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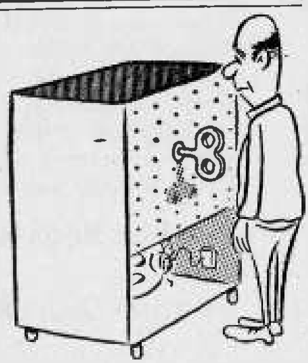

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service shop tips

FM Is Not AM

Please tell me how to modify my FM receiver front end to extend its range from 108 MHz to about 122 MHz.

—L. J. H., Chattanooga, Tenn.

While it could be done, you wouldn't benefit since there are no FM stations up there, only AM aviation stations—which your set would not demodulate. Why not give some serious thought to putting together a superregen?

Wasted Watts

I have an old TV set that was given to me which I use only as a phono amplifier. I would like to make it more compact by eliminating the picture tube. However, I learned that it is in series with the rest of the set and the amplifier section won't function without it. Can I replace the tube with something smaller and still use the set as a phono amplifier?

—R. T., Harrisburg, Pa.

Sure, you could—only it hardly seems worth it. Reason is that you're burning up a lot of kilowatt-hours of power running a whole TV set and making use of only two or three of its tubes as a phono amplifier. If the set draws 160 watts and you get one watt of audio out, you've got a mighty inefficient lash-up. Since you can buy a comparable amplifier in kit form for as little as $10.95, why don't you have the trashman take away that old TV set?

CCTV with Sound

Is it legal to have sound with my closed-circuit TV camera? If so, could my camera be converted? Or, could I use one of the new FM wireless microphones converted to operate on TV Channel 6?

—M. F., Prescott, Ariz.

Write to the TV camera manufacturer and ask if they have a sound modulator for use with

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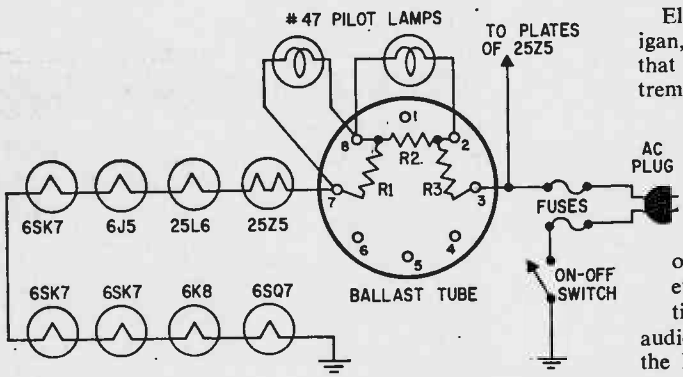
your camera. Sylvania and others make them. It is simply an FM transmitter which is fed directly to a TV set. The new FM wireless microphones operate in the 88-108 MHz FM broadcast band and may not be lawfully used if modified for one of the TV channels. You could use one if you use an FM receiver to pick up the sound at the required location.

Ballast Tube Needed

I recently acquired an old Hallicrafters AC-DC shortwave receiver. All the tubes and the BK-29D plug-in ballast tube were missing. The tubes can be replaced but I can't find a ballast. It is connected into the circuit as shown in the diagram. Can I use resistors in place of the ballast and if so what watts?

—M. G., Chicago, Ill.

Have you tried Hallicrafters right there in Chicago? For R1 use a 200-ohm 20-watt resistor, the same for R2, and a 30-ohm 10-watt resistor for R3.

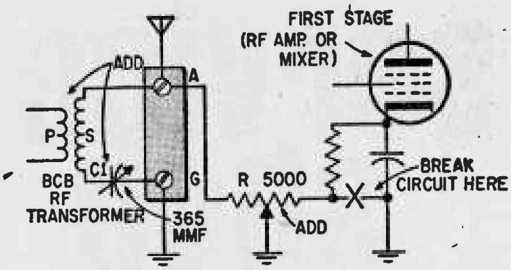


BCB Traps

On my shortwave receiver I pick up AM BCB stations between 1.7 and 2.2 MHz (mc). What causes this and is there any remedy? The problem gets worse after dark.

—C. W., Albany, N. Y.

Yours is a common trouble encountered with receivers with too much gain or inadequate front-end selectivity which causes intermodulation. Try a shorter antenna. If this doesn't solve the problem, connect a wave trap across the antenna and ground terminals or add an RF gain control as shown in the diagram (see top of next column) or do both. Tune C1 to eliminate a specific BCB signal. Adjust R1 to provide just enough gain to receive the signal you want. Another solution to your problem would be to add a tunable RF preamp between the antenna and antenna terminals.



Q-Multiplier Coil

While building a Q multiplier I came across a part in the schematic, a variable coil labeled "tune to IF of radio." My IF is 455 kHz but I have been unable to locate such a part. I have been advised to use half of an IF transformer.

—P. G., Ann Arbor, Mich.

You can use an IF transformer by disconnecting the capacitor from across the coil you do not intend to use. You might be able to buy a ready-made coil from Hammarlund Manufacturing Company, Mars Hill, N. C. Ask for the price and availability of a quadrature coil for an FM-50A.

My, What Big Ears You Have

Where can I get a microphone that will pick up sounds at a long distance?

—J. B., Terre Haute, Ind.

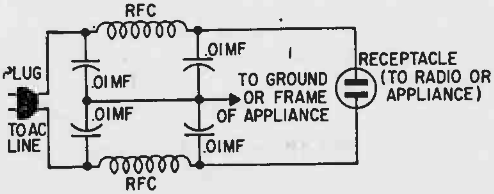
Electro-Voice, Buchanan, Michigan, manufactures a microphone that is highly directional and extremely sensitive. Since your letterhead indicates you are a private detective, you should be aware that *radio* "snooping" devices can no longer be used except by authorized police agencies because of a recent FCC ruling. However, if you pick up conversations and transmit them on an audio basis within the same state, the FCC has no jurisdiction.

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.

Marines Have Landed

What kind of an antenna should I use to pick up long wave, CB and marine band stations? I can't pick up 2-3 MHz band marine signals with present antennas.

—*A. A., Rochester, Minn.*

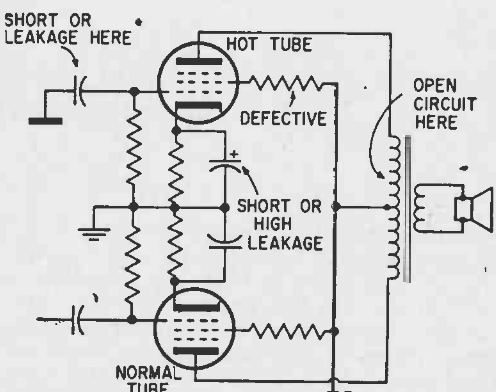
You're about 150 miles from the Great Lakes but not too far from the Mississippi. You should be able to receive marine signals at night, but not necessarily in the daytime when range is limited to about 50 miles over water, and there is land to cross. For all but CB, use a long wire antenna and a ground. For CB, use a 9-foot vertical wire or regular CB antenna.

Not So Hot

My stereo receiver uses four EL95 tubes. After 15 minutes of operation the plate of one of the tubes glows orange and gets very hot. Any tube in the same socket does the same. The set sounds O.K. Is this normal?

—*T. W., Calumet City, Ill.*

There probably is distortion in one of the stereo channels and you're not noticing it if there is a defect in your receiver. It could be a leaky coupling capacitor which allows positive DC to reach the grid of one of the tubes (see diagram), causing it to draw excessive plate current. It is possible that the screen of the affected tube is glowing instead of the plate. This would happen if one side of the output transformer is open, as shown in the diagram.



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I own a Sibley AF-950 receiver. It covers the AM, FM and SW (4-12 MHz) band. When I tune in the FM band on certain frequencies

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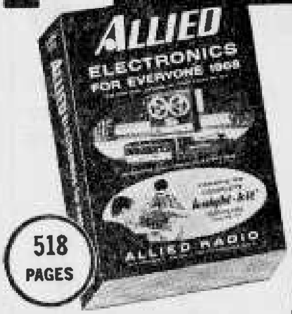

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service shop tips

(104-105 MHz) my favorite television and the family's TV picture and sound just go off on Channel 9. Is there anything wrong with the radio receiver?

—*A. S., Chicago, Ill.*

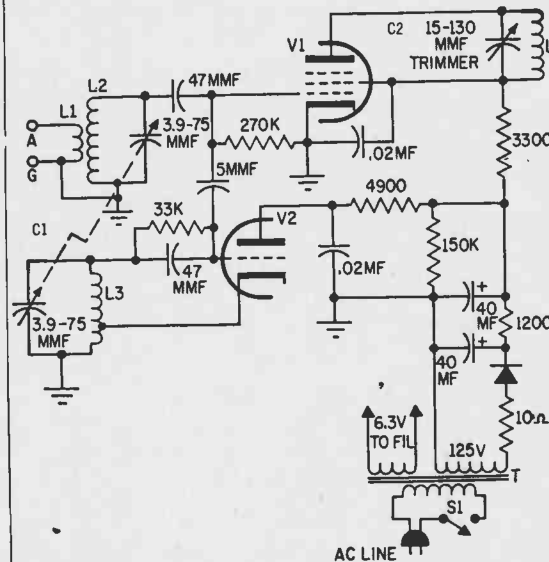
Sounds like the trouble is caused by radiation from your receiver's local oscillator. Move it further away from the TV sets. Also, think of using a coax TV antenna lead-in. Frankly, there may be something wrong with your TV antenna and lead-in wire. Check it today!

Shortwave Converter

I have a Zenith AM radio. Can you give me a circuit for a shortwave converter to use with it?

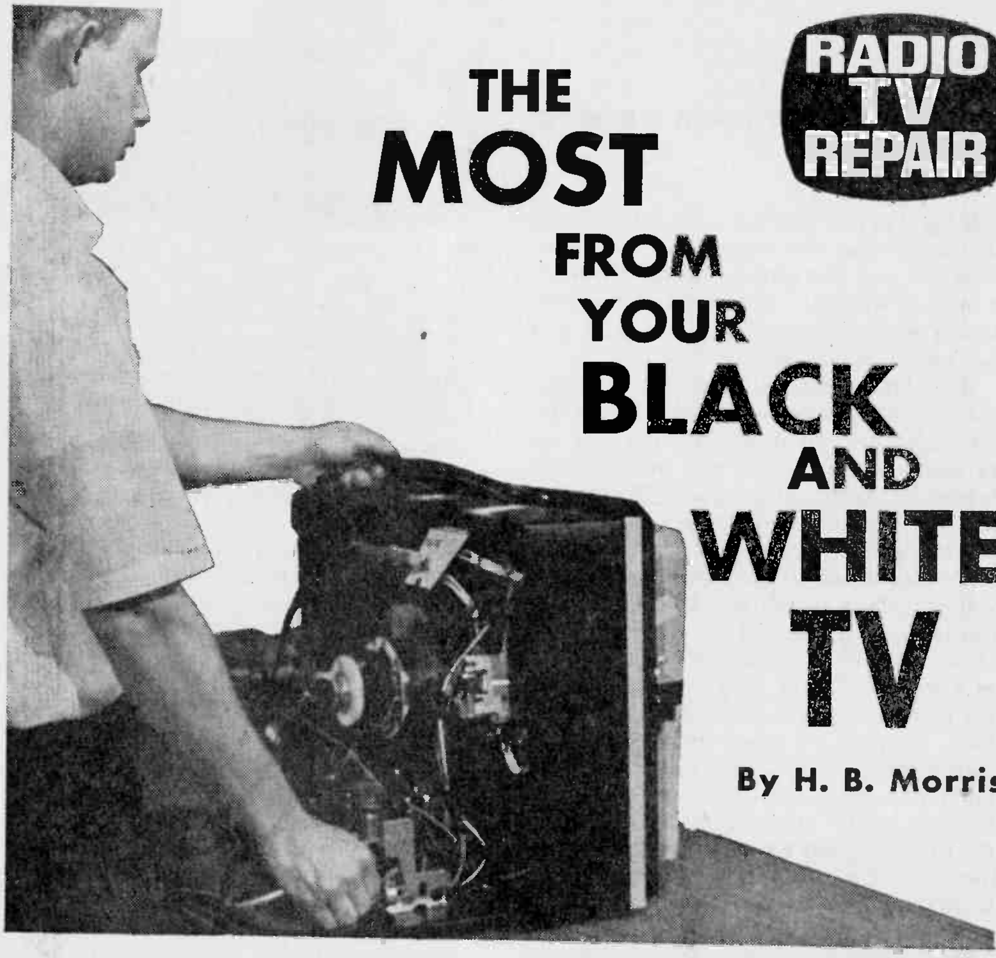
—*R. A. R., Hayward, Calif.*

You can use a separate pentode (V1) and a triode (V2) or a combination pentode-triode tube such as the 6GH8 connected as shown in



the diagram. Coils L1 and L2 are wound on the same plug-in coil form. Coil L3 is also a plug-in coil. You'll have to wind your own or select non-plug-in coils for the shortwave bands you want to cover from a J. W. Miller catalog. Radio parts stores in Oakland and San Francisco should have the catalog and many of the coils.

Coil L4 is a BCB loop antenna which should be placed close to your AM radio, assuming it too uses a loop. Set the radio to a clear spot on the dial around 1500 kHz. Tune in SW stations with C2 and adjust C1 for best reception. ■



RADIO TV REPAIR

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 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."

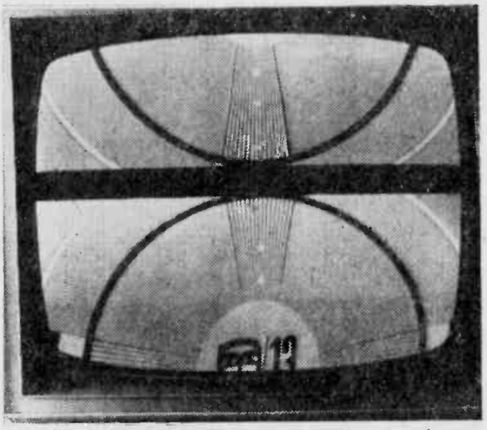


Fig. 1. Even if picture isn't rolling as above, vertical hold control may not be set properly.

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

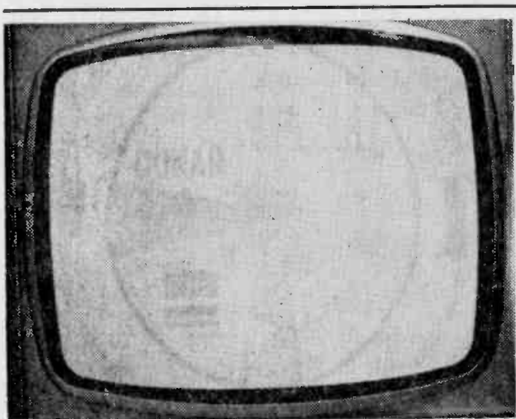


Fig. 4. Setting brightness control too high will cause a picture detail to wash out.

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

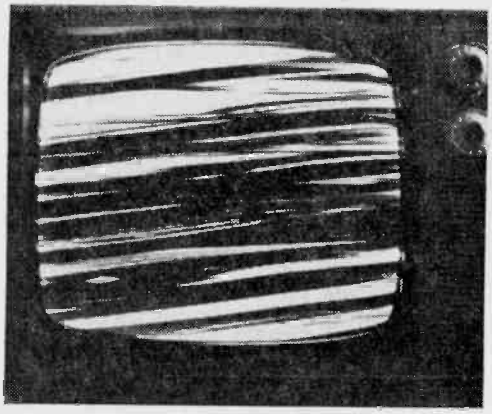


Fig. 2. Horizontal hold should be set so picture is stable after channel is changed.

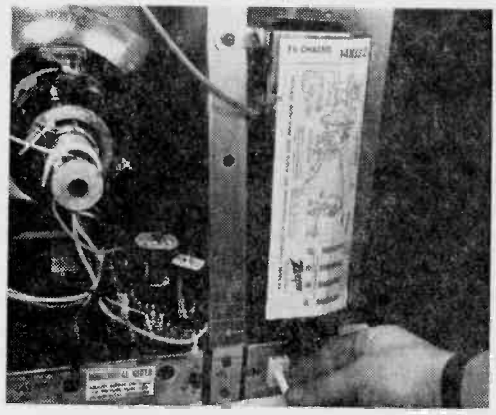


Fig. 3. Many late-model sets have horizontal-hold control located on the back of cabinet.

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).

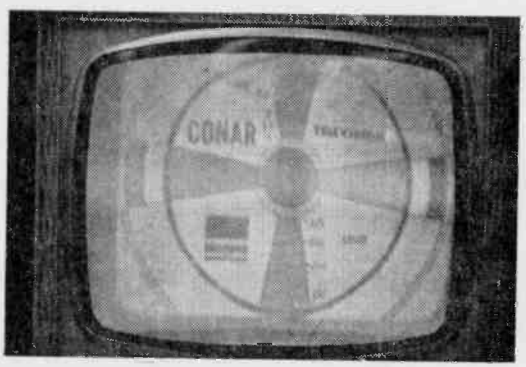


Fig. 6. Unstable picture with low contrast may indicate need for AGC control adjustment.

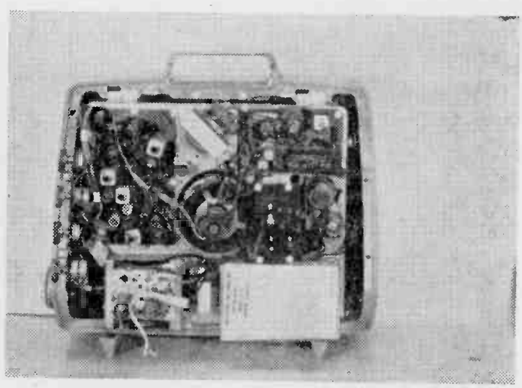


Fig. 7. Back of set may have to be removed for access to little-used controls.

MOST FROM 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-

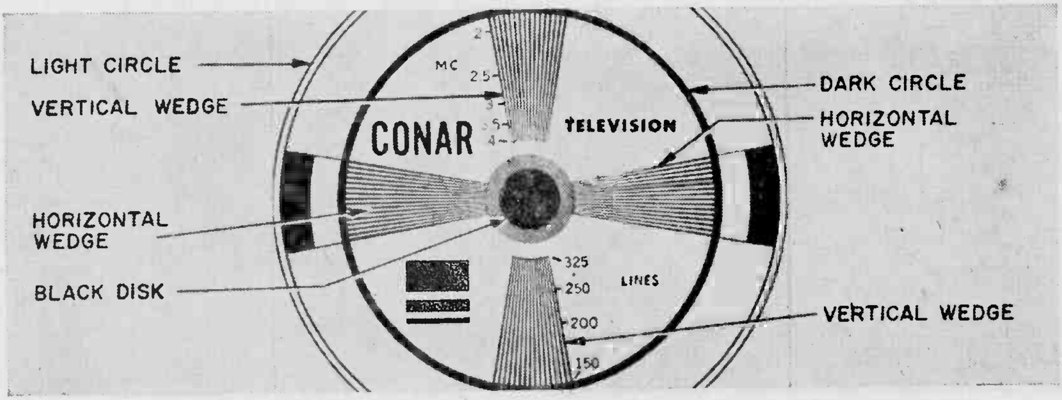


Fig. 8. Test pattern transmitted by most TV stations before and after regular programming is invaluable for adjusting set's controls. Important elements are labeled above.

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 com-

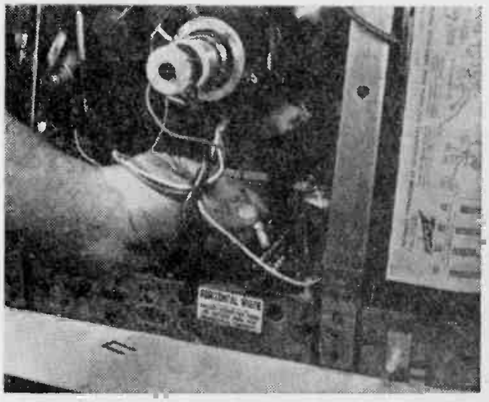


Fig. 10. One type of focusing arrangement is adjusted simply by selecting proper tap.

pletely distorted or it may even become completely negative.

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

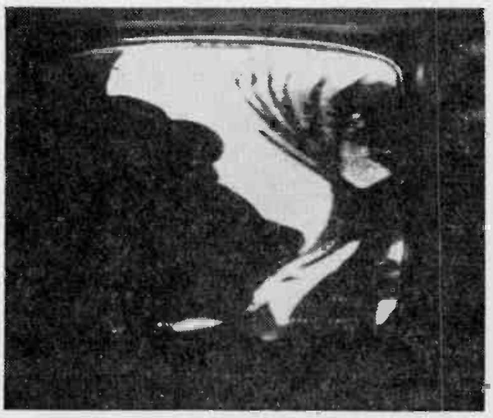


Fig. 9. Improper setting of AGC control causes variety of symptoms like one above.

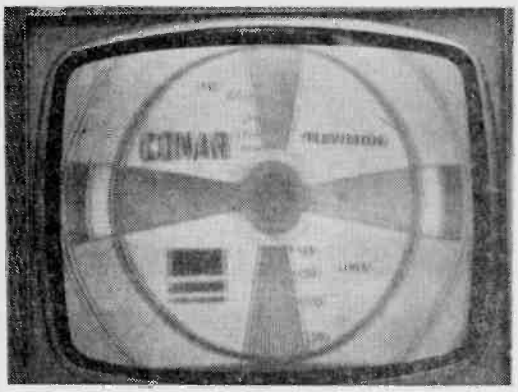


Fig. 11. Typical indication on screen when picture tube requires focusing adjustment.

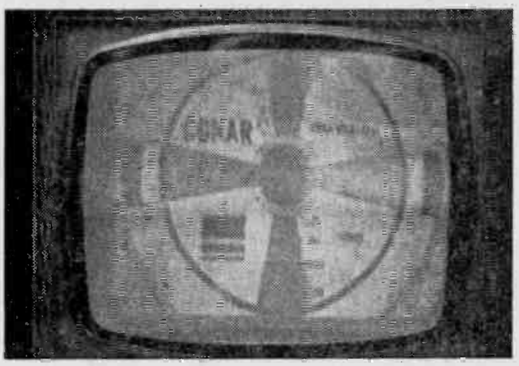


Fig. 12. Sets with sync stability control will require adjustment of this control when the condition in the photo is observed.

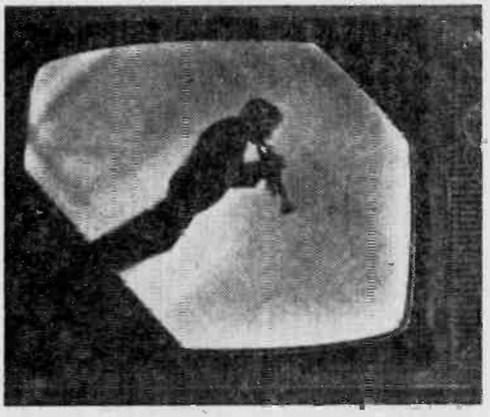


Fig. 13. Tilted picture occurs when yoke has rotated on picture tube neck, usually as a result of set being sharply jarred.

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.

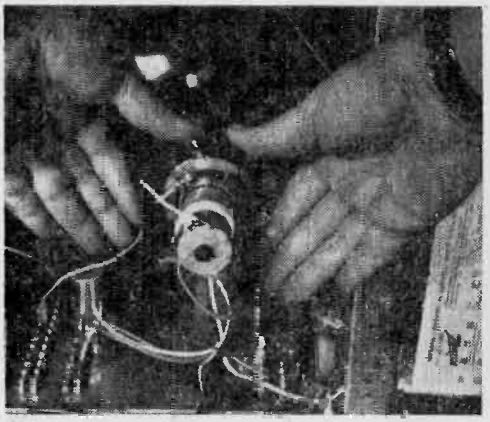


Fig. 14. To adjust yoke, loosen clamp screw, hold only insulated part, and rotate carefully.

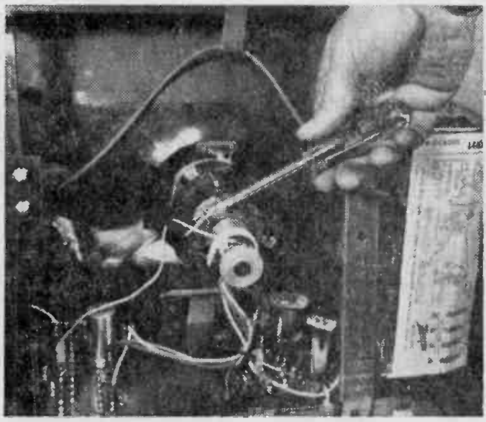


Fig. 15. When yoke is positioned, tighten clamp screw, being careful not to over-tighten.

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

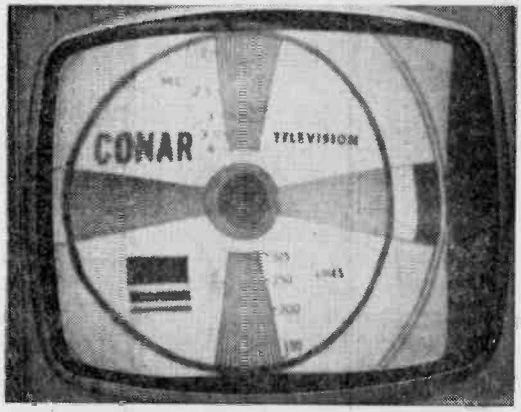


Fig. 17. Unfilled screen on either side indicates that horizontal centering controls generally are incorrectly set, though problem can also stem from electrical defects in circuits.

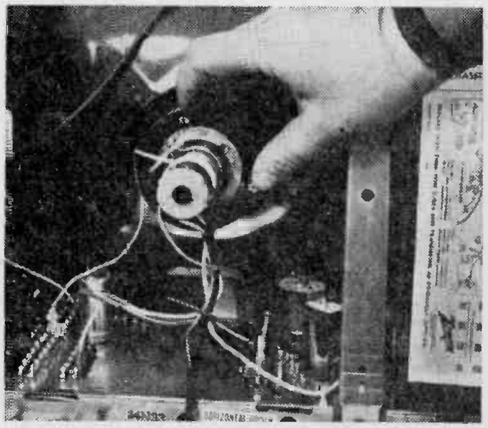


Fig. 18. Magnetic rings on picture tube neck behind yoke are used to center picture. The two tabs are rotated around neck for both correct horizontal and vertical centering.

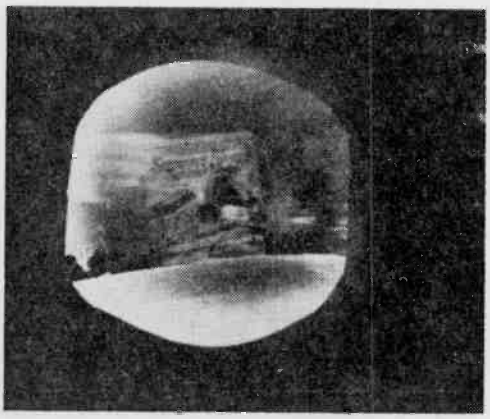


Fig. 16. If picture doesn't fill screen, yoke isn't properly seated against picture tube.

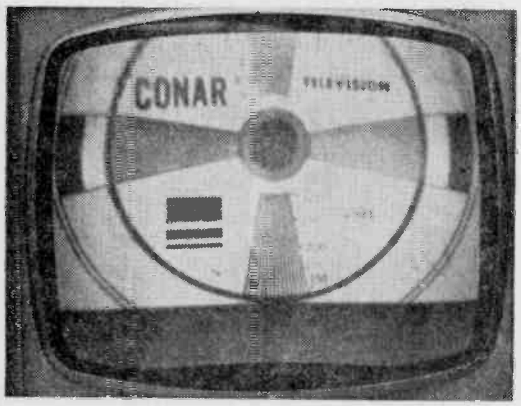


Fig. 19. Incorrect vertical centering in photo above is adjusted as shown in Fig. 18.

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-

(Continued on page 99)

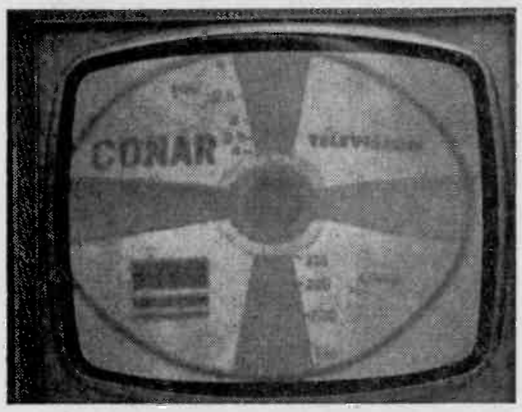


Fig. 20. Condition above is corrected by adjustment of both the horizontal linearity control and the width or drive control.

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

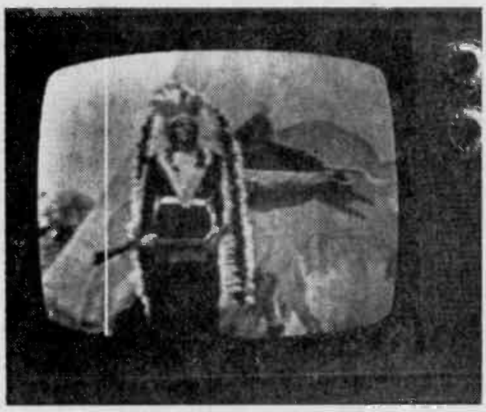
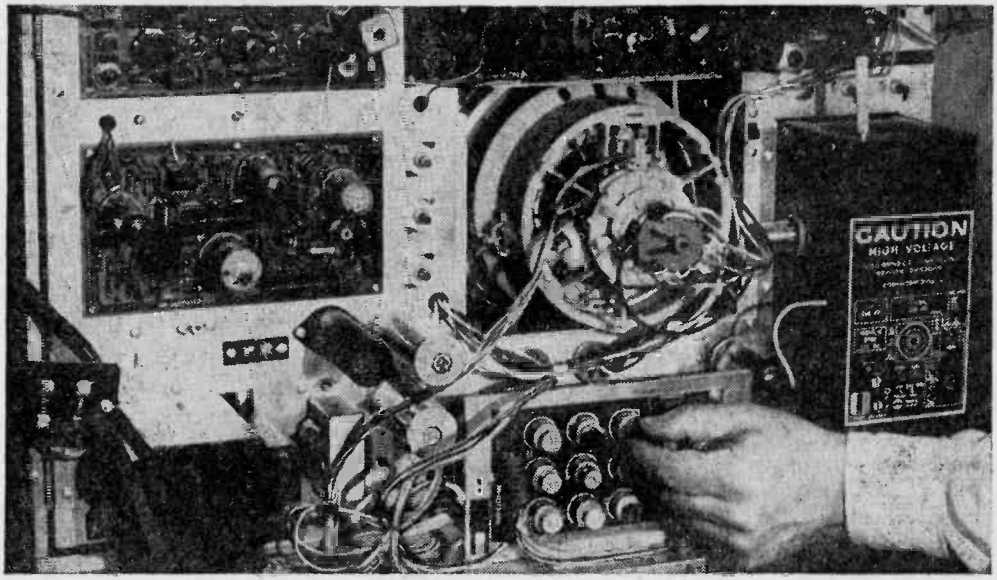


Fig. 22. Too much horizontal drive causes vertical white line to appear on screen.

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

What To Do

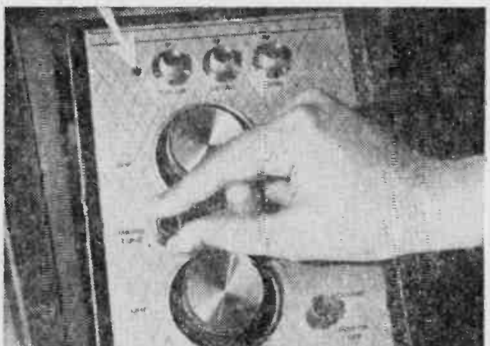


For Truest Blue

(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

RADIO TV REPAIR

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-

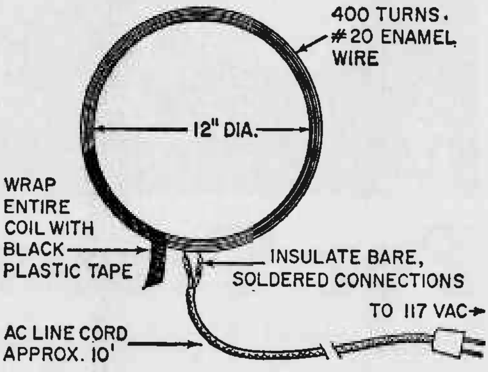


Fig. 1. For color TV receivers without automatic degaussing, a simple degaussing coil is needed.

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.

