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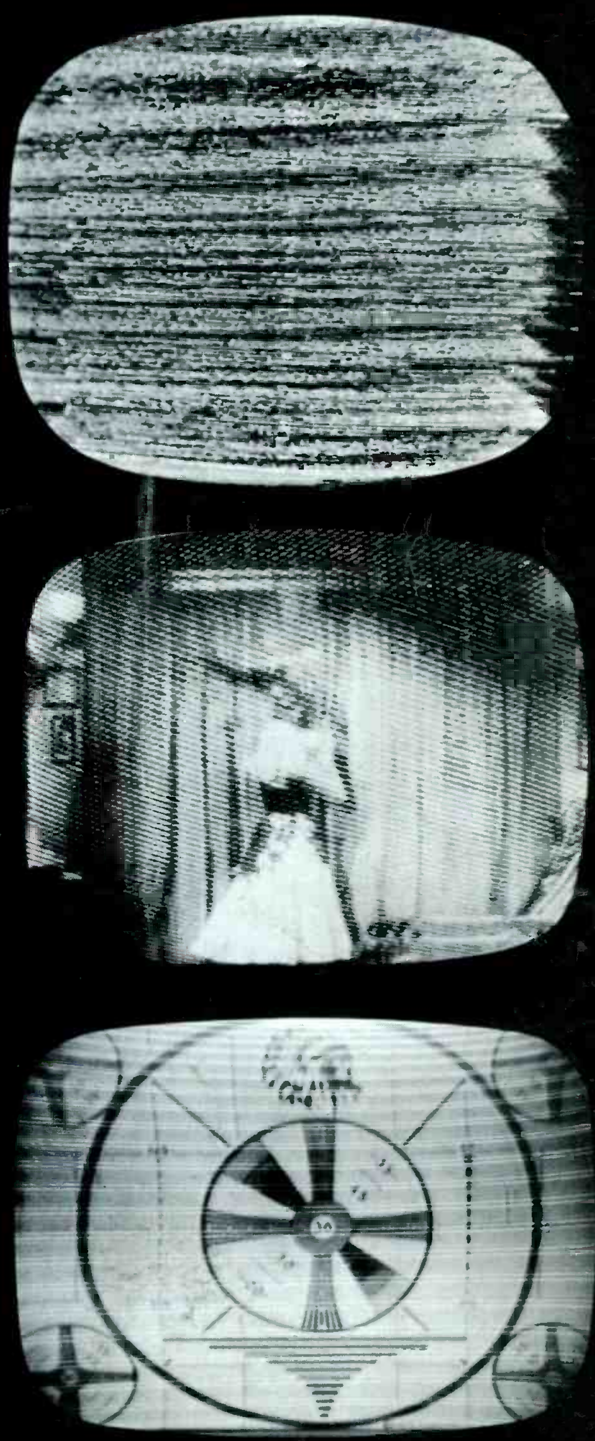
October, 1968/75c

