjusts a noise rejection circuit so that noise in the picture signal will not upset the sync. To properly adjust the sync stability control, observe the picture on the strongest local station with the AGC control properly set, and rotate the sync stability control counterclockwise until the picture bends at the top. Then back off the adjustment until the bending stops.

Buzz Control. Some late model, quality TV receivers, such as the Conar Custom 70, have a buzz control. This control is adjusted to the position at which hum, or buzz, in the sound is minimum.

Correct adjustment of the fine tuning control, the AGC, and Contrast Controls also help eliminate buzz. These controls should be checked first for proper adjustment, then the buzz control should be adjusted for minimum buzz.

Ion Trap Magnet. To adjust the ion trap magnet, move it back and forth along the neck of the picture tube, rotating it slightly at the same time, until you obtain maximum brightness on the face of the picture tube. Next, adjust the focus and positioning controls (described below) and readjust the ion trap magnet. You may have to adjust the ion trap magnet so that the brightness is decreased slightly in order to improve the focus.

Many modern TV sets do not use an ion trap magnet. The phosphorous coating on the face of the picture tube is backed with a thin layer of aluminum. Electrons readily pass through this aluminum layer to strike the phosphor coated screen, but the heavier ions are blocked by the aluminum layer. The aluminum layer also reflects the light back to the viewing side of the screen that normally would radiate into the back of the picture tube. This type tube both dispenses with the ion trap magnet and will give a brighter picture than the type which does not have the aluminum layer.

Deflection Yoke. The deflection yoke is located on the neck of the picture tube. Its purpose is to produce the varying magnetic field necessary to deflect the electron beam vertically and horizontally to produce the scanning raster on the screen of the picture tube. If the yoke is not correctly positioned, a tilted picture will result (see Fig. 13). To correct a tilted picture, first make certain the yoke is positioned as far forward on the neck of the picture tube as the bell will allow, and then rotate the yoke (Fig. 14) until the picture is level. When the yoke is properly positioned, it should be secured

(Continued on page 72)

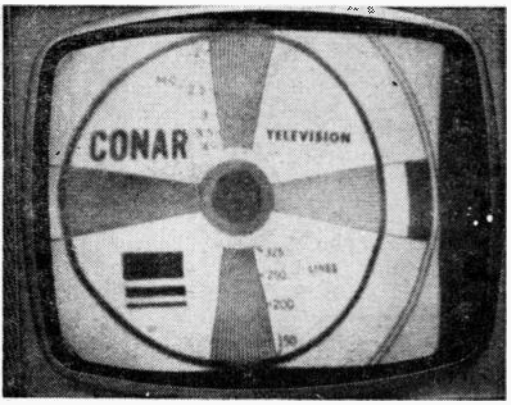


Fig. 17. Unfilled screen on either side indicates that horizontal centering controls generally are incorrectly set, though problem can also stem from electrical defects in circuits.

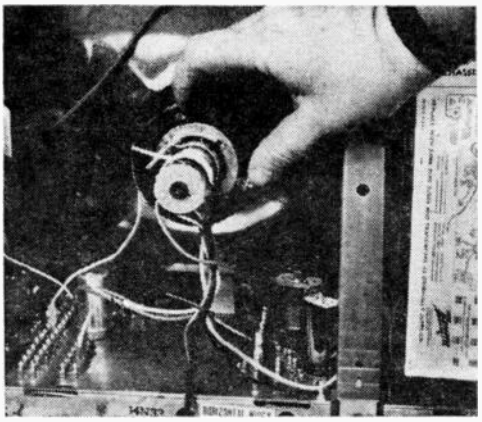


Fig. 18. Magnetic rings on picture tube neck behind yoke are used to center picture. The two tabs are rotated around neck for both correct horizontal and vertical centering.

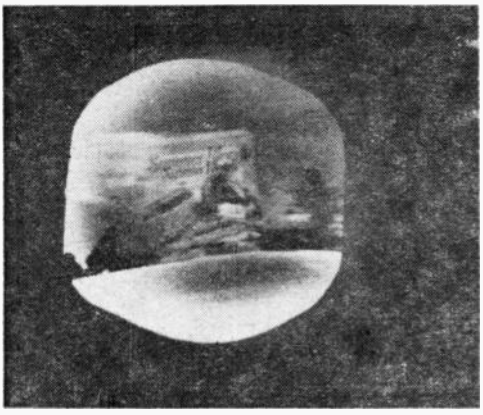


Fig. 16. If picture doesn't fill screen, yoke isn't properly seated against picture tube.

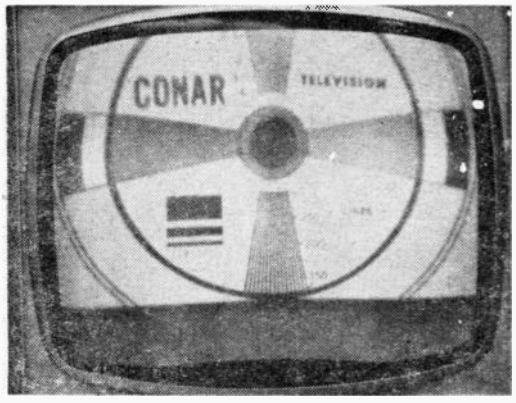


Fig. 19. Incorrect vertical centering in photo above is adjusted as shown in Fig. 18.

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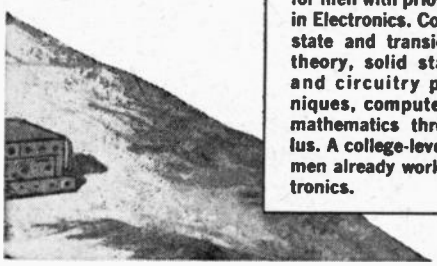

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(Continued from page 67)

in position by a clamp or lock screw (Fig. 15). Note in Fig. 16 that the picture doesn't fill the screen if the yoke isn't against bell or flared part of the picture tube.

Horizontal Centering Control. The effects of misadjustment of the horizontal centering control on the picture may be seen in Fig. 17. To center the picture horizontally, move the metal rings on the yoke cover (see Fig. 18) until the picture assumes the desired position.

Vertical Centering Control. This control is accomplished in a similar manner to horizontal centering. Actually it is necessary to adjust for both vertical and horizontal centering at the same time. Fig. 19 shows a picture with the vertical centering control out of adjustment.

Horizontal Linearity Control. The horizontal linearity control may be adjusted to change the horizontal radius of the picture from the center to the left or right side. Fig. 20 shows the effect of a misadjusted horizontal linearity control. Note the elongated left side of the picture compared with the right side. To adjust the horizontal linearity control, rotate the shaft until the horizontal radius of the picture from the center to the left side is equal to the radius from the center to the right side. It's often necessary to adjust the horizontal size control along with the horizontal linearity control.

Width (horizontal size and drive) Control. In some instances there are two con-

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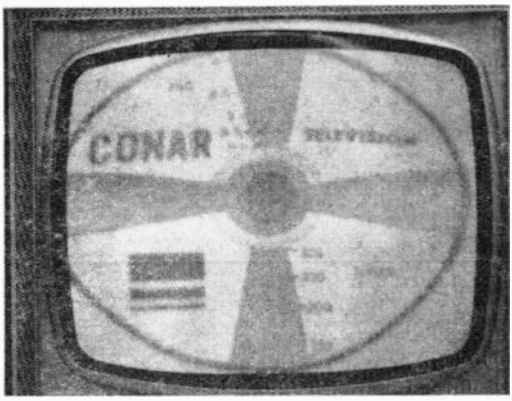


Fig. 20. Condition above is corrected by adjustment of both the horizontal linearity control and the width or drive control.

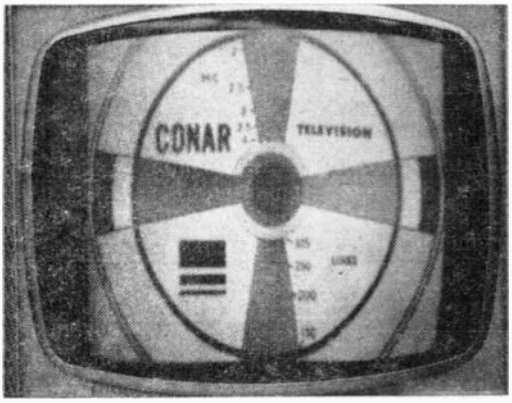


Fig. 21. Picture with insufficient width to fill screen can be corrected by simply adjusting width control until picture is wide enough.

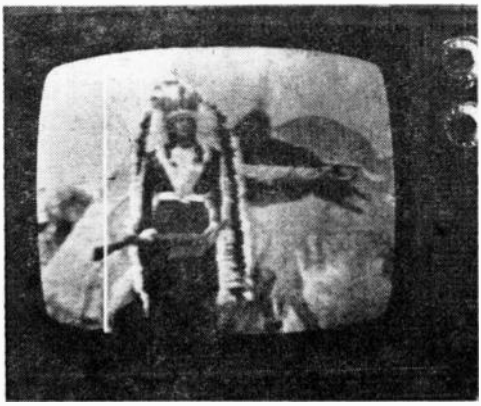


Fig. 22. Too much horizontal drive causes vertical white line to appear on screen.

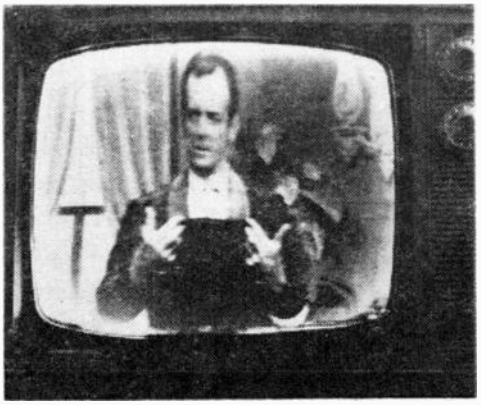
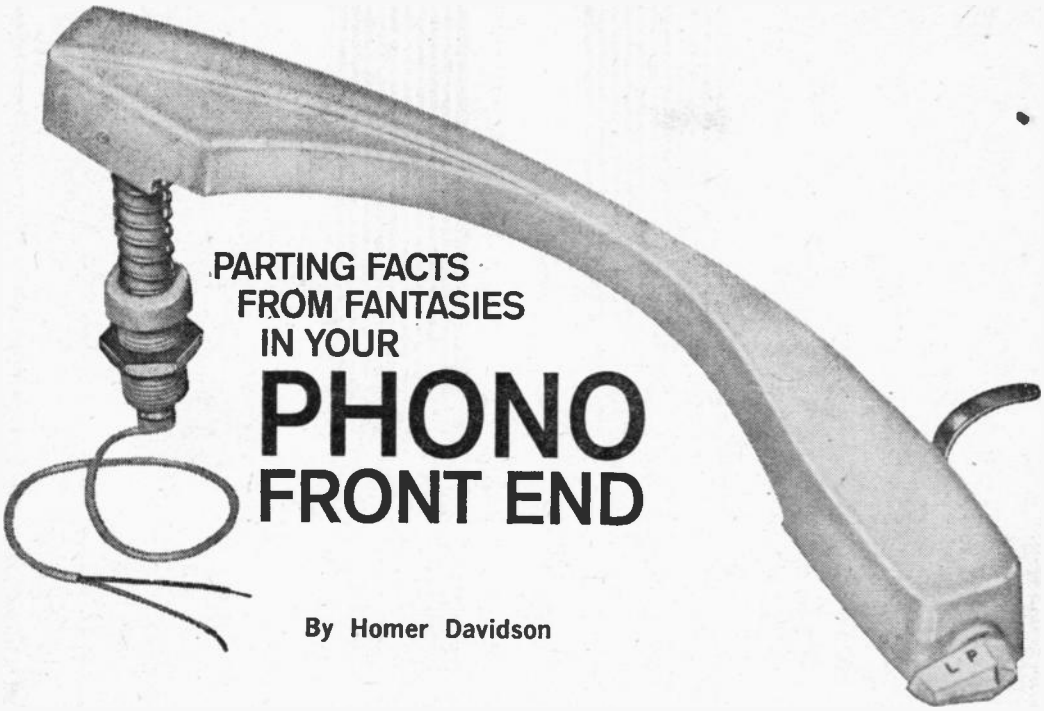


Fig. 23. Long skinny people can be cut down to size by adjusting vertical height control.



PARTING FACTS FROM FANTASIES IN YOUR PHONO FRONT END

By Homer Davidson

■ There's lots more to needle, cartridge and record care than meets the eye and these are the items subjected to the most abuse of all the components in a phonograph. The basics of servicing and maintenance of "what's up front" in a phono are simple—once you know them. So come with us as we present the hows and whys essential to keeping your disc show on the road. And if you're an old timer that knows all about it, this may be just the refresher needed to keep you heading right.

First Of All. How do you know that your phono needle (stylus) is defective? To find out, there are several simple tests you can make. If the tone arm of the phonograph slides across the record after setting down, change the stylus. This check should be made on a new (unwanted or unloved) record.

Now take a look at the stylus to see if dirt or dust is lodged between it and cartridge. If there is, brush it out, using a small camel's hair brush.

Play the record once again. Often, dust or dirt will cause mushy music. If there is still no improvement, let's try another check.

Take a new record or one that is clean. Set the changer to manual position, and play about one inch of the record. See Fig. 1 on the next page. Is the one inch played-space duller looking? If so, replace the stylus.

Other Ways. Another method is to take a clean white cloth and wipe the record after it has been played. If the stylus is defective and cutting the groove, you'll pick up small black record chips (black or dark dust) on the cloth. Replace the defective stylus.

Another way is to take a magnifying glass, like Grandpa used to read with, or a low-power microscope, and take a good look at the tip of the stylus. A sharply-pointed one will chisel out the groove of the record. Maybe there is a flat spot on the point. Replace the stylus in the above cases.

A good stylus will go towards a sharp point, but will be rounded off at the pointed end as shown in Fig. 2.

Check to see if you have excessive noise or scratchy *needle-talk*. This test should also be made on a fairly new record. (Be sure the volume is down when making this check.) Bend down close to the record and you should hear a little *needle-talk* even under good conditions. With a very bad needle or defective record, you can hear the noise from quite a distance.

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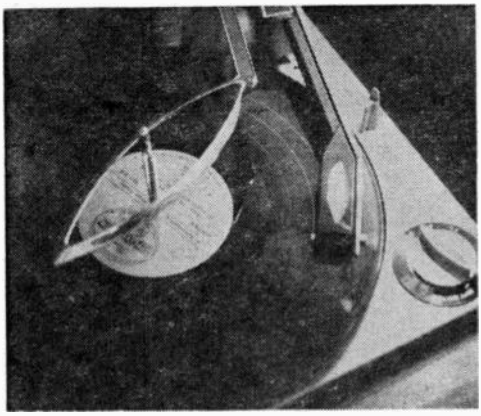

Fig. 1. A chipped or worn stylus will cut the grooves of a record, making them dull-looking; if so, better get a new stylus.