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:

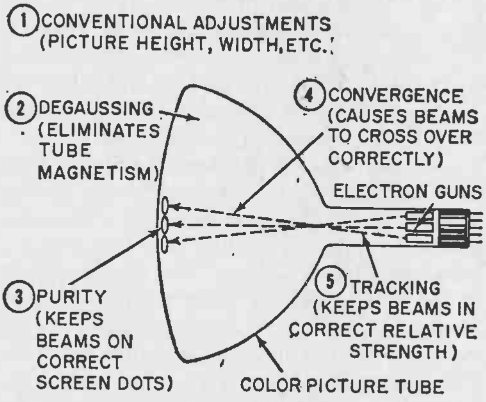


Fig. 2. The five major steps to accomplish in adjusting color TV for optimum performance.

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-

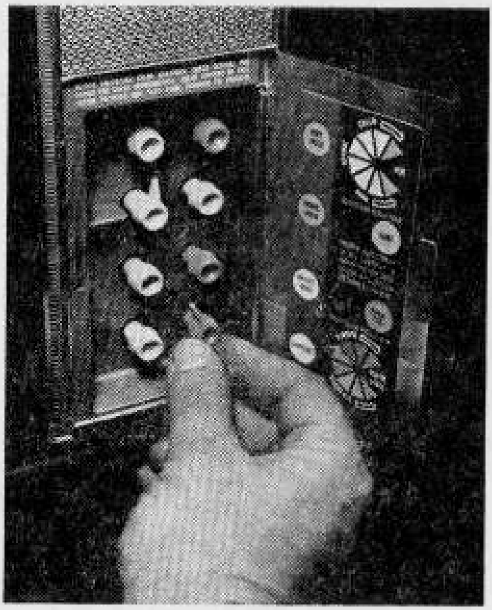


Fig. 3. All conventional controls—hold, width, linearity, etc. must be carefully adjusted first.

COLOR-TV ADJUSTMENTS

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.)

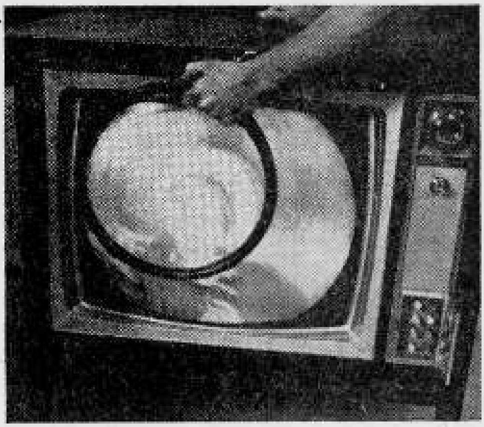


Fig. 4. Degaussing rids picture tube and other parts of stray magnetism that affects color.

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 (narrow 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.

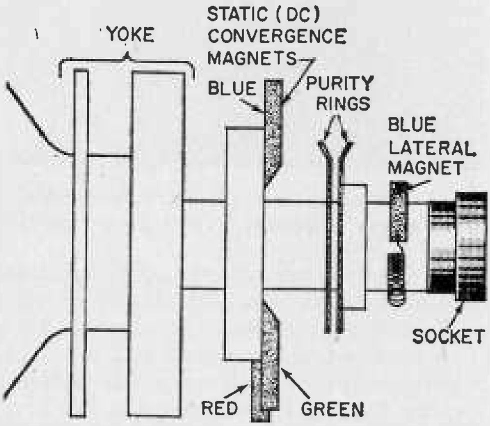
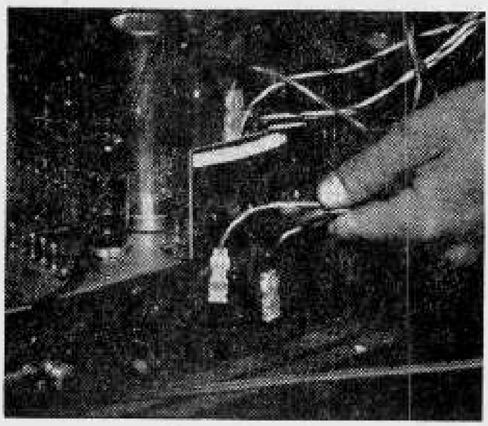


Fig. 5. Purity and static convergence adjustments are made on picture tube behind yoke.

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.

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



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 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

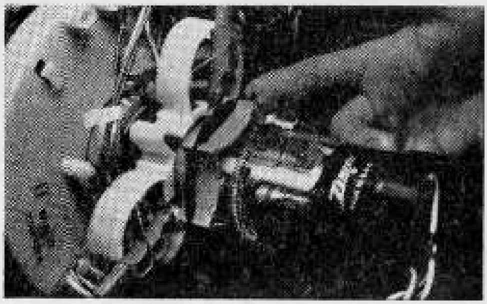


Fig. 7. The red area on the screen is moved to the center using the tabs on the purity rings.

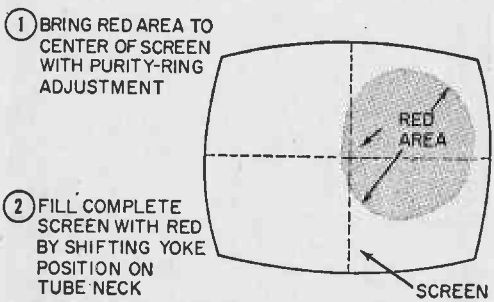


Fig. 8. The red area of the TV screen has to be centered and then expanded to fill the screen.

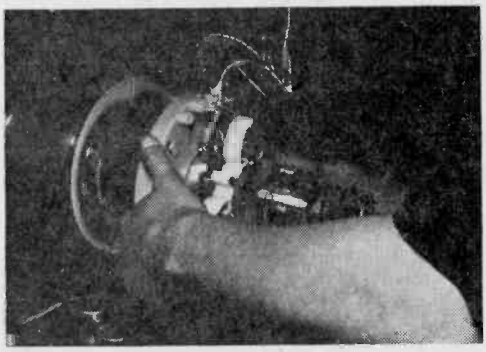


Fig. 9. Shifting the yoke along the tube axis causes a beam deflection that covers screen.

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

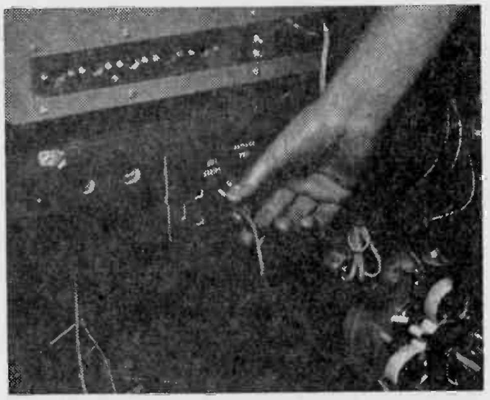


Fig. 10. The color generator output is coupled to the television receiver's antenna terminals.

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-

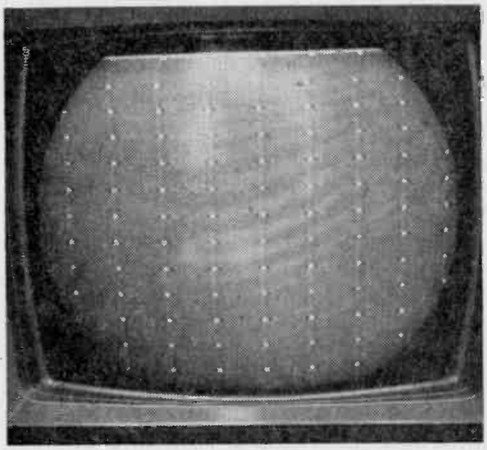


Fig. 12. Dot pattern is used during most color adjustments; is also used for conventional ones.

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

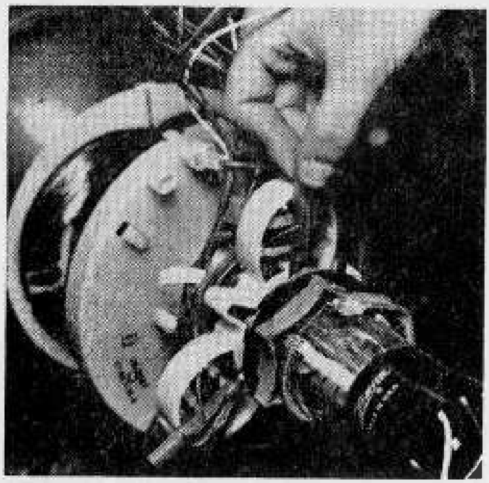


Fig. 13. Static convergence magnets are located in holders clamped around neck of tube.

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

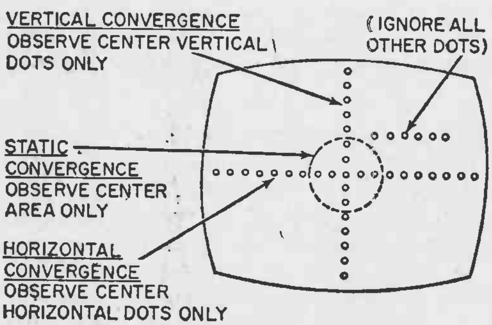


Fig. 14. In static convergence adjustments, observe only dot pattern in center area of screen.

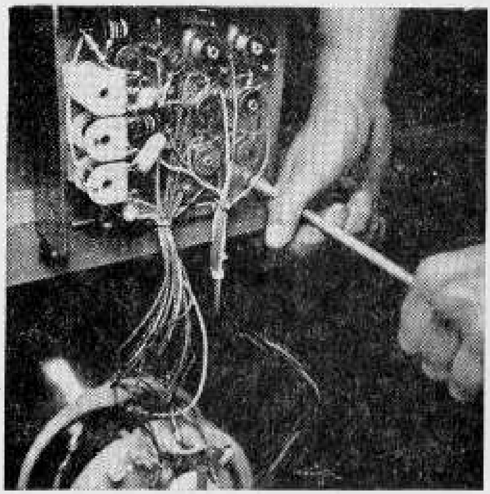


Fig. 15. For convenience, remove the dynamic convergence control board and secure where accessible for your tools and for visibility.

COLOR-TV ADJUSTMENTS

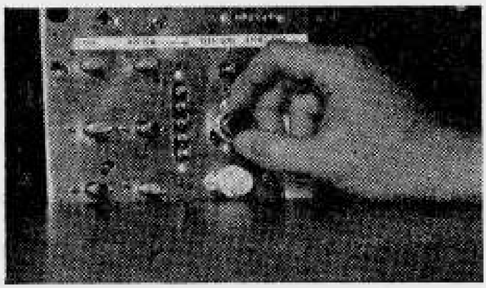


Fig. 16. When "board" is secured to top rear of set, it can be adjusted while viewing screen.

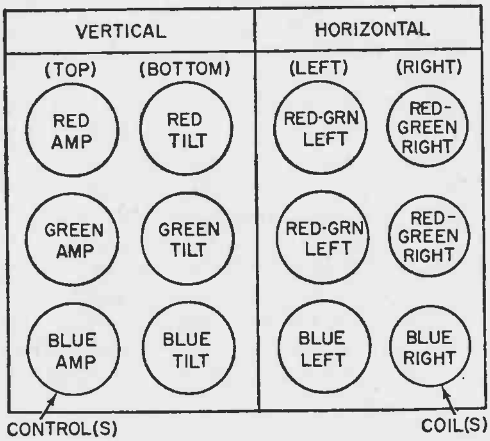


Fig. 17. The dynamic convergence board layout conveniently groups horizontal and vertical controls into logical position and color pattern.

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.

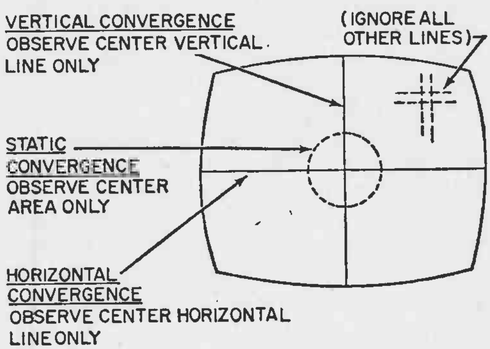
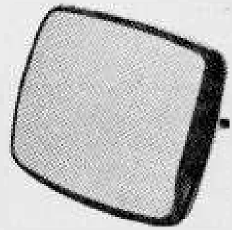
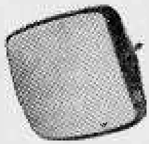


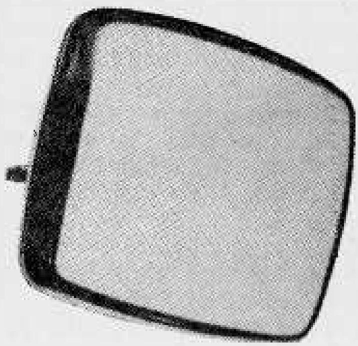
Fig. 18. Color generator can be set to give a crosshatch pattern for convergence adjustments rather than dot patterns discussed.

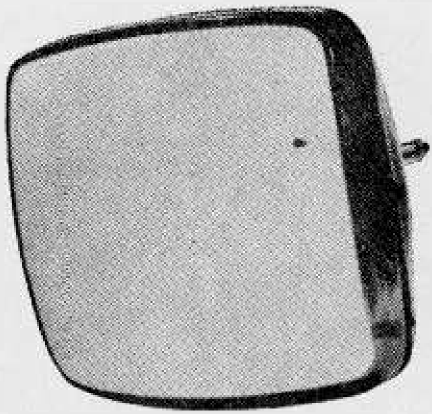
This completes the job. How well does a color TV stay in adjustment? There is no set period, but you can expect that, with normal conditions, convergence remains fixed for fairly long periods, say upwards of two years or more. Any jostling, magnetizing or moving the set especially affects color purity.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



So you want to replace a BOOB TUBE





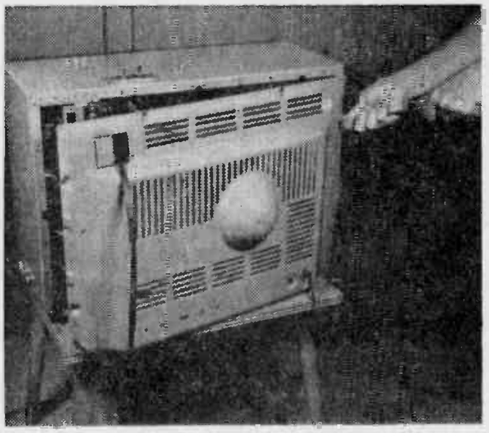


By Len Buckwalter, K1ODH

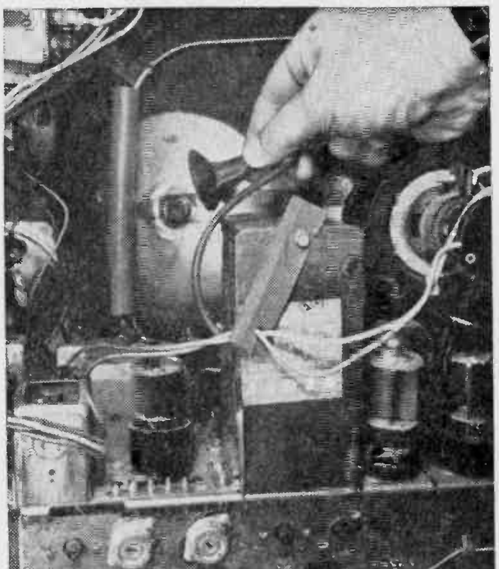
■ Can anyone change a picture tube? Not the yank-'n pull mechanic; he could fudge the job. The careful worker, however, can reap a double reward: a husky saving in cash and the satisfaction of restoring a good-as-new picture to an aging TV set. Significantly, success doesn't depend on an intimate knowledge of electronics. There are few mysteries surrounding the removal and reinstallation of the picture tube. The big factor is a healthy respect an installer must have for the tube. Fragile glass construction can't tolerate rough handling. So if you are willing to handle the TV picture tube with loving care—avoiding

RADIO TV REPAIR

REPLACE BOOB TUBE



Removing back cover of TV is first step in replacing picture tube. AC cord, interlocked to back cover (lower right), comes off with it.



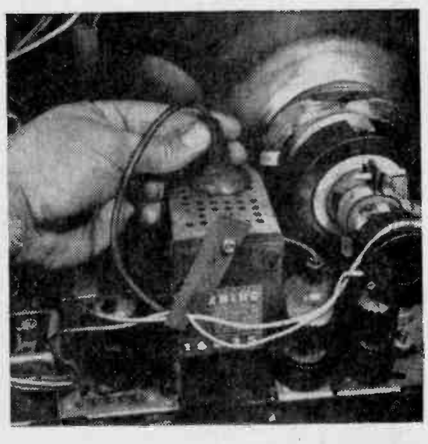
Carefully remove rubber anode cap plugged into the side of the picture tube by simply pulling or, if a clip type, by squeezing.

accidental strain, bumps or scratches—the job shouldn't prove too difficult.

Is the tube really at fault? This is a crucial first question. It's a crushing experience, as some have learned, to buy and install a picture tube—only to find the old trouble pop up on the new screen. Some faults give the exact same symptoms as a bad picture tube. So pinpoint the culprit.

Complete Loss of Brightness. The picture tube needs high voltage to produce brightness. Check for this voltage by finding the anode cap shown in the step-by-step photos. With power turned off, unplug the cap from the side of the tube (grasping only the rubber part). Now tape the cap so it sits about a quarter or half-inch away from its socket. Move away and turn on the power. If high voltage is present, you'll see and hear it; a blue spark should jump the gap and produce a sputtering, crackling sound. Some small chassis tubes which can kill high voltage are the horizontal oscillator, horizontal amplifier, high-voltage rectifier or damper. A blown high-voltage fuse is also a possibility. These items may be identified by the diagram pasted inside the set's cabinet or with the aid of a schematic. If these stages are causing high-voltage trouble, a new picture tube won't work.

Gradual Loss of Brightness. If this occurs over a long period, it's a good sign of a failing picture tube. You can milk additional months of service with a booster, but this is only a delaying action. Another possibility is the build-up of dirt on the screen (high voltage attracts dust like a magnet). In some sets, it can be cleaned from the front of the set if the manufacturer has provided a re-



Short circuit the anode cap against chassis several times to dissipate any charges that might be present.

movable safety glass. Otherwise, the tube must be removed to gain access to the screen surface. (If you have a late-model set with a bonded safety glass, usually stated in the advertising literature, dirt can't accumulate inside.) In any case, a good cleaning of the screen surface in older sets can yield a remarkable increase in brightness, especially if there's more than one year's accumulation.

The darkening screen, however, which inevitably occurs some two or more years after the set is purchased, spells decreasing emission from the tube's electron gun. A good clue to this condition is the length of time it takes for the set to warm up and produce a usable picture. Low-emission tubes take two or three times longer to heat than when the set was new.

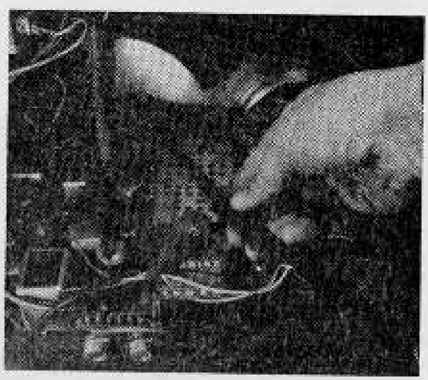
Other clues. Turning the brightness control has no effect; the picture stays bright. This is an excellent sign of a shorted grid in the picture tube. Such tubes deserve replacement, but there are two tricks for delaying the job. One is to purchase a special picture-tube booster which also can isolate the shorted grid. (It works only in some cases.) The other is a hit-or-miss method which might produce results, for a while anyway. Very gently tap the neck of the tube with the end of a pencil. This could dislodge the shorted element and unshort it.

Another valuable sign of a bad picture tube occurs when the picture goes negative; that is, blacks reverse to whites. This is caused by air seepage into the tube, molecule by molecule, over a long period of time. Such "gassy" tubes should be replaced. One misleading symptom is picture "blooming." As the brightness control is turned up to a normal position, the whole image expands like an inflated balloon. Image brightness dims as the picture grows in size. This is not caused by a bad picture tube. In nearly every case the reason is a bad high voltage rectifier, a small tube which is unable to keep high voltage up as electron-beam current rises to create more brightness.

Filament. Many people will tolerate a dimming image as the picture tube ages, but few will accept the condition which causes most outright failures. It is the burned-out filament. Investigating a dead filament should begin at the picture-tube neck. With the power on, a dull orange glow should be seen near the end of the neck, next to the socket. One exception may occur in the series-filament set, one without a power transformer. A burned-out filament in any of several small tubes could also cause the picture-tube filament to darken. Thus, dark or cold tubes in the series set must be checked individually before assuming that the trouble lies in the picture tube filament.

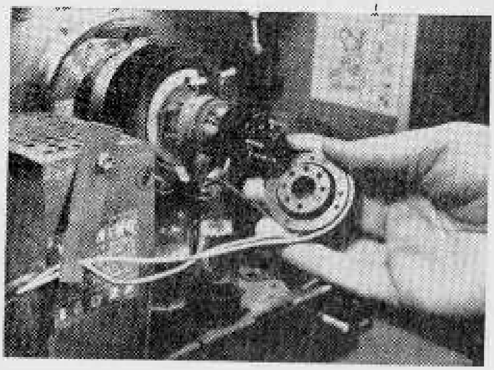
Occasionally, a picture-tube filament grows dark due to a mechanical fault in the socket, usually a loss of tension in the spring clips which grasp the tube pins. This may be detected by applying gently pressure to the socket, in all directions, and observing if the tube filament lights during any of these movements. If so, a new socket can be wired into place.

The professional installer usually makes a direct measurement of the filament to verify failure. One method is with an ohmmeter touched to the picture tube pins (after the socket is removed). An unbroken filament reads a few ohms resistance. Most tubes



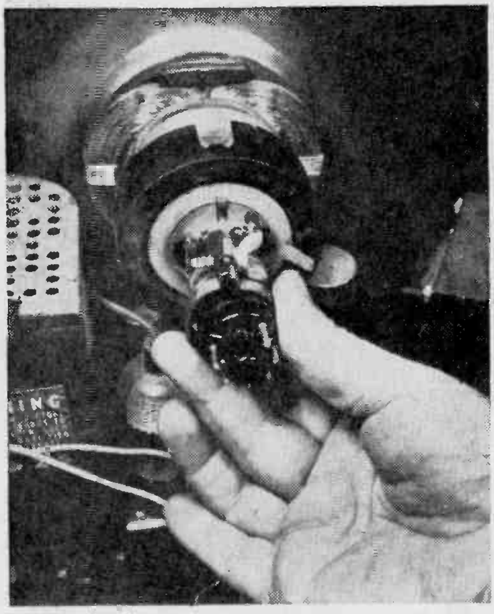
Short circuit voltage stored in picture tube by touching insulated screwdriver to anode and chassis a few times.

Now remove the picture tube socket from the tube pins at the base of the neck. A slight rocking action will probably be necessary.

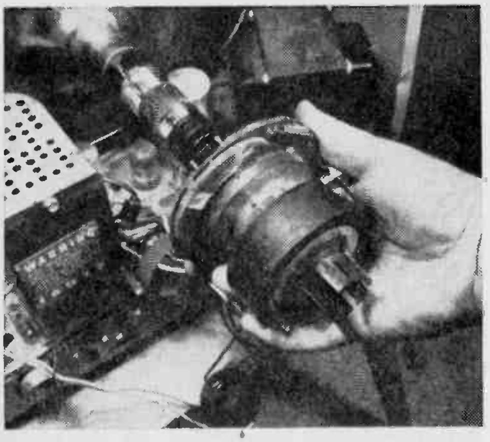


RADIO TV REPAIR

REPLACE BOOB TUBE



First loosen wing nut, then slide off yoke clamp. (In many sets this will be ion-trap magnet held by a spring around tube neck.)

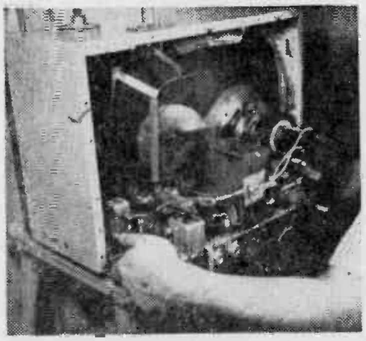


Slide off yoke and centering magnet assembly (usually in one piece). If a yoke clamp isn't used, loosen the wing nut on top of the yoke.

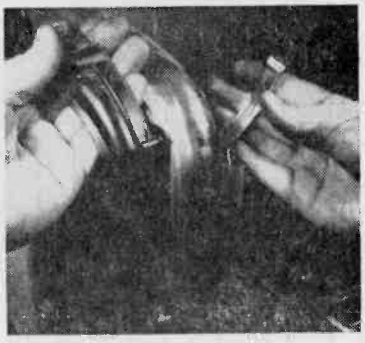
use one of the following filament-pin combinations: 1-8; 1-12; 3-4; or 4-5.

After you've determined that the picture tube is bad, the next consideration is the type of replacement to purchase. Unless you have a private pipeline to one of the big producers, you cannot get a *new* TV picture tube. All TV replacement tubes are rebuilt. This may imply a compromise in quality. Not so in most cases. Only the glass envelope is reused in the rebuilt tube; screen and electron gun are new. Yet, there is still a range in price. If a budget-priced rebuilt is purchased, it could run nearly half the cost of a rebuilt from a big-name producer—GE, RCA, etc. In this writer's experience, the budget-price rebuilts are economically attractive, but in numerous cases have failed to maintain proper emission (and therefore brightness) much beyond the 1-year guarantee period. It could be due to poor quality control by some small rebuilding houses. The choice is left to the buyer. Whatever the purchase, a replacement containing an aluminized screen, if available in your number, is highly recommended. The difference in tube performance is considerable; light is not wasted in the rear end of the tube, but reflected back to the viewer's eye.

Removal. The precautions shown for discharging high voltage retained by the tube

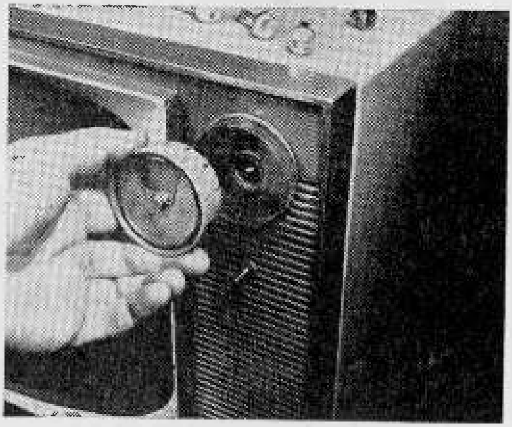


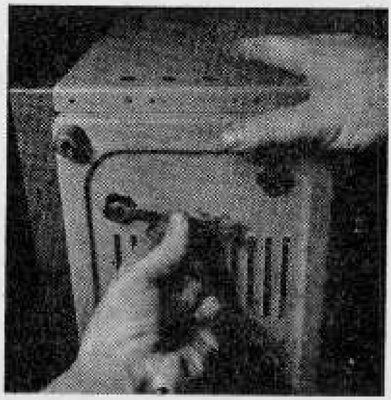
In this set, tube and chassis are removed together. When this is the case, make sure the tube face isn't held by cabinet.



Remove mounting hardware from all around the front rim of the tube. Be sure to retain all clamps, screws.

If it's necessary to remove chassis from cabinet (see text), remove all of the control knobs from the set first.

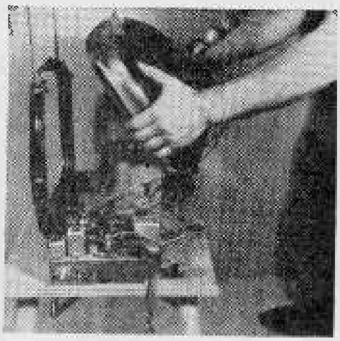




Chassis is usually secured to cabinet (shown here tilted) with bolts. Keep cabinet level when loosening.

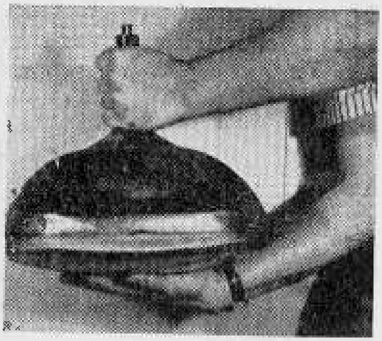
are mainly intended for protecting against breakage. The charge is not electrically dangerous. Rather, it may cause a person to jump back or jerk his arm while holding the tube, and thereby dropping it. Be sure to discharge the tube repeatedly for about a minute to get rid of the last tickle. Never hold the tube by its neck alone. It's the weakest part. Neck-holding may be done for balancing, but not for support of the tube weight. To further increase the safety factor, it's recommended that the installer wear a pair of safety goggles and apron, or other substantial piece of clothing. A fractured tube can implode and fling dangerous glass splinters.

Since the step-by-step photos show the general technique for removing the picture tube, let's consider variations from one set to the next. The first major consideration is observing how the tube is mounted, for this determines whether the chassis has to be removed from the cabinet. There are two principal systems: in the first, the tube is mounted directly to the front panel of the cabinet, true for many large, or 21-inch, sets; and, the second, where the tube is fastened directly to the chassis. (The model in the photos is of the latter type.) The system can usually be discovered by close observation of the tube. Frequently, a large tube will be seen fastened to a bracket around its forward rim. After items on the tube neck are removed (such as the deflection yoke) unbolting the forward tube support frequently permits the tube to be withdrawn while the chassis remains in place. That is, if the chassis presents no obstructions. Small tubes blocking the way may be temporarily removed, but if a transformer presents an obstacle, the chassis will at least have to be pulled out part way. In the chassis-mounted tube, both chassis and



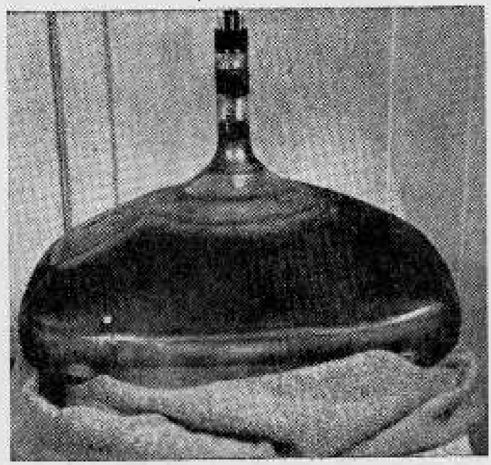
The picture tube must be withdrawn very carefully to avoid disturbing the other components on receiver's chassis.

Carry picture tube by supporting all its weight with your hand under screen; grasp neck only for balance.

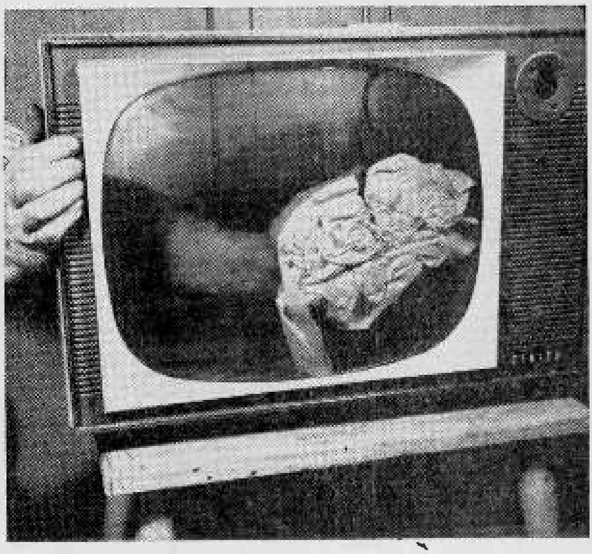


RADIO TV REPAIR

REPLACE BOOB TUBE



Avoid scratching face of old tube by placing on soft surface. Scratches increase danger of implosion and could affect trade-in value.



While picture tube is out of cabinet, take advantage and give safety glass a thorough cleaning with water and a drop of detergent.

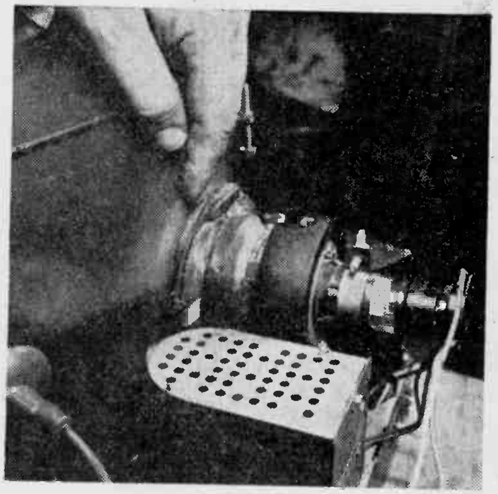
tube emerge from the cabinet as one piece. Generally, this type requires the removal of screws which fasten the top rim of the tube to the front cabinet panel.