PF Reporter®

PHOTOFACT

the magazine of electronic servicing



TVI... its causes and cures

page 10

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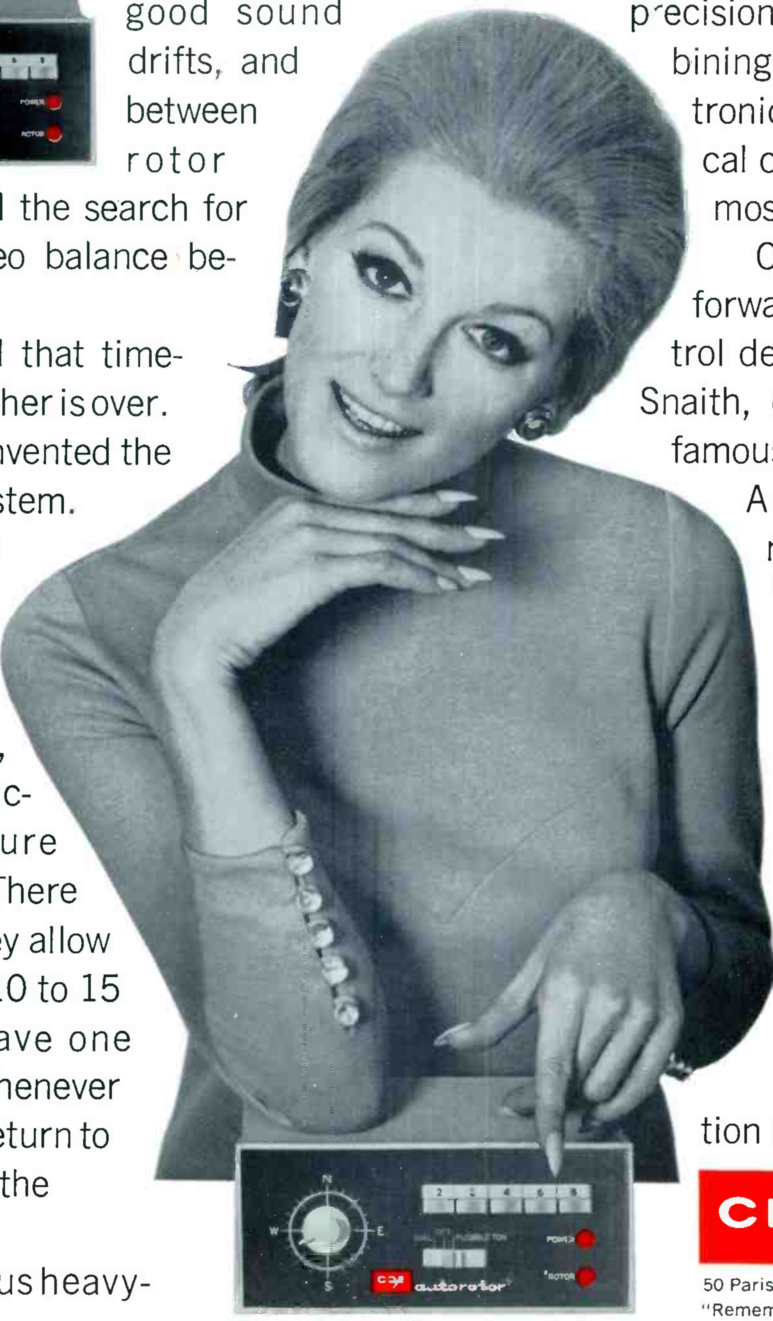

Circle 1 on literature card

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WATCH FOR NEW CENTERS UNDER DEVELOPMENT

Circle 2 on literature card

October, 1968 • Volume 18, No. 10

PF Reporter

PHOTOFACT

the magazine of electronic servicing

in this issue...

ABOUT THE COVER

The TV screens on this month's cover exhibit the effects of interference caused by spurious signals picked up along with the desired TV signal.

DEPARTMENTS

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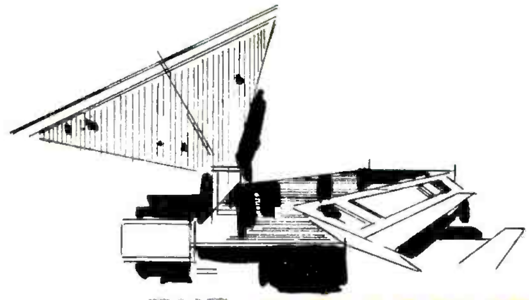


THE ELECTRONIC SCANNER

FTC Ruling on TV Servicing Rate Schedule

The Federal Trade Commission was recently requested to render an advisory opinion with respect to the legality of a trade association preparing and distributing a standard rate and service pricing manual for common use by electronic servicemen with the general public.

It was represented that a major problem in the industry is the lack of guides by which the public can determine whether prices charged for various repair services are fair and equitable. This lack has led to many customer complaints and to fraudulent operations by unethical repairmen. The association took the position that a standard rate schedule would protect the public and free ethical servicemen from unjust accusations.

The Commission advised that it could not give its approval to the proposed common use of a standard rate and service pricing manual by competing electronic servicemen. While the adoption and dissemination by the association of such a manual may be motivated by a purpose to remove evils affecting the industry, it appears to go further than is reasonably necessary to accomplish the desired result.

Even though use of such a manual is accompanied by disclaimers, there is implicit, therein, too grave a danger that it will serve as a device through which service rates and fees would become uniform and stable throughout the industry. While adoption of a means likely to create competitive uniformity in terms of service pricing may be a convenience to trade association members, this factor is far outweighed by the benefits to the public of the intense competition between competing servicemen, and it is this competition which the law protects, the FTC stated.