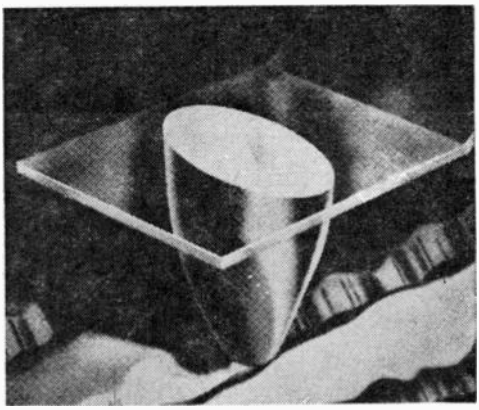

Fig. 2. The tip of a good stylus is actually a rounded "ball" that won't chisel into the soft vinyl record groove.

PHONO FRONT END

Record Wear. Most phonograph records will last for years if proper care is used. Before any record is played, wipe it off with a *record* cloth. Handle all records by the edge. Don't grasp them in the middle or with one hand. Little hands should not handle expensive records. Sticky fingers will smear the record with grease which will lodge dust and dirt into the record groove.

Don't leave a stack of records on the spindle center post or turntable after shutting off the record player. They will start to warp and on a very warm day may begin to droop. Phonograph records left on the turntable will also collect dust. Return all records to their jackets or record cabinet.

Watch Your Speed. Watch for correct speed settings and correct stylus position for the record being played. For instance, if a 78 stylus is played on a 45 or 33⅓ record, damage can be done. Also the pickup arm will tend to skate on the record.

Can a new record be defective? It certainly can be. Check for a poor cut in the record grooves. Also, if the starting cut is too shallow or narrow, the pickup arm may drop off the record or start ahead of the music (Fig. 3). Check to see if the finish

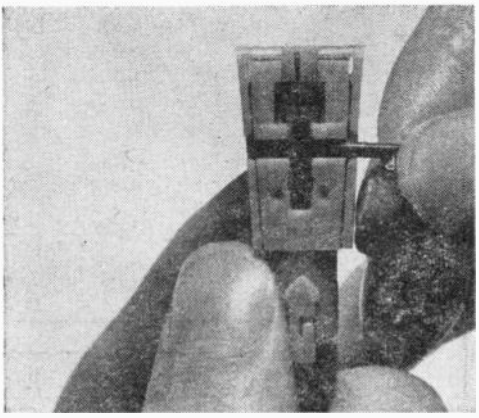

Fig. 6. On this popular cartridge, the stylus shank simply snaps into the plastic cartridge body.

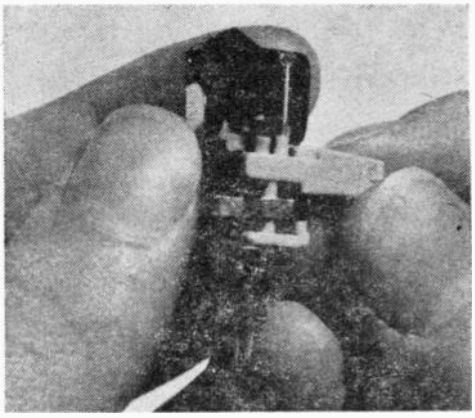

Fig. 7. To remove the stylus assembly from this type cartridge, position the turnover lever as shown.

Fig. 3. Poor sound can also be the fault of the record even if it's a new one. Compare sound against other records.

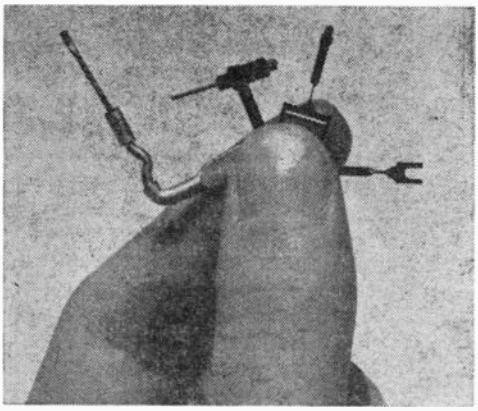

Fig. 4. Dozens of different types of styli can make for confusion on your part. Four typical styli are shown here.

track of the record is triggering the changer. If other records play at these settings, you have purchased a defective record.

In case a new record doesn't drop down from the center post, it's possible the center hole is not perfectly round. Generally a defective record will stand alone while all other records play perfectly.

To avoid getting a defective one, select a new record in its original sealed jacket. One that has been opened may have been played several times before. Also, buy only good known brand records to make sure you don't get stung.

Diamond Or Sapphire. What type of replacement stylus should you buy? There are pros and cons on whether to buy a dia-

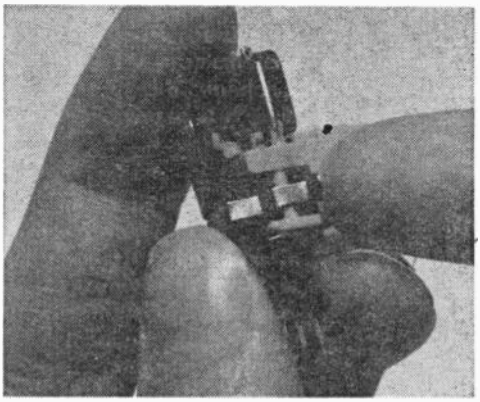

Fig. 5. When removing the stylus for replacement, first check to see how it is attached to the cartridge.

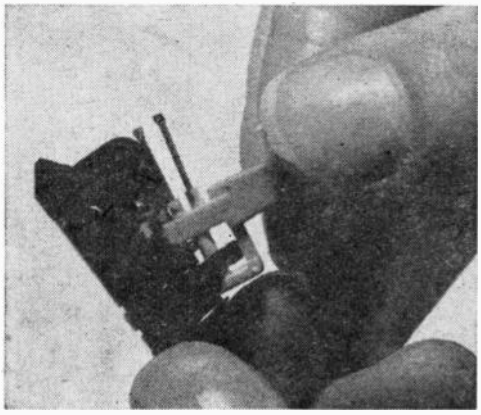

Fig. 8. Gently pull up and away on the stylus assembly; the metal clip gives way with very little pressure.

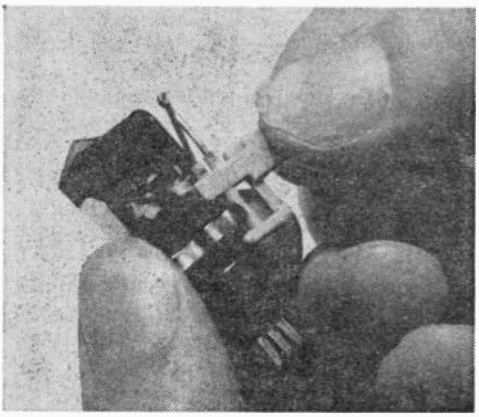

Fig. 9. Pull the stylus assembly clear being very careful not to put strain on the stylus shank or "saddle."

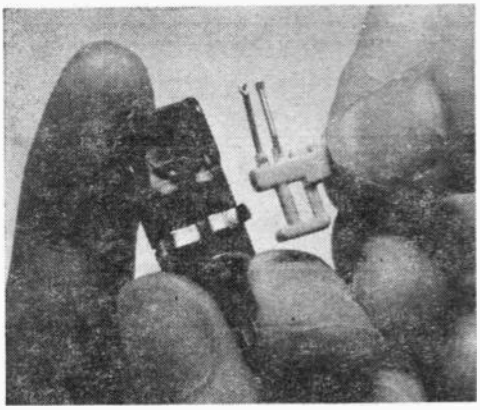

Fig. 10. Replacement of this type of stylus is exactly the reverse process of the removal procedure.

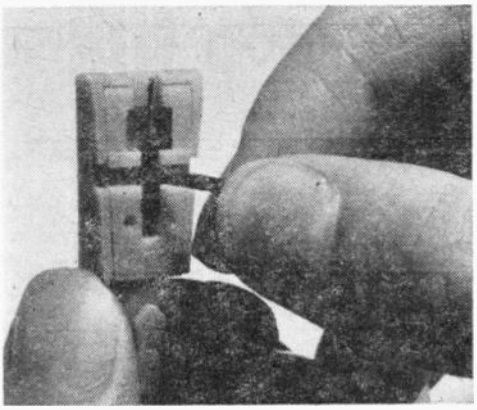

Fig. 11. To remove the stylus assembly in this type of phono cartridge, first turn the stylus-flip lever straight out.

PHONO FRONT END

mond or sapphire stylus. Don't replace the "small fry" phono stylus with a diamond. You're throwing good money away.

A new diamond stylus will give a great many more plays than the sapphire. But then diamond, as every girl knows, is more costly than sapphire. The sapphire stylus will cost from $1.50 to $4.50, while the diamond will vary from $4.95 on upwards. However, on an hours-of-play-per-dollar basis, the diamond stylus outshines them all. A handful of typical and vastly different replacement styli are shown in Fig. 4.

Some people get more hours per stylus than others. But this is the choice of the operator. One person may hear a worn stylus before another.

Some hi-fi bugs will replace the stylus when it has less than 500 plays. Other music enthusiasts replace the stylus four or five times a year—with the seasons.

On really good records, a diamond stylus should be used. Extra record care can save you money.

Stylus Replacement. Can you replace your own stylus? Certainly, by knowing how and using a little care. Pull the arm up and take a glance at the stylus and cartridge.

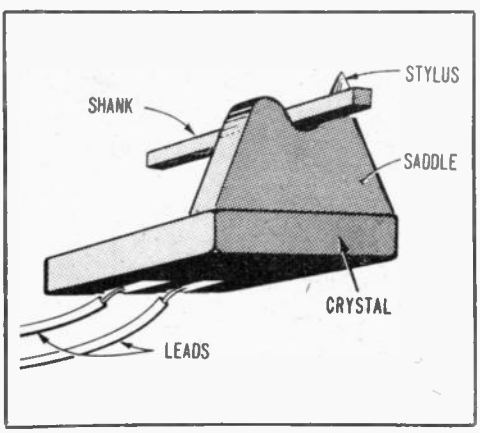

Fig. 15. Stylus shank rides in saddle which is connected to the cartridge element that turns groove wiggle into sound.

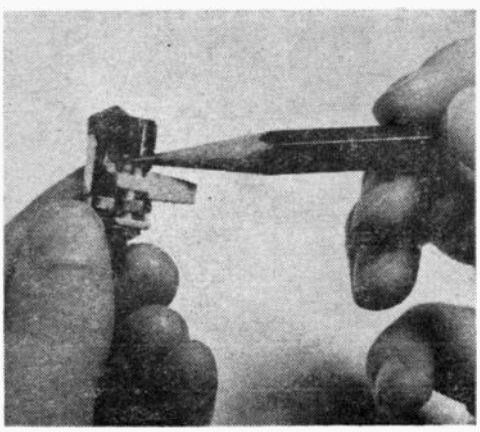

Fig. 16. The pencil points to the U-shaped saddle in a typical cartridge. Be sure stylus shank is properly seated in saddle.

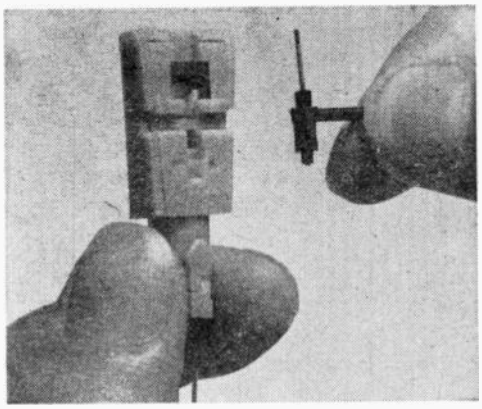

Fig. 12. Then pull it straight away from the cartridge body. To replace the stylus, use the reverse procedure.

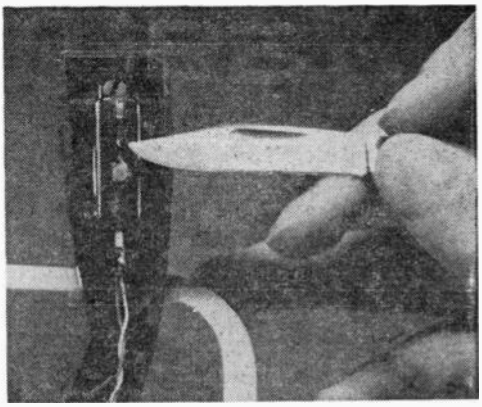

Fig. 13. Another type of stylus mounts on a rubber grommet and can be removed by carefully popping it off with a knife.

Some styli are held down with a metal clip as in Fig. 5; some snap into position as in Fig. 6. Others plug into a slot or are bolted in place with a small nut. With a steady hand, anyone can replace a stylus. If nervous, let someone else do it.

Figs. 7-10 show you how to change a stylus in a clip type of cartridge. There are many types of styli on the market but they all replace fairly easily. Figs. 11-13 shows another typical stylus replacement procedure. In some cases it may be necessary to drop the cartridge out of the holder before the stylus can be replaced, as seen in Fig. 14.

Instruction booklets that come with the phonograph will illustrate how to replace the stylus. Look at the instructions on the

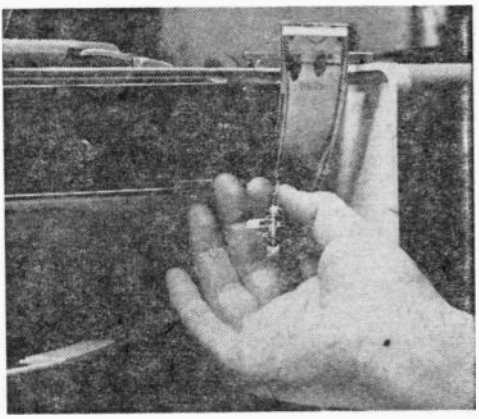

Fig. 14. If the tone-arm has limited vertical movement, cartridge can be removed for easier stylus replacement.

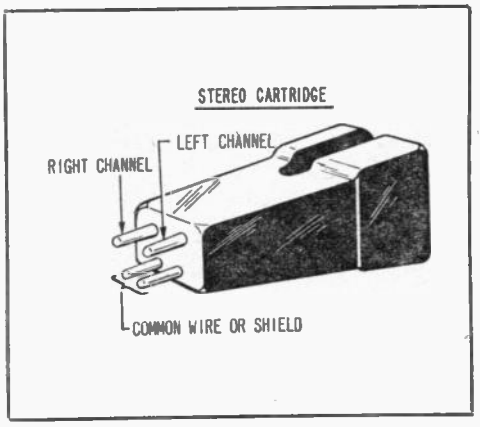

Fig. 17. Typical stereo cartridge has four terminals but only three connecting wires since ground connection is shared.

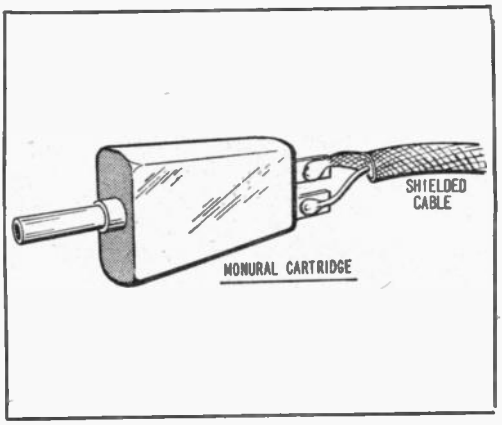

Fig. 18. Mono cartridge is usually hooked up with a shielded cable though in cheapies, it may be just a twisted pair.