Some Differences. The sequence of removing components from around the tube neck is subject to some variation. If the chassis does not have to be removed, neck components must be dismounted before the tube is taken from the cabinet. In the tube-on-chassis type, it is simpler to slide off the neck parts after the chassis is out of the cabinet. The neck components vary considerably in different sets, but this should present little problem as long as they are replaced according to the original layout. The first part to be removed is the tube socket. In many older sets it will not easily pull off. Gently insert a screwdriver at several points around the socket rim and pry it away gradually. In some sets, the next item is the ion trap. It is a small, square magnet clipped around the tube neck and held by a spring. (The set in the photos uses no ion trap.) Since the trap presents the most critical adjustment after installing a new tube, it's advisable to carefully note its position on the neck of the tube. This, at least, will provide an approximate starting point later on. (Some ion traps have a small arrow, which indicates the front of the set.)

Next on the tube neck is a focus coil or centering magnet assembly. It is unfastened and slid off. Finally, there is the deflection yoke which fits snugly against the flare, or bell-shape, portion of the tube. The usual fastening for this component is a wing nut, which is loosened. (Through age, the yoke may stick. Very gently work it loose.)

Installation. The new tube is inserted and mounted in the reverse order. Again, gentle handling is important. Just before the tube is strapped and bolted into its mounting, check the position of the anode socket. It should be on the correct side of the chassis to receive the anode cap. Also, check if the tube sits squarely in the mount; not slightly askew. One guide can be the marks indented by the old tube into the rubber or other soft material which retains the front rim of the tube.

The neck components are installed as closely as possible in their original locations. These positions, however will rarely be absolutely accurate, so don't give them a final tightening at this time. After you've checked everything for completeness, don't turn on the set. The following step applies if the tube uses an ion trap. Turn the brightness control about half-way up. Place a mirror in front of the set (if necessary) so the screen can be viewed while you're at the rear of the

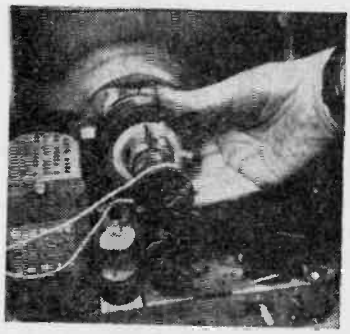


When replacing yoke on a new tube, make sure it seats against flare of tube, or picture won't fill screen.

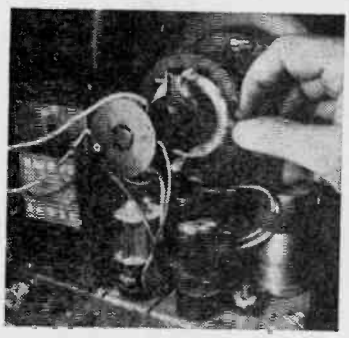
Before replacing the back cover, check the picture for alignment on the screen. If it isn't horizontal as here, the yoke must be rotated on the tube neck.

set with one hand on the ion trap. Now have someone turn on the power. Quickly rotate the trap about the neck, and move it back and forth, until brightness appears on the screen. If two positions provide light, use the brighter of the two. This position should be found within a minute to prevent heavy ions in the electron gun from bombarding the screen and causing possible damage. Now, move the trap slightly to find the point of maximum brightness. (If you're a photo fan, you can use this trick: an exposure meter placed in front of the screen makes the job easier; watch pin for highest indication.)

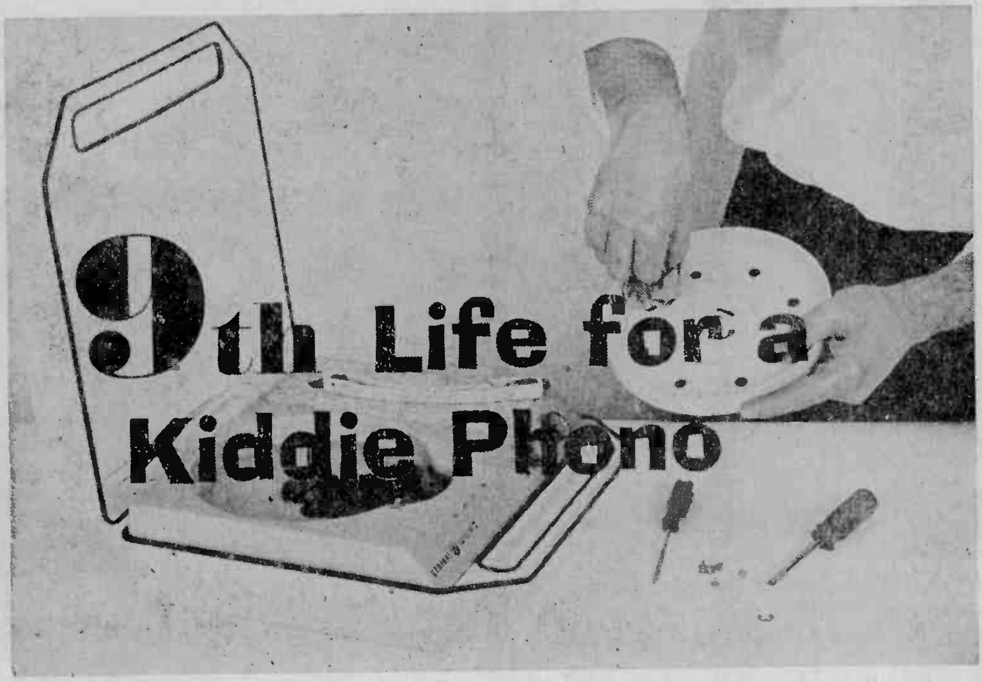
Back in Focus. Now get a picture on the screen. Are its fine horizontal lines slanting? If so, small rotation of the deflection yoke permits correction. Just be sure that the yoke remains snugly against the bell of the picture tube or the image may not fully fill the screen. When grasping the yoke, hold only its insulated portion. It may be difficult, while adjusting the yoke, to check the picture for its true horizontal position (unless words, for example, appear on the screen). A convenient method is to adjust the set's vertical hold control so a thick black bar appears on the middle of the screen. This serves a good horizontal reference. Corner shadows or incorrect picture position are corrected by moving the tabs on the centering assembly. Finally, touch up ion trap again; other adjustments may have thrown it off slightly. ■



When rotating the yoke around the tube neck, grasp only the insulated cover of the yoke.



To center picture on screen adjust the two metal tabs on the centering of magnet assembly.



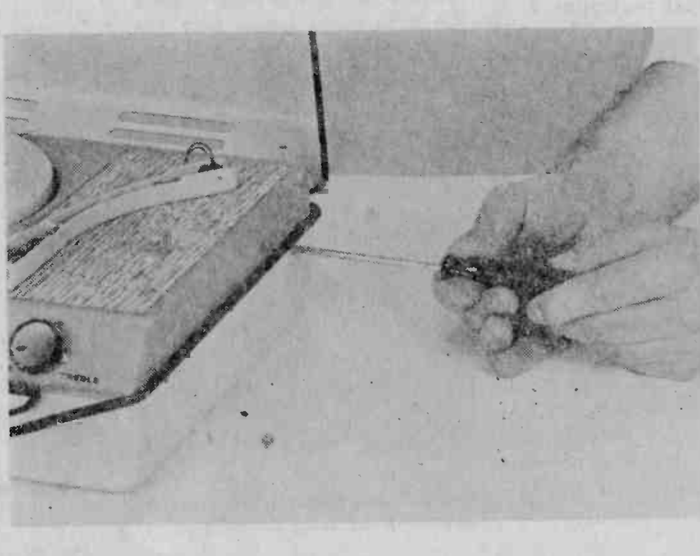
9th Life for a Kiddie Phono

■ **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 are due for 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-

(Continued on page 98)



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.

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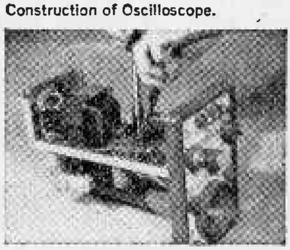
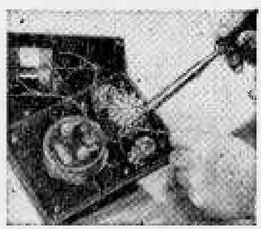
Transistor experiments on programmed breadboard – using oscilloscope.



Construction of Oscilloscope.



Construction of Multimeter.

FOREIGN TUBE REPLACEMENT GUIDE

Anyone who's gone past the tuning knob of a foreign-built shortwave receiver has discovered an unexpected twist or three—unorthodox-looking capacitors, metal-film resistors, possibly some outstanding point-to-point wiring. Another distinguishing feature of foreign electronic gear is tube designations, which often bear no resemblance whatever to those current in American circles. The following listing equates foreign tube types with their closest American equivalent. Though slight differences exist in some cases, in general any tube of a pair is directly interchangeable with its mate.

1C1	1R5
1F3	1T4
1FD9	1S5
1P10	3S4
1P11	3V4
5B250A	807
6BK8	6267
6C16	6BL8
6D2	6AL5
6F22	6267
6F29	6EH7
6F30	6EJ7
6FD12	6DC8
6G5G	6U5G
6H5	6U5G
6L12	6AQ8
6L13	12AX7
6M1	6U5G
6P15	6BQ5
6PL12	6BM8
12DT7	12AX7
13D2	6SN7GT
30C1	9A8
30P18	15CW5
30PL12	16A8
63ME	6U5G
150C2	0A2
150C3	0D3
B36	12SN7GTA
B65	6SN7GTB
B152	12AT7
B309	12AT7
B329	12AU7A
B339	12AX7A
B719	6AQ8
BPM04	6AQ5A
CV124	807
CV133	6C4
CV140	6AL5
CV283	6AL5
CV452	6AT6
CV453	6BE6
CV454	6BA6
CV455	12AT7
CV491	12AU7A
CV492	12AX7A
CV493	6X4
CV504	6U5
CV509	6V6GTA
CV511	6V6GTA
CV522	7B7
CV525	12A6
CV543	12SK7
CV544	12SK7GT
CV546	12SQ7
CV547	12SQ7GT
CV553	25L6GT
CV562	35L6GT
CV564	35Z3
CV571	50L6GT
CV572	6X5GT
CV574	6X5GT
CV575	5U4G
CV578	6A8
CV580	6A8
CV581	6C5
CV585	6C6
CV587	6Q7G
CV589	6Q7
CV591	6SJ7
CV614	75
CV617	80
CV686	0C3
CV692	0Z4
CV697	12SJ7
CV717	5R4GYB
CV728	5V4GA
CV753	1A3
CV755	1A5GT
CV756	1A5GT
CV782	1R5
CV783	1S4
CV784	1S5
CV785	1T4
CV797	2D21
CV818	3Q4
CV819	3Q5GT
CV820	3S4
CV850	6AK5
CV858	6J6A
CV877	7A7
CV885	7C5
CV887	7C6
CV901	7Y4
CV918	12K7GT
CV924	12SL7GT
CV925	12SN7GTA
CV1186	6F6G
CV1287	25L6GT
CV1347	6K8
CV1377	5AR4
CV1633	3V4
CV1741	6CA7
CV1800	1A7GT
CV1802	1A7GT
CV1818	1H5GT
CV1820	1H5GT
CV1823	1N5GT
CV1831	2A3
CV1832	0A2
CV1833	0B2
CV1856	5Y3GT
CV1862	6AQ5A
CV1863	5Z4
CV1870	6A7
CV1893	6B8
CV1900	6D6
CV1906	6E5
CV1911	6F6G
CV1928	12BA6
CV1929	6H6
CV1931	6H6
CV1932	6J5GT
CV1934	6J5GT
CV1935	6J7
CV1937	6J7
CV1938	6K6GT
CV1941	6K7
CV1943	6K7
CV1944	6K8
CV1946	6K8
CV1947	6L6GC
CV1950	6L7
CV1956	6N7GT
CV1958	6N7GT
CV1959	50C5
CV1961	12AU6
CV1969	6SC7
CV1970	6SC7
CV1978	6SG7
CV1981	6SK7
CV1985	6SL7GT
CV1988	6SN7GTB
CV1990	6SQ7
CV2129	5763
CV2500	35Z4GT
CV2514	43
CV2524	6AU6A
CV2526	6AV6
CV2747	6U5
CV2901	6267
CV2975	6BQ5
CV2984	6080
CV3523	6146A
CV3908	6BH6
CV3909	6BJ6
CV3912	1U5
CV3998	6688
CV4007	5726
CV4009	5749
CV4012	5750
CV5041	6CL6
CV5042	12BH7A
CV5072	6CA4
CV5073	6AM4
CV5074	6AF4A
CV5215	6BL8
CV5307	807
CV5331	6ES8
CV5358	6DJ8
CV5365	6BQ7A
CV5434	6FG6
CV5810	6EJ7
CV5831	6EH7
D63	6H6
D77	6AL5
D152	6AL5
DAC32	1H5GT
DAF91	1S5
DD6	6AL5
DF33	1N5GT
DF91	1T4
DH63	6Q7
DH77	6AT6
DH118	14L7
DH149	7C6
DK32	1A7GT
DK91	1R5
DL33	3Q5GT
DL91	1S4
DL92	3S4
DL94	3V4
DL95	3Q4
DM70	1M3
DP61	6AK5
DY86	1S2
DY87	1S2A
E2157	12AT7
E2163	12AU7A
E2164	12AX7A
EB34	6H6
EB91	6AL5
EBC90	6AT6
EBC91	6AV6
EBF89	6DC8
EC90	6C4
EC97	6FY5
ECC32	6SN7GTB
ECC81	12AT7
ECC82	12AU7A
ECC83	12AX7A
ECC85	6AQ8
ECC88	6DJ8
ECC91	6J6A
ECC189	6ES8
ECC230	6080
ECF80	6BL8
ECF82	6U8A
ECF86	6HG8
ECH35	6K8
ECL82	6BM8
ECL85	6GV8
ECL86	6GW8
EF86	6267
EF93	6BA6
EF94	6AU6A
EF95	6AK5
EF183	6EH7
EF184	6EJ7
EH90	6CS6
EK90	6BE6
EL34	6CA7
EL84	6BQ5
EL90	6AQ5A
EM84	6FG6
EN91	2D21
EZ35	6X5GT
EZ80	6V4
EZ81	6CA4
EZ90	6X4
GZ30	5Z4
GZ31	5U4G
GZ34	5AR4
HBC90	12AT6
HBC91	12AV6
HD14	1H5GT
HF93	12BA6
HF94	12AU6
HK90	12BE6
HL92	50C5
HM04	6BE6
HY90	35W4
KT32	25L6GT
KT63	6F6G
KT66	6L6GC
KT71	50L6GT
KTW63	6K7
KTW74M	12K7GT
KTZ63	6K7
L63	6J5GT
L77	6C4
LZ319	9A8
LZ329	9A8
M8212	5726
N16	3Q5GT
N17	3S4
N18	3Q4
N19	3V4
N148	7C5
N379	15CW5
N709	6BQ5
N727	6AQ5A
OM10	6K8
PCF80	9A8
PCF82	9U8A
PCF801	8GJ7
PCL82	16A8
PCL84	15DQ8
PL84	15CW5
PL500	27GB5
PM04	6BA6
PM05	6AK5
QV03-12	5763
QV05-25	807
QV06-20	6146
R52	5Z4
STV150/30	0A2
U50	5Y3GT
U52	5U4G
U70	6X5GT
U74	35Z4GT
U76	35Z4GT
U78	6X4
U147	6X5GT
U709	6CA4
UU12	6CA4
VFT6	6U5
W17	1T4
W63	6K7
W76	12K7GT
W727	6BA6
X14	1A7GT
X17	1R5
X61M	6K8
X63	6A8
X65	6K8
X77	6BE6
X147	6K8
X727	6BE6
Y61	6U5
Y63	6U5
Z14	1N5GT
Z63	6J7
Z729	6267
ZD17	1S5

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, non-technical, 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 scatter-gun 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 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

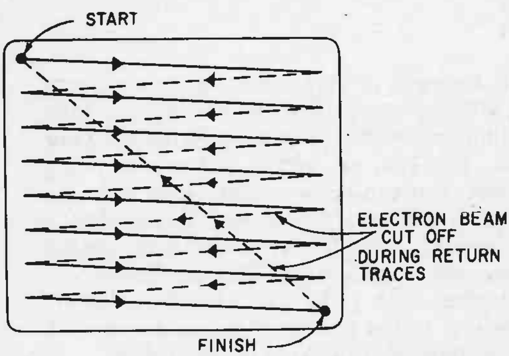


Fig. 1. Simplified diagram of TV raster does not show complicated interlacing.

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,*

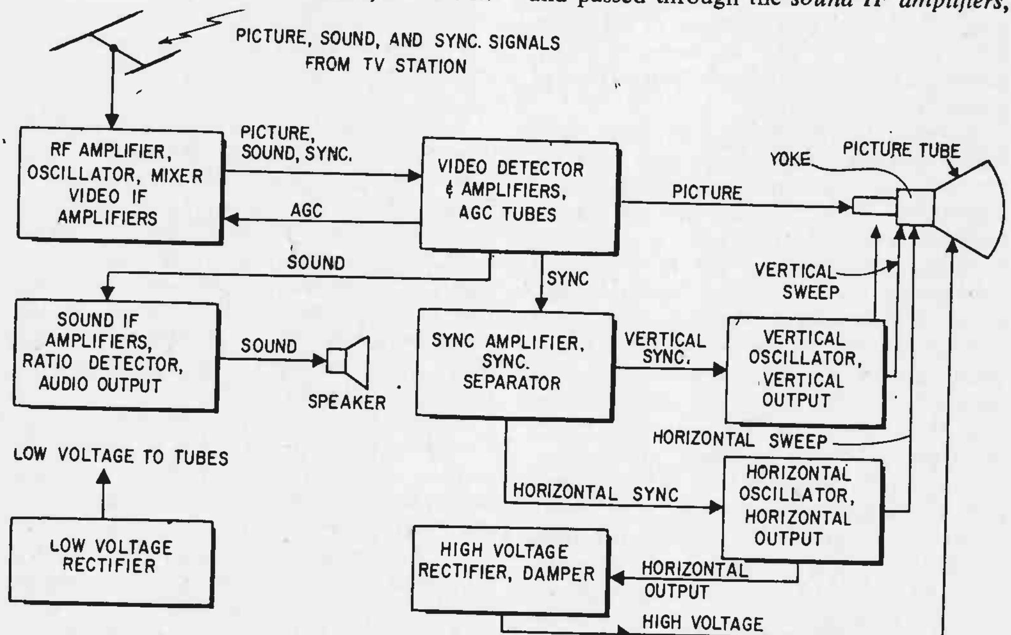


Fig. 2. Block diagram of TV circuitry is just about the same for all black & white TV sets.

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 happens 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.

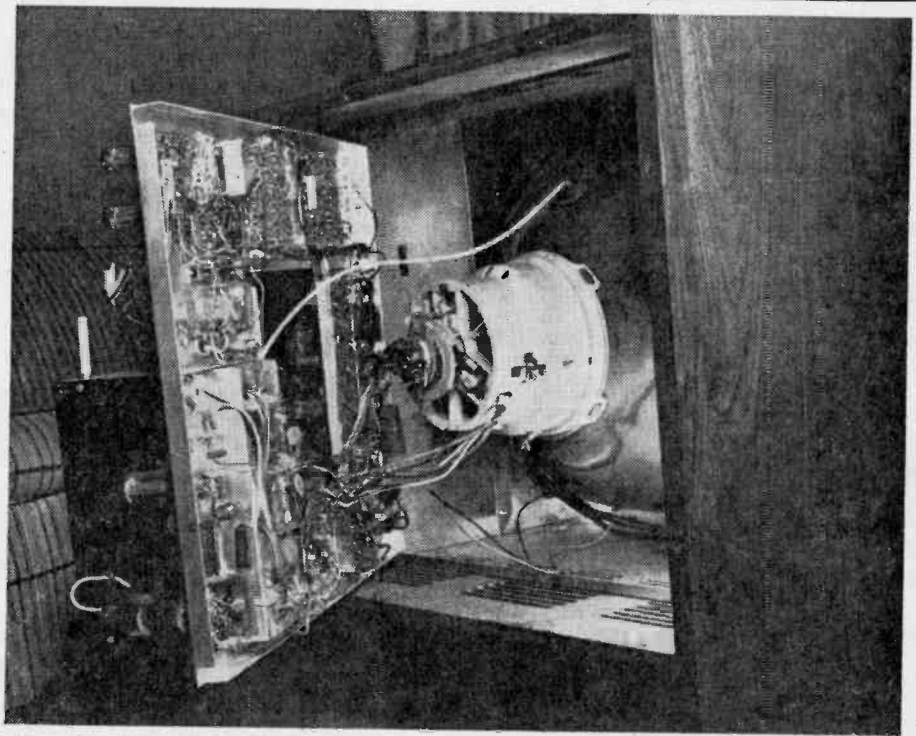
4. When you replace a tube, be sure that the new one is the correct type number as marked on the tube location diagram. Don't switch tubes around just because they look alike, unless they have the same number.

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! ■

HOW TO CHANGE



A COLOR TV TUBE

By HOMER L. DAVIDSON

■ When your color picture tube becomes dim and one or two colors are real weak, you can replace that color tube yourself. Follow the photos and text in this article and you can save yourself some dough. This article shows how to replace the round and rectangular color picture tubes. The sizes are 21-inch round, 25-, 23-, and the 19-inch rectangular color CRT's.

The initial preparation consists of taking the TV chassis from the cabinet. First, remove all knobs and the rear cabinet cover from the TV receiver (Fig. 1). Discharge the high-voltage charge of the tube with a long, insulated-handle screwdriver—from anode connection to the TV chassis. Be real careful, and do a good job of grounding out the high-voltage cable. In older TV receivers, the high-voltage cable must be unfastened from the metal box before you open the lid of the box. This lead will pull out of a pin socket. In newer TV sets, the high-voltage lead unplugs from the glass picture tube. Unbolt the TV chassis and unplug all wires going to the TV chassis.

This includes the picture tube cap or socket, yoke leads, and speaker leads. All the colored wires going to the deflection yoke are marked on the yoke where they are plugged in. There is little danger of getting them wrong when replacing them. Unhook the blue grounding lead from the blue lateral magnet. Unplug the convergence yoke cable from the TV chassis and also loosen the antenna terminal assembly.

Before pulling out the chassis, be sure

RADIO TV REPAIR

CHANGE COLOR TUBE

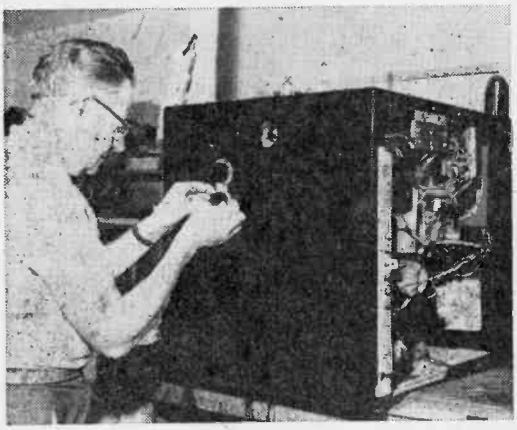
all cables and wires are disconnected. On the older models, pull out the chassis three or four inches and loosen the ¼-inch metal screw, holding down the small-controls assembly. Slide the assembly back and pull up. Now the chassis is free (Fig. 2).

The Tube Comes Out. The cabinet should be turned over on its face before removing the color tube. Be sure to lay a blanket or thick padding upon the floor to keep the cabinet in ship shape. Have a friend (Fig. 3), or the wife, help place the TV cabinet front down upon the padding.

In the older color sets the dynamic convergence magnet assembly (Fig. 4) slides separately off the neck of the tube. In the rectangular 25-inch sets the yoke assembly also contains the convergence coils and fits tightly against the color tube.

Four nuts hold the picture tube in place—two at the top and two at the bottom. A metal flange surrounds most tubes, near the face of the tube. In the newer color sets, the automatic degaussing coils (ADG) are fastened to this framework. In the 25-inch sets the metal flange must be removed before you can get to the nuts holding the color tube in place.

Now remove the components from the neck of the color picture tube. In case you are not familiar with the location of these components, measure their position (Fig. 5) on the neck of the color picture tube. This procedure is quite helpful when replacing



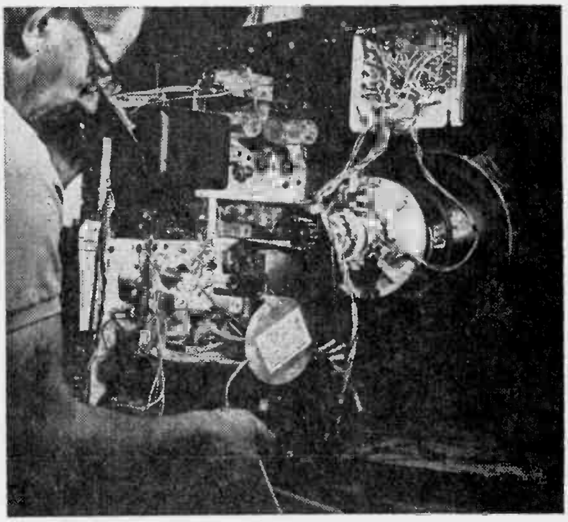
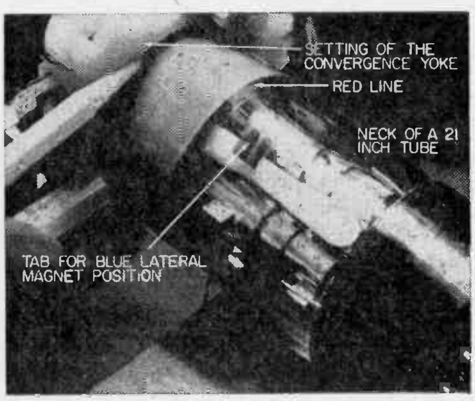


Fig. 1. (top, left) Removing the control knobs.

Fig. 3. (below) Place cabinet face down on folded blanket to protect pic tube and finish.

Fig. 4. (right) Point of pencil indicates the setting of convergence yoke and red band.

Fig. 2. (above) Don't be afraid to make notes about various connections as you disconnect chassis from CRT and yoke. It can save you a little hunting later.



these components to the neck of the new color tube. *As a safety precaution, wear safety glasses* when working close to the picture tube. Do not put pressure on neck of CRT or let tube rest on neck.

Clear the Neck. Place the kinescope face down on a drop cloth or newspaper to protect the face from scratches. Now remove the components from the neck of the tube. When you remove the blue lateral magnet, you will notice that it sets over a tab or clip inside the tube neck (Fig. 6).

In the older sets, the purity ring sets over the red ring marked inside the tube. Note that the blue wires from the convergence assembly (Fig. 7) go to the top of the picture tube over the blue gun, the red wires at the left side, and the green wires on the right going to the green dynamic convergence coils.

The large deflection yoke is loosened with a ¼-inch nutdriver (Fig. 8) and can be lifted off the neck of the tube. It is very heavy; do not drop it! Be especially careful not to rap the CRT with a tool or heavy object. *The CRT must be handled with care since it can implode and cause serious damage to you and the set.*

The masking must be removed from the front edge of the CRT, as in Fig. 9. On the rectangular tubes, a strap with corner flanges must be removed by loosening a side-bracket bolt. Remove the bracket (i.e., masking) assembly from the old CRT and place it upon the new tube.

Be sure the CRT is laying in the same position as mounted in the TV cabinet. Now place the strap in place on the new CRT and tighten up the bracket assembly. Be sure the high-voltage (anode) button is at

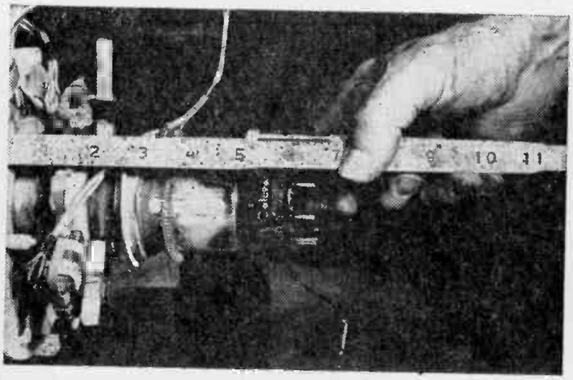


Fig. 5. (top) Be sure to mark down measurements so you can replace the yoke assembly.

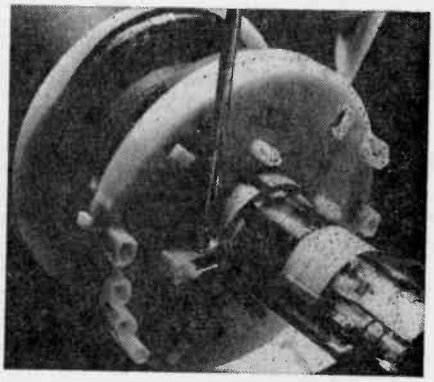


Fig. 8. (above) After yoke assembly has been loosened with nutdriver it can be removed. Assembly is quite heavy—don't drop it.

Fig. 6. (below) Here author is pointing to blue lateral magnet and the tab inside the neck of the CRT. Tab is not obscured by blue lateral magnet in Fig. 4. By first replacing the components according to the measurements most adjustments are minor.

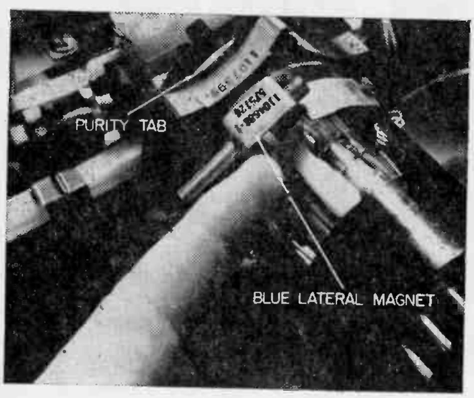
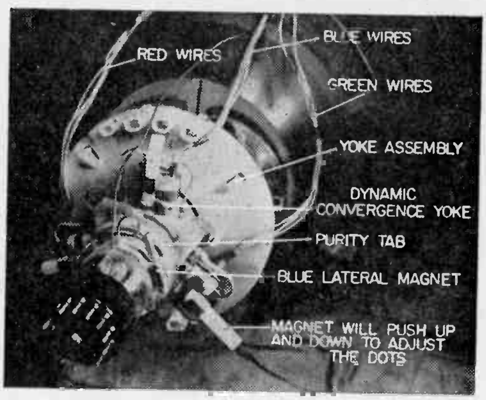


Fig. 7. (below) All components of the yoke assembly are indicated. Once you can tell the difference between a dynamic convergence yoke and a purity magnet you have an easier job of following these instructions.



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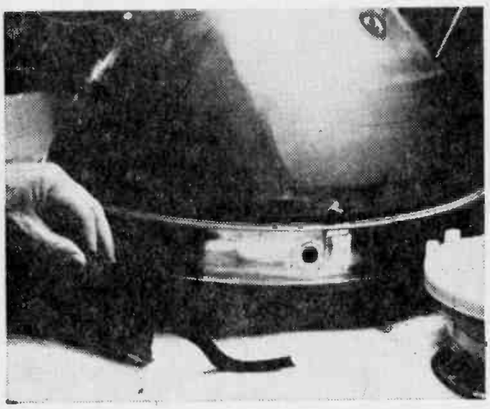
the top of the set on a 25-inch picture tube (Fig. 10). The 23-inch and 21-inch round-CRT anode connections (Fig. 11) are on the side of the tube.

Reassembly. Place all components back on the neck of the CRT. Use the previously taken measurement for their approximate position. In the older sets the yoke must be mounted so it will slide back and forward for purity checks. The 25-inch yoke assembly fits snugly against the bell of the tube. This yoke slides back and forward inside of the large yoke assembly. Two small screws are loosened on each side of the plastic yoke assembly.

Tubes that are not bonded have a safety glass—be sure the glass is clean. Wash it with soap and then rinse with clear water. Make sure there is no lint or dirt on the face of the new CRT (Fig. 12). Seat the tube in its place in the cabinet and bolt it to the front brackets. Replace the metal shield and degaussing-coil assembly, if the set has one.

Now set the cabinet upright and fasten the convergence board in place (Fig. 13). Install the TV chassis and connect all cables. Make certain that all parts are replaced and tightened. Banging against metal parts will sometimes induce magnetism into these parts and a second job of degaussing may be required. Be sure that all cables are connected and in place. Turn on the color receiver and leave it on for 15 to 20 minutes before purity or convergence checks are made.