—the Antenna, Oklahoma TESA

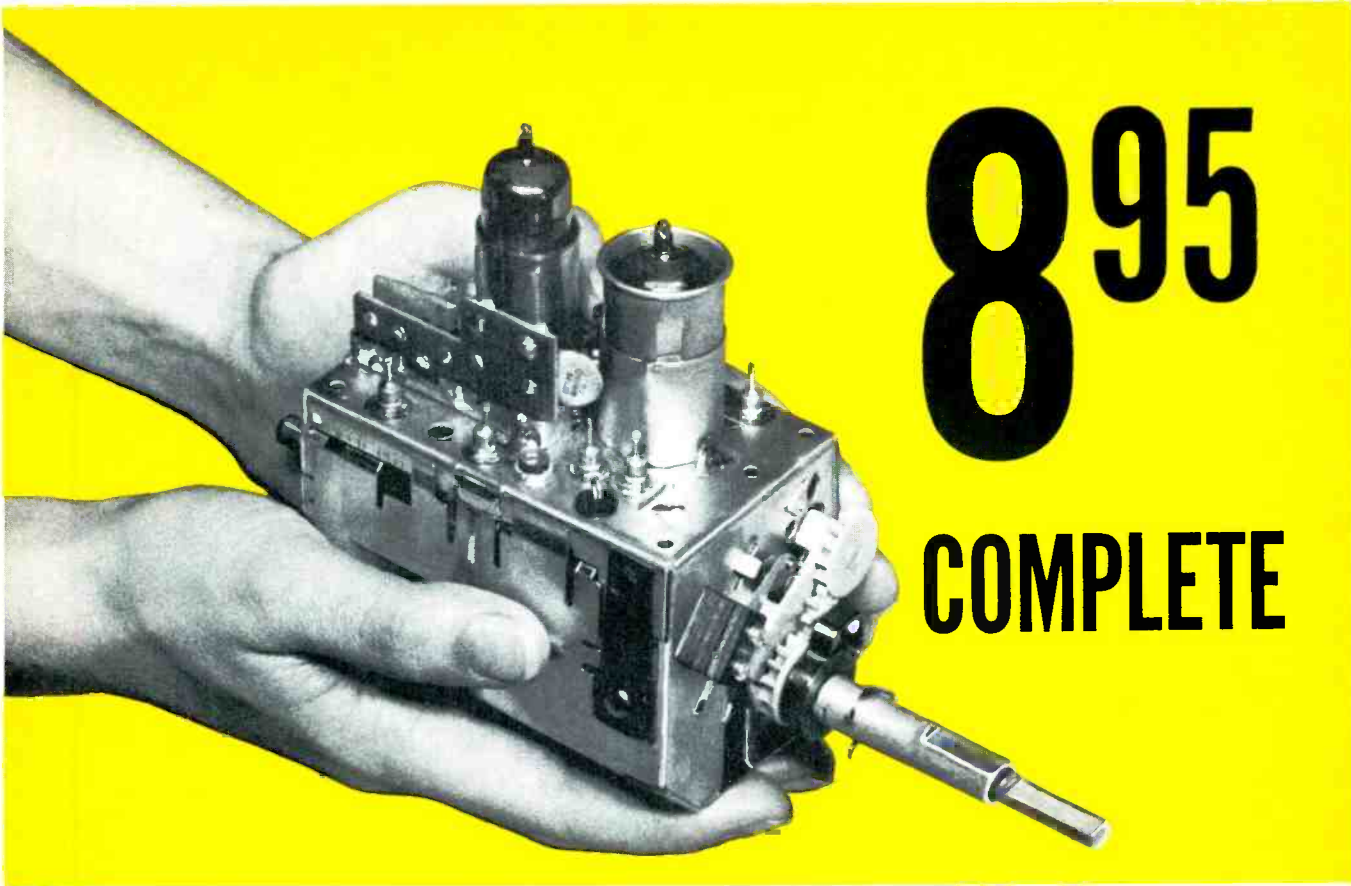
Facts About TV Radiation

In an effort to help eliminate any public misconceptions about color television radiation, Packard Bell Electronics Corporation has published, as a public service message, a 16-page pamphlet aimed at answering such questions as: What is radiation? How is it created? How is it blocked? What are the amounts of radiation caused by TV receivers? Is radiation harmful? What are the standards and tests for television radiation? Why all the publicity about it?