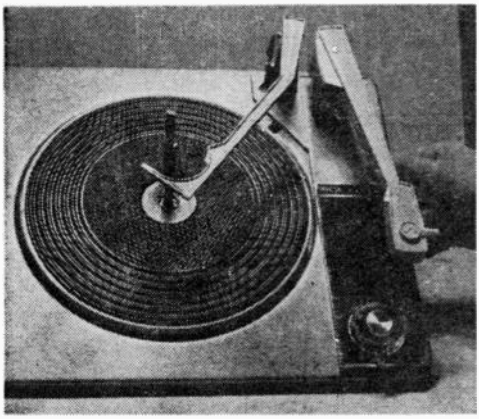

Fig. 19. Using a changer in "manual," be careful not to drop arm as record, stylus, and cartridge may be damaged.

PHONO FRONT END

replacement stylus carton for further directions.

Fragile-Don't Drop. One thing to be careful of—don't damage the cartridge. If you do, you may end up spending a few unnecessary dollars. The stylus and also the stylus assembly are extremely vulnerable, so exercise care here, too.

Take a close look at the front end of the cartridge for a "U" shaped saddle (shown in Fig. 15). This saddle, or plastic piece, goes down into the cartridge and fastens to the crystal element. Do not put any pressure on or disturb the saddle: accidentally dropping the pickup arm may also destroy or crack the cartridge.

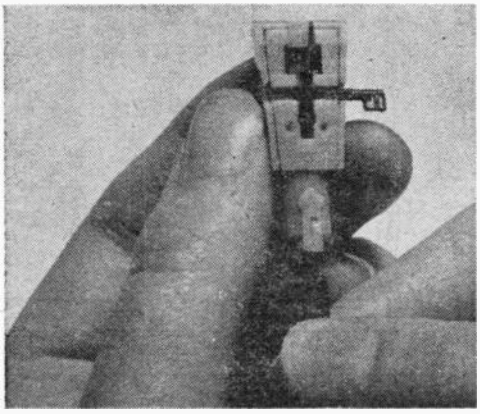

Fig. 22. On this type cartridge, the connecting wires are soldered to a small adapter which then plugs on to the cartridge.

The defective stylus should be removed and taken to a record shop or TV dealer for replacement. If it has broken into several pieces, take all of them with you to help identify the part.

You can also locate the stylus replacement part number by referring to the manufacturer's operation booklet. If the booklet is lost, look at the back of the console or underneath the back cover for a model number. If possible, the original stylus should be replaced with one carrying the same part number. But in case the brochure has been thrown away and the model number of the phonograph torn off, take the old stylus with you.

In A Haystack. Perhaps the stylus has dropped out and can't be found; draw the outline of it as you remember it. Since there are dozens of different styli types, you're not likely to describe it properly and hope to return with the right one.

It is wise to scotch- or mask-tape the old stylus carton number to the back of the record compartment. The next time you need a new one, the information is close at hand. Don't leave the whole carton in the record compartment; during cleaning it can easily be thrown away.

After the stylus has been replaced, be sure its shank is lying in the "U" shaped saddle shown in Fig. 16. The stylus might be bent out of place, not touching the saddle—the result will be no music. A lot of styli are destroyed or lost when the cleaning cloth snags it during routine dusting.

It may be rather difficult to replace the stylus if the pickup arm will only pull up a few inches. In this case, drop the phono cartridge down by loosening the two side mounting screws and then replace the stylus.

Cartridge Check. Before removing the stylus, always check to see if the cartridge is functioning. Take your thumb or finger and lightly draw across the stylus. You should hear a thumping or rumbling noise. If so, the cartridge and amplifier are working.

In case there is no noise at all, the cartridge, amplifier or speaker is dead. Turn the volume on the amplifier wide open. If a hum is heard, suspect a defective cartridge.

Remove the cartridge hook-up wires and place a finger or the blade of a small screwdriver against one of the unshielded wires.

You should hear a loud hum. If so, the cartridge is defective. If not, the amplifier or speaker is dead.

There may be two, three or four wires leading to the phono cartridge. The monaural cartridge has only two wires connected to it, as shown in Fig. 17. It may consist of a small shielded cable. Some low-priced phonographs have two separate, unshielded wires.

A phono cartridge with three or four wires indicates a stereo unit. Generally, the ground or shielded wire goes to each side of the cartridge with the "hot" or grid wires being inside of the braided shield, as indicated in Fig. 18.

Defective Cartridge. A defective phono cartridge may be cracked, become weak, and produce distorted, intermittent or mushy sound. The weak or dead cartridge will produce mushy or no sound in the speaker. A cracked cartridge will work intermittently. A cracked cartridge may result from dropping the pickup arm. See Fig. 19.

It is possible to have distortion or intermittent pickup in only one stereo channel. You can isolate the cartridge by switching the two channel hook-up cables. Either switch the cable at the amplifier or the cartridge hook-up wires.

For instance, if the left channel is good and the right channel is mushy, distorted, or intermittent, switch the outside cartridge hook-up wires. If the right channel is still inoperative, you know the cartridge must be replaced.

Intermittent. Now check for intermittent conditions while the switched wires are in this position. Simply place a new record on the turntable and apply a little pressure on the pickup arm. Be careful and use one finger to push up and down on the pickup arm. The intermittent cartridge will snap off and on with intermittent music. In case the amplifier is defective, a good place to start is to check all tubes.

Replacing The Cartridge. Some phono cartridges are bolted to the pickup arm while others snap into position. Hold the pickup arm up where you can see the cartridge. Usually, mounting screws will be located on each side of the cartridge assembly. A short Phillips screwdriver may be needed to get to the screws. Snap-in type cartridges will pull down from the front end of the unit.

Other turn-over cartridges may be removed by first removing the small set-screw in the turn-over knob. A typical turn-over

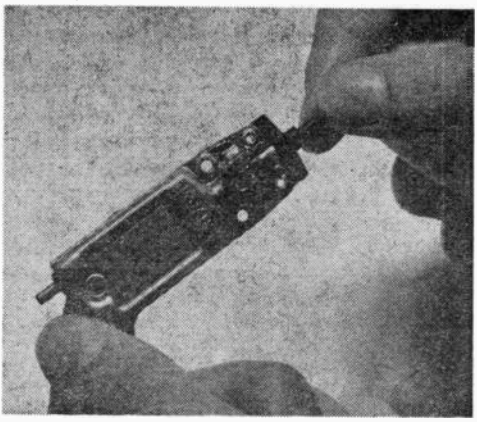

Fig. 20. Old turnover type crystal cartridge mounts and pivots on front shaft; it's removed by taking turnover knob off.

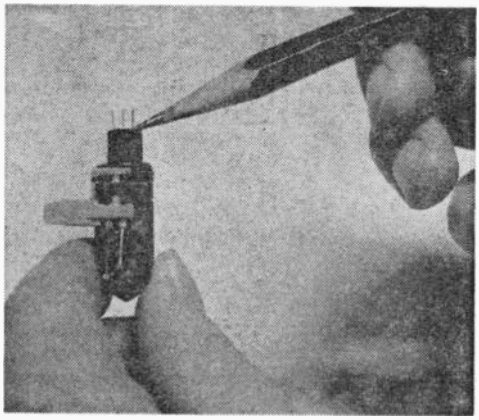

Fig. 21. Some stereo cartridges have only three terminals with center one being common ground for both sides of cartridge.

Fig. 23. Replacement cartridges often come with a choice of different mounting brackets to suit different tone-arms.

Phono Front End

cartridge appears in Fig. 20. A thin screwdriver blade is needed to remove the small recessed screw. Be careful not to lose the small screw or tension spring on removing the cartridge.

After the phono cartridge has been dismounted, unhook the small connecting wires. Write the color code of each wire on a piece of scrap paper. Look for a ground wire under the cartridge mounting screws—see Fig. 21. Most connecting wires just plug into the cartridge. Others solder to a plug-on adapter as in Fig. 22.

Clip Care. Be careful when replacing or removing small wire clips. In case the wires are frayed at this point, resolder the clip connection; be sure it is removed from the cartridge when soldering, as excessive heat can destroy the cartridge.

Use rosin-core solder sparingly, as excessive solder can run into the clip and plug up the connection hole. It is best to grasp the clip with a pair of long-nose pliers close to the area to be soldered so solder can't run into the plug or connection.

Connecting wires on a turn-over cartridge can break off or become frayed and short against one another. Poor or no sound can result from this condition. Check the wire connection on all replaced cartridges for possible trouble.

Excessive hum from the phonograph may be caused by an open ground or connecting wire. Turn the volume down to see if hum originates in the amplifier or tone arm. If the hum is still present, check for a dried-out electrolytic filter capacitor in the amplifier and replace it.

In case the hum disappears when the volume is down, look for a broken wire or shielded cable. A defective cartridge can induce hum when the amplifier volume is wide open. This is the result of the cartridge output voltage failing to override the open ground or grid line. Try reversing the two cartridge wires in a monaural phonograph. Check the common center ground wire in a stereo pickup arm for an open circuit.

Genuine Parts Only. A cartridge should be replaced with the original part if possible. If not, there are many replacement cartridges on the market—see Fig. 23. Be sure the new cartridge has approximately the same output voltages and weight as the original. Correct weight may be checked if a stylus pressure gauge is handy.

Check the cartridge for correct wiring connections after installing the new cartridge. See that the stylus is riding in the "U" shaped saddle. If the cartridge is the turn-over type, rotate the turn-over knob to see that the small wires and clips do not touch. Now turn the volume up and thumb the needle of the new cartridge. A rough sound should be heard.

Check The Changer. While replacing the stylus or cartridge, a few, quick checks should be made on the record changer.

See if the pickup arm sets down at the starting point of the record. If not, look for adjustment screw on back or underneath the arm. Adjust until satisfied that the landing point on two or three different records is correct.

Now check the inside reject point. This adjustment is under chassis and it is wise to let a known radio-TV repair shop make this and other critical adjustments. If 45-rpm records don't change as they should, use talcum powder on the large spindle.

You may even want to pull the record changer or record board from the cabinet to clean up properly. See Fig. 24. Generally, several Phillips head screws hold the turntable to the cabinet. To check adjustments on the record changer, you can prop it up on two quart paint cans.

Armed with the straight dope, the future care and feeding of your record player shouldn't be a problem, and can even be downright fun. Happy playing. ■

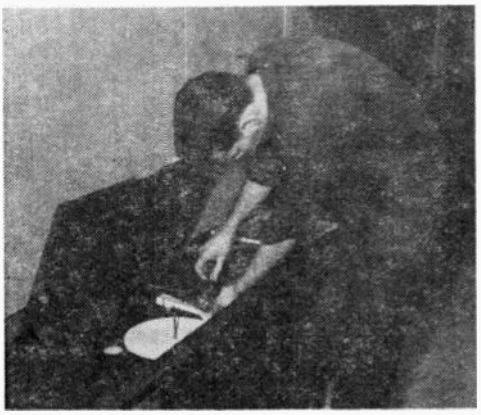

Fig. 24. Most changers can be removed for servicing by unscrewing the two bolts on each side of the base plate.

TUNING UP THE ALL AMERICAN 5

By Mannie Horowitz

Modern radio as we know it today, is due to one great invention—namely the superheterodyne receiver. Sure people used radios before the circuit was widely adapted. The multi-dial TRF (tuned radio frequency) set was quite popular in the '20's —especially if you could afford one. However, commercial five tube radios as we know them today, originated with the low cost superheterodyne circuit. This circuit has proven itself so fine and effective that it has been adopted for use in practically every FM receiver as well as for the popular five-tube, AM radios flooding this country.

As was the case with the TRF receiver, the RF signal is selected by varying the capacitor in the resonant circuit. This signal is fed to the first tube, known as the mixer, converter, first detector, or anything else you may wish to call it. Along with this RF signal, a second signal, which is generated in the receiver, is fed to the mixer. The frequency of the signal generated by this local oscillator in the receiver, is 455 kHz *above* the frequency of the radio station. Thus, if the radio station broadcasts on a frequency of 1100 kHz, the oscillator frequency is set to 1100 + 455 or 1555 kHz. If the radio station broadcasts on a frequency of 880 kc, the frequency of the oscillator is set to 880 + 455 or 1335 kHz. The frequency generated by the local oscillator is varied by a capacitor in the oscillator circuit, as shown in Fig. 1.

It is quite simple to accomplish the varia-

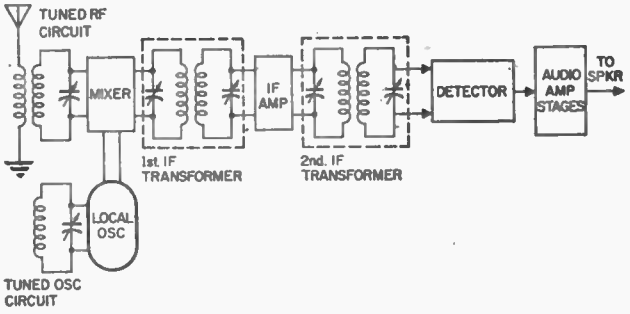

Fig. 1. In the superheterodyne receiver, the incoming RF signal is reduced to an intermediate frequency in the mixer.

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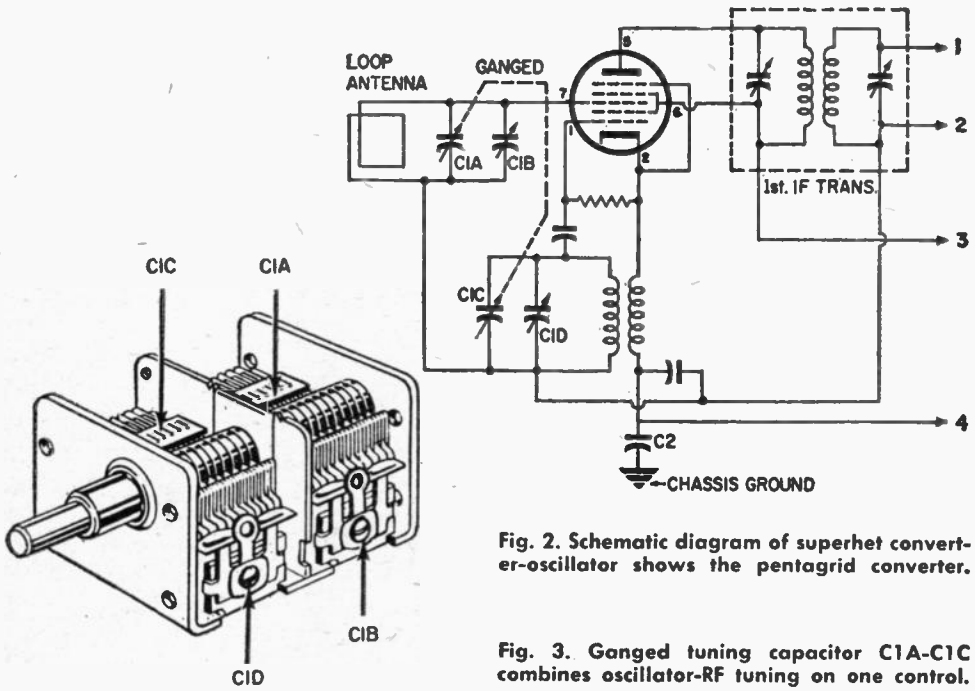

Fig. 2. Schematic diagram of superhet converter-oscillator shows the pentagrid converter.