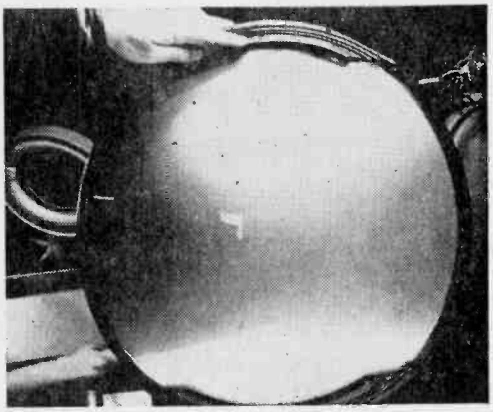
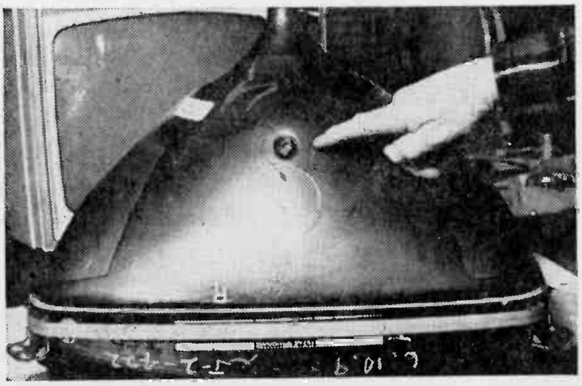


Fig. 9. (top, left) Make careful note of how the front protective mask is removed from CRT to make replacement much easier. Plastic mask on 21-inch CRT must be placed evenly (top, right) before taping in place.



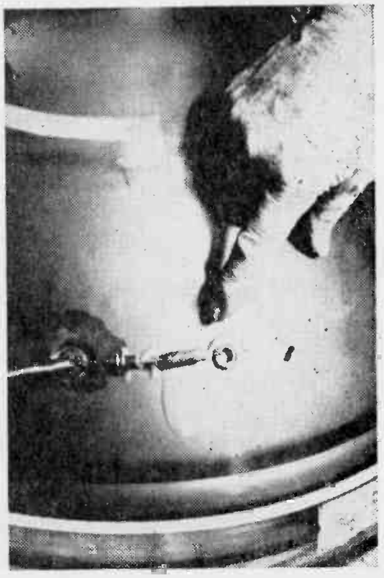


Fig. 10. High-voltage connector is at top of 25-inch CRT's—on side of 19- and 23-inch CRT's. Make sure! Fig. 11. Resistor, with spring, bridges anode buttons.

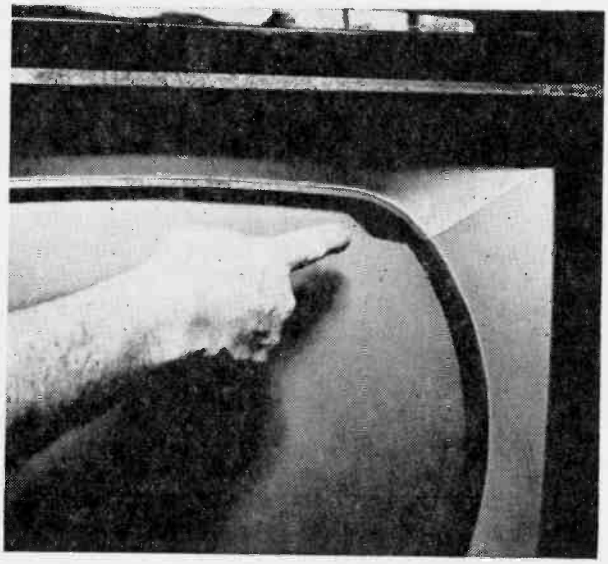
Basic Adjustments. Color-TV convergence can take time and may require skill. You may want to degauss and converge the color TV yourself, if correct equipment is available. If not, get help from a good reliable color-TV serviceman and pay him to finish the job.

If you want to do it yourself; here goes: Position a degaussing coil near the picture tube (Fig. 14) to completely neutralize any induced magnetism. This step will help insure proper purity and convergence when the picture tube is converged. Hook up the Dot-Bar color generator and let it warm up as the color-TV set warms up. When replacing the CRT, even sets with built-in degaussing coils should be degaussed just as if one was not built into the TV cabinet.

Take a quick look at the TV screen and if there are any color shaded areas the set should be put through a purity check up.

To start the purity adjustment (Fig. 15), turn off the set and unplug the IF cable going to the tuner. Plug the AC-interlock cord back in, let the receiver warm up, and short out the green and blue grids through a 100K resistor. (There are commercial kinescope grid-shorting switch boxes on the market for just this purpose.) At the moment the screen should be red. Adjust the center purity ring for a center red coloring. Then push the yoke back and forth and adjust the purity ring until the entire screen has an even red tint. The red-, blue-, and green-grid connections are generally on the top of the chassis. These three colored wires go to the picture-tube socket.

If the purity adjustments are done correctly, the green and blue shading will fall in line. It is always best to check each one



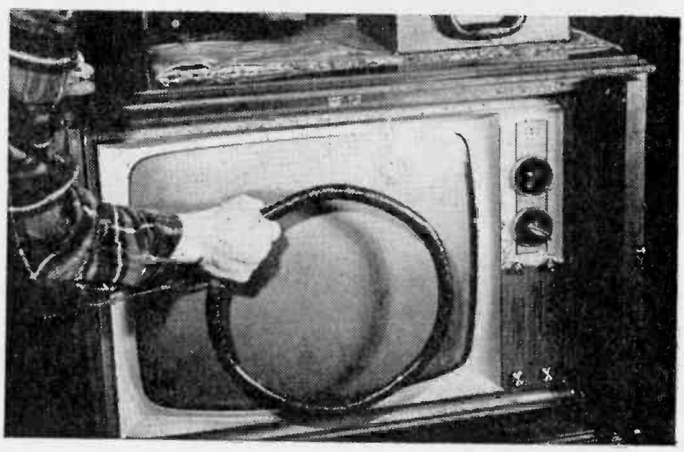


Fig. 12. (top, left) When replacing CRT's that are not bonded, safety glass must be cleaned of fingerprints and lint. Double check mask to make sure it is aligned properly in set.

Fig. 13. (top, right) When convergence board has been reinstalled and all nuts and machine screws have been tightened the chassis can be returned to the cabinet and secured too.

Fig. 14. (right) Degauss the CRT even if there is a built-in degaussing coil.

separately by shorting the other two grids to ground through a 100K resistor. If a little shading persists, try degaussing the CRT again and start over with the red adjustment procedure again.

At this time, check the level of the picture and see if the picture is in focus. Sometimes it is difficult to do a good job of convergence with the set out of focus. When you reset the focus control, convergence dots are way off.

Getting a Picture. Convergence is relatively easy on the new color receivers. The older models require patience and plenty of time. Connect the Dot-Bar generator to the antenna terminals. Remove the convergence board from the back of the set and place it on the slots at the top and back of the set. Tighten the two metal screws so the board is solidly in place. Watch the wires that connect the board to the yoke assembly so that they do not get tangled.

If the receiver was in convergence when the color CRT went bad, the dynamic convergence controls will generally need only a touch up. Set the generator to get *dots* on the CRT screen and check the dots down through the center of the screen. Short out the blue gun with the 100K resistor. Bring the red and green dots together on a center dot. Slide the red and green magnets in on top of one another. Readjust the setting, if needed.

If they won't quite come together, remove and rotate the red magnet a half turn and reinsert it, and adjust again. Now, once the red and green dots are centered, short the green grid and line up the red and blue dots. (The blue-beam magnet moves the blue dot up and down. The blue lateral-beam moves the blue dot horizontally. Place them on top of one another). Go back and check the red and green guns once again. Check that all three dots are together. You should now have a white dot. The amplitude and tilt controls should not be adjusted unless the dots fail to converge.

Now, step back and take a look at the screen from a distance. Tune in a black-and-white program from a local station and check for color fringing. Generally, the convergence board does not need to be adjusted unless tampered with.

If the dots do not converge at the ends, top, and bottom, the vertical and horizontal adjustments must be made. Use the manufacturer's convergence and adjustment information and follow their alignment procedure. It is best to go over color convergence several times and then get away from the dots. Go back in a few minutes and recheck.

Follow the factory adjustment for black-and-white setup. The newer TV color receivers have a *service-normal* switch mounted at the rear of the chassis. When this control is thrown to the *service* position the raster collapses into a thin white line. You adjust the three screen controls until the vertical line is perfectly white. Now flip the switch to *normal* and the picture is black and white. ■

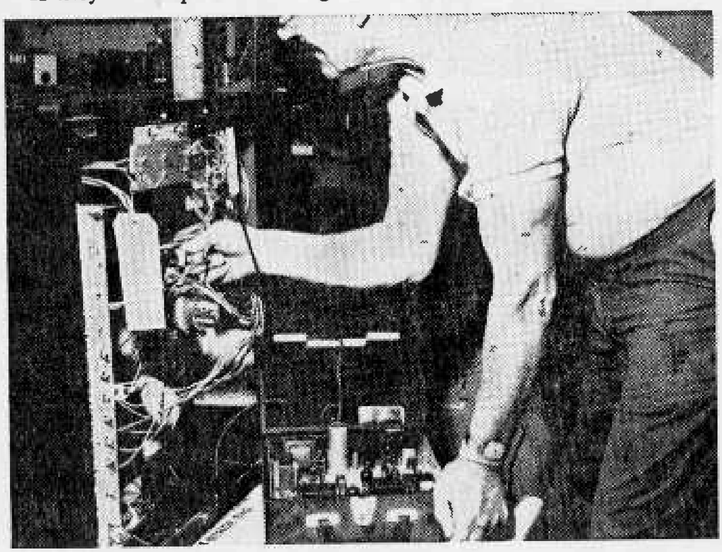
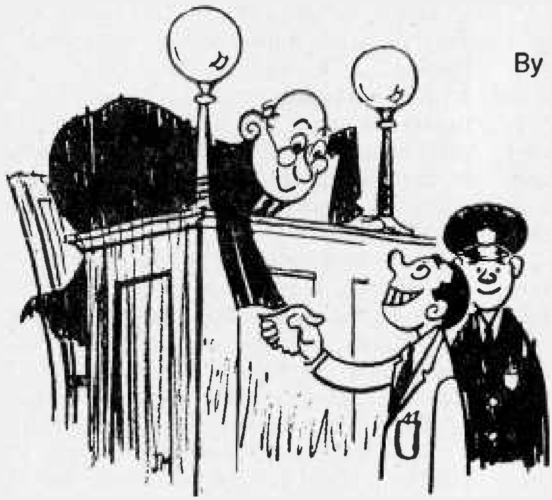


Fig. 15. The last step is the most crucial of all the steps in the replacement of a color CRT. Color purity has a lot to do with the overall enjoyment you get when watching your favorite programs. No-one can thrill to faces that are tinged with green, or grass that has a purplish tinge. If you don't have the necessary equipment you can have your local TV service technician do both the color purity and convergence adjustments. Fee is much less than paying for complete job by TV technician.

By Len Buckwalter, KIODH/KBA4480



Pardon for the Color Killer

Here's the dope that'll give your TV a new lease on color.

The most avid color-TV viewer sometimes wishes his receiver didn't show color. Like when he's watching a black-and-white program. After all, good old Bogart looks better in gray and Count Dracula shouldn't be caught dead wearing a yellow cape and pink gloves. So color TV receivers are equipped with a circuit called a color killer. When it's working properly, the set won't murder the monochrome.

The color killer is first cousin to the squelch found in CB and other communications gear. Squelch automatically switches off audio when no signal is received, thus you don't hear annoying static and electrical interference in the speaker. Once an incoming carrier trips the squelch, the audio section comes alive and it's automatic: the squelch circuit can sense the presence of the carrier and take it from there.

That's similar to the operation of the color killer in TV. Only the static is false color spilling into a black-and-white picture.

The color-killer circuit doesn't have an easy time of it. Before it acts, it must decide whether you've tuned to a station transmitting in color. Also, it shouldn't disturb normal black-and-white reception. These are tall restrictions when you consider that in much of the receiver, color and black-and-white are as inseparable as a Mars bar and its wrapper around mid-July. Yet there is one electronic clue that instructs the color killer to paralyze color circuits at just the right time. That clue, as we'll see, is a received signal that's called the "burst."

The Human Killer. Early color receivers required the viewer to be the color killer. The viewer selected a channel and visually decided whether it transmitted in color. If not, he flipped a switch and disabled any circuits likely to feed false color to the screen (Fig. 1). Though that block diagram is greatly simplified, it illustrates the point. All frequencies which make up the video signal—black-and-white plus color—arrive at the upper left. Frequencies for black-and-white travel to the picture tube. (These frequencies span a range up to about 3 MHz and represent picture brightness and detail.)

You can see, too, that the video signal is split and also applied to the bandpass amplifier. Purpose of this stage is to snatch out color information contained in the complete video signal. It is actually a tube with tuned circuits which peak between about 3

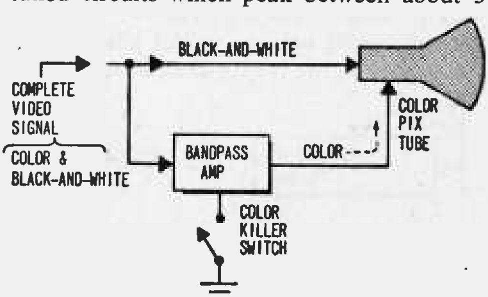


Fig. 1. Basic color killer turns color circuits on/off at appropriate time.

to 4 MHz, where color resides. After color information is trapped by the bandpass amp, it undergoes further processing until it reaches the picture tube to control the electron guns.

The bandpass amp can cause problems during black-and-white reception if permitted to remain alive. Noise, static or other interference could reach up into the color region of 3 to 4 MHz. These spurious signals are amplified by the bandpass stage and blotches of willy-nilly color appear on the screen. This stage should be completely disabled during monochrome reception.

As shown in Fig. 1, there's a switch for turning the bandpass on and off. Now the viewer may completely disable the stage to block the interference path. Some hash can still reach the screen over the black-and-white path but it's far less annoying when it appears as old-fashioned, black-and-white snow. If it sneaks through the bandpass, though, it fills the screen with heinous multicolored "confetti."

Murder, Inc. The trend in electronic equipment, however, is toward total automatic control. And since the set is already cluttered with many knobs, why not try to eliminate one? So the manually operated switch of the color killer has evolved into an all-electronic technique that's found in just about all modern color receivers. The switch is supplanted by a special sensing circuit that latches on to a portion of the color signal. It results in a go, no-go condition of the bandpass amplifier.

A Thirst for Burst. As mentioned earlier, color and black-and-white signals are closely tied together. What's more, they experience constant change as picture scenes and color vary. These wandering signals, therefore, cannot directly operate a color killer. There is one part of the color signal, though, that's an electronic Old Faithful. It's the "burst." This signal is transmitted in machine-gun fashion at the end of each picture line scanned across the screen. Not only does it repeat regularly, but is indifferent to program content. Since the burst is transmitted by the TV station only during a color program, it's a good reference for controlling the killer stage.

Before looking at the circuit, it should be said that the burst is not created solely for operating the color killer. Its main purpose is controlling a crystal oscillator located elsewhere in the receiver. This oscillator provides an accurate color sub-carrier signal needed during color detection. Nevertheless, we can steal a small sampling of burst signal and make it perform admirably well for operating the killer circuit.

Automatic Slaughter. The simplified block diagram in Fig. 2 reveals how the main part of the color receiver relates to the burst and color killer stages. The transmitted signal enters the antenna and travels to the video amp. Black-and-white proceeds to the picture tube even during a color program since it supplies the brightness, or "luminance," portion of the picture. The complete video signal also descends on the bandpass amp. Along with it rides the burst, shown as a series of cycles. (Each burst occurs at a frequency of 3.58 MHz. We're not concerned at this time with further details on the burst except to note that it always occurs when the program is in color.)

The burst is a fragile signal so a burst amp is placed in the circuit to beef it up and get rid of other components of the color signal that might interfere with the following operations of automatic color killing.

The amplified burst signal is next applied to the killer detector. Purpose of this section is to convert the burst—a high-frequency RF signal—into a negative DC signal that is more manageable for control purposes. The control signal is next handed to the color killer stage, an amplifier that boosts the negative control signal. Finally, the color

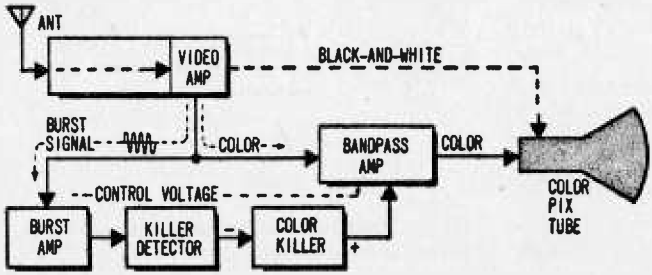


Fig. 2. Block diagram of automatic color killer circuit showing how burst signal is used to operate killer stage which in turn controls bandpass amplifier.

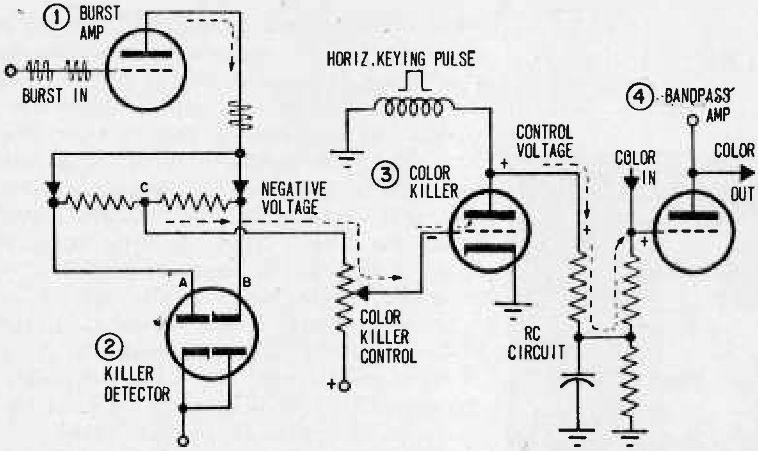


Fig. 3. Simplified schematic of typical killer circuit. Gating of killer stage by horizontal keying pulse makes circuit operation virtually immune to noise.

killer is hooked up to control the bandpass amplifier's operation.

Now when a burst signal appears in the receiver, it's converted to a control signal that electronically switches on the bandpass amp. Color signals may now flow from the video amp, through the bandpass amp and following stages in the long hard trip to the picture tube.

Before looking at an actual schematic, consider another detail in the operation of the color killer stage. Note in Fig. 2 that a negative control signal is entering this stage —but it emerges as a positive signal. The change in signal phase is typical of amplifier stages; when the tube grid is driven negative, the output signal is not only amplified but made opposite in polarity. This is an important effect in the color killer circuit. The positive signal (produced whenever burst is present) is applied to the grid of the bandpass amplifier. This creates a positive bias that turns on the stage, allowing it to pass color signals. When burst is absent, the bandpass grid is very negative and blocks color signals.

Tracing the Schematic. A simplified diagram of the killer circuitry in many of today's color sets is in Fig. 3. We can begin at the burst amp (1) shown receiving the burst signal. After amplification, the burst is applied across the killer detector (2). This stage is a pair of diodes such as might be found in the detector of an FM receiver and the function is similar: it converts a radio signal (here, 3.58 MHz) into DC by acting as a rectifier. Burst voltage is applied across the dual-diode tube, at plate A and cathode B. Resultant current flow through the stage creates a negative voltage between the load resistors (see point C).

The negative voltage is next applied across a potentiometer—the color killer control. Although the total circuit is automatic in operation, the control is adjusted when the color TV receiver is first installed, or when the antenna is changed. It permits the circuit to be set up for a threshold adjustment, or compromise, for stations of different strength. (More on this when killer troubles are considered.)

Next, the negative signal moves to the grid of the color killer (3). Here it is amplified and reversed in phase, as described earlier. Notice a special feature of this tube: its plate is not powered by the usual B+ supply voltage. Plate potential for this stage, rather, is picked by via a winding on the receiver's horizontal output transformer (also known as the flyback or high-voltage transformer). Purpose for this arrangement is to power the color killer only as the burst signal is transmitted. By keying-on the tube during this period only, the killer becomes immune to other signals (picture, noise, etc.) that could sneak through burst and detector stages and operate the killer at the wrong time and allow color to contaminate the black-and-white picture. The horizontal transformer can provide a properly timed keying pulse since it produces voltage in the interval between each picture scanning line, precisely the same time the burst is received.

Output of the color killer, now a positive signal, is applied to the bandpass amplifier (4). It biases the grid positively so the tube is able to conduct normally. The color signal, also applied to the grid, may now be tuned and amplified for further processing. Note that the positive control signal has also passed through a resistor-capacitor (RC) network just before reaching the bandpass

RADIO TV REPAIR

COLOR KILLER

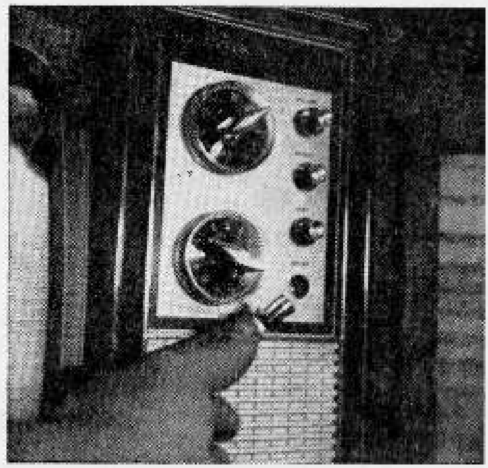


Fig. 4. Adjustment of color killer threshold may be required if antenna installation is changed or as result of aging components.

grid. This network forms a time-constant, or storage, circuit that extends the length of the positive signal. This delay enables the original, short-term control signal to stretch its effect over one full picture scanning line on the screen. The bandpass amplifier now remains alive for a period far longer than did the original burst.

Controlling A Killer. The color killer control must be properly adjusted for satisfactory operation in the circuit. The adjustment is often done by turning a potentiometer shaft located at the rear of the set or behind a front control as shown in Fig. 4. In a typical receiver, the killer is adjusted in this fashion: Tune to a weak station transmitting a black-and-white program. There should be snow on the screen. If not, tune to an unused channel and observe the snow caused by atmospheric noise. By rotating the control in one direction, you should reach a point where flashing dots of color appear on the screen. Correct adjustment is obtained when the control is turned so the multicolored snow just disappears. Don't turn it too far or you'll affect reception on color telecasts, especially in a fringe area.

The adjustment is checked by turning to all stations you can receive in your area. There should be no colored confetti on any black-and-white program, and no disturbance to the picture during color reception.

Clues To The Killer's Crimes. Before attempting to analyze trouble in the color killer section, be sure the problem isn't originating elsewhere in the receiver. The set should be producing good black-and-white pictures and normal sound. Any problem that weakens the received signal could affect the killer circuits. A weak front-end tube, a damaged antenna or lead in, for example, might cause erratic color-killer operation. These faults, however, usually affect black-and-white reception as well. Thus if color creeps into a black-and-white program that otherwise appears normal, this is a sign of trouble in the color killer.

Four major symptoms, shown in Fig. 5, help spot trouble in the color killer. Always begin by checking to see if the killer threshold adjustment is correctly set, as described above. Inability to obtain the desired action with the control strongly suggests trouble in the killer circuits. Then consider and analyze the following clues.

In the first symptom in Fig. 5 (A) the set is tuned to a station transmitting black-and-white. If the signal is on the weak side, snow might appear as colored confetti flashing over the screen. When a station is strong and no snow appears, a faulty color killer might cause color to appear around the edges of people or objects in the picture. (This shouldn't be confused with mis-convergence, another problem. You can tell it's the killer if the fringes of color consist of rainbow-like hues, rather than single strokes of color.)

In symptom B, the set is receiving a color program. The image on the screen, however, is perfect black-and-white—the same as if you'd turned down the color or chroma control on the front panel. The absence of any hue suggests that the color killer stage is falsely cutting off the bandpass amplifier and interrupting the color signal. A trouble of this kind might be caused by a component that has radically changed value—say a burned-out resistor or open capacitor.

Again in the C, the set is picking up a color telecast. But now the color image is satisfactory only when the signal is strong. Weak color stations are seen in black-and-white. This in-between type fault suggests a component that has changed value (rather than burned out or shorted). Only a strong signal creates enough voltage to open up the bandpass amplifier.

When color reception is intermittent (D)

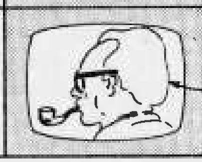
	PROGRAM	PICTURE	SYMPTOM
A	BLACK-AND WHITE		COLORED "CONFETTI" OR MULTICOLORED OUTLINES on B&W PICTURE
B	COLOR		BLACK-AND-WHITE PICTURE OK, BUT COLOR COMPLETELY MISSING
C	COLOR		COLOR PICTURE OK, BUT RECEIVED ONLY WHEN TUNED TO STRONG STATION(S)
D	COLOR		COLOR IN PICTURE INTERMITTENT OR MIGHT CHANGE IN STRENGTH AT RIGHT SIDE

Fig. 5. Four common indications that the time has come for the color killer to be investigated and possibly administered corrective action.

—color fades in and out of the black-and-white image—it could mean there's an intermittent component in the killer circuits. In some sets, fading color toward only one side of the picture might also suggest killer trouble since bias on the bandpass stage may not be holding constant over the span of each picture line.

Find-A-Fault. If all symptoms point toward the color killer stages, begin by checking tubes associated with that section. They're the stages shown shaded in Fig. 6. In many instances, one tube type will contain more than one stage. (For example, color killer and bandpass amp might be in a single 6EA8.) If a tube doesn't cure the trouble, carefully check circuit connections for a cold-soldered joint or hairline crack in the printed-circuit board, if one is used in your set (see Fig. 7).

Further investigation requires a VTVM and the set manufacturer's service literature giving socket and test point voltages. These items enable you to check for correct DC voltages at each stage. Chances are these readings can help locate many major faults which afflict the killer. These include burned-out and shorted resistors, and shorted, possibly leaky, capacitors. With the receiver turned off, resistance checks with the VTVM's ohmmeter section provide valuable information in finding the fault.

In Fig. 8, there's a typical color killer schematic with voltage points that can be measured by a VTVM. Note that the plate is identified as pin 3 and voltage at this point should be −50V. At the grid, pin 2, voltage reads 0.5V when no signal is in the receiver, but increases to —12V when a color signal is present. These schematics also give such detail as how various controls are set while taking measurements and permissible voltage error (usually about 20 percent). Note in this circuit an additional feature not mentioned earlier. It's the "Color Off" switch. Since the color killer might not remove confetti from extremely weak black-and-white images in fringe areas, this manufacturer adds a manual switch. Operation however, is usually automatic.

Tough Dog Killers. These simple checks will localize most trouble. But those tough

(Continued on page 100)

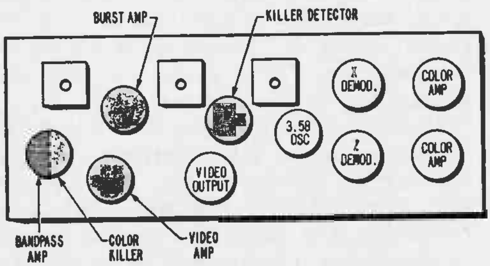


Fig. 6. Typical chroma board found in modern TV sets contain most color tubes. Killer circuit tubes are shown shaded.

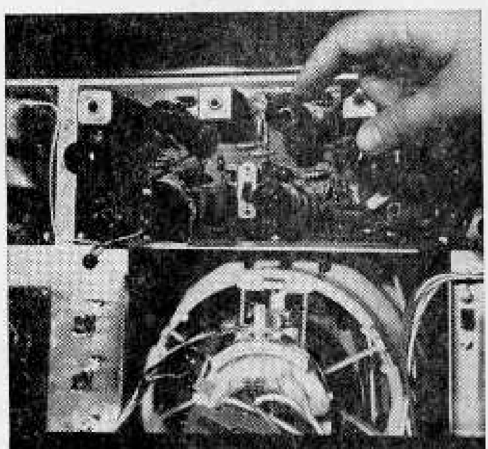


Fig. 7. Problems in color reception can usually be traced to tubes on chroma board. Finger points to killer detector.

G8

WHAT TO DO WHEN COLOR'S GONE

BY

LEN BUCKWALTER, K1ODH

The troubles that plague a color TV could fill a volume of *"Who's Hue."* There's *runny* color, where tints sprint across the screen. There's *wrong* color that makes a bowl of tomato soup resemble crankcase sludge. But one of the most outstanding symptoms is *no* color. And it's about as exciting to look at as our peacock without a tail.

Missing color first seems like total disaster. Could the costly picture tube (about $100-plus) have expired? Fortunately, whenever color *only*—not the black-and-white image—disappears, it probably means an inexpensive repair. Total color loss can be traced to a few stages in the receiver.

Pre-operative Procedure. Before taking off the back of the set, carefully check symptoms. In the case of the missing color, it's assumed the set is receiving normal black-and-white pictures (even on color programs as in Fig. 1). This proves that a vast section of the receiver, including the precious picture tube, is above suspicion. First, be certain the set is tuned to a station known to be transmitting color. Since the color signal tends to pop in at a narrow setting of the fine tuning control, run the knob over its complete range. No hue? Check if the chroma or color control on the front panel is turned up. Jiggle the knob a few times just in case a control is intermittent. If proper color flashes on the screen, you've located the trouble. If not, here's how to check further.

Up Tight Color Killer. There's a good chance the color killer is set too "tight." This adjustment, found on the rear chassis apron or behind a front panel knob, disables color circuits during black-and-white programs (Fig. 2). Though correctly set at one time, the passage of time might shift circuit components enough so the killer is squelching color, too. Turn the control full range to see if you can restore color. Then try it on an unused channel. At some point in the color killer adjustment, snow on the screen should turn to colored confetti. (The proper setting of this control is usually at the point where color in the snow just disappears.)

If you're convinced that loss of color is not due to any of these superficial reasons, consider the antenna system. Although it's not common for an antenna to kill color completely, you might be victim of the exceptional case. Color signals are fragile and could be sliced away if the antenna has too little bandwidth. Consider this if the antenna is new and one not specifically rated for color reception. (A good black-and-white antenna usually works well for color). Another weak point in the antenna system is the lead-in. Reflected signals along twinlead could cause some phase cancellation of color. This is especially troublesome if one wire in the twinlead is broken or disconnected at the antenna elements or at the back of the set. Wet weather or poor antenna orientation are other possibilities.

Running Down The Block. Before pulling off the back of the set, consider likely trouble spots that cause the no-color trouble. These can be spotted in the block diagram of Fig. 3. Since we're assuming the set is able to receive black-and-white programs—or color shows in black-and-white—the block marked "Black-and-White" is trouble-free. That includes tuner, IF strip and video amplifiers. It's also evidence of a good picture tube since red, blue and green guns are firing color at the screen in the correct proportions to produce a scale from black to white. What's missing is color information that's simultaneously applied to the picture tube. Called "chroma" signals, they unbalance the guns so they no longer add up to black-and-white, but appropriate color mixtures. Consider the other blocks in Fig. 3 (see next page):

Color Amplifier. This is the first point where the incoming color signal is split from black-and-white. Thus it comes under suspicion in the no-color symptom. A dead tube here, for example, prevents the complete color signal from penetrating further into the chroma circuitry of the receiver. It may easily explain why you can receive perfect black-and-white and absolutely no color.

You're apt to encounter different designations for stages in this region of the receiver. We've shown it as Color Amplifier, but some call it Chroma IF or Chroma Bandpass. You'll note in Fig. 3 there is another block marked "Bandpass Amp." Whatever the name, the purpose of this stage (which may occupy two tubes) is to separate color from the black-and-white signal. It does it by suitable coils and capacitors which tune only a portion of the incoming frequencies. The black-and-white signal at this time is ranging from about 0 to 3 MHz. (Large details of the BW picture occupy the low frequency section; small details occur at the higher frequencies.) The color signal is borne in the vicinity of 3.58 MHz. So the Color or Bandpass Amplifier is designed to be selective in the color-signal region and thus prevent black-and-white from disturbing the following chroma stages.

Demodulators. The demodulator section of the block diagram in Fig. 3 appears in a dotted line because only in rare instances does it remove all color from the picture. But it's included since it's helpful

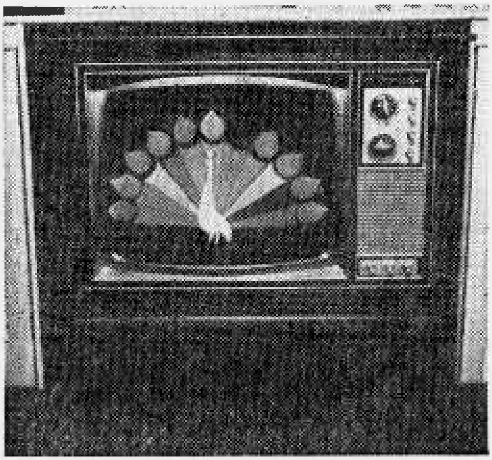


Fig. 1. TV showing perfect black-and-white picture during color program provides important clue to nature of problem and shows that majority of set's circuits is functioning correctly.