Also included in the pamphlet is the following full text of a recent statement by Dr. Victor P. Bond, M.D., Ph.D., associate director of Brookhaven National Laboratory and chairman of the Radiation Bio-Effects Advisory Committee for the Public Health Services National Center for Radiological Health:

"First let me say that X-ray protection standards for TV receivers have been established by appropriate authoritative groups such as the National Council on Radiation Protection (NCRP). The basic exposure guide is 0.5 milliroentgens (mR) per hour at 5 cm (2 in.) from the surface of the receiver under normal operating conditions (Radiology, Vol. 75, pg. 22, 1960). Standards such as this, particularly for the general public, are deliberately conservative, and are set well below levels of exposure that carry a significant probability of detectable medical effects in the exposed individual ("somatic effects") or his progeny ("genetic effects"). Nonetheless, manufacturers can, and in my opinion should be required to, provide for adequate shielding and testing such that these guides are adhered to.

"The question arises of the probability of medical effects if, perhaps through faulty construction, this limit is exceeded by sizable factors in some receivers. Even if exceeded by perhaps 10 or 20 times, or even more, the doses and dose rates are still very low, and no medical effects have ever been demonstrated at the resultant levels of exposure of the viewer. On the other hand, there is evidence leading to the hypothesis that small



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CR6XL	Parallel 6.3v	2½″	12″	41.25	45.75	10.45
CR7XL	Series 600mA	2½″	12″	41.25	45.75	11.00
CR9XL	Series 450mA	2½″	12″	41.25	45.75	11.00

*Selector shaft length measured from tuner front apron to extreme tip of shaft.

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Circle 4 on literature card

doses of radiation carry a probability, however small, of some damage, particularly genetic (genetic effects could, of course, be detected only in subsequent generations). Thus a categorical statement that there is no probability of any damage at the low doses and dose rates involved cannot and should not be made.

"However, the probability of such effects is extremely low, and is now lower than previously thought, particularly at low dose rates. This is because of the demonstration in the last decade that biological repair (effects are less "cumulative") does take place for genetic damage as well as for somatic damage. Thus it can be stated definitely that the probability of genetic effects at the low doses and dose rates involved is so low that they could not be demonstrated in subsequent generations even if a very large population of human beings were now exposed.

"With respect to the person actually exposed, no demonstrable or significant effect will result from viewing under usual conditions. The low doses and dose rates involved are unequivocally far below those that would lead to "radiation illness" in an exposed adult or child, and certainly they are not large enough to cause medical effects detectable by the practicing physician. Even with a markedly defective receiver and under most unusual circumstances (e.g., prolonged stay very close to the surface of the receiver emitting the most X-radiation), the probability of detectable medical effects is extremely small.

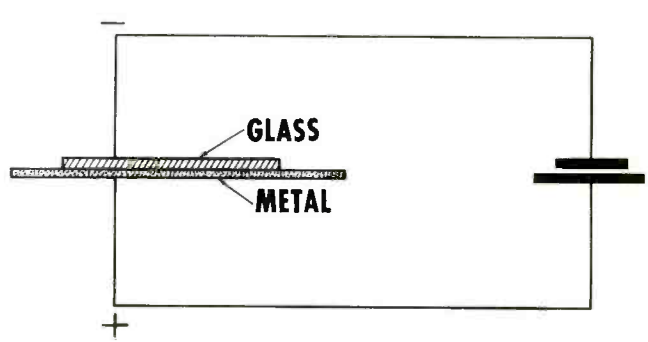
"Thus while it is prudent to control and severely limit exposure to radiation (as well as to all other potentially injurious agents), it is quite clear that the probability of significant or even detectable medical effects from X-rays emitted by faulty color TV receivers is vanishingly small."

—Packard Bell

Hermetic Sealing of Glass to Metal

A fundamental new discovery for the hermetic sealing of glass to metals—including semiconductor materials—with wide potential utilization in diversified consumer, industrial and government applications, has been announced by P. R. Mallory and Co.