Fig. 3. Ganged tuning capacitor C1A-C1C combines oscillator-RF tuning on one control.

tion of the oscillator frequency with the variation of the frequency of the resonant circuit in the RF section. The capacitors which tune the oscillator and the RF signal are actuated by one knob. Thus, when a specific station is selected by the RF section of the capacitor, the corresponding oscillator frequency is selected by the oscillator section of the capacitor.

The two signals are combined in the mixer stage. The output from this stage is the 455 kHz difference between the two signals. The 455 kHz difference in frequency is maintained between the oscillator and radio station; thus the difference frequency is available for all radio stations over the tuning range. It should be noted that the audio signal, which was received by the antenna as intelligence riding on top of the RF signal, is now transferred to the 455 kHz signal. It rides on top of this 455 kHz IF or *intermediate frequency* signal.

IF Amplifiers. This 455 kHz signal must now be amplified. The 455 kHz is carefully selected by two IF transformers. Between these two transformers is a stage of IF gain involving a vacuum tube or transistor. This is not unlike a standard tuned RF stage, except here, only one frequency must be selected and only one frequency must be amplified. This can be done most efficiently.

In the remainder of the unit, the IF signal is detected to separate the audio from the IF carrier, the IF is discarded, the audio is amplified, and sent on to the speaker.

Why the choice of any specific IF frequency, is difficult to determine. It seems that 450 kHz or 500 kHz would be a more logical choice. Is there less interference or better sensitivity using 455 kHz? Or is it just a choice someone made and the number happened to stick? Whatever the reason, the industry has accepted this as the standard. We have no choice but to use this figure when aligning a radio.

Alignment Requirements. Although no outline of exact procedures has been described, the above discussion of the superheterodyne radio indicates the alignment requirements. There are two precise factors which must be satisfied.

First, the IF transformers must be aligned so that they will pass the 455 kHz IF frequency while rejecting all other signals.

Second, the variable capacitor must be adjusted so that the difference in frequency between the RF signal and oscillator is 455 kHz over the entire broadcast band.

Exact procedures using a signal generator and an output meter will be discussed below. However, before this is done, it would be helpful to discuss the circuit of a typical superheterodyne receiver. We will consider the receiver one stage at a time. If you would hook-up the leads (with arrowheads) represented by identical numbers in two successive stages (or two successive schematic figures), you have the schematic diagram of a complete superheterodyne receiver.

Typical 5-Tube Superhet. The first tube of the superhet (see Fig. 2) serves several functions. First, it is the oscillator—pins 1 and 2. Then, it receives the RF signal at pin 7. Finally, the two signals mix through the maze of grids to give the final IF frequency —455 kHz at the plate. The first IF transformer is tuned to this 455 kHz. Other RF frequencies that happen to get to the plate circuit are bypassed to ground via the power supply by the action of the 1st IF transformer.

Because these receivers are quite sensitive, the RF signal does not have to be picked up by an antenna on the roof. Instead, a loop antenna at the receiver is usually used. This may consist of several turns of wire on a flat piece of cardboard, or several turns of wire on a ferrite rod. The ferrite material is composed of iron and other metallic oxides combined with ceramic material for rigidity. This ferrite rod is also known as a loopstick.

The loop antenna works in conjunction with capacitor C1A (see Fig. 3) to form a resonant circuit to tune to the radio station. A small variable mica capacitor, C1B, is usually mounted on C1A and connected in parallel with it by the manufacturer of the capacitor. This C1B is used in the alignment procedure. It is known as a trimmer capacitor and is used to trim the combined values of C1A and C1B so that it will resonate at the proper frequency with the loop antenna coil, and at the proper setting of the tuning dial.

The oscillator coil, in junction with C1C and C1D form the resonant circuit to determine the frequency which the oscillator will generate. Capacitor CIC (see Fig. 3) is the main tuning capacitor for the oscillator, and C1D is the trimmer, arranged very much like the combination discussed above for C1A and C1B in the RF section.

Capacitors C1A and C1C are attached to one shaft. One knob is used to turn both capacitors simultaneously. Screwdriver adjustment screws are set in the variable mica capacitors which are mounted on its respective large air capacitor.

You can usually tell which section of the capacitor refers to the oscillator and which to the RF circuit. The oscillator resonates at a higher frequency than does the RF circuit. Therefore the oscillator section usually has less or smaller plates than does the RF section. This is very much like musical instruments where higher pitched notes come from smaller instruments.

In Fig. 4, a simple IF amplifier stage using the 12BA6 and a second IF transformer, is shown. These are used to amplify the signal from the converter and first IF transformer and provide better selection of the IF frequency. These, in turn, are connected to the detector diodes in the 12AV6, the triode voltage amplifier in the 12AV6 and finally the power amplifier 50C5 which drives the speaker. All this is shown in Fig. 5.

The AC-DC power supply used to provide the necessary DC voltages to operate the radio circuit, is shown in Fig. 6, using a 35W4. Some radios used selenium or silicon rectifiers instead of a tube.

The various interconnections between sections are self-evident. Lead 1 is the link connecting the output from the IF transformer in Fig. 2 to the input of the IF amplifier tube in Fig. 4. Lead 3 in Fig. 2, 4, 5 and 6 is used to interconnect the B+ supply to all stages. Lead 4 in these figures is the common B− ground. (*Turn page*)

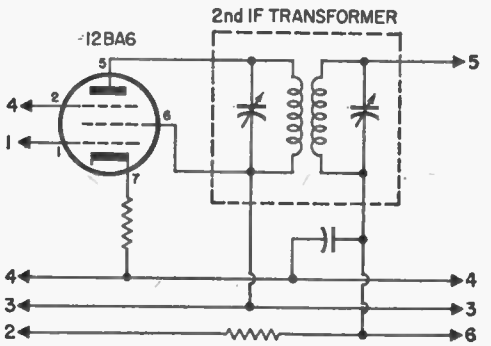

Fig. 4. IF amplifier tube 12BA6 boosts signal; second IF transformer increases selectivity.

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Lead 5 in Figs. 4 and 5 connect the second IF transformer to the detector, while lead 6 connects the audio to the volume control through a resistor.

Introducing AVC. Only lead 2 requires some additional discussion. This lead is used to conduct part of the detected signal back, as DC, to the earlier stages. This DC controls the gain of these stages. On strong signals, the gain of the IF and mixer amplifiers is reduced due to this DC. Thus, this lead completes an Automatic Volume Control (AVC) circuit. It sort of equalizes the strength of the final output signal for all stations. In alignment procedures, AVC action is undesirable, for it limits variations in gain at the output. During alignment, the test signal levels are kept low so that AVC action will be negligible.

One other factor should be observed in this circuit. The chassis is not used as a ground for the B− Because B− is connected to the AC line, grounding the chassis to B− and hence the AC line, can be hazardous. To keep the chassis from floating, it is connected to B− ground through a small capacitor. This is shown as C2 in Fig. 2.

Aligning Instruments. Two instruments are necessary in this procedure. One is to be used as a signal source. The second is to be used to measure the output.

In the alignment procedure, three signals should be used. An audio signal should be fed to the audio amplifier section of the receiver (Fig. 5) to be certain that it is operating.

Next, a 455 kHz signal modulated by an audio tone should be fed to the IF stages. The IF stages are adjusted for maximum output by monitoring the audio signal strength at the speaker.

Finally, two modulated RF signals are required to permit adjustment of the RF and oscillator circuits. One RF signal must be at the high end of the band and the other RF signal must be at the low end of the band.

Several signal generators are available that are capable of producing all these signals. They are shown in the photograph in Fig. 7. The switch positions given in the following text are for the EICO 324 unit which is typical of the units available.

The audio output can be gotten from the two jacks at the lower left hand corner of the unit. The Signal Selector knob is to be set at the "Int. Mod/AF Out" position to get an internally modulated audio output. The "AF Mod/Output" control is used to adjust the amplitude or strength of the modulated audio signal output from the generator. None of the other controls have any effect on the audio. They are concerned only with the RF signal.

The connector at the lower right hand corner of the unit is used for the RF and IF output. The Signal Selector knob is set at its previous position for a modulated output signal. The frequency is selected by use of the Band Selector switch and the rotary frequency control knob. Thus if 455 kHz is required, the Band Selector is set at "B," for this band covers the range from 400 kHz to 1.2 MHz (marked near the tuning scales). The tuning knob is then rotated until 455 kHz appears under the pointer in the window. A similar procedure must be followed for any RF frequency that may be required.

The amount of RF signal output is controlled by the RF Course and RF Fine controls. These are usually kept near minimum during the alignment procedure.

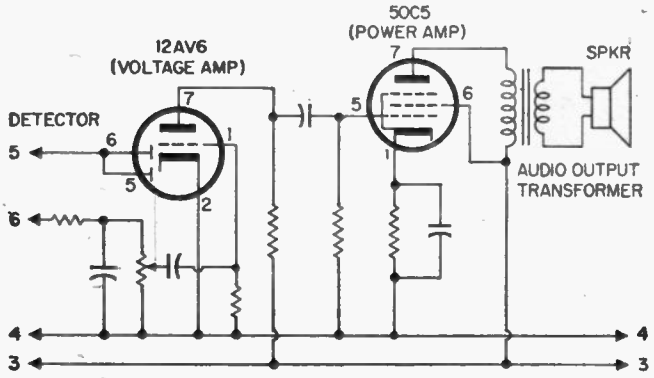


Fig. 5. The audio amplifier section of the receiver combines detection and voltage amplification in the 12AC6 tube, and power amplification in 50C5.

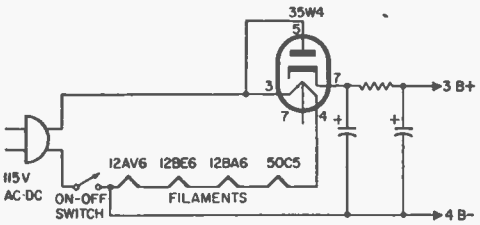


Fig. 6. The power supply that provides the DC voltages for receiver utilizes 35W4 diode tube in filtered half-wave rectifier circuit.

Finally, the output from the radio must be monitored in some way or other to perform a proper alignment. The low voltage AC scale on any multimeter can be used to measure the output voltage.

If no meter is available to monitor the output, the signal level may be checked audibly by listening to the speaker and judging the levels.

The Test Setup. When the receiver, generator, and meter are interconnected, details and precautions should be carefully observed.

The meter should be connected to the speaker leads in Fig. 6. If one of the speaker leads is connected to a chassis of B− ground, connect the common lead from the meter to this point. If you use the instrument illustrated, it is the lead with the alligator clip.

Connect the AC probe to the remaining lead to the speaker. If the speaker has no grounded leads, the meter may be connected in either direction. If you use a meter which does not have to be connected to the AC power supply, such as a VOM, the leads may be connected in either direction to the speaker.

Now set the Function switch on your meter so that it will read AC. Set the range switch to the lowest range above 1 volt. The output meter is now set up for the entire alignment procedure.

The common from the signal generator must be connected to the B− ground. During the alignment procedure, the signal will be injected from the Audio and RF outputs to various points in the radio. Just where to inject the signal will be discussed in the procedure methods.

Several precautions must be observed when making this setup.

1. Make all connections to the receiver when it is turned off.

2. Excess hum during test may be reduced by reversing the position of the AC power plug in its socket.

3. Never connect an external ground (radiator, water pipe, etc.) to any point on the receiver.

4. In conjunction with caution #3, never place the chassis on a metal bench, steam heat radiator, or any grounded object. If you must use a metal bench, be certain that the power plug is not in the socket or that there is some insulating material between the receiver with the instruments and the table. A large piece of cardboard will do. To avoid shock, do not touch the metal bench and the receiver or instruments simultaneously.

5. To avoid shock when aligning the unit, do not touch any grounded electrical conductors.

6. Use insulated or special aligning tools so that the alignment will not change when you remove the tool from the adjustment screws. A small insulated metal screwdriver may be used.

With this in mind, we can now proceed with the actual alignment procedure.

Aligning the IF's. Before touching the IF cans, you must be certain that the audio section is working properly. Connect the top (hot) lead from the audio output of the generator to the hot side of the volume control. This is the top, ungrounded end of the control in Fig. 5. Turn the volume control on the radio and the gain control on the generator to give the maximum output. Now, turn the output level control on your generator down until the sound comes through clean and undistorted to the ear. Note the voltage. During the remainder of the procedure, never let this meter read more than ½ this voltage. If it should rise above this value, decrease the output from

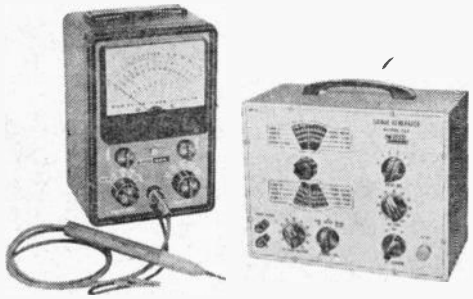


Fig. 7. VTVM and signal generator are all you need to align superheterodyne receivers.

All American 5

the generator with the appropriate control.

Now set the generator to produce a modulated 455 kHz signal. Adjust the modulation control to less than 100% modulation. This is easy with most generators, since they are either not capable of this much modulation or use fixed modulation with no front panel controls.

Connect the RF output from the generator, through a .01 *u*F capacitor, to the grid of the tube preceding the final IF transformer. In Fig. 4, it would be pin 1 of the 12BA6. Adjust the trimmers in the final IF transformer for the maximum output. Keep the oscillator output low enough so that the maximum desirable output voltage level, discussed above, will not be exceeded.

Now, connect the same probe to the RF grid of the converter stage. In Fig. 2, it is pin 7 of the 12BE6. Because of impedance conditions, the level of the output from the generator will probably have to be increased to get a reading on the meter. If no reading can still be made, it will be necessary to temporarily disconnect the tuned RF circuit. This tuned circuit consists of C1A, C1B and the loop antenna in Fig. 2. Now adjust the trimmers in the first IF transformer for the maximum output. Be certain to reconnect RF circuit after alignment is complete.

RF Alignment. The big problem with RF alignment is to find a convenient point at which to inject the RF signal.

If there is an antenna terminal, connect the output from the generator to it, through a capacitor. If there is no antenna terminal, as is the usual case, wind several turns of wire into a small coil or "hank." The size is only important in that it should be convenient to place it a few inches away from the flat loop or loopstick antenna, without shifting its position relative to the antenna. A small hank of four loops or turns of ordinary insulated hook-up wire wound in circles of about 3 inches in diameter will do nicely for this coil. The various turns can be held together at several points with masking tape. The masking tape can be used to hold it near the antenna during the alignment procedure.