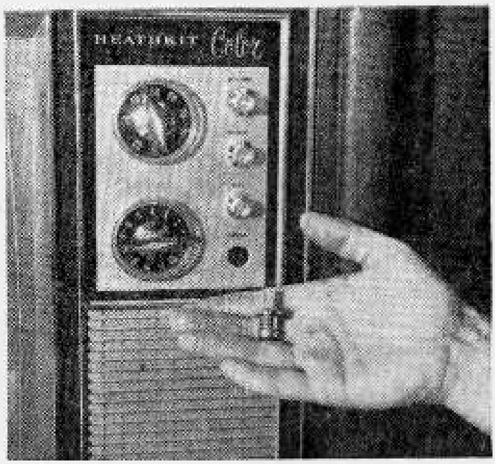


Fig. 2. Lack of color can be caused by incorrect setting of color killer control. On set above, this control is accessible after removing color knob though most sets have control on rear apron.

WHEN COLOR'S GONE

to know its function as a guide to other important stages that do affect overall color reception.

The demodulators take raw color signals transmitted in the 3.58 MHz region and convert them to a form which is usable by the picture tube. And since demodulators consist of several stages working with more than one color, any trouble in this section rarely leads to total color loss on the screen. A defect here generally knocks out just one hue. So the demodulator circuits are probably the last points to check.

It would be a remarkable coincidence if all circuitry failed at once. (One exception, though, is a defect in the power supply leg which powers the demodulators and the red, blue and green amplifiers which they operate.)

3.58 MHz Oscillator. The 3.58 MHz crystal-controlled oscillator aids the demodulator in converting transmitted color to the form required by the picture tube. Complete failure of this stage to oscillate can disable the demodulators and thus cause the no-color condition. In some sets, the picture goes completely green when this stage is inoperative, so watch for this useful clue.

The 3.58 MHz oscillator must generate a carrier which is exactly in step with the carrier at the transmitter. To lock receiver and transmitter in perfect synchronization, the TV station broadcasts a string of short 3.58 MHz bursts. (The burst system conserves spectrum space, and keeps the color signal narrow.)

In most cases, failure of the burst amplifier causes loss of color sync on the screen; colors are incorrect or they ripple across the screen. But it may also cause complete absence of color.

Color Killer. This stage, as mentioned earlier, prevents color from intruding into a BW program. Since it controls the bandpass amplifier(s), a defect in the killer might block the total color signal as well. The color killer is turned on and off at appropriate times by the burst amplifier.

Thus, the block diagram reveals that missing color can spring from a number of stages in the "chroma" section of the receiver. Certain circuits, like color or bandpass amplifiers, are prime suspects since they stand directly in the path of the total color signal. In remaining circuits—burst, killer, demodulator—there might be color loss, but often there will be a lack of color sync, too.

Troublesome Bottles. Tubes are usually the major cause of trouble so check them first. Since the no-color problem is almost always in receiver circuitry that handles only color, you won't have to look very far. It is common practice for the manufacturer to localize all chroma stages in one area. In many cases it is a separate printed circuit board, as in Fig. 4. And usually the function of one or more chroma stages is con-

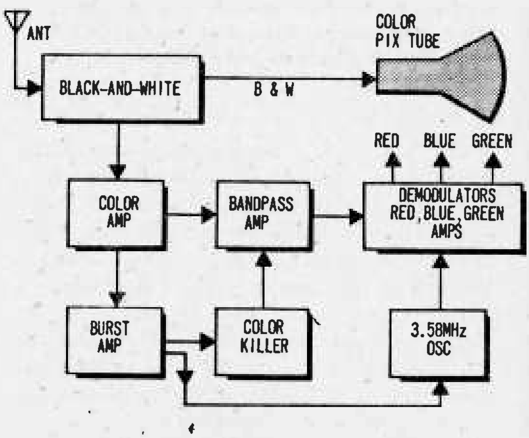


Fig. 3. When color's gone, these are the circuits to check first. Since defective tubes cause the majority of TV troubles, checking the tubes in these stages will often solve the problem.

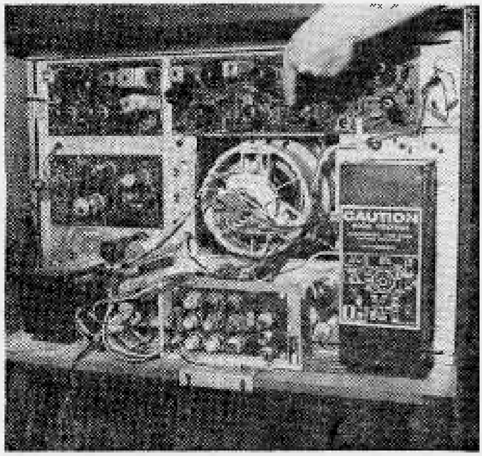


Fig. 4. Most color circuits are located on the "chroma" board. In typical set above, finger points to chroma board that occupies most of top half of chassis.

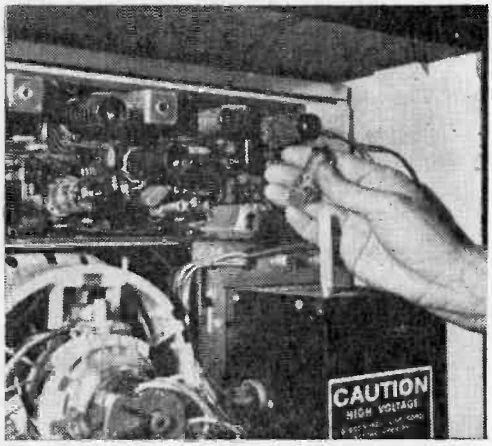


Fig. 5. The best way to check for defective tubes on chroma board is to substitute with new ones.

tained within a multi-purpose tube. There might be eight or nine separate stages in the schematic of the chroma section, but often they add up to approximately five tubes. Some typical combinations in a single tube envelope: bandpass amplifier and color killer; 3.58 MHz oscillator and its reactance control; phase detector and color demodulator.

The recommended system for tube checking is substitution (Fig. 5). Plug a known good tube into the socket of a suspicious stage. It's a good idea to try only one new tube at a time and note if color returns. Substituting all new tubes in the chroma section simultaneously is wasteful since you won't isolate a bad one.

Crystal Oscillator. If tubes don't restore color, you'll need a VTVM to do some further checking. And a good place to start is at the 3.58 MHz oscillator (Fig. 6). Set makers often provide a test point for measuring grid voltage developed by the oscillator during normal operation. Voltage in a typical oscillator (see Fig. 7) is about −6 to −10 VDC.

If a check at this point produces no reading in this range, the oscillator transformer

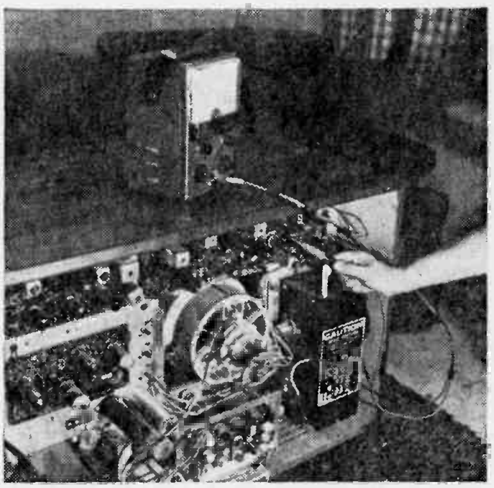


Fig. 8. Manufacturer's service literature is very helpful when locating test points for voltage checks.

may need to be adjusted with a tool that matches its alignment slug. While observing the VTVM, try to obtain highest negative reading (Fig. 8). Failure to obtain a peak could mean a defective crystal. But before replacing the unit, be certain no other part associated with that stage is at fault. Voltage and resistance tests should agree with those supplied by the service literature for your particular set.

Bandpass Amplifier. This stage is another major cause of missing color. As you can see in Fig. 9, it is little more than an

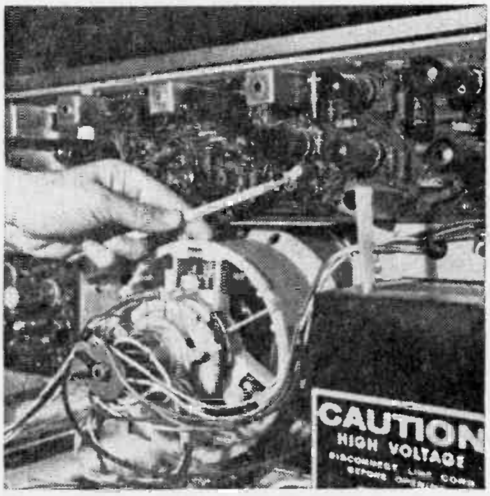


Fig. 6. If tubes don't seem to be causing the problem, try checking the 3.58 MHz crystal.

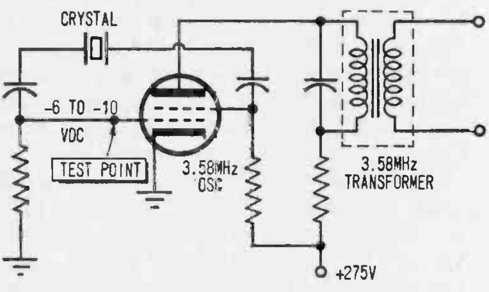


Fig. 7. Circuit of typical 3.58 MHz oscillator. A voltage check with a VTVM will determine if it's OK.

amplifier tube that feeds the bandpass transformer. Since the transformer has a specially shaped response curve (to favor color and reject BW), don't attempt to adjust it. This must be done with a signal generator, oscilloscope and precise markers. Anyway, the transformer will rarely go out of adjustment and normally needs no attention. There is, however, a possibility of an open winding, or a resistor or capacitor in the associated circuit could short and pull excessive current through the windings. This will become evident in continuity checks you perform.

Output of the bandpass usually has a front-panel color control for adjusting the intensity, or saturation, of color that appears on the screen. This control is subject to the usual weakness of any potentiometer; it becomes dirty with age or loses spring tension.

be − 14 VDC measured at the killer plate. Any fault which causes high negative voltage at this point during color reception will also cut off color.

Investigate the color killer's threshold control, often placed at the grid of the tube, as shown. This potentiometer should be operating with proper resistance since it governs action of the killer tube.

Problems Resolved. The stages discussed

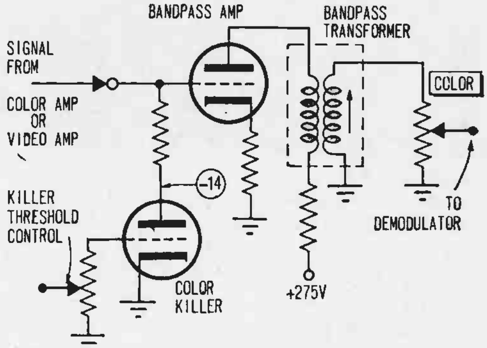


Fig. 9. The bandpass amplifier is another likely candidate when color's gone. Voltages given are typical but will vary from set to set.

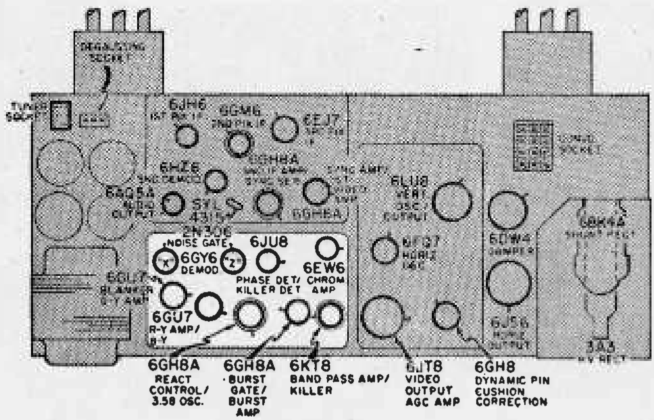


Fig. 10. This is the color section of a Sylvania DO2-1 color chassis. Color section is easily identified by tube location chart pasted in set or on back cover.

These faults may interrupt the signal on its way to the demodulators and kill all color. So be sure to check it for proper action and correct value.

Color Killer To Bandpass. Notice also in Fig. 9, that the color killer is tied into the grid of the bandpass amplifier. This enables the killer to control color-signal amplification of the bandpass (depending on whether the burst is being transmitted). When the receiver is picking up a BW program, a relatively high negative voltage is sent from the killer plate to the bandpass grid. This cuts off the bandpass and prevents false color from interfering with reception. In our example, the manufacturer states in his literature that with no signal in the receiver, there should

to this point will be responsible for many no-color cases you're apt to encounter. Chances are that close examination of circuit values will pinpoint the culprit. There is, too, the occasional instance where a stage in the chroma section is indirectly influencing, say, the bandpass or oscillator stage. Some sets have automatic color control circuits which might also cause color-bearing stages to go awry. A burst amplifier may be dead and cause the color killer to turn off the bandpass stage. But despite the complexity of color circuits, you should be able to measure DC voltages or resistances with a VTVM on the five or so sockets found in the chroma region of the chassis. Shown in Fig. 10 is another typical chroma board—note its position.

Exotic Problems. When voltage and resistance measurements won't locate trouble, signal tracing should provide the answers. One item you'll need is a color generator, which injects standard color signals into the circuit. If a stage is functioning properly, the signals emerge with correct shape and level. Viewing the signals is done on an oscilloscope rated at a bandwidth of 5 MHz. The probe used with the scope must be a low-capacity type to prevent any possible detuning of the color signal as it passes through the various stages.

Service literature prepared for your specific model is a virtual necessity in signal tracing. And most manufacturers go to great lengths to provide guideposts you'll need in troubleshooting. A good example is in Fig. 11 which shows the various signals in the chroma circuits of a Heath chassis. Here are some details which should be of assistance in using such information.

Scope Points. The shaded arrows on the schematic (see Fig. 11) refer to points where the oscilloscope is connected. If we locate the one near the bottom right, we see it's at the plate of the 6EW6 burst amp. Then, if we study the two waveforms below, it's seen the scope should display 15750 Hz at 180 volts peak-to-peak when the stage is functioning normally.

Literature To Service By. Service literature also provides other important information you'll need. On many Philco chassis, for example, the manufacturer states that to observe these waveforms, the generator is applied to the antenna terminals and adjustments made to the set's controls until .5 volt appears at a given point.

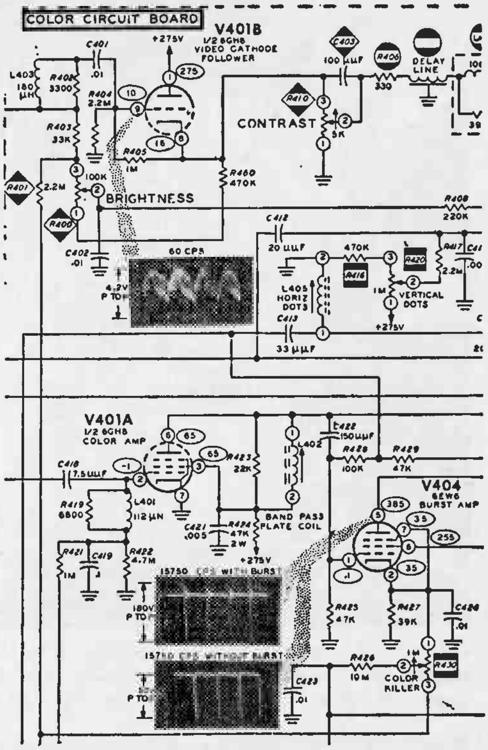
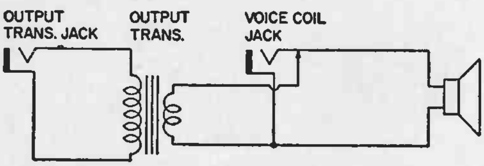


Fig. 11. Tough-dog problems can be tracked down using service literature, VTVM, and scope.

This establishes the same standards used by the manufacturer in obtaining normal waveforms. Once you learn how to handle this kind of information—and gain a bit of experience with a set in good operating condition—much of color's complexity fades out, and hue fades in. End result is a color-TV in prime working order. ■

DISCARDED PORTABLE BECOMES TEST SPEAKER



■ If you own an old tube-type radio portable that's ready for the garbage can, you're in for a windfall by simply converting it to a portable test speaker.

Begin by scrapping all of the set's guts except the PM speaker and output transformer. Now scrounge up open-circuit and closed-circuit phone jacks (see schematic diagram), phone plug, wire, and two alligator clips with rubber sleeve insulators. Wire up the portable case as shown in the schematic diagram and label the cabinet's front panel so you will know which jack is which.

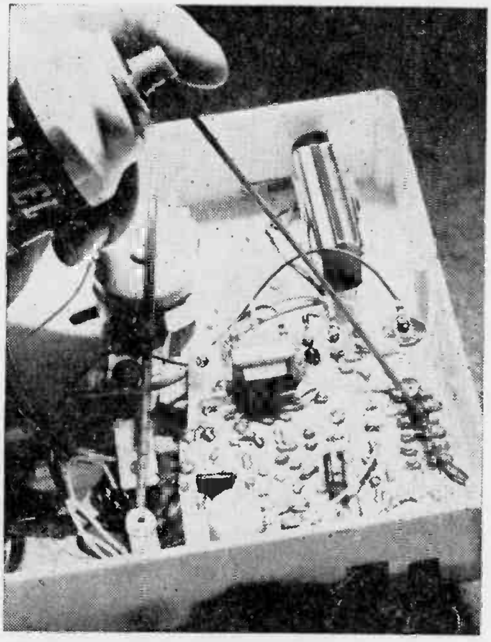
Now wire up a patch cord using 3 feet of rubber test lead lengths to the phone jack and install the alligator clips to the wire's free ends. What you will end up with is an extremely versatile unit which you can connect to either the speaker terminals or into audio plate circuits at will. ■

THOSE MINOR TAPE TROUBLES

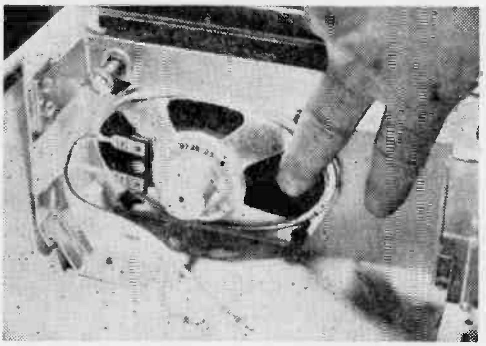
. . . and what you can do about them

By HOMER L. DAVIDSON

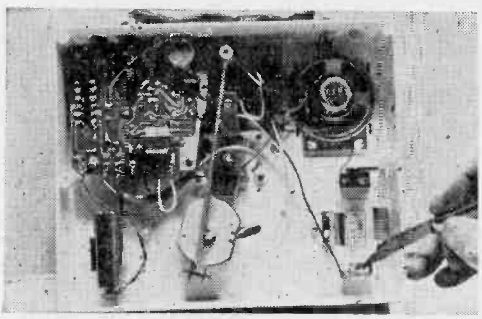
■ Ben Franklin wasn't thinking of tape-recorder repair when he observed that "a penny saved is a penny earned," but the fact is that you *can* cut service calls by making minor recorder repairs yourself. Our photos present a rogue's gallery of common tape-recorder ills, with the suggested remedy indicated 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. ■



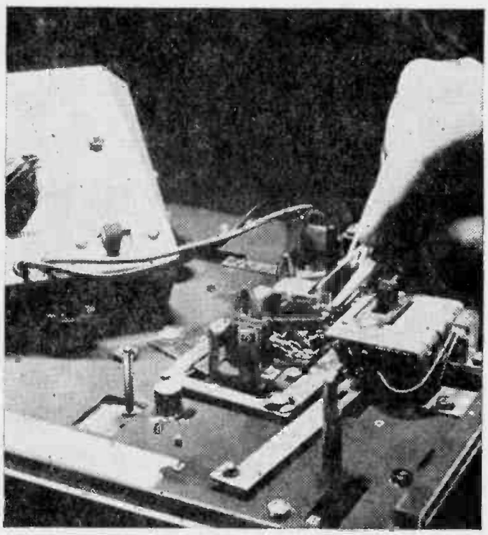
Oil has caused more tape troubles than it has cured, though it can be a godsend if used sparingly. But oil mechanical parts only.



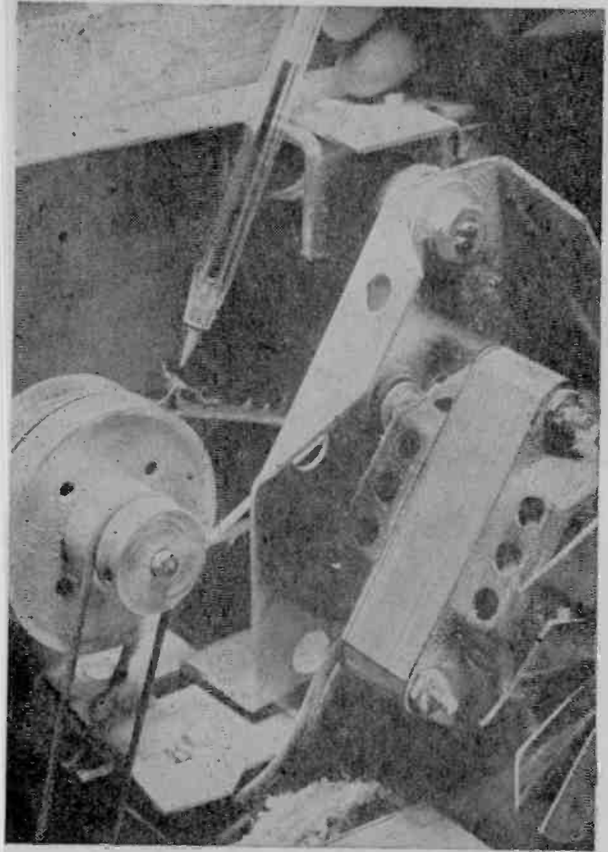
Speaker is often responsible for distorted sound, particularly if finger pressed against cone corrects trouble. Remedy is new speaker.

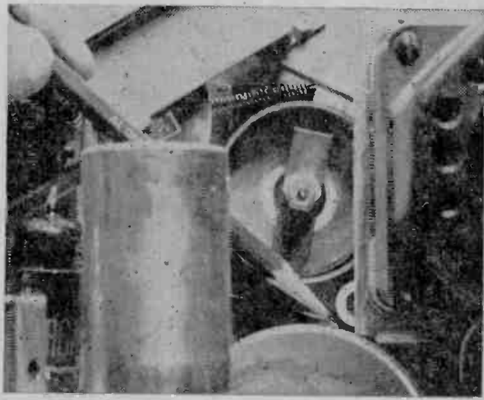


Batteries (if used) should be replaced often and removed whenever recorder is stored. Knife here points to corroded terminals.

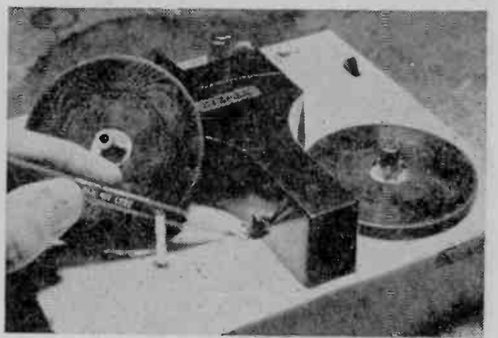


Tubes or transistors are chief reason for loss of record/play functions. Audio generator should quickly pinpoint defective one.



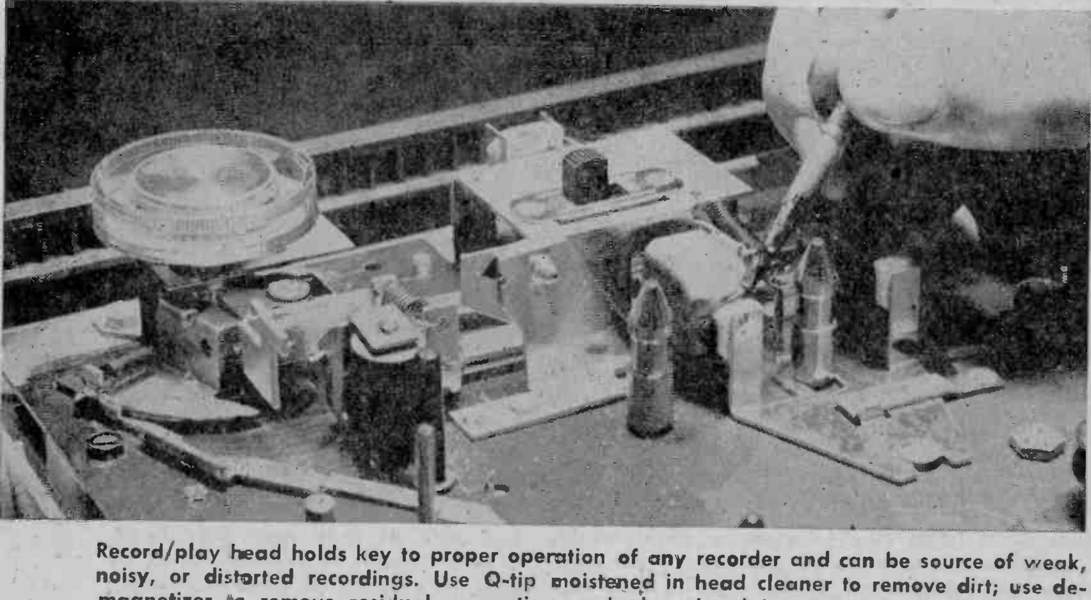


Capstan flywheel, if oily, can result in slippage, as can hardened rubber drive assembly. Remedies: clean flywheel, replace drive.



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

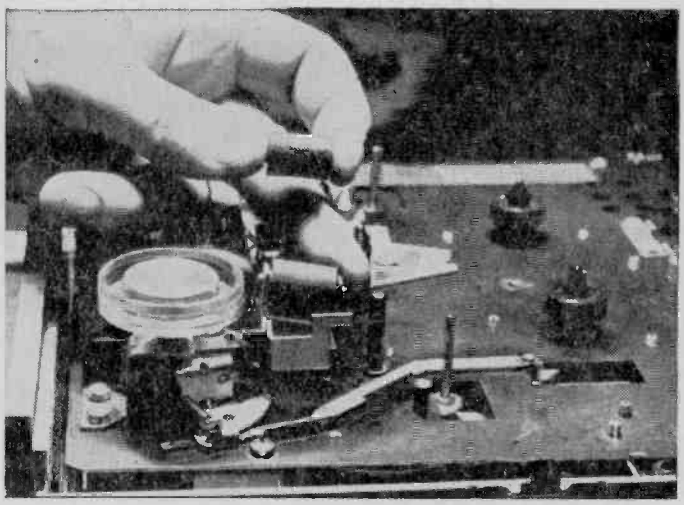
Tape guides and levers can slow tape, even stop recorder if bent or otherwise damaged. To fix, check and correct tape path.



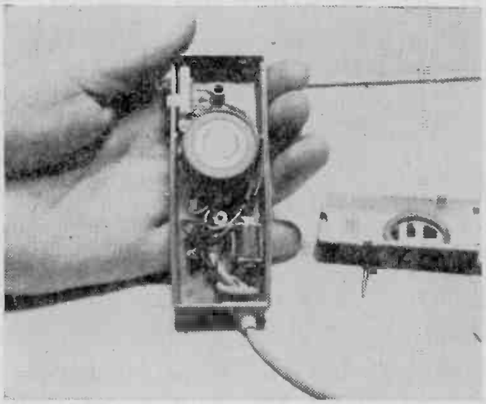
Record/play head holds key to proper operation of any recorder and can be source of weak, noisy, or distorted recordings. Use Q-tip moistened in head cleaner to remove dirt; use demagnetizer to remove residual magnetism and place head in neutral state. *(Turn page*

TAPE TROUBLES

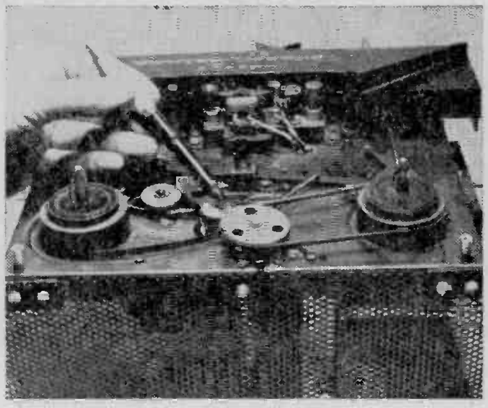
Continued



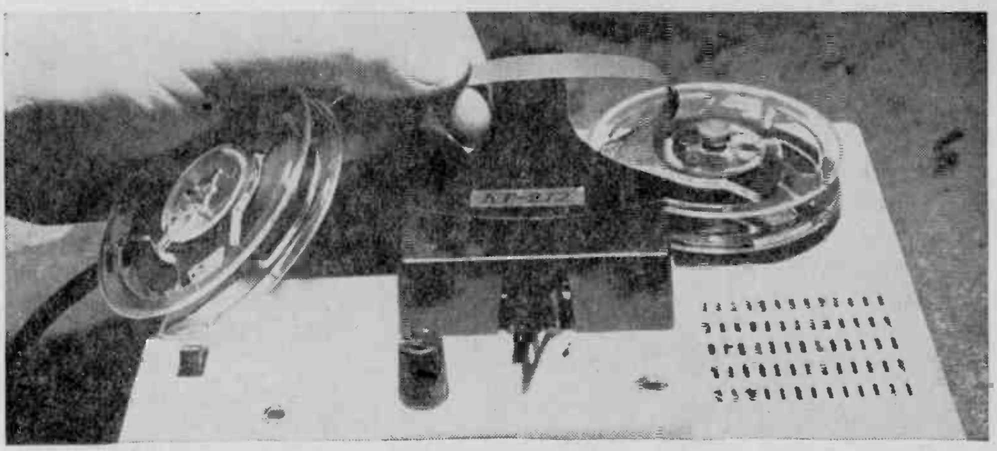
Rubber pressure roller can result in uneven tape motion, particularly if badly worn (as is roller being held by hand in photo). Since a worn roller cannot be repaired, an exact replacement must be secured from either the manufacturer or his agent.



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).

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-

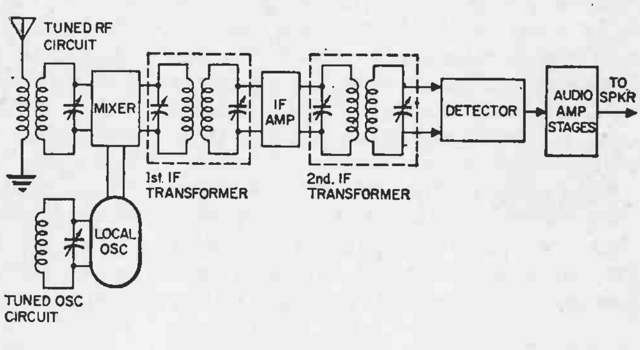


Fig. 1. In the superheterodyne receiver, the incoming RF signal is reduced to an intermediate frequency in the mixer.

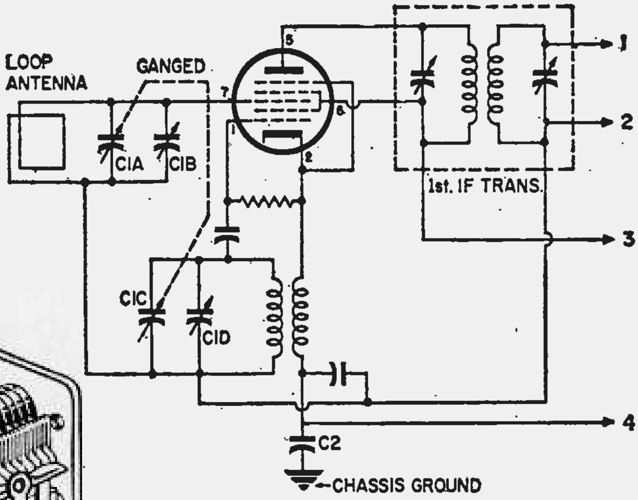


Fig. 2. Schematic diagram of superhet converter-oscillator shows the pentagrid converter.

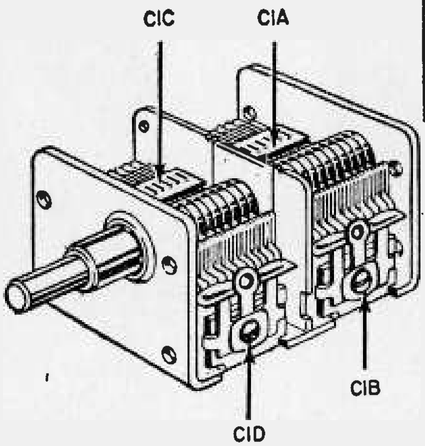


Fig. 3. Ganged tuning capacitor C1A-C1C combines oscillator-RF tuning on one control.