If you made the RF loop discussed, disconnect both the RF and AF generator leads from the chassis or B− ground. Connect the two leads from the hook-up wire loop to the RF leads from the generator. Should this loop stop the generator from oscillating (as noted by no output in the receiver) more turns will be required. Just how many turns can be found by trial and error.

If there is an antenna terminal on the receiver, do not disconnect the generator from ground, but connect the RF lead through a 200 *u*F. capacitor to the antenna terminal.

Feed a 1400 kHz modulated signal to the receiver. Set the dial on the receiver to 1400 kHz. Adjust the oscillator trimmer condenser, C1D, for the maximum output.

Now feed a 600 kHz modulated signal to the receiver and set the dial on the radio to 600 kHz. Adjust the oscillator padder condenser,* if any, for maximum output. If there is no padder condenser, there is usually a screwdriver adjustable slug in the oscillator coil. Adjust this for maximum output.

Next, recheck the 1400 kHz adjustment. Repeat both adjustments (the one at 1400 kHz and the one at 600 kHz) until you get the maximum output and best tracking.

Now that the oscillator section has been adjusted, the RF circuit must be adjusted. Once again, feed a 1400 kHz modulated signal to the receiver. Tune the radio to 1400 kHz. Adjust the RF trimmer condenser (C1B in Fig. 2) for maximum output.

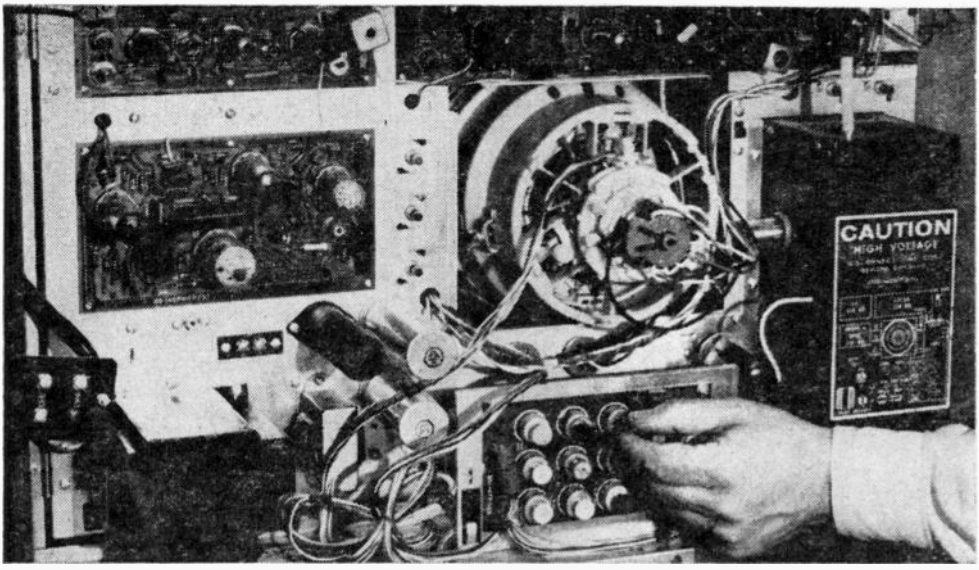
Next, feed the 600 kHz signal to the receiver and set the dial to 600 kHz. Adjust the padder condenser or slug in the antenna coil, if either exists. In some units, it is possible to adjust the position of the coin on the loopstick for maximum output signal. In other units, where no padder facilities exist, the trimmer must be adjusted to give the best maximum output compromise at 600 kHz and 1400 kHz.

If your listening habits favor one end of the band over the other, or one station more than another, it is best to adjust the RF trimmer for the maximum output at the frequency of the favored station.

Repeat the RF alignments at 1400 kHz and 600 kHz until the best compromise is achieved. Alignment is complete when you remove the leads from the signal generator and the RF coil you made. ■

* Some receivers have a capacitor between the parallel combination of C1C-C1D and the oscillator coil. This is the padder condenser. A padder condenser may be placed in a similar position in the RF circuit.

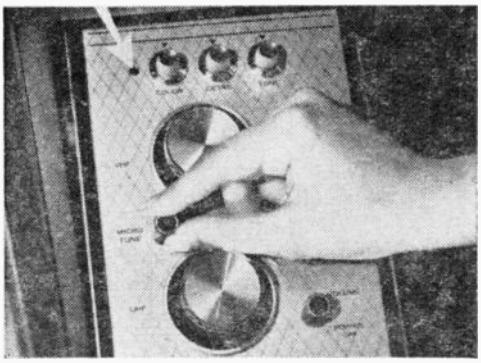
What To Do



For Truest Blue
(and red) (and green)

Though color-TVs can be frighteningly complex instruments for the uninitiated, they ultimately turn into old friends for the owner-in-the-know

By LEN BUCKWALTER



Fine-tune control and indicator light (arrow) make for easy tuning on many modern color-TVs, but they can't correct misadjustments.

Anyone who has switched from black-and-white TV to color viewing makes a disturbing discovery. No longer do little picture distortions—out-of-round circles or misshappen figures—sink into the background. Color permits less of a compromise. Misadjustments may spring out at the viewer to clutter the picture with a spectrum of colorful smears, nightmarish tints and ghoulish hues. We don't mean "fault"-type problems—outright failure of tubes, parts or antenna. These need servicing. Rather, it is the slow drifting that comes with time, or the intrusion of other factors which affect performance of an otherwise trouble-free set. The manufacturer anticipates such problems with a whole series of adjustments for correcting such error. Not just the user knobs on the front panel, but a complement of in-back controls that need an occasional touching up. They keep colors clean and the monochrome picture truly black and white.

Besides long-term drift, another significant force is at work. It is the stray magnetic field. So sensitive is the color receiver to magnetic forces that just moving the set around the room could deteriorate color, not to mention

COLOR-TV ADJUSTMENTS

going from room to room or house to house. Even the earth's weak magnetic field has been singled out as a disruptive influence. Stray magnetism and inevitable drift, however, are readily corrected in the steps to follow.

It's probably occurred to some viewers that symptoms of misadjustment may really be signs of deeper trouble. In many instances this is true. But until you've developed a sharp eye for these differences, there's the trusty trial-and-error approach to provide the answer; if routine adjustments to be described won't restore performance, chances are the circuits need servicing. Adjustments can be performed without major chassis removal, often requiring little more than removing the back cover.

How difficult? It follows the old law: the beginner flounders around at first, the experienced adjuster breezes through the job in mere minutes. So don't expect push-button precision at first. It takes a little time to get the feel and effect of the various controls. One thing in your favor: the set, though uncomfortable to view, may be just slightly out of adjustment. This means you can avoid time-consuming confusion by not moving any controls more than just a slight amount while observing the desired result. And don't despair over two factors peculiar to color TV: (1) you rarely set a control once and leave it there. Interaction is the rule, so be prepared for much repetition and (2) aiming for utter perfection is not only impossible but often a waste of time. Color TV is still a miracle despite traces of color error, especially at screen edges, or some color fringing around some objects in the black-and-white program. The adjuster tends to see the screen with a far more critical eye than when he sits five or more feet away as a program viewer.

Required Equipment. Unlike the simpler black-and-white receiver, which usually can be adjusted by eye, the color set needs at least one test instrument. It's the color generator, a device which displays on the screen a pattern of dots, bars and other images which serve as a reference. Without such a unit, the adjustment job becomes hopelessly complex. At least one kit manufacturer markets a suitable generator in kit form for approximately $65. Commercially wired units begin at higher prices. Clipped to the antenna terminals of the TV receiver, the generator "transmits" the desired pattern selected by a knob on the front panel. Not only is the device needed for critical color adjustments but also serves for lining up certain black-and-white adjustments.

Next piece of equipment is the degaussing coil, the unit which demagnetizes stray pickup by the picture tube. Although such units are available, one may be inexpensively assembled by following the illustration in Fig. 1. You'll need about four pounds of No. 20 enamel-covered ("magnet") wire. This is wound around some temporary form of 12-inch diameter for 400 turns. After removal from the form, the coil is held together by a wrapping of black plastic tape. A long AC cord (with plug) is attached to the two free ends of the coil.

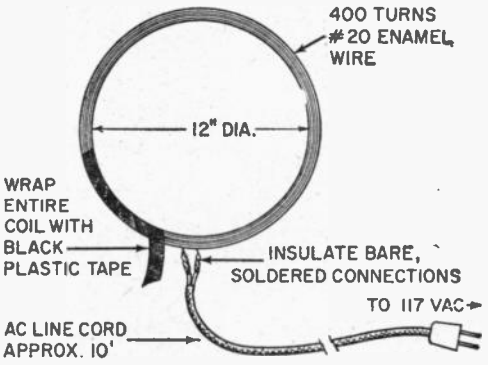


Fig. 1. For color TV receivers without automatic degaussing, a simple degaussing coil is needed.

A handy accessory during adjustments is a mirror. It's awkward, if not impossible, to get a good view of the entire screen while manipulating certain controls from the rear of the set. The mirror should be large enough to give a total view of the screen when placed in front of the set. A chair provides a good support of approximately correct height. (Two additional items, "cheater" cord and hex tool, are described later.)

Finally, the set's service manual should be on hand. Now that numerous TV makers have entered the color field, there are apt to be variations in location and set-up of controls from one set to the next. The step-by-step discussion to follow applies generally, but the manufacturer's special comments should also be checked.

Major Steps. Adjusting the color set requires no grasp of complex theory, but a quick preview of major steps (see Fig. 2) and why each is performed could prove helpful. The job begins with:

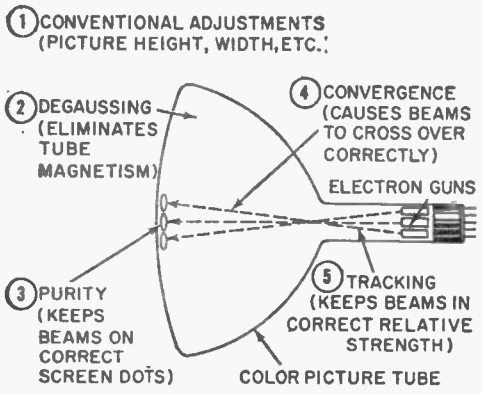


Fig. 2. The five major steps to accomplish in adjusting color TV for optimum performance.

1. Conventional Adjustments. These are the familiar controls found on all TV receivers, monochrome or color. They include height, width, focus and linearity (see Fig. 3). Unless preset for proper performance, adjustments which control color will be seriously affected. Even setting of horizontal and vertical hold controls should be done with care. Misadjustment of horizontal hold can cause fanning out at the top of the picture, while a vertical hold set improperly may produce slanting retrace lines. (A suitable crosshatch pattern from the color generator can serve as a guide for these initial picture adjustments.)

2. Degaussing. This is the demagnetizing step mentioned earlier. It cancels out magnetism picked up by the metal shell of the picture tube and surrounding parts. The operating principle of the degaussing coil is similar to that of an erase head in a tape recorder: by applying a rapidly changing magnetic field (provided by 60-cycle house current), the magnetized object is returned to a neutral state. (Degaussing will not be required for the newly-announced receivers by RCA; it's done automatically by an internal circuit.)

3. Purity. If the color set cannot produce single, pure colors, it cannot be expected to properly render thousands of color mixtures required during a color program. This introduces purity—first major color adjustment. Done in two steps, it lines up three beams from the electron gun in the neck of the tube so they fall precisely on their respective screen color dots—red, blue and green. Actually, purity is accomplished by using the red beam only. The other two colors will automatically fall into place.

4. Convergence. Not only do the three beams have to center properly on the screen, they must also come to a point just before reaching their corresponding screen dots. The beams are magnetically squeezed together (converged), and form a point just before striking the screen. Travelling a slight distance further, they cross over, fan out slightly, then strike their corresponding dots. To achieve this focusing effect for the entire screen surface, convergence is done in two steps. The first sharpens the image at screen center, the second corrects the problem of variable distance between guns and screen. (The beams must travel farther to hit the edges of the screen.)

5. Tracking. Although the receiver is designed for color reception, its black-and-white performance is still critical. This final adjustment keeps color out of the monochrome image. Since the black-and-white picture is created by mixing red, blue and green in a fixed amount, any upset intro-

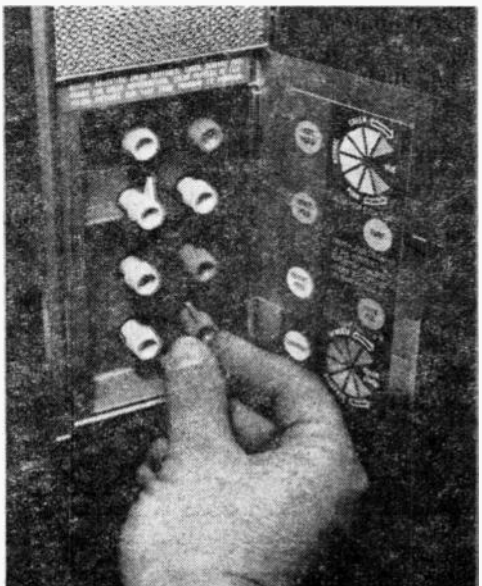


Fig. 3. All conventional controls—hold, width, linearity, etc. must be carefully adjusted first.

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duces undesired color tinting. This is corrected by adjusting the beam strength of each electron gun for the proper gray shading.

Preliminary Set-Up. Decide now where the set is to be located in the room for normal viewing—and leave it there throughout the whole course of adjustments. Some of your work will be undone if the cabinet is moved to a convenient area for better access, then returned to its permanent place. Plumbing pipes, air vents or other masses of metal unpredictably warp the surrounding magnetic fields which influence purity and convergence.

Room lighting is another factor which may be considered. Is the set to be viewed as daylight enters the room, or under artificial illumination? Photo fans will see the analogy; outdoor color film is balanced against the blueness of natural light, while the indoor film type takes into account the yellowish hues of artificial light. In adjusting the color set, these lighting factors affect the outcome. A set adjusted during the day for a good black-and-white picture, for example, can assume a hue of color under lamplight. Adjustments, if possible, should be made under normal viewing conditions. Since most viewing is ordinarily done in the evening, it's helpful to adjust at that time or draw the shades and exclude natural light.

Other preparations. Turn on both set and test generator in advance. Both units should be allowed about 20 minutes to warm up and stabilize at operating temperature. Also, the back cover of the set is removed. There is some variation in interlocks here, devices which automatically kill dangerous voltages when the cover is removed. This safeguard is designed to protect against accidental shock. During adjustments, however, the set must be fully powered with the cover off. This usually requires the use of a special "cheater" cord to defeat the interlock. A suitable one for the particular set should be obtained, if necessary.

The matter of safety is even more critical for color than in the conventional black-and-white receiver. Voltages in color circuits run up to some 24,000 volts. While none of the adjustment points bear voltage, care should be exercised to avoid any accidental contact with nearby, exposed parts. There is no need to open the high-voltage cage or remove the cap plugged into the picture tube.

Some sets have removable top or side panels for access to certain internal controls. Others may have a springy wire which shorts the high voltage when the back cover is removed. These and other variations should be checked in the manufacturer's literature. Let's consider now, step-by-step, the various color adjustments. It's assumed that the conventional black-and-white settings (width, height, etc.) have been properly set.

Degaussing. (In this first step the receiver may be warming up, but it does not matter if the set is off during degaussing.) Degaussing is a simple procedure but one that requires careful technique. Don't be surprised if the coil warms up after plugging it into house current. It is designed solely to be powered for the short time required for the job. (Some sets may have "rim" or "field-neutralizing" magnets. If so, they must be retracted before turning on the degaussing coil.)

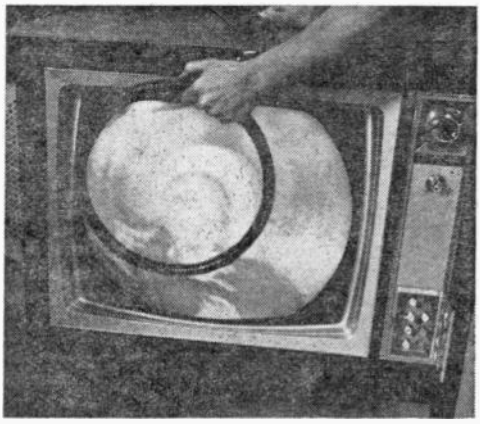


Fig. 4. Degaussing rids picture tube and other parts of stray magnetism that affects color.

As shown in Fig. 4, the coil is held with its flat side about an inch from the screen. Move it in circles over the whole area of the screen's face-plate and overlap into the bordering mask area to rid that region of possible magnetism. This part of the operation is done for about a minute. Now *slowly* back away with the coil, holding it in the same parallel position as before. When you've reached a distance of about six feet, turn the coil at right angles to the screen (nar-

row side points toward set). Now it's safe to pull the plug out of the wall. Another precaution: don't use a plug that is loose in the wall socket. Any make-break in AC power during degaussing can remagnetize the tube.

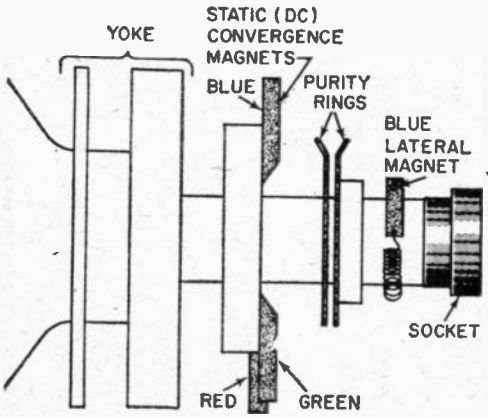
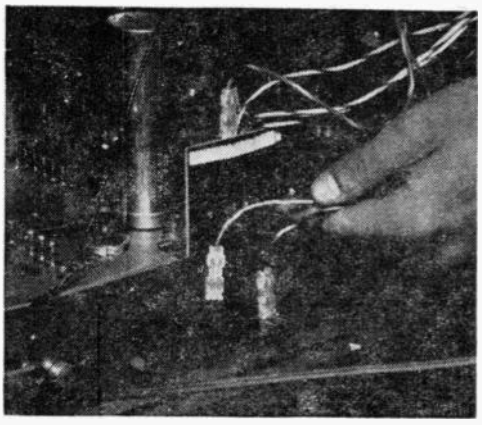


Fig. 5. Purity and static convergence adjustments are made on picture tube behind yoke.

Purity. This 2-step job (Fig. 5) begins by eliminating any possible source of interference on the screen, done simply by removing one of the receiver's I.F. tubes, or unplugging the I.F. cable running from tuner to chassis. (Don't forget to replace these after purity adjustments are completed.) Next is completely disabling blue and green electron guns in the picture tube. Only red will operate at this time. In the recent receiver illustrated in Fig. 6, note that blue and green guns are deactivated by removing two clip leads from a terminal strip. For other sets, a small commercial adapter is plugged into the picture-tube base. It has switches for disabling desired guns. (Such adaptors are often provided with the color dot-bar generator.) Some manufacturers specify clip leads for shortening out the guns.

Turn the set's contrast control fully off, brightness control to about halfway. The screen should now be essentially red. Locate the movable tabs (see Fig. 7) on the purity

Fig. 6. Before making purity adjustments, disable blue, green guns by method set provides.



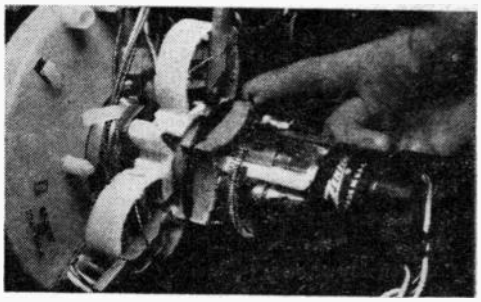


Fig. 7. The red area on the screen is moved to the center using the tabs on the purity rings.

rings and make the red color move to the *center* area of the screen. Some back-and-forth adjusting might be necessary. Not only should the red area predominate at the center, but its color be as uniform as possible. Step 2 in the purity adjustment is sliding the yoke back and forth to cause the red area to fill the entire screen (see Figs. 8 and 9). (There's a screw clamp to loosen the yoke.) Note that the yoke does not nudge up against the bell-shape rear of the picture tube as in

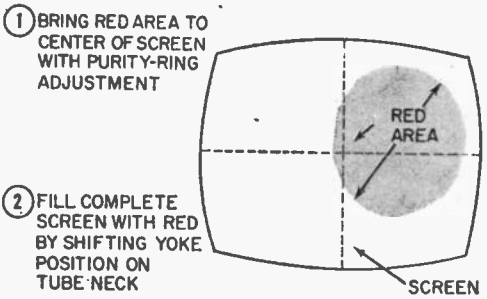


Fig. 8. The red area of the TV screen has to be centered and then expanded to fill the screen.

COLOR-TV ADJUSTMENTS

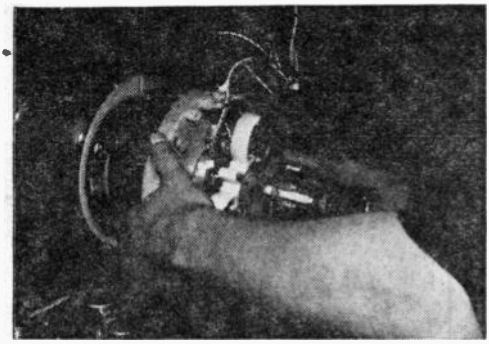


Fig. 9. Shifting the yoke along the tube axis causes a beam deflection that covers screen.

black-and-white sets. There is some play to permit purity adjustments.

The result of these steps should be uniform, uncontaminated red that slightly extends beyond (overscans) the borders of the picture-tube mask. In some sets, rim magnets around front the edges of the picture tube are adjusted for correcting color impurity existing out at the edges of the screen.

Convergence. For this step, the color generator is clipped to the antenna terminals in the set-up illustrated in Figs. 10 and 11. (Be sure the I.F. tube or plug removed earlier is back in place.)

The aim of convergence is a series of adjustments to produce pure white dots throughout the complete screen (see Fig. 12) Done in two major steps, static (or

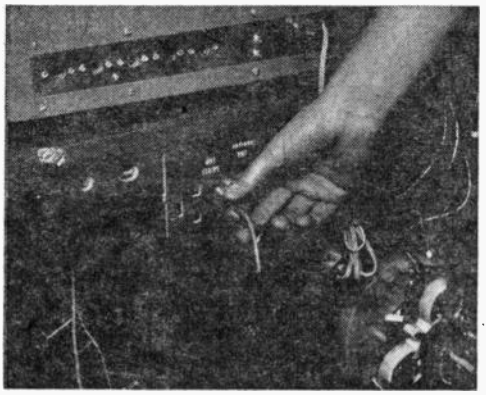


Fig. 10. The color generator output is coupled to the television receiver's antenna terminals.

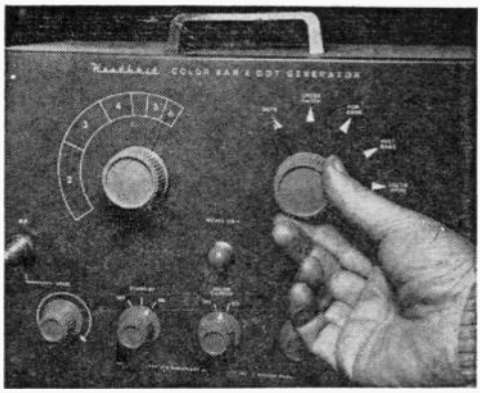


Fig. 11. Color generator is tuned to frequency of an empty channel and set to generate dots.

DC), and dynamic convergence, it should be possible to apply the right amount of correction. Begin with static convergence, done with three movable magnets (see Fig. 13) which can be slid in and out of their holders. During this step kill the blue gun, but keep red and green guns active. By careful oper-

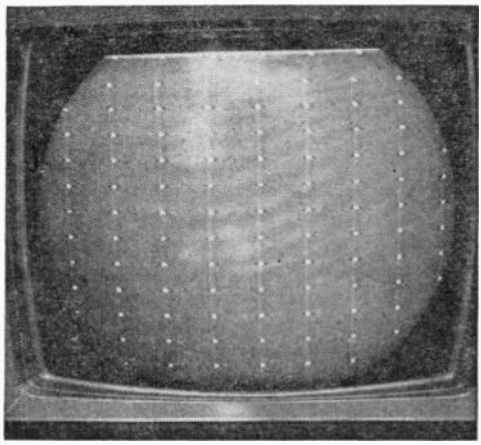


Fig. 12. Dot pattern is used during most color adjustments; is also used for conventional ones.

ation of red and green magnets it should be possible to bring together close-spaced red and green dots on the screen. As they merge, they form a single yellow dot. It's especially important that these static-convergence adjustments be made while viewing dots only at the *center* area of the screen, as shown in Fig. 14. Now activate the blue gun. Its magnet is slid to cause the blue dot to overlap the yellow dot. An additional control—the blue lateral magnet clipped on the tube neck near the base—permits side motion of the blue dot. As in other adjustments, static

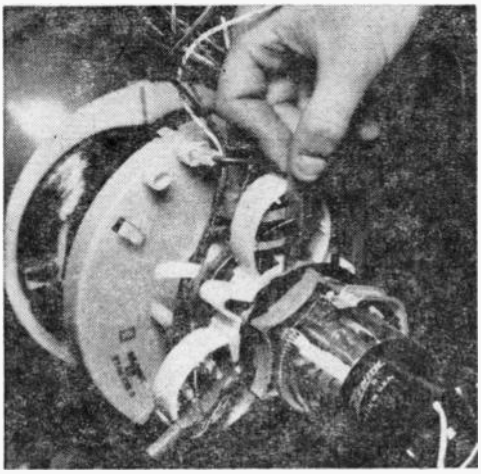


Fig. 13. Static convergence magnets are located in holders clamped around neck of tube.

convergence requires some juggling back and forth among controls to achieve satisfactory results. The end product should be pure white dots in the central screen area.

Controls for dynamic convergence, which bring together dots lying outside screen center, are generally mounted on a separate "convergence board." In many instances (see Fig. 15) long cables to the board permit it to be mounted conveniently on the rear top edge of the cabinet. Note how it is temporarily fastened in place by two screws. Thus, controls are accessible while the screen is viewed directly (Fig. 16).

A typical convergence board layout appears in Fig. 17. The various controls are divided into two major screen areas; horizontal and vertical. With the color generator producing the same dot pattern used earlier, begin with vertical convergence, the six knobs on the board's left side. During these adjustments, it is important to view only the *middle vertical row* of dots, as pictured in Fig. 14. All others are ignored. Red-green controls can be adjusted first, and the blue gun turned off at this time. While watching the vertical column of dots, carefully turn Red Tilt, Red Amp, then Green Tilt and Green Amp in an effort to merge red and green dots so they form single yellow dots. Following this, the blue gun is restored and Blue Tilt and Blue Amp adjusted so the blue dot overlaps the yellow dot for the desired result; a pure white dot, more specifically, a complete vertical row of white dots.

This process is apt to be confounding at first due to interaction—turning of one control upsets the setting of another. And, in fact, when upper and lower dots appear to be perfect, *center* dots in the vertical row go out of whack. This is to be expected. The remedy is to go back and touch up the magnets used earlier for static convergence to re-align the center.

There's another approach to dynamic convergence which might prove helpful until more experience is gained. This is to leave the blue gun on, then adjust red and green controls to bring those dots into line with blue (which serves as a reference). Also, some technicians prefer not to use the dot pattern at all for convergence. They switch the generator for a crosshatch pattern (see Fig. 18). Here, only the vertical column or line at the center of the TV screen is

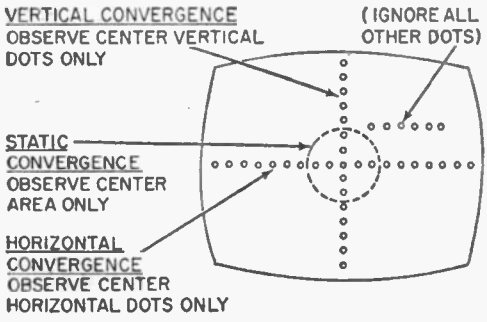


Fig. 14. In static convergence adjustments, observe only dot pattern in center area of screen.

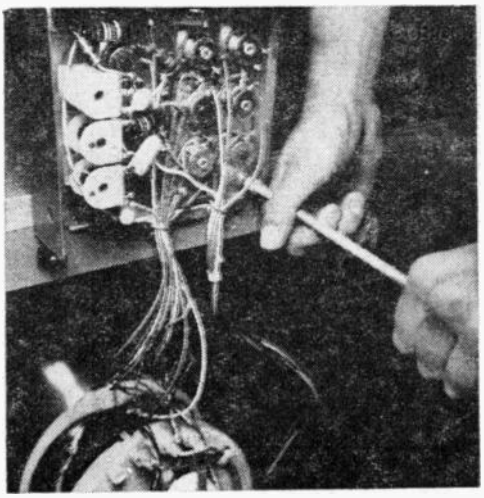


Fig. 15. For convenience, remove the dynamic convergence control board and secure where accessible for your tools and for visibility.

COLOR-TV ADJUSTMENTS

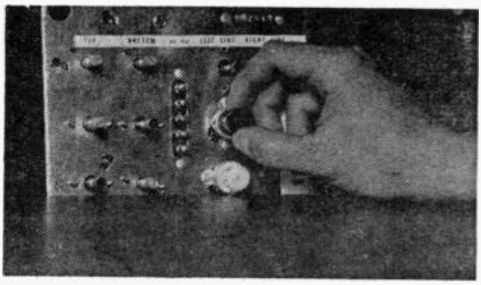


Fig. 16. When "board" is secured to top rear of set, it can be adjusted while viewing screen.

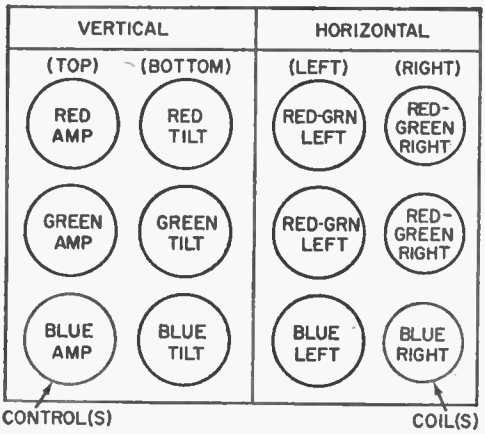


Fig. 17. The dynamic convergence board layout conveniently groups horizontal and vertical controls into logical position and color pattern.

viewed for vertical convergence adjustments.