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*)

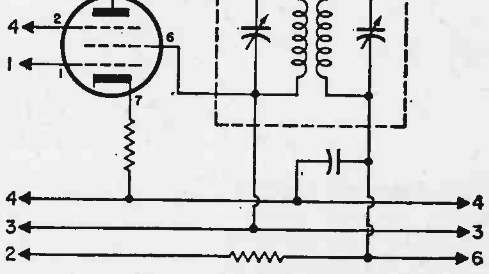


Fig. 4. IF amplifier tube 12BA6 boosts signal; second IF transformer increases selectivity.

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.

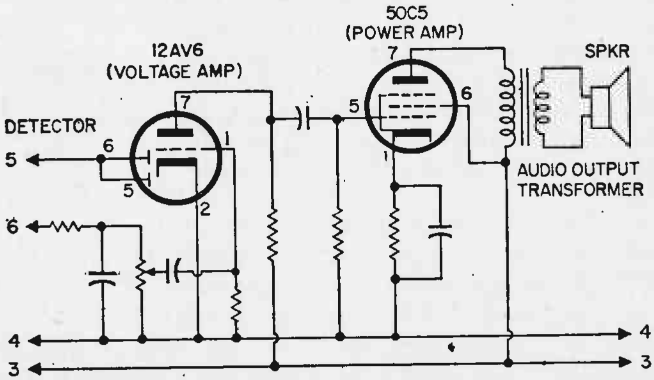


Fig. 5. The audio amplifier section of the receiver combines detection and voltage amplification in the 12AC6 tube, and power amplification in 50C5.

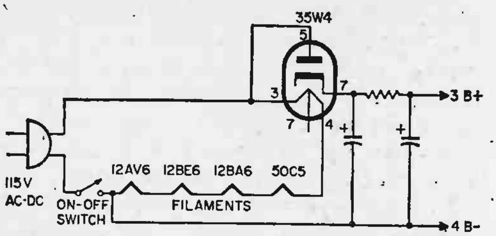


Fig. 6. The power supply that provides the DC voltages for receiver utilizes 35W4 diode tube in filtered half-wave rectifier circuit.

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

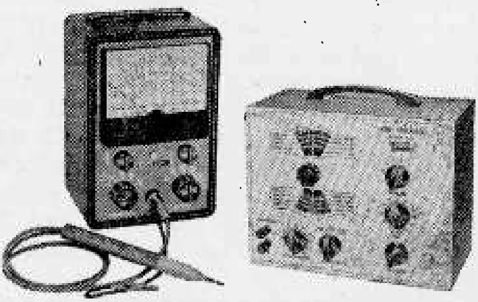


Fig. 7. VTVM and signal generator are all you need to align superheterodyne receivers.

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.

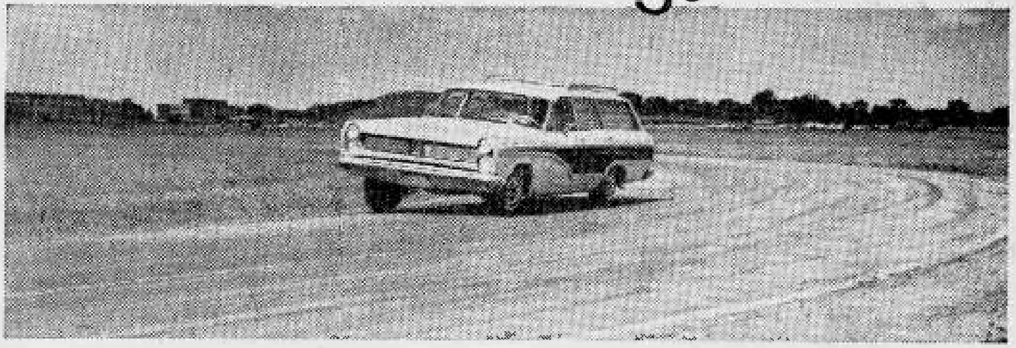
If your listening habits favor one end of the band over the other, or one station more than another, it is best to adjust the RF trimmer for the maximum output at the frequency of the favored station.

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.

By Homer L. Davidson

free wheeling fixit for solid-state rigs



With our brains and your brawn, you'll save a heap of dough and soon be an expert in the know putting the fix on that thru-way juke-box!

■ You too can repair your own transistor auto radio with just three small, low-cost test instruments. For signal tracing, a *noise generator* will inject a signal from base to collector terminal of each stage. Each suspected transistor can be checked for quality, short, open, or leaky condition on a *transistor tester*. And a *VOM* or *VTVM* will pinpoint the actual defective component with in-circuit voltage and resistance measurements. Naturally, a schematic diagram of your particular set is a handy thing to have on hand.

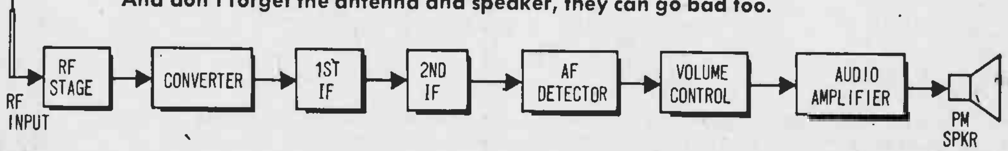
The solid-state auto radio is just a big brother of the transistor pocket radio. Both of these transistor radios use a superhet circuit, but the auto receiver is better constructed, has a higher output power (more volume), and greater fidelity. The block diagram of a typical transistor receiver in Fig. 1 shows all the basic circuit elements.

Checking The Circuit. The shielded lead-in from the outside auto antenna plugs directly into a transistorized RF stage. The desired incoming signal is selected by a permeability-tuned coil and coupled to the convertor circuit. Another permeability-tuned coil of the oscillator circuit is found in the leg of the emitter terminal.

Most auto radio converter circuits use only one transistor for oscillator and mixer operation—see Fig. 2. In some AM/FM auto receivers, a separate oscillator and mixer stage is employed in the FM section.

The difference between the frequency of the tuned incoming station and local converter stage is the intermediate frequency of 262 kHz. You will find only a small signal gain in the converter section. Right here the

Fig. 1. Keeping in mind the seven stages shown in the block diagram of a typical car radio will make it lots easier to pin-point the area causing trouble. And don't forget the antenna and speaker, they can go bad too.



FREE WHEELING FIXIT FOR SOLID-STATE RIGS

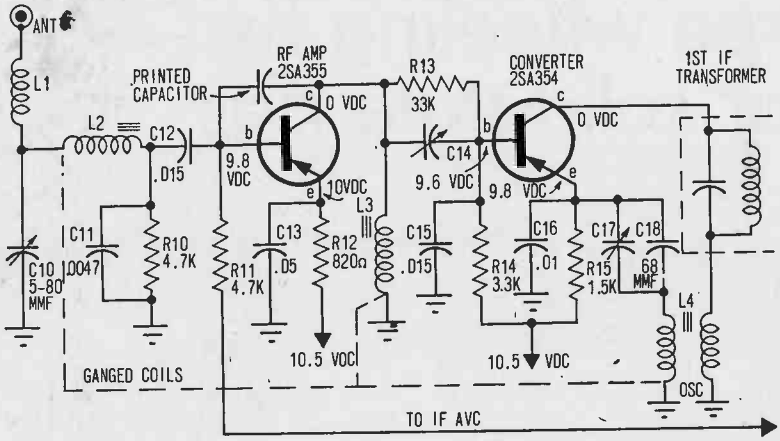


Fig. 2. RF section of typical auto radio; common defects here will often cause only local station pickup, or no stations on high end of band.

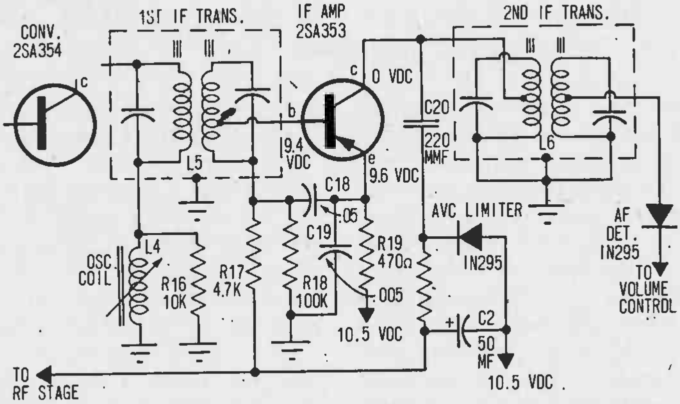


Fig. 3. Defective IF or detector may result in weak sound. Intermittent reception can usually be traced to defective IF transistor or transformer.

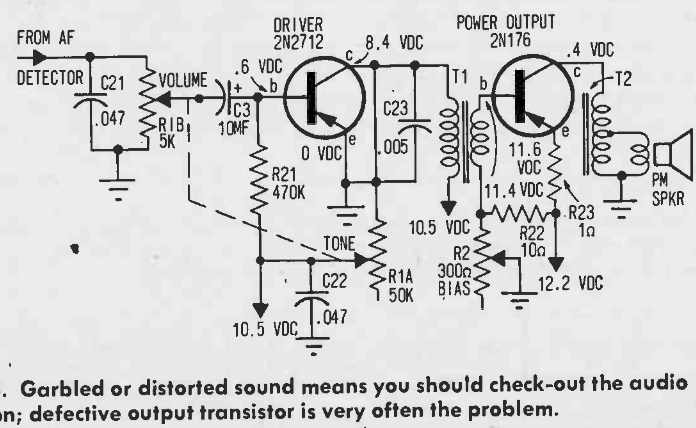


Fig. 4. Garbled or distorted sound means you should check-out the audio section; defective output transistor is very often the problem.

portable transistor and auto receiver differ. The standard broadcast radio has an IF of 455 kHz, while the auto receiver IF frequency is 262 kHz. So, if you replace a defective IF transformer, be sure the IF frequency is 262 kHz or you may have a modicum of alignment trouble.

There are two IF amplifier stages with a crystal diode as an AF detector. These two intermediate frequency stages amplify the 262-kHz signal, which is then demodulated to audio frequency with the AF detector—see Fig. 3. At this point we find a volume control in the audio circuit to adjust AF gain.

After the volume control, we find a driver stage with a single power output transistor as shown in Fig. 4. In the large deluxe auto receivers you may find two power transistors in push-pull operation for greater audio poop and higher fidelity.

Continuity Check. First, before pulling the auto radio from the car, take a couple of simple continuity checks. Pulling the auto radio, you'll discover, is the hardest job of repairing these receivers. You practically have to stand on your head to loosen the mounting bolts and connecting cables. So a few continuity checks may eliminate the upside-down position and more than a few impolite words.

Take the ohmmeter and check antenna and speaker for continuity. It is possible to remove the auto radio and still find the trouble in the car wiring. Set the ohmmeter on the low-ohms scale and check the continuity of the speaker. Not only should you have a low ohmmeter reading, but each time the leads are touched to the speaker terminals, you should hear a click in the speaker. This click proves the voice coil isn't open.

Antenna Check. Now check the auto antenna lead-in. See if there is a leakage between the shield and shielded wire. On the highest ohmmeter scale there should be no reading at all between shield and shielded wire. If water has seeped into the lead-in cable you may get a high resistance reading—see Fig. 5.

Stick one ohmmeter lead through the car window. Clip the other ohmmeter lead to the center terminal of the antenna lead-in. Touch the outside antenna and you should have a dead short showing on the ohmmeter. If not, the lead-in cable is open and must be repaired.

Most broken lead-in wire is found at the male plug-in or at the bottom of the auto

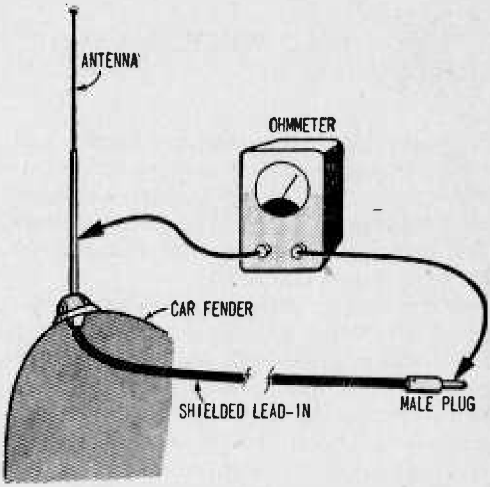


Fig. 5. Intermittent and noisy reception can be caused by antenna. An ohmmeter is the easiest way to check it for open or short circuit.

antenna mast. Cut off the male plug and solder a new one in place of it. If the wire is broken or loose at the base of the antenna, forget it, and install a new antenna. It is a lot simpler to replace the antenna and cable since these are supplied as one replacement unit.

You can spot a loose antenna cable connection by wiggling the antenna mast back and forth with ohmmeter attached. While the radio is playing, the antenna mast can be pushed and pulled around to determine whether it's the cause of noisy or intermittent reception. The base of the antenna must be tight for a good ground connection. Generally, this is accomplished by a large star washer that bites into the underside of the car body sheet metal. If the washer is corroded or loose, it is a likely spot for static or intermittent ignition noise to originate.

Removing The Radio. Remove the dash mounting nuts around the volume and tuning controls. In some cases, two dash mounting bolts are added to each side of the radio.

After the mounting bolts have been removed, pull out the antenna plug. Remove the A or hot lead going to fuse block or fuse holder. Some auto radios have a separate dial-light lead wired up to the dash lights. Now disconnect the speaker cable. Note where the various plug-in leads and cable attach for later radio replacement.

When troubleshooting the radio chassis, a 12-volt DC bench power supply or battery must be used to power the auto radio. An easy way to get the power is to run a rub-

RADIO TV REPAIR FREE WHEELING FIXIT

ber cable between outside car battery and radio. You shouldn't try hooking up a tube/vibrator car radio in this manner. But since most solid-state auto radios pull less than two amps, there's only a small voltage drop between battery and radio.

In hooking up the auto radio, be sure the positive terminal is going to the A or hot lead, and negative terminal to ground or radio chassis. These solid-state auto radios won't operate if the two leads are reversed and in a very short time you can ruin several transistors. Use the voltmeter to check for correct battery terminal polarity. All current American-made cars, except some trucks, use negative-ground radios, while most of the small foreign jobs have a positive-ground chassis on both car and radio.

When the car radio doesn't play after a dead or charged battery, suspect wrong hookup polarity or reversed battery polarity. The auto will perform perfectly, but the radio won't. Sometimes the car battery can be charged up wrong or battery terminals hooked up backwards.

Dead Solid-State Radio. A dead auto radio is easy to fix, but a weak or intermittent one is more difficult and takes a little longer. Connect power and hook up the two speaker leads to the dead radio. Turn the radio switch on and check for a click or thumping in the speaker. Try rapidly turning the radio off and on and listen for sounds in the speaker.

If there is a click or thumping sound in the speaker, the output transistor is probably good. This is only a quick output stage check and doesn't mean that this stage isn't weak or defective.

About 75 percent of solid-state auto receiver troubles are located in the power output stage. But before jumping to any conclusions, it's wise to actually locate the defective section or stage. Here's the chance to put the noise generator to use.

Signal Tracing. Take the two noise generator leads and attach them directly to the center terminal of the volume control and chassis ground. Starting at this point, you are breaking the radio circuit in half and can quickly determine whether the fault lies in the RF or AF section. If you hear a loud audio tone in the speaker, you can assume the audio section is good. But if the signal is weak or there's no signal at all, the trouble presumably lies between the volume control and the speaker.

Start signal tracing with the noise generator on the base of the AF or driver transistor and chassis. Go from the base to the collector terminal of each transistor stage until the signal is heard in the speaker. You can also start at the base of the output transistor and proceed toward the volume control. Ground the black lead from the noise generator and touch the red lead to transistor terminals.

When starting at the base of the transistor output stage and going towards the volume control, the signal should become stronger. A loss or weak signal will indicate the defective stage. Stop here and take voltage measurements.

Check the voltage on the base, collector, and emitter terminals of the transistors in and next to the defective stage. In most auto receivers you will find the collector terminal at zero or close to ground potential (see Fig. 6), while the base is -8 to -10 volts negative. The emitter will give the highest negative voltage reading (exact values will be found in the radio's schematic diagram).

The IF, converter, and RF stage can be signal traced in the same manner, using the noise generator. Start at the crystal detector with the volume control turned full up. For instance, if you have a signal at the volume control, you should also have a signal on the opposite side of the detector. Here, though, the audio signal is a lot weaker than on the cathode side of the crystal detector. No

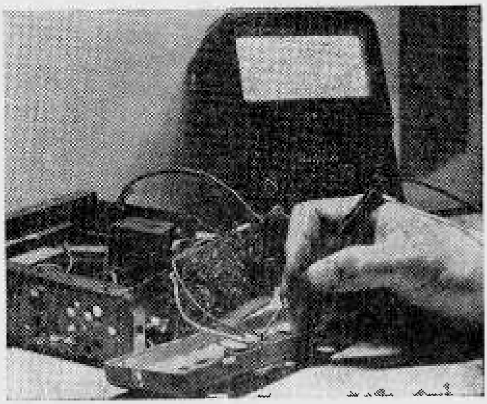


Fig. 6. Taking voltage checks on output transistor will tell if it's bad. This one uses back cover of radio as heat sink.

signal at all will show up an open crystal diode, in which case it should be replaced.

Switch the noise generator to RF position. Now go to the collector terminal of the second IF amplifier. Proceed to the base of the same transistor and see if you have a signal. Proceeding toward the antenna, the IF stage should increase the signal volume. The noise generator signal is weaker in the RF and converter stages, but still each stage can be handily signal traced to find the problem. Remember, the point where the signal disappears is the defective stage. Start making voltage readings and transistor tests to locate the defective component.

Transistor Replacement. A transistor may become weak, shorted, leaky, or extremely noisy. Though the life of the solid-state device is greater than that of a vacuum tube, it can still go bad. Don't become alarmed if power output transistors feel warm to the touch after an hour of operation. But in case you find a small transistor quite warm, you have located a shorted or leaking transistor. Quickly replace it. Also, check component parts in its circuit. You may find a shorted or leaking capacitor and charred resistors.

Small transistors should be soldered or unsoldered using a pair of long-nose pliers as a heat sink. Remove one terminal at a time. A handy gadget to remove solder around the transistor wires and etched wiring is a medicine syringe. As the soldered joint is heated, the rubber bulb will suck the melted solder into the rubber end. A commercial soldering iron and suction bulb combo is available on the market for removing components from the PC board. Excessive solder can also be removed when heated with a soldering iron and brushed away with a small paint brush.

After the transistor is removed from the PC board, note the position of the collector hole. Use this as a replacement point for all other terminals. Some PC boards have the

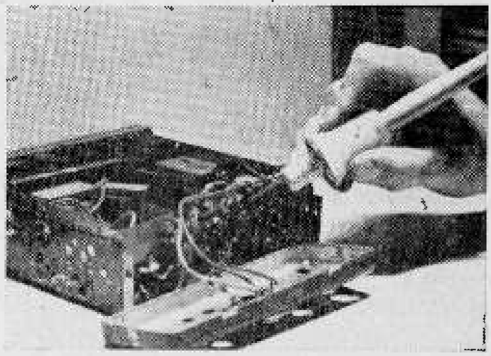


Fig. 8. When soldering on those space-age printed circuit boards, use a small pencil iron so's not to damage the goodies.

b, e, and c terminals lettered on the board—see Fig. 7.

Be careful with molded-plastic contained transistors when removing them from PC board. The terminal leads can easily be turned in the plastic body, ruining a good transistor. In some intermittent conditions, the lead has vibrated loose, resulting in intermittent radio reception.

Replace the new transistor in the correct PC board holes. Do not cut off the terminal leads until the radio is performing. But in case the PC board has etched wiring on both sides of the board, as in some auto radios, it is quicker to cut off the defective transistor terminals close to the PC board. Then cut the new transistor leads to correct length and form a loop in each terminal lead. Solder the looped ends over the short, cut-off wires on the PC board—see Fig. 8.

Power Transistor Replacement. The power output transistor is found mounted on a metal heat sink or on the outside of the receiver case. Sometimes the power transistor is insulated with a clear piece of insulation material. Take a second glance because the thin piece of insulation should be replaced when mounting a new power transistor—see Figs. 9 and 10. Otherwise, you have a

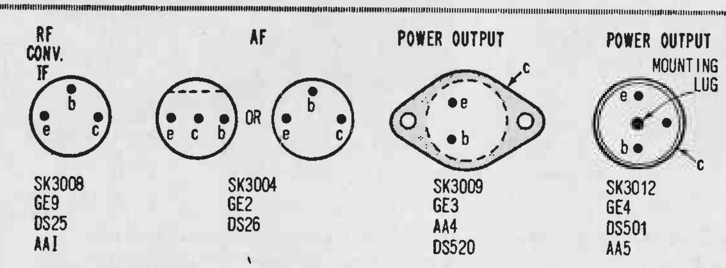


Fig. 7. Most transistors you'll have to deal with in repairing your auto radio will be the ones shown. When replacing one of them, be sure to hook 'em up the right way.

shorted collector circuit and can ruin a new transistor you just installed. (These power transistors are not very cheap, either!)

Be sure to place a layer of silicone grease between insulator and radio chassis. The metal cover of the power transistor is the collector terminal and is bolted against the metal chassis. Remember, power transistor emitter and base terminals are off center on the power transistor and should be lined up in proper position, as shown in Figs. 11 and 12.

If you don't have a transistor tester handy, make a quick resistance check as shown in Fig. 13. Though these resistance measurements vary from transistor to transistor, they can indicate a shorted or high-leakage condition. Use the transistor tester, if handy, for a quick, accurate transistor checkup.

Garbled, Distorted Music. Generally, you'll find most garbled and distorted sound troubles stem from troubles in the audio output stages. Go directly to the power output transistor and replace it with a new one. (See the transistor replacement chart in Fig. 14 and 15.) Before turning on the switch, check for burned or overheated resistors in the emitter and base terminals. Double-check the variable bias resistor for erratic or open reading. A defective output transistor can produce motor-boating in the speaker.

Also check the driver transistor in cases of distorted sound. A leaky coupling capacitor or burned bias resistor will have the same symptoms. By taking voltage and resistance readings, you can easily spot the defective stage (see Fig. 4).

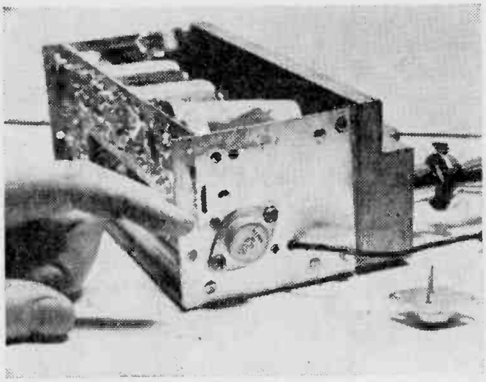


Fig. 9. Power output transistor is the big one, maybe two in push-pull, mounted on side or back of radio chassis.

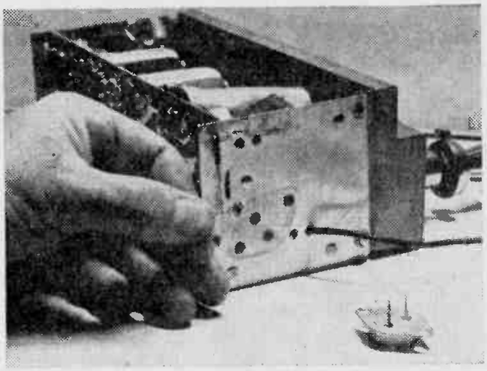


Fig. 10. When removing output transistor, be sure to see if there is a clear plastic insulating wafer between it and chassis.

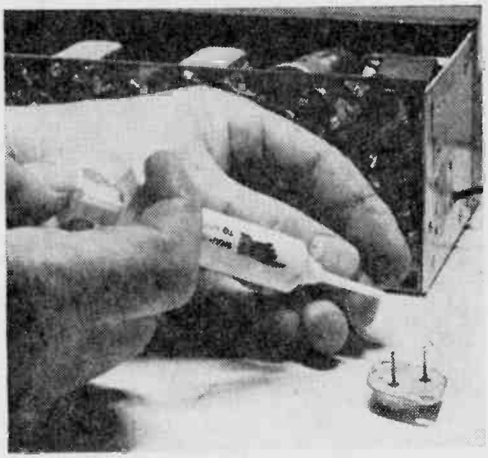


Fig. 11. When putting in a new output transistor, apply silicone grease on insulating wafer.

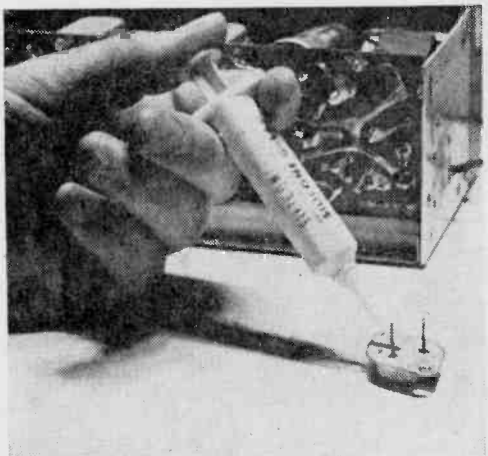


Fig. 12. Put grease on transistor too, it conducts heat from transistor to chassis.

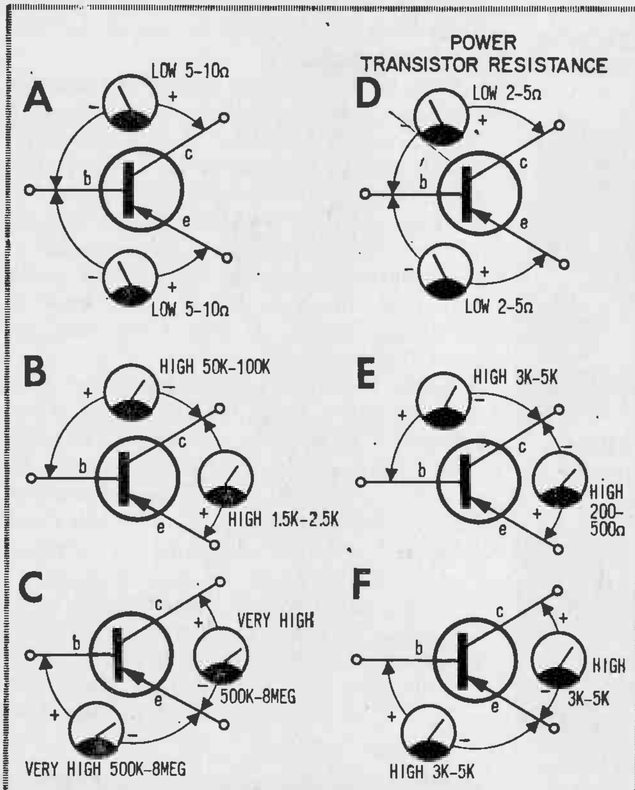


Fig. 13. Transistors can be checked with an ohmmeter for leaks and shorts as shown in above diagrams.

The cracked or broken PC board can be found by pushing and prodding around on the board. If possible, hold a light behind the PC board while working on it. Sometimes it's quicker to solder all connections and wiring on the PC board to eliminate an intermittent condition (Fig. 16). A cracked board can be repaired by bridging the break with bare hookup wire (Fig. 17). Don't solder the cracked wiring and expect it to hold, since vibration of the auto will soon break the connection loose. Never use any acid soldering paste when making soldering joints on PC boards.

The IF transformer is another source of intermittent reception. Simply prod or tap the soldered terminals with an insulated tool or twist the IF can while the radio is playing. Use an ohmmeter to check winding continuity (Fig. 18). Generally, the small capacitors in the base of the IF transformer are the intermittent components.

Don't forget the possibility of an intermittent transistor. When the suspected transistor is placed in a transistor tester, tap the transistor and watch the meter. An inconsistent reading will show up an intermittent transistor.

Noisy Reception. First, see if the interference is outside of the car radio. Check and see if the noise is from the motor and distributor system by starting up the car, then turning the auto ignition off. Noise in the auto distribution system can be cured with generator and distributor suppressors. Perhaps the interference is picked up from high voltage lines or some other outside electrical disturbance.

Actually, all outside noise can only come in through the 'A' or antenna lead. Remove

Transistor Replacement Chart
Fig. 14.

Type		RCA	G.E.	Delco	Workman
RF and Converter	AM	SK3008	GE-9	DS-25	AAI
	FM	SK3006			
IF Transistors	AM	SK3007	GE-9	DS-25	AAI
	FM	SK3006			AA3
AF Detector			IN34 IN60		
AF Amp or Driver		SK3004	GE-2	DS-26	
Power Output		SK3009	GE-3	DS-520	AA4
Power Output		SK30012	GE-4	DS-501	AA5

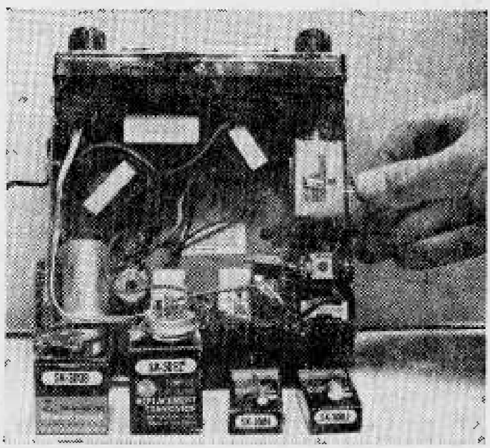


Fig. 15. When replacing transistors, be sure you get the right one in the right place or you may have problems.

RADIO TV REPAIR

FREE WHEELING FIXIT

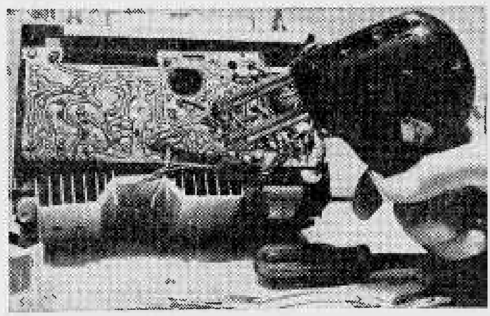


Fig. 16. The fastest way to remedy a hard-to-find cold or intermittent solder joint is to re-solder all the connections.

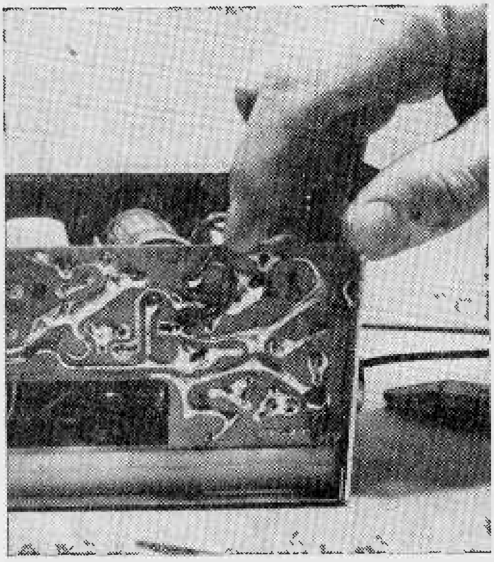


Fig. 17. Finger points to short piece of wire used to bridge broken spot in printed circuit wiring.

the antenna plug to see if the noise is being picked up by the auto antenna. If you still have noise in the radio, place a 0.5 mF capacitor at the fuse connection and ground. Now place a suppressor in the center terminal of the distributor cap. If you still have motor noise, set the plug gap and breaker points closer together. A new set of interference type ignition cables will help finish off the most difficult motor noises.

In case the noise is inside of the radio, replace the audio transistors one at a time. Then replace IF and RF transistors. A partially shorted IF transformer will cause excessive internal noise. When the volume control is turned up and down you will hear if it's dirty or worn. If the control is worn too badly, replace it.

Surprising as it may sound, a transistor can become microphonic, just like a vacuum tube. You will find these microphonic transistors in the RF, converter, and last two audio stages. Microphonic transistors will act up when the car radio is first turned on. In most cases, touching the base terminal of the suspected transistor with a test probe will cause the transistor to snap back to normal operation. If this is the case, replace the transistor.

Filter Troubles. Excessive filter hum may be caused by a filter capacitor. When tuning in a broadcast station, a defective filter capacitor can cause a screeching or squealing condition. Sometimes the connecting wires to the capacitor may be pulled too tight and vibration can cause the terminal lugs to snap off inside the aluminum can.

Simply shunt a good 500 mF electrolytic pacitor at the fuse connection and ground. and right away the hum or squealing condition should clear up. Notice that these filter

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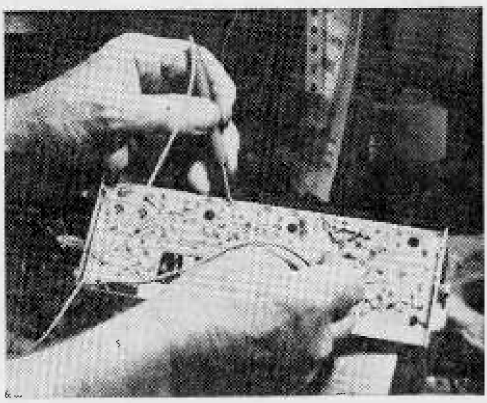


Fig. 18. Quickest way to find imperceptible cracks in printed wiring is by making continuity checks with ohmmeter.

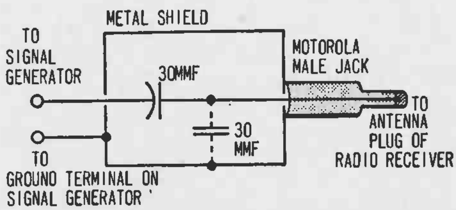
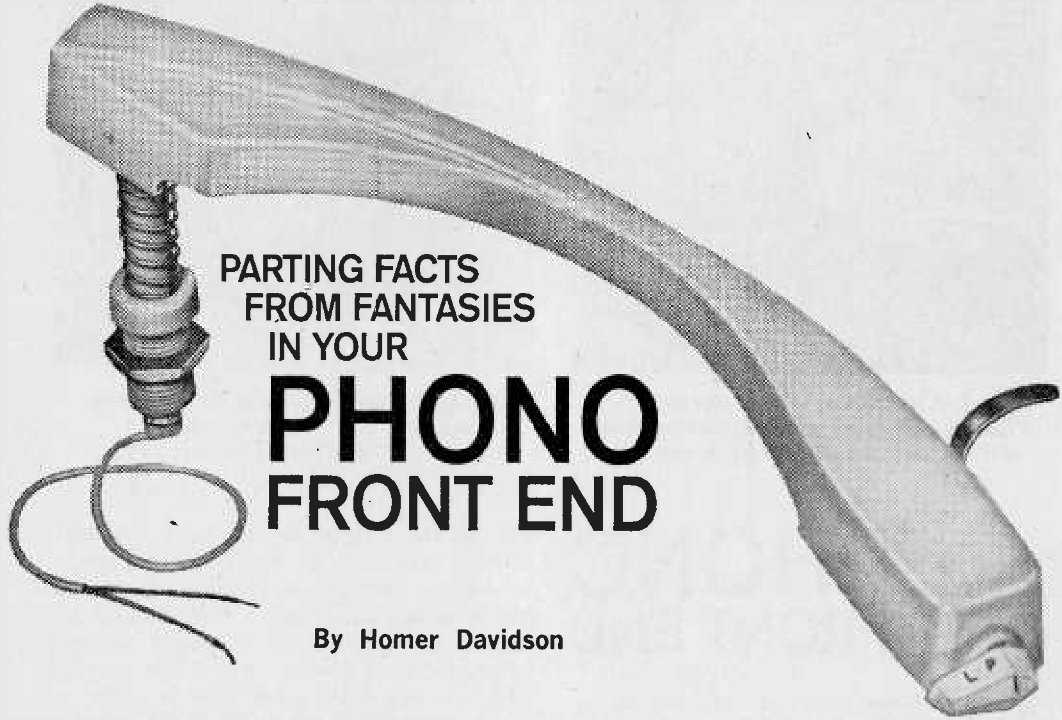


Fig. 19. Dummy antenna is easily constructed and is great aid when performing alignment.



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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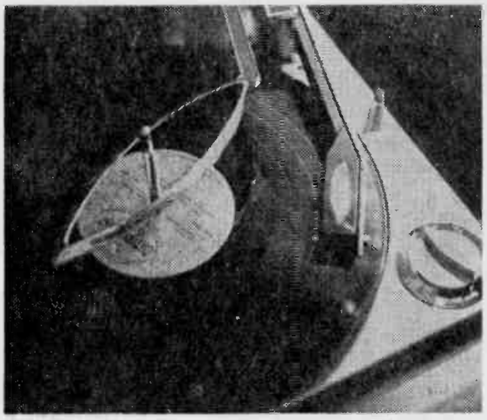

Fig. 1. A chipped or worn stylus will cut the grooves of a record, making them dull-looking; if so, better get a new stylus.

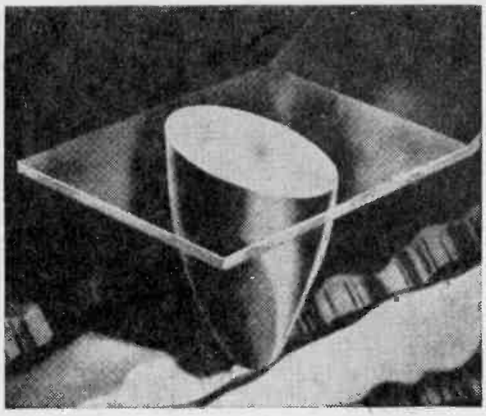

Fig. 2. The tip of a good stylus is actually a rounded "ball" that won't chisel into the soft vinyl record groove.

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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

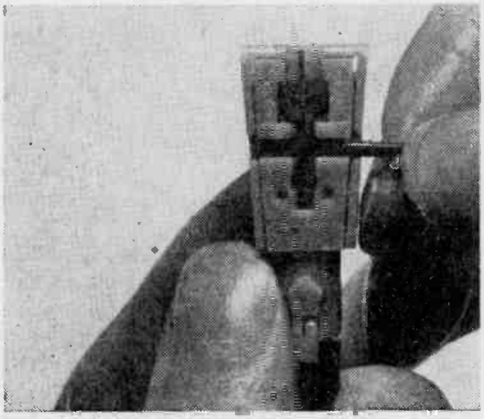

Fig. 6. On this popular cartridge, the stylus shank simply snaps into the plastic cartridge body.

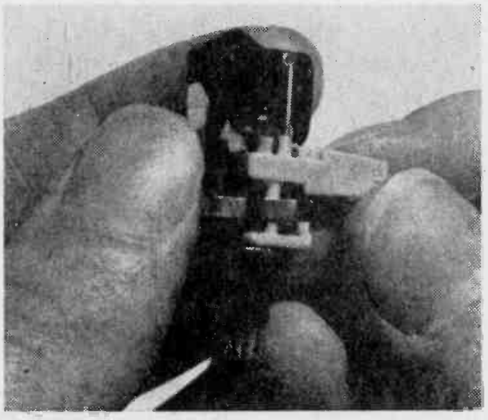

Fig. 7. To remove the stylus assembly from this type cartridge, position the turnover lever as shown.

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

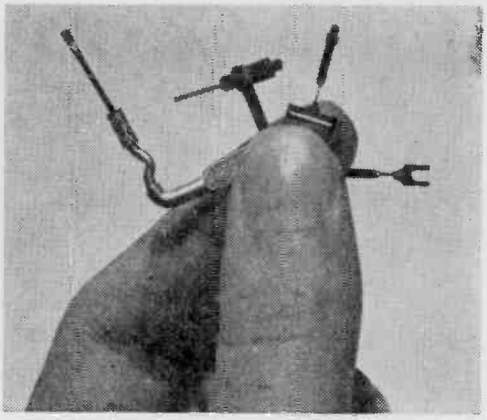

Fig. 4. Dozens of different types of styli can make for confusion on your part. Four typical styli are shown here.

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-

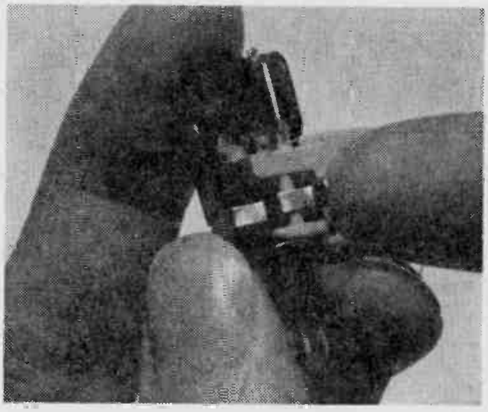

Fig. 5. When removing the stylus for replacement, first check to see how it is attached to the cartridge.

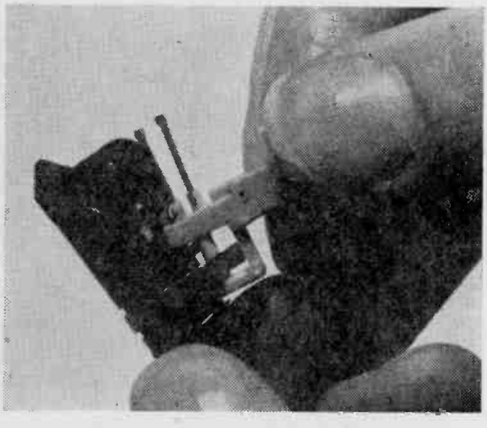

Fig. 8. Gently pull up and away on the stylus assembly; the metal clip gives way with very little pressure.

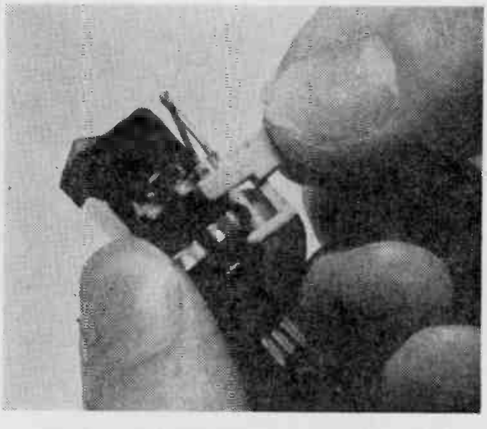

Fig. 9. Pull the stylus assembly clear being very careful not to put strain on the stylus shank or "saddle."

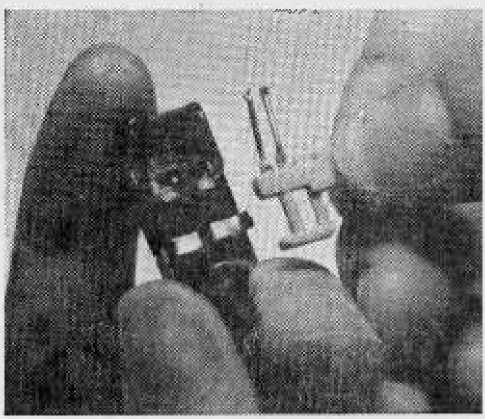

Fig. 10. Replacement of this type of stylus is exactly the reverse process of the removal procedure.

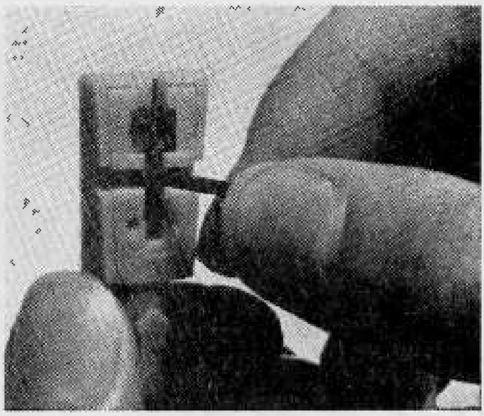

Fig. 11. To remove the stylus assembly in this type of phono cartridge, first turn the stylus-flip lever straight out.

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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.

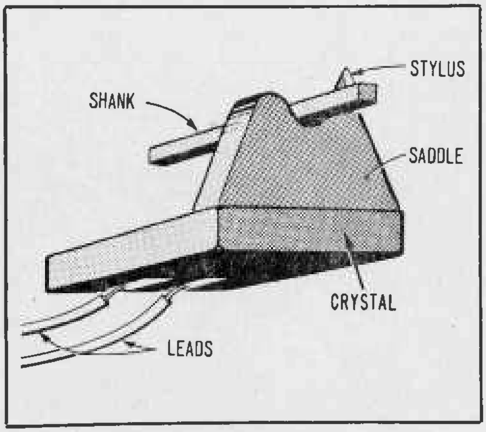


Fig. 15. Stylus shank rides in saddle which is connected to the cartridge element that turns groove wiggle into sound.

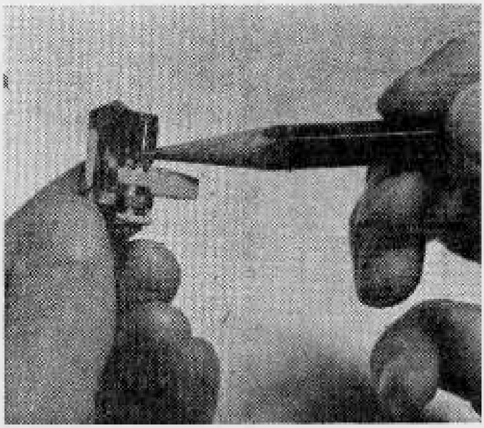


Fig. 16. The pencil points to the U-shaped saddle in a typical cartridge. Be sure stylus shank is properly seated in saddle.

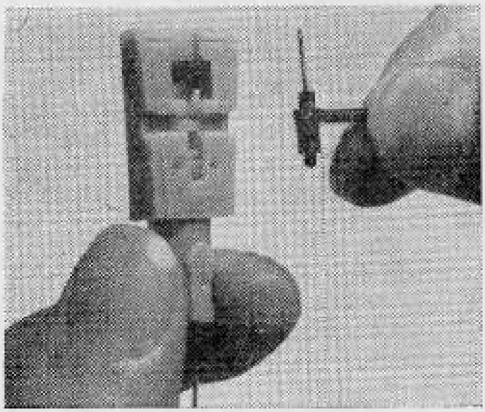


Fig. 12. Then pull it straight away from the cartridge body. To replace the stylus, use the reverse procedure.

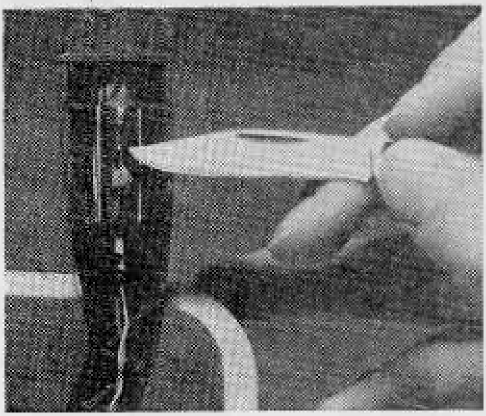


Fig. 13. Another type of stylus mounts on a rubber grommet and can be removed by carefully popping it off with a knife.

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

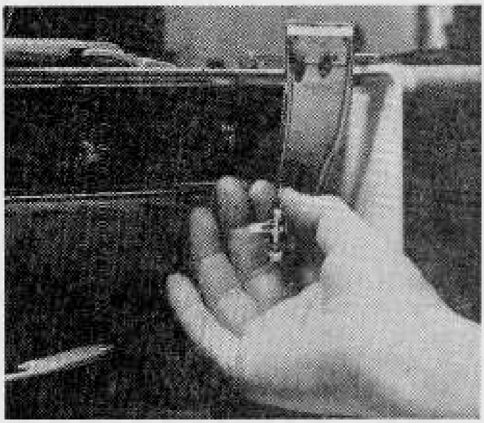


Fig. 14. If the tone-arm has limited vertical movement, cartridge can be removed for easier stylus replacement.

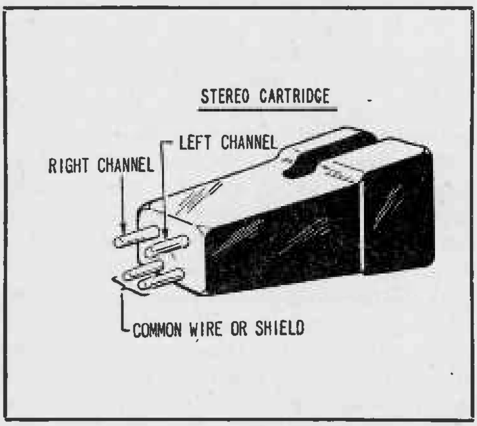


Fig. 17. Typical stereo cartridge has four terminals but only three connecting wires since ground connection is shared.

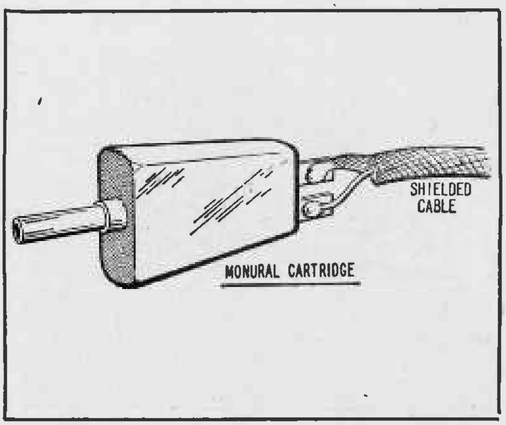


Fig. 18. Mono cartridge is usually hooked up with a shielded cable though in cheapies, it may be just a twisted pair.

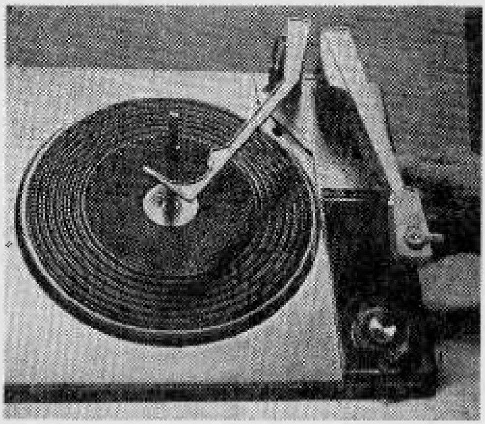


Fig. 19. Using a changer in "manual," be careful not to drop arm as record, stylus, and cartridge may be damaged.

RADIO TV REPAIR 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.

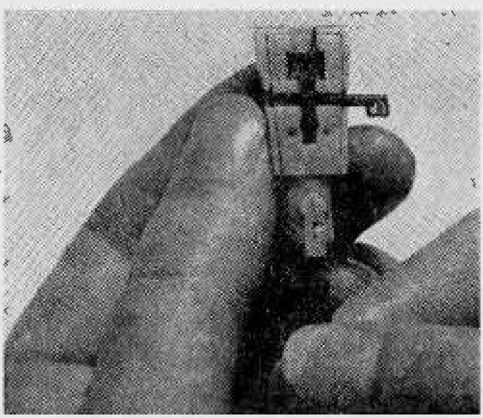


Fig. 22. On this type cartridge, the connecting wires are soldered to a small adapter which then plugs on to the cartridge.

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

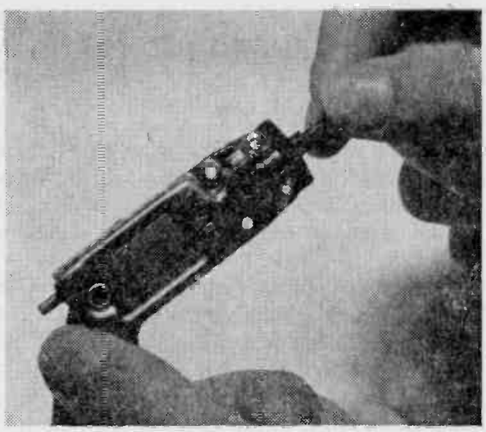


Fig. 20. Old turnover type crystal cartridge mounts and pivots on front shaft; it's removed by taking turnover knob off.

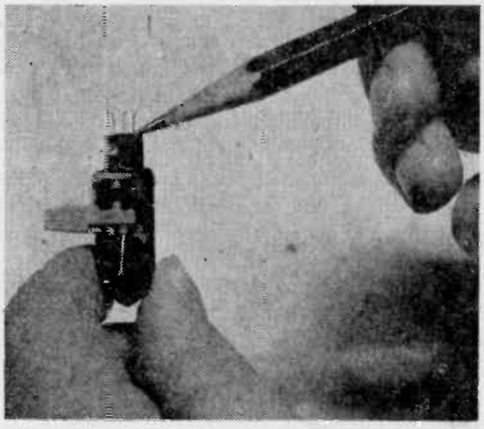


Fig. 21. Some stereo cartridges have only three terminals with center one being common ground for both sides of cartridge.

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.

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

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.

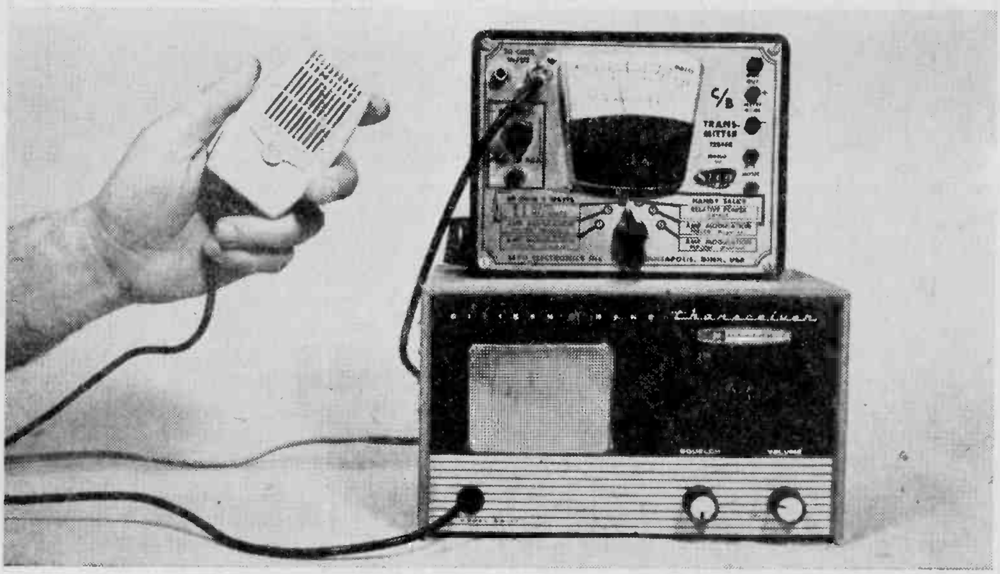
Check The Changer. While replacing the stylus or cartridge, a few, quick checks should be made on the record changer.

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. ■



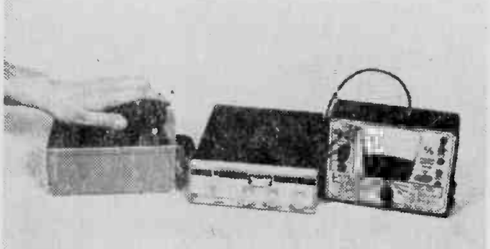
CB Servicing Simplified

By Bill Britton

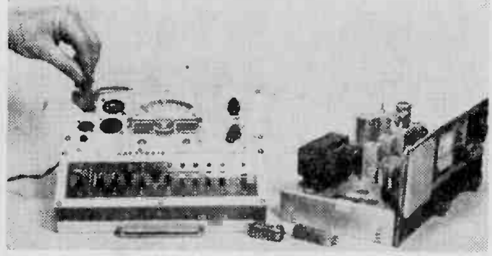
□ Because almost all CB transceivers (with the possible exception of high performance frequency synthesis models) do not use highly sophisticated circuitry, it takes just a few relatively inexpensive instruments—and common sense—to handle most of the problems you're likely to run across. It's only when you want to take on the responsibility (and extra fees) of frequency measurement that specialized test gear is required.

Eyeball Checkout. As in all electronics servicing, the first checks should be made with the eyes; just a few careful glances can save a lot of unnecessary troubleshooting. All connecting cables such as power and antenna leads should be inspected for fraying, broken strands, and complete breaks. (Many is the CB rig that is repaired by simply replacing the power cord that has the conductors broken under the insulation.) If the transceiver's power cord has an in-line fuseholder, check the wire where it enters the holder. All too many manufacturers use solid wire for the mobile power leads, and solid wire tends to break at a bending point.

And don't forget to check the fuse. It's not uncommon for a fuse to become "fatigued" and open for no apparent reason. If a replacement fuse blows, check for a shorted tube or transistor. Tubes can be checked in a tube-checker; transistors can be checked by touching the transistor case (a shorted transistor generally runs relatively hot). *(Turn page.)*



Placing mike on top of speaker emitting steady tone saves talking when checking modulator.



Most CB troubles are solved by replacing bad tubes. When in doubt, try a new tube anyway.

CB SERVICING

If the fuse blows only on the mobile power supply you'll have to check the mobile supply power components—the vibrator (if used) and its associated capacitor filters (if any) or the switching transistors.

Should eyeball checks fail to reveal the nature of the breakdown, start with the most basic of servicing techniques—a complete tube check. (90% of all service work is simply a replacement tube). But keep in mind that tube-checkers aren't infallible. If a tube tests *good* but the pointer moves erratically when the tube is tapped, or if the pointer wavers, try a new tube, anyway. Tubes used in RF service have been known to check out okay in a tube-tester but still fail to operate in a transceiver.

Troubleshooting. While a CB transceiver is more complex than an ordinary AM radio, servicing is somewhat simplified because the circuitry is arranged in interdependent blocks (see our diagram). The power supply excepted, the failure of one block often doesn't cause the failure of another block. For example, in our block-diagram transceiver, failure in the IF amplifier section wouldn't prevent the transmitter from functioning. Similarly, failure in the transmitter wouldn't interfere with reception.

What happens if the modulator fails? Simple—you couldn't receive and you couldn't modulate, but you *could* transmit a "dead carrier."

See the logic to the *block system* of CB servicing? You use the working circuits as signposts to the defective circuits.

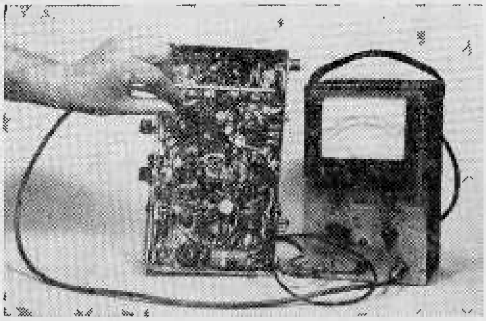
Try your hand on a few typical CB service problems to get the hang of block circuits. Tackle this problem first: The customer complains of no reception. What is your first troubleshooting procedure? If you said test for modulated RF output you are correct. Here's why.

If the transmitter can be modulated it shows that the power supply and the audio amplifier/modulator are working. Therefore, you have eliminated the audio section as a probable cause of trouble, and the breakdown in the receiver must be between the antenna and the detector.

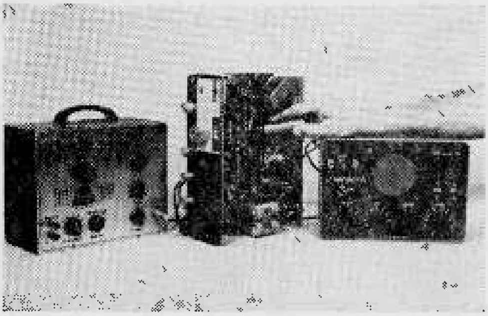
Here's another. The complaint is no modulation. What's your first check? You're right if you try the mike preamp. If the transmitter is working as evidenced by a "dead carrier," and the receiver is working, you know that the section of the audio system common to the receiver and transmitter is okay. Referring to the block diagram you see that there is a preamplifier which is used only for transmitting. The logical place to look for trouble then is in the preamplifier.

And how about this one? Complaint is that the entire transceiver is inoperative but that the tubes light. You can't get any reception, get nothing through the PA output, and the transmitter fails to budge the RF output meter. Where to look first? Right, the power supply, since it's common to all circuits in the transceiver.

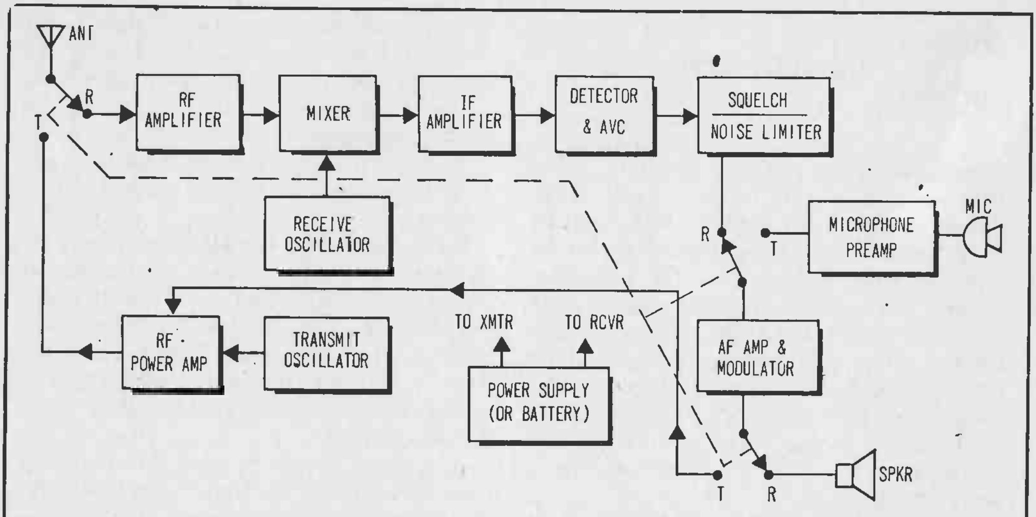
Test Gear. Once the defective circuit is located, you've got to get in there and find the exact component(s) that's defective. Best instrument for this job is a VTVM. Why not a VOM? Because a VOM's internal resistance can seriously load the RF, IF, and oscillator circuits in a tube transceiver and virtually all the circuits in a solid-state model. On the other hand, a VTVM with its very high DC probe resistance (generally about 11 megohms) won't affect critical circuits. In fact, you can even measure DC on the



For the serious do-it-your-selfer, a VTVM is very advantageous for accurate measurements of critical RF circuitry in CB gear.



For the really tough dogs, using a signal generator and a signal tracer provides a sure-fire route to pinpointing the problem.



Simplified block diagram of typical CB rig can be used as a guideline in troubleshooting.

oscillator plate without detuning the oscillator.

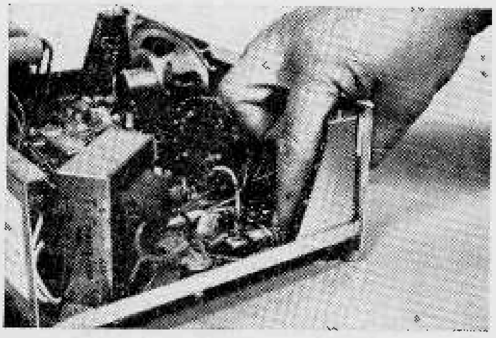
While a DC voltage and resistance analysis will often eventually locate the trouble, it's a time-consuming way to do it. Receivers can generally be quickly serviced by signal tracing. For example, feed an RF signal into the antenna input, and then, using an RF/AF signal tracer, you trace the signal from the plate of the RF amplifier to the speaker.

At some point you will lose the signal—and the defect then lies between that point (say the plate of an IF amplifier) and the previous check point where you heard the signal in the tracer (say the grid of the IF amplifier). You then have the trouble pinpointed and a few DC and resistance checks should turn up the defective component(s).

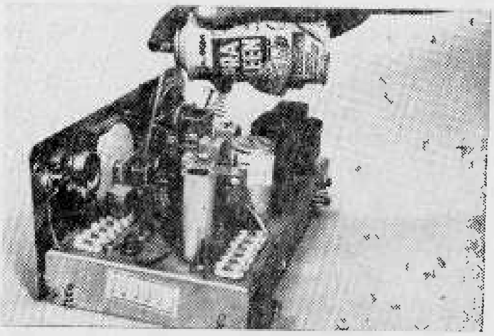
The transmitter can be similarly "traced," though the signal source and the signal tracer are different. The signal source is the oscillator itself. The signal tracer is an RF probe connected to the VTVM that indicates RF in terms of DC voltage reading. Starting at the oscillator plate you move the RF probe towards the antenna. The defect is between the point where the VTVM fails to indicate and the previous point which resulted in a meter reading.

The Dirt Problem. Quite often, extensive troubleshooting will turn up nothing more spectacular than a speck of dirt. Just a little dirt on an exposed relay terminal (the T/R relay) is all it takes to knock out the DC supply to a receiver section, or prevent the RF from getting from the transmitter final to the antenna.

Relays are best cleaned with a burnishing tool, a specially etched strip of metal that will remove dirt and corrosion from relay contacts without destroying the contact. Never use sandpaper to clean relay (or



Shorted transistors tell on themselves by heating up. For this reason, a limber finger can locate shorted transistors in a jiffy.



Contact cleaner in a spray can is great for cleaning up dirty switch contacts; just spray on while flipping switch a couple times.

switch) contacts; this can result in pitted contacts, which will in turn cause more pitting until the relay contacts fuse together.

Noisy volume controls should always be replaced, since noise is generally an indicator of a worn carbon element, and the noise is bound to return if the control is just cleaned. But in a pinch, there's nothing wrong with shooting control cleaner under the control cover to stop the noise. Just don't be surprised if the noise returns. (When you're doing a paying job always replace a noisy control.)