Horizontal convergence is next, a procedure not unlike the one above, only now the *middle horizontal row* of dots (or lines for crosshatch) comes under adjustment (see Fig. 14). There is a difference; red and green occur *together* on each of the two left and right controls. Thus, the red and green color dots will move at the same time. Blue, as shown, has its own individual controls. Also, the extreme right-hand controls are not usually provided with knobs, but require the insertion of a plastic hex-type aligning tool. After turning off the blue gun, the various red-green controls are used to produce single yellow dots on *right* and *left* halves of the screen over the entire middle horizontal row. When yellow dots are visible, activate the blue gun and adjust the two blue controls. As blue overlaps yellow the desired white dots should appear. Those blue controls only move the blue dots up and down. For side to side motion, it is necessary to return to the blue lateral magnet mentioned earlier. Again, static convergence (on screen center) may be affected by dynamic convergence, so some back-and-forth adjusting might be in order. It's a good idea, too, to make a final check of color purity, described in the preceding section.

Tracking. After purity and convergence are completed, output of red, blue and green electron guns is adjusted. This assures that a correct proportion of primary colors will be delivered for creating the black-and-white picture. The controls are usually at the rear.

Although tracking controls may differ in number and marking, the general idea is as follows: First tune to an unused channel and turn the set's contrast and front-panel color controls to minimum. This should fill the screen with white light (or raster). With the brightness control turned up (though not to maximum) adjust red, green and blue screen controls for best, color-free white light. If, for example, blue is apparent, back off slightly on that control.

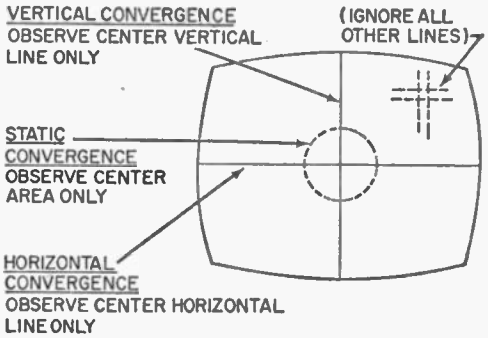
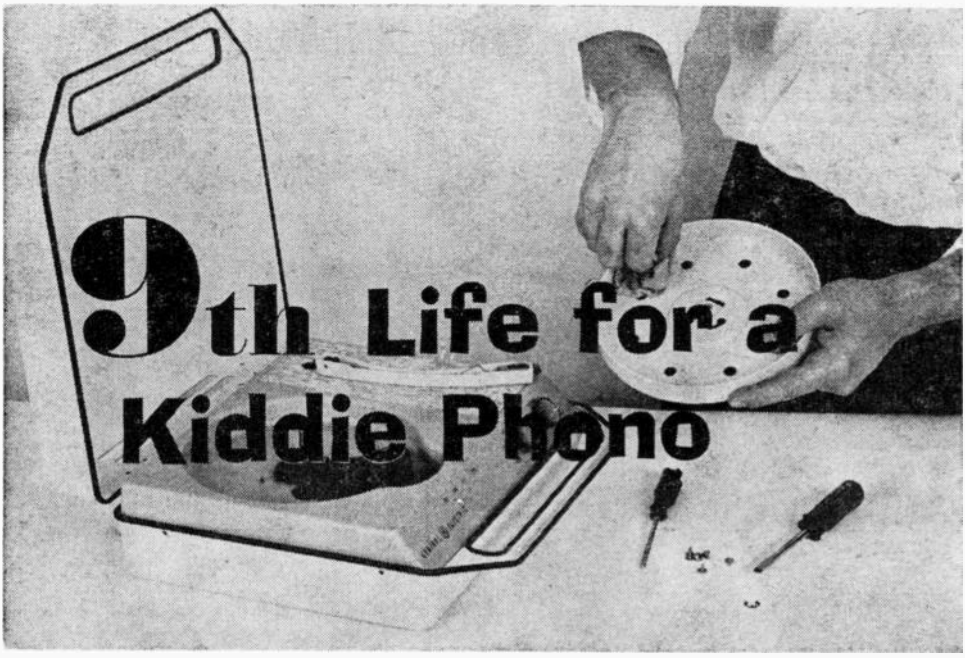


Fig. 18. Color generator can be set to give a crosshatch pattern for convergence adjustments rather than dot patterns discussed.

This completes the job. How well does a color TV stay in adjustment? There is no set period, but you can expect that, with normal conditions, convergence remains fixed for fairly long periods, say upwards of two years or more. Any jostling, magnetizing or moving the set especially affects color purity. But knowing when to repeat the job is the easiest step of all. During day-to-day viewing, your eye will make that decision. ■

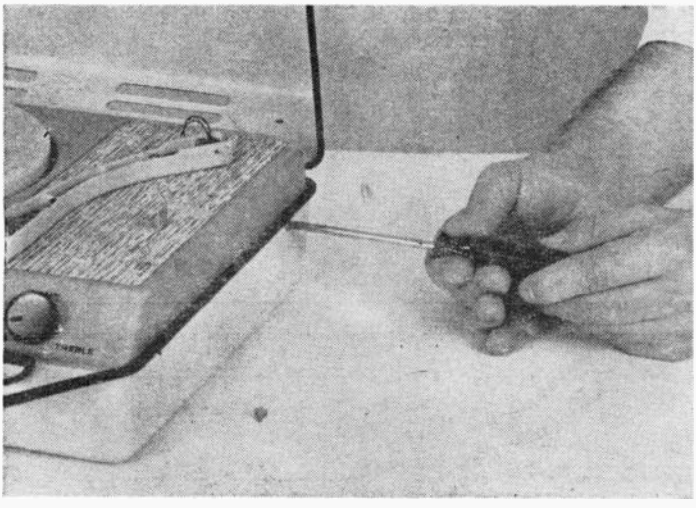


9th Life for a Kiddie Phono

■ **If your child's** phonograph has given up the ghost for what you insist *has* to be the last time, think again. For a kiddie phono is so simple a gadget it's bound to have nine lives (perhaps even ninety-nine) before it ends in the trash can. And whether due for its ninth or its ninety-ninth life, any kiddie phono requires a minimum of skill to return to working order.

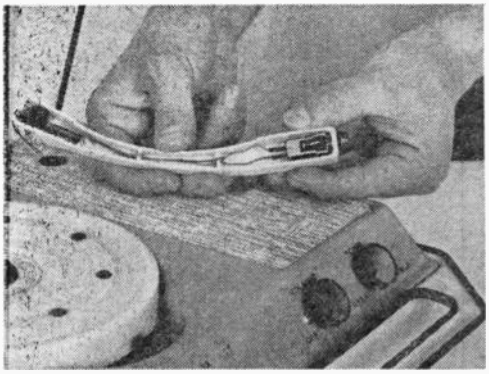
One of the reasons kiddie phonos are such a breeze to repair stems from the fact that there is really very little that can go wrong. Basically, any kiddie phono consists of a motor and turntable, a pickup and cartridge, an amplifier and speaker—plus a cabinet to house the lot. And aside from a broken cabinet, most repairs to kiddie phonos center around one of these three basic areas. In other words, it's either the motor and turntable, the pickup and cartridge, or the amplifier and speaker that the due for your servicing attention.

Unless the motor has conked out completely—in which case the entire assembly should be replaced, a general cleanup will probably put things back in the AOK cate-

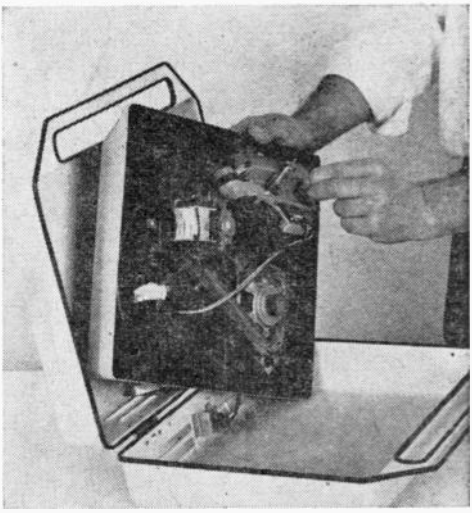


Kiddie phonos vary widely in general mechanical layout and construction, but this General Electric player is not unlike several other brands that have been on the market at one time or another. Disassembling this unit required unplugging line cord from socket at rear, then removing series of Phillips-head screws with a screwdriver.

Kiddie Phone Repair



Cartridge and tone arm easily fall prey to injury (note absence of tone-arm base in player above). Needle should almost always be renewed with exact replacement, as should both tone arm and cartridge, if condition warrants.

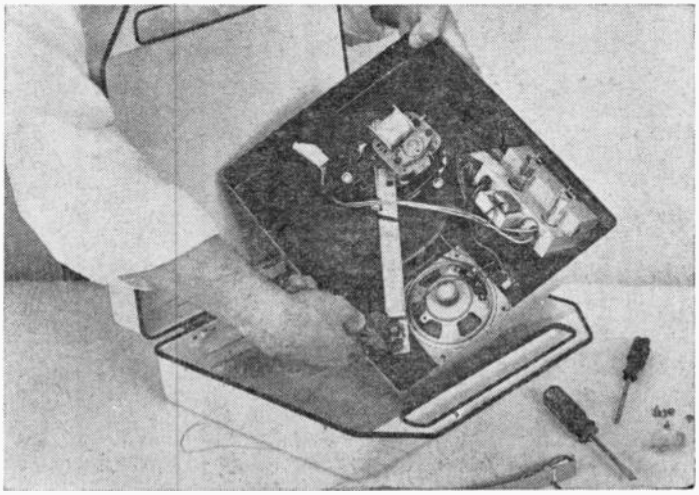


Amplifier/speaker section of kiddie phono generally contains one or two tubes in an AC/DC circuit. Inoperative amplifier usually stems from burned-out tube; damaged speaker often proves to be the cause of distorted sound.

gory. This can easily be accomplished by removing the pin or E-ring from the turntable, carefully pulling the turntable from the spindle, then cleaning the underside of the turntable as well as the motor shaft and idler assembly with a suitable solvent—a small bottle of GC carbon tetrachloride being a good choice. Use the cleaner sparingly on rubber parts, and be certain to clean the rim of the turntable thoroughly (see photo at top of facing page).

A new needle (now generally referred to as a *stylus*) should put the arm-and-cartridge combo back in like-new condition unless either or both has been damaged. If they have, it's usually best to replace both with a new arm-and-cartridge assembly as shown in the photos.

As for the amplifier and speaker, burned out tubes and punctured speaker cones account for something like 90% of kiddie phono troubles in this area. Effecting a cure is almost child's play—plug in a new tube or toss in a new speaker, and you'll have every reason to expect that the set will play like new again.—*Ron Mitchell* ■



After carefully noting wiring of leads running into amplifier from cartridge, leads were unsoldered, then single hex nut was unscrewed to permit removal of tone-arm assembly. Since new tone arm was virtual duplicate of damaged unit, fitting it in place called for little more than a reversal of disassembly procedure.

Most from B&W TV

Continued from page 72

trols for adjusting the correct width of the picture. These are the width and horizontal drive controls. If the picture is too wide or too narrow, first adjust the width control until the picture approaches as near as possible the correct width. (Fig. 21 shows a picture that is too narrow.) Then adjust the drive control until the picture fits the mask. If the drive control is incorrectly adjusted to give excessive drive, a vertical white line (overdrive line) will appear on the screen. Fig. 22 shows the effects of excessive drive on the picture.

Height (or vertical size) Control. Fig. 23 shows the effect on the picture of an incorrect adjustment of the vertical size or height control. In this illustration the picture is too narrow from top to bottom, but symmetrical with respect to the center.

Vertical Linearity Control. Fig. 24 shows a picture in which the vertical linearity control is misadjusted. In this case the picture is cramped from top to center while the bottom half is elongated. To adjust the vertical linearity control, rotate the shaft until the picture dimensions from top to center and from bottom to center are the same. To do this it is usually necessary to adjust the vertical linearity and vertical size controls alternately until the picture is linear and fits the screen.

The End (!). If you've taken a half hour or so to make various adjustments, the set is warm enough for the next step. By retuning slugs in the TV tuner's local oscillator, you can shift the fine-tuning control so it centers on each channel. (This is not necessary on late models that have pre-set or "memory" fine tuning.)

Begin by pulling off both main and fine-tuning knobs (VHF only), as shown in Fig. 25. This should reveal a small access hole in front of the tuner. Turn to your highest channel and set the fine-tuning shaft at the center of its rotation. Insert a non-metallic screwdriver into the access hole and tune the slug for best picture and sound, repeating this for every channel you receive. (Temporarily put back the main channel knob to flip to the next channel, but leave fine tuning undisturbed.)

Tired of all that tuning and adjusting? If so, our special televised message in Fig. 26 should prove reassuring. ■

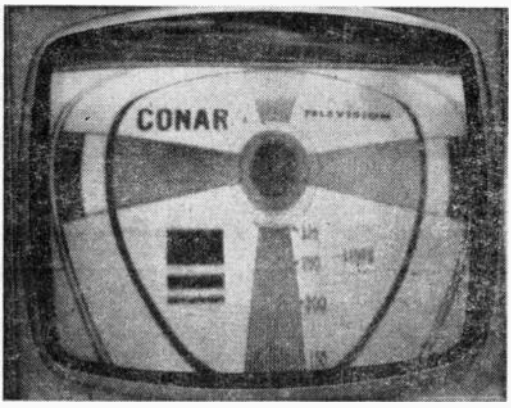


Fig. 24. Flat-topped circle can be made round again by adjusting both the vertical linearity and the vertical height controls together.

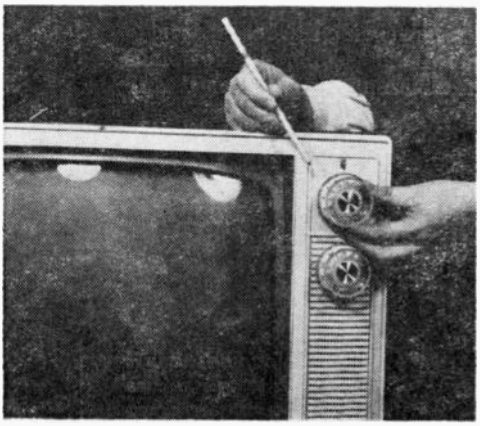


Fig. 25. Final tune-up consists of adjusting tuner slugs to center range of fine-tuning.

Fig. 26. The final result of these adjustments is a great picture that's the living end.

Hot Receiver

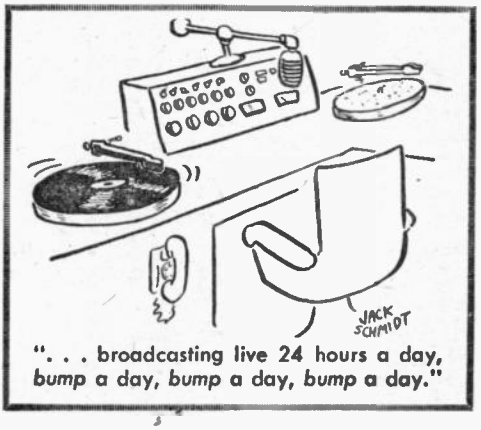
Continued from page 43

I changed the 220-ohm suppressor-to-ground resistor to one of about 3000 ohms, and bridged the fone/CW switch by a 0.02 *u*F or larger capacitor as shown in Fig. 1. This switches the S-meter zeroing potentiometer from suppressor to ground when the receiver is in the CW mode.

By rotating the potentiometer, really fine control of oscillation can be obtained, and the final IF stage can be used as either a Q multiplier or BFO. The modification doesn't interfere with normal S-meter operation when the receiver is switched back to fone. I could now receive 28 MHz hams on SSB. Not bad for such a simple receiver.

One more suggestion which could be useful: on such a simple receiver, it isn't possible to have both automatic gain control and a BFO at the same time, so strong stations can cause blasting. Connecting the antenna to a 2000- to 5000-ohm potentiometer, as shown in Fig. 2, gives a simple gain control that doesn't alter anything in the receiver.

Having made these modifications—without any more equipment than a soldering iron—I am now the proud possessor of a rather more grown-up HA-226. ■



". . . broadcasting live 24 hours a day, bump a day, bump a day, bump a day."

Service Shop Tips

Continued from page 10

coaxial cable is included plus a control box which permits adjusting the antenna electrically for best reception on a specific channel. Sometimes a good omnidirectional FM antenna can do the job.

Wants AC Only

I have an AC/DC shortwave receiver. I would like to know if there is an inexpensive way to convert it to an AC type?

—B. E. M., Sterling, Ill.

The easiest way is to connect a 1:1 isolation transformer between the set's power plug and the power outlet. They come equipped with a line cord and receptacle into which you can plug in your set. The harder way is to rewire the tube heaters from series to parallel and to install a power transformer in the set. The first way is cheaper, easier and the results are the same.

Why Ask Us?

Could you please tell me what type or types of batteries I could use in a Silvertone Model 1919 receiver?

—T. A. R., Utica, Mich.

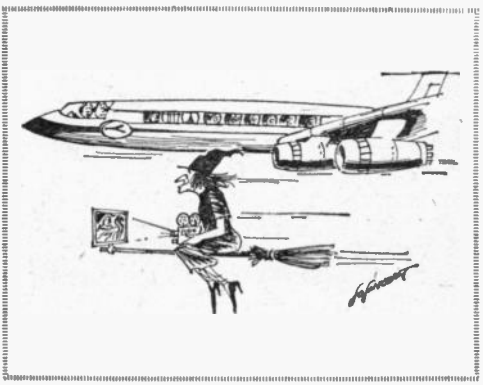
Write to Sears, Roebuck & Co., Arthington Ave., Chicago, Ill., where such information should be on file.

Color Blind

I want to buy a color TV set but am confused. One company advertises that its sets are better because of hand-wiring. Most others use printed circuits. Which is better?

—F. A., Flushing, N. Y.

Hand-wiring costs more. But, printed circuits are considered so reliable that most military and aerospace equipment employs them. Our experience indicates that the hand-wired TV sets are excellent, not necessarily because of hand-wiring, but so are many that employ PC boards. Our formula for purchasing a color TV set is simple: find the model you want in a showroom, and if it is working with good color, buy that floor model and nothing else. Sure, your set will be slightly used, but if it works in the showroom, it'll work at home. ■



Tackle That Totable TV

Continued from page 30

the trouble and the tubes are O.K. Check for low grid drive voltage on the output tube and check the associated components. Most width problems are found in the horizontal output sweep circuit (see Fig. 15).

Also look for a brass sleeve (on some portables) around the CRT gun and yoke assembly. Loosen up the yoke assembly screw and pull the brass shim out toward the picture tube socket to increase picture width. On deluxe portables with a horizontal drive control, check that it's set correctly. Try adjusting the control for correct width. Going too far will produce one or two white vertical drive lines from the middle to the left side of the CRT screen, in which case the control should be backed off a bit.

Horizontal Lines. Check the horizontal tubes when lines are lying across the CRT and cannot be straightened up with the horizontal hold control (see Fig. 16). If this doesn't do the job, adjust the horizontal frequency coil slug. Set the horizontal hold control in the center of rotation and adjust the horizontal frequency coil slug until the picture locks in. Now switch the channel selector knob to another channel and see if the horizontal circuit stays locked in. If not, it may be necessary to make another fine adjustment of the horizontal frequency coil.

When the horizontal lines will not straighten up or the raster goes into a *Christmas-tree* effect or jagged horizontal lines, check for a defective AFC circuit. In current portables, a duo-diode rectifier with three leads serves as the AFC component as shown in the schematic in Fig. 17.

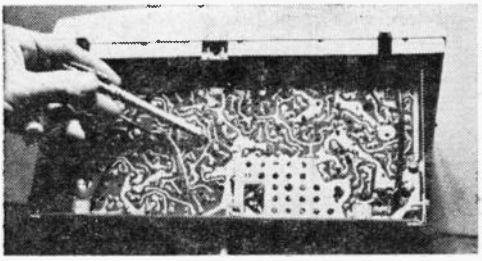


Fig. 24. Last but not least in the stable of portable TV troubles is the printed circuit board. Check it for cracks and cold solder joints in the area of the defective circuit, especially around heavy components.

To remove the duo-diode, cut off the leads about ½ in. from the PC board. Now you can solder a new AFC diode (or the old one) to these leads. Take a resistance measurement of the duo-diode rectifier; these are usually of the common cathode type (the center terminal is common to the two outside leads). Connect the ground lead from the ohmmeter to the center diode terminal. Now measure the resistance from each outside lead; the reading should be around 20 K. Reversing the ohmmeter leads should produce a zero-ohms reading. A leaky duo-diode will show a low resistance both ways.

A keystone, or triangular, picture is caused by a shorted deflection yoke and can only be remedied by replacing it with a new one. Bending and pulling of the picture can be caused by a defective horizontal oscillator or output tube. Excessive blooming of the picture when the brightness control is cranked up is caused by weak horizontal output or high voltage tube.

Bright Horizontal Line. If the picture consists of a single horizontal line, replace the vertical oscillator and multiplier tube. The bright horizontal line indicates the vertical sweep is not operating (see Fig. 18).

If tube replacement does not help, try adjusting the vertical height and linearity controls, or both. It is possible for the vertical height control to have a burnt spot, causing the vertical sweep to collapse. Check for continuity of the vertical output transformer windings. Also check to see if the feedback coupling capacitor shown in Fig. 19 is leaky.

For insufficient height, at top or bottom of the raster, adjust the vertical height and linearity controls. A weak vertical oscillator or output tube can cause this problem, too.

Constant vertical rolling of the picture can often be cured with a new vertical oscillator tube. If the picture is unstable both vertically and horizontally, the fault lies in the sync section. Replace both vertical and sync separator tubes. Some portables have both features in one tube, while others may have these sections in a separate tube or located in one-half of another dual-function tube.

Snowy Picture. A picture very light in detail with a lot of snow on the screen as in Fig. 20 is usually caused by a defective RF tube in the tuner. Substitute a new RF, oscillator, and first IF tube and see if the situation improves. *(Continued on 102)*

LITERATURE

ELECTRONIC PARTS

★2. Now, get the all-new 512-page, fully illustrated *Lafayette Radio* 1969 catalog. Discover the latest in CB gear, test equipment, ham gear, tools, books, hi-fi components and gifts. Do it now!

★5. *Edmund Scientific's* new catalog contains over 4000 products that embrace many interests and fields. It's a 148-page buyers' guide for Science Fair fans.

4. *Olson's* catalog is a multi-colored newspaper that's packed with more bargains than a phone book has names. Don't believe us? Get a copy.

1. *Allied's* catalog is so widely used as a reference book that it's regarded as a standard by people in the electronics industry. Don't *you* have the 1969 *Allied Radio* catalog? The surprising thing is that it's free!

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106. With 70 million TV and 240 million radios somebody somewhere will need a vacuum tube replacement at the rate of one a second! Get *Universal Tube Co.'s* Troubleshooting Chart and facts on their $1.50 flat rate per tube.

10. *Burstein-Applebee* offers a new giant catalog containing 100s of big pages crammed with savings including hundreds of bargains on hi-fi kits, power tools, tubes, and parts.

11. Now available from *EDI (Electronic Distributors, Inc.):* a catalog containing hundreds of electronic items. *EDI* will be happy to place you on their mailing list.

6. Bargains galore, that's what's in store! *Poly-Paks Co.* will send you their latest 8-page flyer chock-full of *Poly-Paks'* new $1.00 electronic and scientific "blis-dor" paks and equipment.

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CB—AMATEUR RADIO SHORTWAVE RADIO

102. No never mind what brand your CB set is. *Sentry* has the crystal you need. Same goes for ham rigs. Seeing is believing, so get *Sentry's* catalog today. Circle 102.

146. It may be the *first—Gilfer's* speciality catalog catering to the SWL. Books, rigs, what-nots—everything you need for your listening post. Go *Gilfer*, circle 146!

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130. Bone up on the CB with the latest *Sams* books. Titles range from "ABC's of CB Radio" to "99 Ways to Improve your CB Radio." So Circle 130 and get the facts from *Sams.*

107. Want a deluxe CB base station? Then get the specs on *Tram's* all new Titan II—it's the SSB/AM rig you've been waiting for!

96. Get your copy of *E. F. Johnson's* new booklet, "Can *Johnson* 2-Way Radio Help Me?" Aimed for business use, the booklet is useful to everyone.

129. Boy, oh boy—if you want to read about a flock of CB winners, get your hands on *Lafayette's* new 1969 catalog. *Lafayette* has CB sets for all pocketbooks.

46. Pick up *Hallicrafters'* new four-page illustrated brochure describing Hallicrafters' line of monitor receivers —police, fire, ambulance, emergency, weather, business radio, all yours at the flip of a dial.

116. Pep-up your CB rig's performance with *Turner's* M+2 mobile microphone. Get complete spec sheets and data on other *Turner* mikes.

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111. Get the scoop on *Versa-Tronics'* Versa-Tenna with instant magnetic mounting. Antenna models available for CBers, hams and mobile units from 27 MHz to 1000 MHz.

45. CBers, Hams, SWLs—get your copy of *World Radio Labs'* 1969 catalog. If you're a wireless nut or experimenter, you'll take to this catalog.

101. If it's a CB product, chances are *International Crystal* has it listed in their colorful catalog. Whether kit or wired, accessory or test gear, this CB-oriented company can be relied on to fill the bill.

103. *Squires-Sanders* would like you to know about their CB transceivers, the "23'er" and the new "S5S." Also, CB accessories that add versatility to their 5-watters.

TOOLS

★78. Want to speed setting of locknut/screw controls? *Xcelite's* new HSC-1 interchangeable hollow-shaft nutdriver with drilled handle lets you adjust nut and screw simultaneously. *Xcelite* will send Bulletin N867 on request.

118. Secure coax cables, speaker wires, phone wires, etc., with *Arrow* staple gun tackers. 3 models for wires and cables from 3/16" to 1/2" dia. Get fact-full Arrow literature.

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★74. Get two free books—"How to Get a Commercial FCC License" and "How to Succeed in Electronics"—from *Cleveland Institute of Electronics*. Begin your future today!

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Continued from page 99

Picture still snowy? Then dig into the antenna coils and lead-in connections. Most portable receivers have isolating capacitors in the antenna input terminals. These capacitors protect the antenna coils and tuner.

In case lightning has struck your antenna, you may find one or both of these capacitors blown open. With an ohmmeter, check continuity of both antenna coils. You will find the antenna coils located on top at the rear, or inside, of the tuner cover. Be sure and replace damaged antenna coils with direct factory replacements.

Stations Won't Stay On Channel. In case the picture will not stay on channel or becomes snowy when the channel selector is jogged, clean the tuner (Fig. 22) with a good tuner spray lube. With the strip or turret-type tuner, clean the contact points with rag and cleaning solution. Bear down with the clean section of the rag to brighten up the contacts. Apply contact grease over the clean contacts and spray the contact springs located under the tuner drum.

Many small tuners use a rotating multisection wafer switch. Spray these contacts and rotate the tuner shaft at the same time. Select a good tuner spray that won't be harmful to plastic parts in the tuner.

Conclusion. There are many troubles that can develop in a portable TV. Remember to go slow and easy. Look, listen, and try to isolate which section the trouble is in. Be careful not to break off any control knobs on the rear of the chassis or damage the set in any other way.

You will find that all tubes and parts are quite close together in portables. Some of the tubes and parts are hard to get at, so proceed with caution (see Fig. 23). If the set has been subjected to abuse, don't forget to check the PC board for possible intermittent condition (see Fig. 24). Especially on the earlier sets, PC boards were subject to many problems.

But with care and a little use of the old think tank, most portable TV problems can be easily solved. So, go to it with confidence and save a few bucks while you're at it. ■

When Color Won't Stay Put

Continued from page 22

pares burst and 3.58 oscillator frequencies and creates the DC correction voltage.

But for comparison action to occur, the diodes in the Phase Detector must be electrically balanced, even when no burst is present. This provides a basis for a simple test. First, place a shorting jumper from grid to ground of the Burst Amp, as shown. This kills any incoming burst which would disturb the test.

Then place a VTVM across the plate of the Phase Detector and to ground. If your circuit is typical of many, you should read approximately −28 VDC at this point. Next measure the diode cathode to ground for a reading of +28 VDC. Voltages in different circuits may vary, but the important feature is that they are typically equal and opposite. This is a good indication of proper balance in the stage. Resistors and capacitors should be checked if voltages are unequal.

O.K. Phase. If there's good voltage balance in the Phase Detector, shift attention to the Burst Amplifier. Voltage and resistance checks here stand a good chance of revealing the trouble. If you can't pinpoint the culprit, perhaps the incoming burst signal isn't reaching the Burst Amp.

We've shown the source of the burst in Fig. 11. Note that it's from a tap-off point from the Color Amp. If any components between this point and the grid of the Burst Amp are defective, there could be an interruption of the burst signal. So check resistors, capacitors, or coils in this part of the circuit. If you're getting color on the screen, even if it's out-of-sync, chances are the other stages shown in Fig. 11 are functioning. Explanation for this fact is that the color signal must traverse those stages in order to reach the picture tube.

Thus, with little more than a VTVM and a jumper wire, you should be able to track down most troubles in color sync circuits. The simple tests described help locate the general area, or even a particular stage that's upsetting color stability.

If you run into an exotic problem that won't yield to these tests, chances are you'll need an oscilloscope to examine actual signals in transit through color-sync stages.

A typical schematic by RCA is illustrated in Fig. 12. Note that the scope waveforms seen at the bottom correspond to numbered points in the diagram. Both the shape of wave and its P-P (peak-to-peak) voltage are given for comparisons. ■

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