The microphone cable of heavily used transceivers often develops "opens" under the outer insulation at the point where the cable leaves the microphone and where it enters the mike connector or chassis (these are the maximum stress points). If you suspect the mike or its connector, simply key the transmitter, and while monitoring the signal on another transceiver or modulation monitor, place your finger on the grid of the mike preamplifier. If you hear hum, either the mike is defective or the cable is broken. (A loud hum with the mike connected is often caused by a broken shield lead.)

The Elusive Ones. Remember, too, that poor transceiver performance isn't always caused by a defective component. Quite often, poor sensitivity and low RF power output is due to normal component aging, which in turn results in detuning of tuned RF circuits. If you suspect the receiver has drifted out of alignment, do a complete alignment job following the manufacturer's procedure. (Never try to "trim" one or two stages). If an IF stage's tuning has drastically changed, it's likely the remaining IF and RF amplifiers have also drifted. Once you've got the signal generator on the bench it's just as easy to do a full alignment as a "trimming."

While any service grade signal generator can be used for alignment, a calibrated-output generator must be used if you want to compare the actual receiver sensitivity against the manufacturer's claims or original performance specifications.

Any transceiver service job should end with a complete tuning and check for the transmitter. Tuning, of course, is easily accomplished by connecting a combination dummy-load/wattmeter to the antenna jack and tuning the transmitter for 5 watts RF plate input power. The RF output power for 5 watts input should then be compared against original performance. If it is more than ½ watt below specs, chances are the transmitter needs something more than just a tuning.

Since transmitter tuning often affects the oscillator output frequency, a transmitter frequency check should be made after the final tune-up. For this job a CB frequency meter is an absolute must. There is no other way to measure frequency, unless you're willing to spend a thousand dollars for a digital counter.

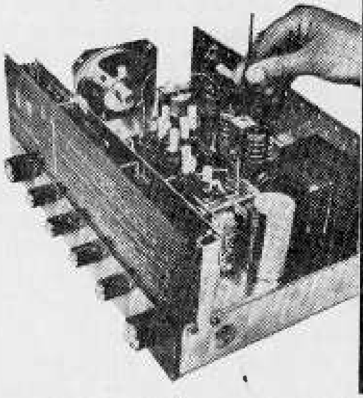
A receiver cannot be used for frequency measurements. While some CBers consider the transmitter on-frequency if its signal causes another transceiver's S-meter to "peak," there is obviously no relationship between the S-meter reading and a transmitter's frequency. In fact, the S-meter "peak" will be determined by the receiver's alignment, not by the transmitter.

Complex Transceivers. As we've indicated, servicing of the more or less common transceiver—using separate receive and transmit oscillators—can be tackled by anyone with a reasonable degree of service skill and experience. However, the new frequency synthesized high-performance transceivers are generally best left to an authorized service center on account of the frequency synthesizer and selective IF filters.

Of course, not all high-performance transceivers are beyond the capabilities of service-grade instruments. Even so, the CB technician should be certain *before* starting any service procedure that his instruments conform to the transceiver manufacturer's minimum standards. ■

CB crystal checkers don't tell you if crystal is really hot—best way is to compare reading of suspect crystal against good one.

By Herb Friedman



soup-up for S-W sets

Old shortwave receivers seldom die—they just try to fade away

■ From the instant it's first turned on, the performance of even the most expensive shortwave receiver slowly deteriorates. And after a year or so, the SW bands get less and less crowded as weaker stations disappear into the receiver's inherent noise level.

Fortunately, most SW receiver ills are caused by normal aging of components in the tuned circuits. And this in plain terms means that a good alignment job should restore like-new performance. We say *should* rather than *will* because receiver alignment, while not normally difficult, can be somewhat tricky. Get sloppy on just one tuning adjustment and any extra care given the other tuned circuits is worthless.

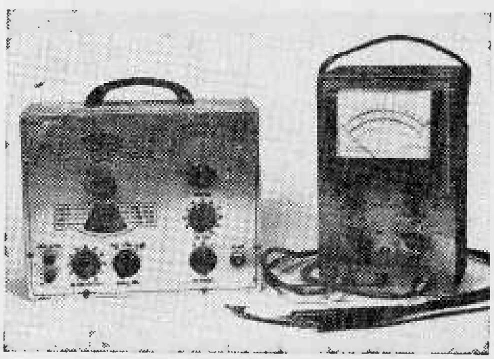
Good receiver alignment requires the technician to have a single point of focus: *maximum gain*. For with rare exception, maximum sensitivity, selectivity, AGC action, and noise reduction are obtained only when all circuits are tuned for maximum gain. In fact, it's only when the receiver has special high selectivity circuits such as a crystal filter that there is a slight departure from the focus of maximum gain.

Why Alignment? The block diagram of a basic SW receiver (see next page) illustrates the importance of alignment. Strange as it seems, it is the IF amplifier that primarily determines which signal (of many) is received.

For the sake of discussion, let's assume two signals are received by the RF amplifier. One signal is at 2 MHz, the other at 2.01 MHz; the difference (separation) between the two signals is 10 kHz. Since RF amplifiers are normally not sharp tuning devices, both signals will pass through. To be sure, one will be amplified more than the other, depending on the RF amplifier tuning. But both will still pass through.

Now these two signals are "beat" together in the mixer with the local oscillator which is at, say, 2.455 MHz. The output of the mixer will consist of several frequencies, one of which will be the difference between 2.455 MHz, and 2 MHz, or 455 kHz; the other will be the difference between 2.455 MHz and 2.01 MHz, or 445 kHz. Obviously, any received signals which fall between 2 and 2.01 MHz will now fall between 455 and 445 kHz at the output of the mixer.

If the IF amplifier following the mixer were tuned to 445 kHz the input signal of 2.01 MHz would be the received signal. On the other hand, if the IF amplifier were tuned to 455 kHz it would be the 2 MHz signal that would be received. Now assume the IF were originally tuned to 455 kHz to receive the 2 MHz signal, but that it had somehow



Three things needed to bring back that SW rig are a service-grade signal generator, a VOM or (preferably) VTVM, and a little patience.

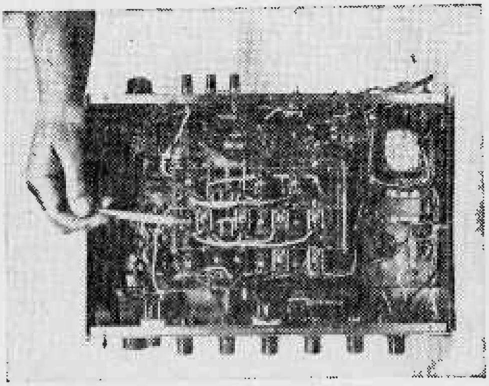
drifted (detuned) to 450 kHz. In this case, the IF amplifier would no longer give maximum gain to the 2-MHz signal but to some signal 5 kHz higher than 2 MHz. As you see, the IF amplifier tuning determines which of many signals fed into the RF amplifier gets maximum gain. Therefore, the IF amplifier should be the first step in alignment procedure.

IF Alignment. Somewhere in the receiver's instruction manual is the IF frequency —or frequencies, in the instance of double-conversion receivers—for your particular receiver. If yours is a double-conversion set, the second IF strip should be aligned first. Set the output frequency of a signal generator to the given frequency and connect a VTVM across the AVC bus. (If you don't have a VTVM, connect an AF output meter or a VOM on its AC range across the speaker terminals.) This done, set the meter to its lowest usable range.

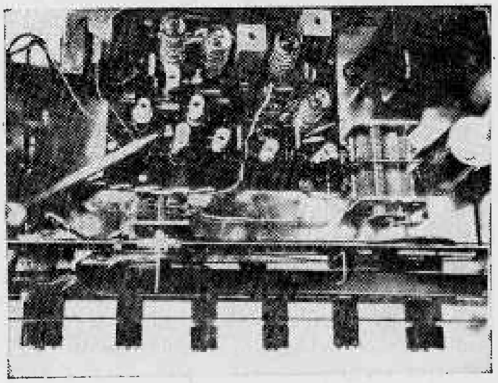
Using a 0.001 uF capacitor (or the value suggested in the generator or receiver manual) in series with the generator's hot output lead, connect the generator to the input grid of the mixer or the first IF amplifier (whichever is suggested by the receiver manufacturer). Next, employing the lowest possible generator output voltage that will cause the VTVM or VOM pointer to just barely rise, adjust the top and bottom slugs of each IF transformer for maximum meter reading. As the adjustment causes the meter pointer to rise, keep reducing the generator's output to the lowest usable level.

Some manufacturers suggest that alignment be done stage by stage, working back from the grid of the last IF amplifier. However, this procedure generally isn't necessary unless an IF transformer or coil has been replaced and the signal can't be fed through the entire IF amplifier as detailed above.

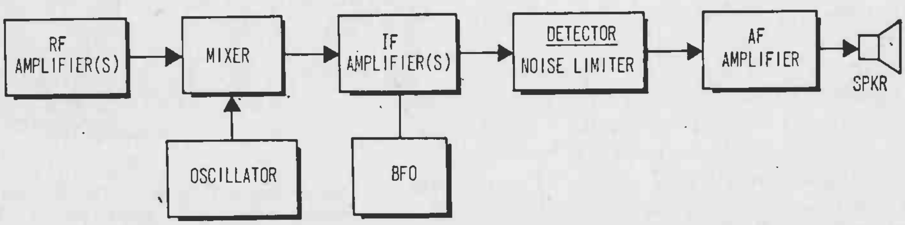
Since adjustment of one IF slug often upsets the adjustment of the other slug, the top and bottom slug of each transformer should be adjusted in pairs several times until no further improvement can be obtained. Further, if the receiver has a crystal filter that requires special alignment techniques, make certain you follow the manufacturer's



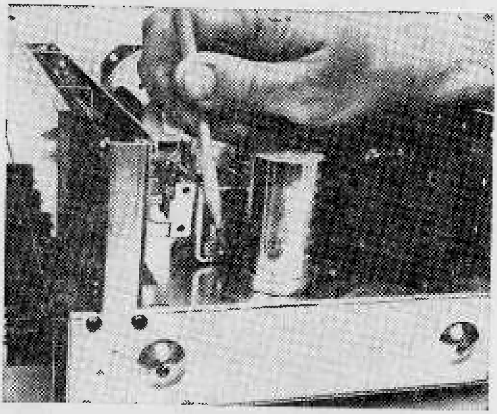
Strip arrangement (see pencil) is common for RF circuits in high-quality receivers.



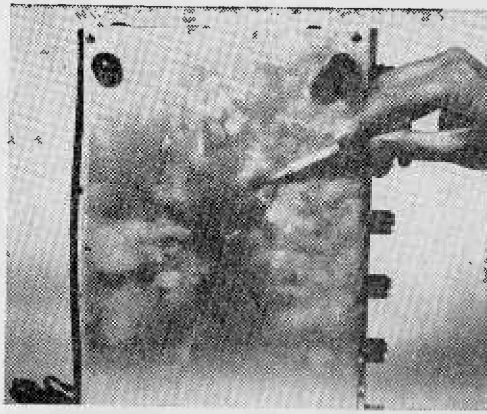
Pencil indicates screw of piston-type trimmer capacitor used in front end of newer SW rigs.



Block diagram shows major sections of typical single-conversion SW receiver.



On some receivers, the Broadcast Band trimmer capacitor is located on tuning capacitor.



Trimmer capacitors accessible through bottom cover should be aligned with cover in place.

procedure to the letter. A misaligned crystal filter can easily destroy overall receiver performance.

The Front-End. After you're certain the IF amplifier(s) is critically aligned, it's time to do the front-end—the RF amplifier and the oscillator tuning.

The front-end performs three functions. First, it provides amplification of the RF signal, which in turn provides a good signal-to-noise ratio by providing a high-level RF input to the mixer. Second, it sharply discriminates against other RF signals not at the desired frequency, thereby reducing or effectively eliminating image response. (Image signals are signals removed from the desired frequency by a factor of 2X the IF frequency. If the front-end cannot reject the image frequency signals, the image frequency will also be fed through the IF amplifier.) And third, the front-end provides the local oscillator that heterodynes (beats) the RF signal to the IF or first-IF frequency.

Though there are many combinations of front-end alignments that will produce received signals, there is only one alignment that will result in accurate dial calibration. And in fact, front-end (or RF alignment as it's often termed) does two things: it adjusts the local oscillator (if it isn't crystal-controlled) so that the dial corresponds to the frequency being received, and it adjusts the tuning of the RF amplifier so that regardless of the position of the tuning control the RF amplifier provides maximum gain at the received signal frequency.

Band By Band. Each band has its own front-end tuning adjustments. If the receiver has five bands there are five sets of tuning adjustments, though the tuning adjustment for the Broadcast Band might differ from those for the various SW bands. The most important part of the alignment, next to accurate calibration of the oscillator to the dial calibration is the tracking.

Each tuned circuit in the RF amplifier and the oscillator has at least one coil and one trimmer (some older receivers have two trimmers). The object is to adjust the coil for tracking at the low end of the band and the trimmer capacitor for high end tracking.

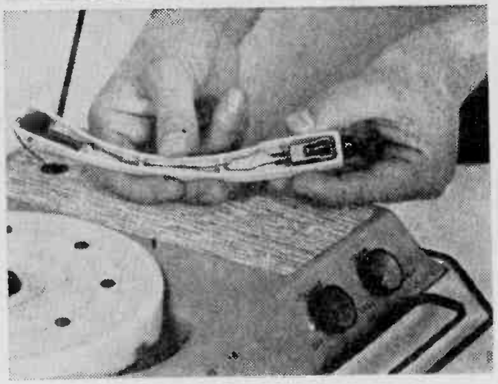
Since the adjustment of the coil affects trimmer adjustment, and vice versa, it's necessary to repeat the coil/trimmer adjustments for each band many, many times, until no further adjustment can be obtained. When the oscillator's coil and trimmer adjustments are correct, the dial calibration should be accurate across the entire band, not just at the high and low end. Similarly, the RF amplifier should have maximum gain across the entire band in step with the oscillator tuning.

Test Equipment. As a general rule, most service-grade signal generators are more than adequate for the average SW receiver alignment, and only a VTVM or VOM is needed to complete the test set-up. However, if the technician desires to compare the receiver's re-aligned vs. when-new performance, a calibrated signal generator is required (such generators have meters to directly indicate the RF input level fed to the receiver).

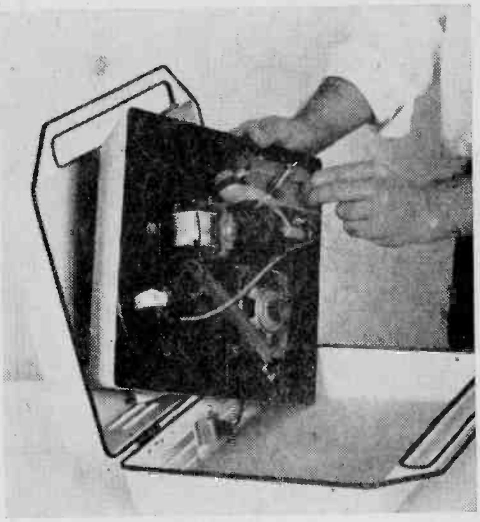
In reality, though, this is really gilding-the-lily; for the calibrated generator offers no effective advantage as far as the actual alignment is concerned. In fact, in meaningful terms, the $50 service grade generator will do just as good an alignment job as the $500 calibrated generator. ■

Kiddie Phono Repair

Continued from page 34



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.



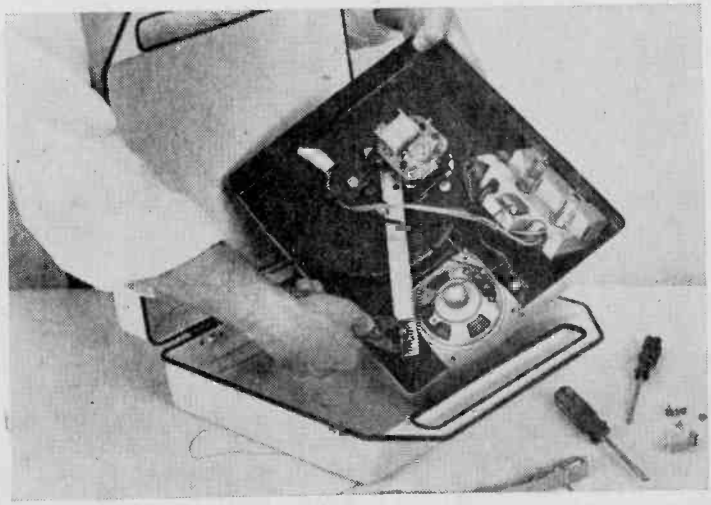
Amplifier/speaker section of kiddie phono generally contains one or two tubes in an AC/DC circuit. Inoperative amplifier usually stems from burned-out tube; damaged speaker often proves to be the cause of distorted sound.

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 18

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.

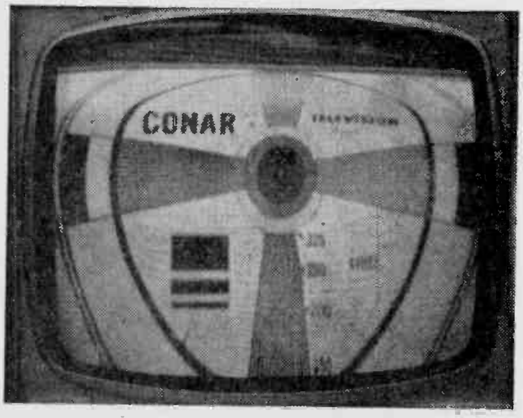


Fig. 24. Flat-topped circle can be made round again by adjusting both the vertical linearity and the vertical height controls together.

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. ■

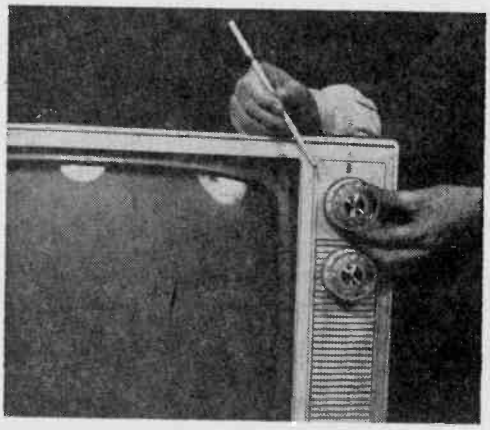


Fig. 25. Final tune-up consists of adjusting tuner slugs to center range of fine-tuning.

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

Color Killer

Continued from page 53

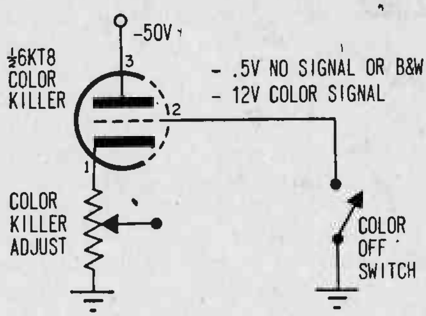


Fig. 8. Color killer stage operating voltages are set up so when no signal comes from burst amp, killer stage will not conduct. Color killer adjust control is set so that weak color signals will just deactivate killer stage.

dog cases require an actual look at the signal as it passes through the killer circuitry. You'll need a reasonably good scope—one rated up to 5MHz—and a low-capacitance probe. This combination permits you to measure the circuit without upsetting its normal operation. Again, the manufacturer's service literature comes to the rescue. As shown in Fig. 9 he supplies actual scope waveforms spotted at important points in the circuit. The scope should not only display the same shape for these waveforms, but voltages must be fairly close as well.

Voltage is almost always shown as P-P, or peak-to-peak, when it refers to a scope waveform. This means the scope must have a built-in calibrator to serve as a reference or you must use an external voltage calibrator to help set up scope controls. An example of scope waveforms in Fig. 9 comes from the burst amp found in an RCA set. You can see that the burst signal applied to the grid should be 65 volts peak-to-peak, while the emerging signal at the plate is 200 volts peak-to-peak. If you see the input signal on the scope, but fail to observe the output, this is a sure sign of trouble in the stage. Note that the +400 volts at the plate (pin 5) is a B+ supply voltage measured with a VTVM. Thus, a combination of scope and meter can track down nearly any killer trouble you're apt to encounter. ■

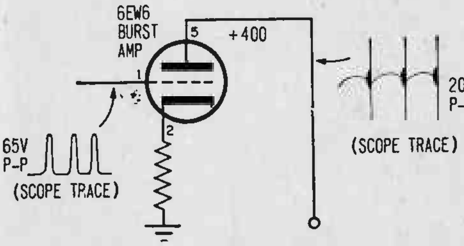


Fig. 9. Tough dog problems can be tracked down with the aid of the manufacturers' service literature showing voltages and waveforms, and a scope.

Free Wheeling Fixit

Continued from page 78

capacitors are of the high capacity variety with low working voltage. The capacity range is usually from 250 to 100 uF at 16 volts.

Receiver Alignment. Auto radio receiver alignment is rather simple if a signal generator is handy. If not, take the radio receiver to a qualified radio-TV shop. Generally, receiver alignment is only necessary after the radio becomes well worn or when replacing a defective IF transformer.

Take the signal generator and couple a 0.1 uF capacitor in series with the probe and hook to the base terminal of the converter transistor. Ground the shield to the radio chassis. Set the signal generator to 262 kHz with 400-Hz modulation, and place an output meter across the speaker voice coil leads. Some VOMs already have built-in output meter jack. Leave the tuning dial at the extreme high end of the radio dial. Adjust the top and bottom slug of each IF transformer for maximum reading on the output meter.

Construct a homemade dummy antenna and place the signal generator in series with it, as shown in Fig. 19. Set the signal generator frequency at 1615 kHz with radio tuning dial at this same frequency. Now adjust the RF and oscillator trimmer screws for maximum reading on the output meter. This done, go back and recheck the whole alignment procedure.

Last Minute Checks. Before buttoning up the bottom cover, check the pilot light. If defective, replace with a 12-volt 1892 or 1891 pilot light. Wipe off the dust from the dial assembly and sweep out chassis dust with an old paint brush. Now is also the time to check and reset those push buttons.

Also, see if the local broadcast stations are in tune with the tuning dial. If not, loosen up the dial pointer and set it. ■

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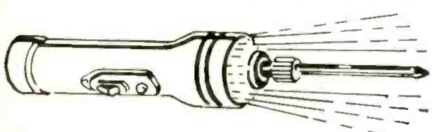

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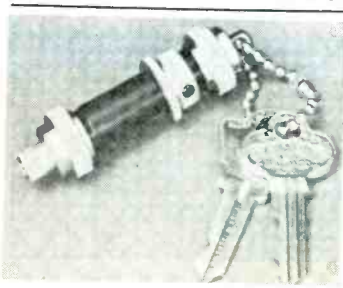
- ☐ Xtra Crystals for G—\$1.50 per box

Model H—6,000 cubic feet
Model G—12,000 cubic feet

NAVAL JELLY Removes Rust

by chemical combination. A modern miracle, use on tools, equipment, autos, toys, etc. Introductory 100 Sq. foot supply \$2.95 postpaid.



Secret Tear Gas Ornament

looks like a tiny key chain gimmick, made for British Secret Service, blasts a wide spread 38 cal. charge of the new McNamara Choice Tear Gas (CS—stun gas)—a real professional, safe, completely secret device that stops an aggressor in his tracks, renders him utterly helpless instantly but is harmless (he recovers in an hour). Precision machined from steel and brass, will not fire accidentally, requires no license or permit. Complete with 2 38-cal. shells, one talcum powder practice shell. We pay all shipping costs anywhere in USA. \$16.50—3 for \$12 ea.

CHEROKEE INSTITUTE, Dept. RT-68
310 West 9th St., Kansas City, Mo. 64105

Ship as follows:

Rod Saws ☐ 1 ☐ 3 ☐ 6
☐ Naval Jelly ☐ Bugmasters as checked above
☐ Pilot Lights ☐ Screw Driver Lights
☐ Tear Gas Ornaments ☐ 1 ☐ 3
☐ Tear Gas Cigarette Lighters @ \$14.95 ea. ppd. (complete with 6 tg shells and 6 blanks)

Name ____________________

Address ____________________

City ____________ State ____________ Zip ____________

BUILD 20 RADIO

CIRCUITS AT HOME

with the New Improved

PROGRESSIVE RADIO "EDU-KIT"®

only **$26.95**

Reg. U. S. Pat. Off.

Training Electronics Technicians Since 1946

A Practical Home Radio Course

Now Includes

- ★ 12 RECEIVERS
- ★ 3 TRANSMITTERS
- ★ SQ. WAVE GENERATOR
- ★ SIGNAL TRACER
- ★ AMPLIFIER
- ★ SIGNAL INJECTOR
- ★ CODE OSCILLATOR

- ★ No Knowledge of Radio Necessary
- ★ No Additional Parts or Tools Needed
- ★ EXCELLENT BACKGROUND FOR TV
- ★ SCHOOL INQUIRIES INVITED
- ★ Sold In 79 Countries

YOU DON'T HAVE TO SPEND HUNDREDS OF DOLLARS FOR A RADIO COURSE

The "Edu-Kit" offers you an outstanding PRACTICAL HOME RADIO COURSE at a rock-bottom price. Our Kit is designed to train Radio & Electronics Technicians, making use of the most modern methods of home training. You will learn radio theory, construction practice and servicing. THIS IS A COMPLETE RADIO COURSE IN EVERY DETAIL.

You will learn how to build radios, using regular schematics; how to wire and solder in a professional manner; how to service radios. You will work with the standard type of punched metal chassis as well as the latest development of Printed Circuit chassis.

You will learn the basic principles of radio. You will construct, study and work with RF and AF amplifiers and oscillators, detectors, rectifiers, test equipment. You will learn and practice code, using the Progressive Code Oscillator. You will learn and practice trouble-shooting, using the Progressive Signal Tracer, Progressive Signal Injector, Progressive Dynamic Radio & Electronics Tester, Square Wave Generator and the accompanying instructional material.

You will receive training for the Novice, Technician and General Classes of F.C.C. Radio Amateur Licenses. You will build Receiver, Transmitter, Square Wave Generator, Code Oscillator, Signal Tracer and Signal Injector circuits, and learn how to operate them. You will receive an excellent background for television, Hi-Fi and Electronics.

Absolutely no previous knowledge of radio or science is required. The "Edu-Kit" is the product of many years of teaching and engineering experience. The "Edu-Kit" will provide you with a basic education in Electronics and Radio, worth many times the low price you pay. The Signal Tracer alone is worth more than the price of the kit.

THE KIT FOR EVERYONE

You do not need the slightest background in radio or science. Whether you are interested in Radio & Electronics because you want an interesting hobby, a well paying business or a job with a future, you will find the "Edu-Kit" a worth-while investment.

Many thousands of individuals of all ages and backgrounds have successfully used the "Edu-Kit" in more than 79 countries of the world. The "Edu-Kit" has been carefully designed, step by step, so that you cannot make a mistake. The "Edu-Kit" allows you to teach yourself at your own rate. No instructor is necessary.

PROGRESSIVE TEACHING METHOD

The Progressive Radio "Edu-Kit" is the foremost educational radio kit in the world, and is universally accepted as the standard in the field of electronics training. The "Edu-Kit" uses the modern educational principle of "Learn by Doing." Therefore you construct, learn schematics, study theory, practice trouble shooting—all in a closely integrated program designed to provide an easily-learned, thorough and interesting background in radio.

You begin by examining the various radio parts of the "Edu-Kit." You then learn the function, theory and wiring of these parts. Then you build a simple radio. With this first set you will enjoy listening to regular broadcast stations, learn theory, practice testing and trouble-shooting. Then you build a more advanced radio, learn more advanced theory and techniques. Gradually, in a progressive manner, and at your own rate, you will find yourself constructing more advanced multi-tube radio circuits, and doing work like a professional Radio Technician.

Included in the "Edu-Kit" course are Receiver, Transmitter, Code Oscillator, Signal Tracer, Square Wave Generator and Signal Injector Circuits. These are not unprofessional "breadboard" experiments, but genuine radio circuits, constructed by means of professional wiring and soldering on metal chassis, plus the new method of radio construction known as "Printed Circuitry." These circuits operate on your regular AC or DC house current.

THE "EDU-KIT" IS COMPLETE

You will receive all parts and instructions necessary to build twenty different radio and electronics circuits, each guaranteed to operate. Our Kits contain tubes, tube sockets, variable, electrolytic, mica, ceramic and paper dielectric condensers, resistors, tie strips, hardware, tubing, punched metal chassis, Instruction Manuals, hook-up wire, solder, selenium rectifiers, coils, volume controls and switches, etc.

In addition, you receive Printed Circuit materials, including Printed Circuit chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools, a professional electric soldering iron, and a self-powered Dynamic Radio and Electronics Tester. The "Edu-Kit" also includes Code Instructions and the Progressive Code Oscillator, in addition to F.C.C. Radio Amateur License training. You will also receive lessons for servicing with the Progressive Signal Tracer and the Progressive Signal Injector, a High Fidelity Guide and a Quiz Book. You receive Membership in Radio-TV Club, Free Consultation Service, Certificate of Merit and Discount Privileges. You receive all parts, tools, instructions, etc. Everything is yours to keep.

Progressive "Edu-Kits" Inc., 1186 Broadway, Dept. 510DK, Hewlett, N. Y. 11557

FREE EXTRAS

• SET OF TOOLS

- SOLDERING IRON
- ELECTRONICS TESTER
- PLIERS-CUTTERS
- VALUABLE DISCOUNT CARD
- CERTIFICATE OF MERIT
- TESTER INSTRUCTION MANUAL
- HIGH FIDELITY GUIDE • QUIZZES
- TELEVISION BOOK • RADIO TROUBLE-SHOOTING BOOK
- MEMBERSHIP IN RADIO-TV CLUB: CONSULTATION SERVICE • FCC AMATEUR LICENSE TRAINING
- PRINTED CIRCUITRY

SERVICING LESSONS

You will learn trouble-shooting and servicing in a progressive manner. You will practice repairs on the sets that you construct. You will learn symptoms and causes of trouble in home, portable and car radios. You will learn how to use the professional Signal Tracer, the unique Signal Injector and the dynamic Radio & Electronics Tester. While you are learning in this practical way, you will be able to do many a repair job for your friends and neighbors, and charge fees which will far exceed the price of the "Edu-Kit." Our Consultation Service will help you with any technical problems you may have.

FROM OUR MAIL BAG

J. Stataitis, of 25 Poplar Pl., Waterbury, Conn., writes: "I have repaired several sets for my friends, and made money. The "Edu-Kit" paid for itself. I was ready to spend $240 for a Course, but I found your ad and sent for your Kit."

Ben Valerio, P. O. Box 21, Magna, Utah: "The Edu-Kits are wonderful. Here I am sending you the questions and also the answers for them. I have been in Radio for the last seven years, but like to work with Radio Kits, and like to build Radio Testing Equipment. I enjoyed every minute I worked with the different kits; the Signal Tracer works fine. Also like to let you know that I feel proud of becoming a member of your Radio-TV Club."

Robert L. Shuff, 1534 Monroe Ave., Huntington, W. Va.: "Thought I would drop you a few lines to say that I received my Edu-Kit, and was really amazed that such a bargain can be had at such a low price. I have already started repairing radios and phonographs. My friends were really surprised to see me get into the swing of it so quickly. The Trouble-shooting Tester that comes with the Kit is really swell, and finds the trouble, if there is any to be found."

UNCONDITIONAL MONEY-BACK GUARANTEE

Please rush my Progressive Radio "Edu-Kit" to me, as indicated below:

Check one box to indicate choice of model

- ☐ Regular model $26.95.
- ☐ Deluxe model $31.95 (same as regular model, except with superior parts and tools plus Radio & TV Parts Jackpot worth $15.)

Check one box to indicate manner of payment

- ☐ I enclose full payment. Ship "Edu-Kit" post paid.
- ☐ Ship "Edu-Kit" C.O.D. I will pay postage.
- ☐ Send me FREE additional information describing "Edu-Kit."

Name ....

Address ....

....

PROGRESSIVE "EDU-KITS" INC.

1186 Broadway, Dept. 510DK, Hewlett, N. Y. 11557

PRINTED CIRCUITRY

At no increase in price, the "Edu-Kit" now includes Printed Circuitry. You build a Printed Circuit Signal Injector, a unique servicing instrument that can detect many Radio and TV troubles. This revolutionary new technique of radio construction is now becoming popular in commercial radio and TV sets.

A Printed Circuit is a special insulated chassis on which has been deposited a conducting material which takes the place of wiring. The various parts are merely plugged in and soldered to terminals.

Printed Circuitry is the basis of modern Automation Electronics. A knowledge of this subject is a necessity today for anyone interested in Electronics.