G. Barron Mallory, president of the Indianapolis firm, said the process is unique in that it utilizes elec-



tric potential rather than adhesive, fluxes or conventional fusing techniques for achieving a bond stronger than the original materials.

Utilizing the new process, bonding can be accomplished in a matter of seconds and without the need for external pressure being exerted on the materials. Typical uses for the process, Mr. Mallory said, could include such diverse applications as the manufacture of hermetic seals for vacuum tubes and other vacuum system applications, and the encapsulation of electronic components.

The bond is formed by placing a flat piece of insulating material, such as glass, on a flat piece of metal, heating the two pieces to a temperature well below the softening point of the glass and then, applying a DC electrical voltage across the glass-metal sandwich with positive voltage applied to the metal.

The time required to complete the bond depends on the surface flatness, the temperature to which the material is heated and on the magnitude of the applied voltage. These factors have been varied from temperatures of about 150 to 1,250 degrees centigrade, from times ranging from several seconds to several minutes and with electrical voltages of a hundred to more than a thousand volts.

NEA Convention Activities

Richard Glass of Indianapolis, Indiana has been elected as the new president of the National Electronic Associations (NEA) at their annual convention in Pasadena, California.

Glass, who is a past president of the same organization, was elected to lead the group of affiliated State Television Service Associations following an all-out election campaign.

Area vice-presidents were also elected and include: Warren Baker of Albany, New York; Warren Gill of Albany, Georgia; Kenneth Young of Washington, Iowa; Ray Demonbrun of Louisville, Kentucky; Charles Enyeart of Lincoln, Nebraska; Norris Brown of Houston, Texas; Colin Gregory of McMinnville, Oregon and Emmett Mefford of Fontana, California.

Leon Howland of Indiana was elected as the new national secretary for NEA and Homer Davidson of Iowa was re-elected as national treasurer.

Changes in Yellow Page Listings

Under three separate resolutions adopted by the convention delegates, it was suggested that because of the confusion and additional costs involved in being listed under many different categories to cover the complete range of business for the majority of electronic industry dealers, the new category headings should be: "Television & Radio, Sales—Service" and "High Fidelity Sound Equipment, Sales—Service."

The second resolution adopted concerns the area of phonographs and recorders. Under the new proposed headings the current six listings would be combined into: "Phonographs, Commercial—Sales-Service" and "Recorders, Commercial—Sales-Service." The same heading would be used with the addition of the word "Renting" for those interested in that category.

The third resolution was in regard to the current practice of placing the rental of television sets that also involves retail sales and service, under the letter "T". It is suggested that this be moved to a classification of "Rentals-Television" and that the directories adequately refer the subscriber to the rental section.

Committee To Work With Manufacturers

A new national committee on serviceability, to be directed by Dean Mock of Indiana, will concentrate on developing a series of national surveys to learn and record the problems involved in servicing new electronic home entertainment products.

According to NEA president, Dick Glass, "We hope that this information can be recorded as quickly as possible so that committee members can set up personal meetings with manufacturing officials in an effort to make their products more easily serviced."

Glass went on to state that, "This is not a gripe committee, but a functional and constructive effort to work with the manufacturers so that by simple adjustments the service industry will be in a better position to service their products faster and at less cost to the consumer. Often times a single test point can make the difference between minutes and hours for the service technician."

RCA Develops Higher-Output Transistors

RCA has announced the use of a new laminated construction technique to build experimental transistors that for the first time rival large electron tubes in power output.

Although the technique is still in advanced laboratory development, one of the new, super-power transistors has already generated radio waves oscillating at one million Hertz with a power of 800 watts. This is three times the 250 watts generated by many standard broadcast radio stations, according to John B. Farese, executive vice-president, RCA Electronic Components. Considerably higher powers and frequencies are expected, he added.

One of these new transistors was shown to the electronics industry for the first time at the company's exhibit at the Western Electronics Show and Convention (WESCON) in Los Angeles.

The new technology responsible for these transistors is being pioneered by a team of engineers led by Hans W. Becke of RCA's Electronic Components organization and is part of a long-term development program. This program, sponsored by the U.S. Air Force and U.S. Navy, may eventually make possible all-solid-state sonar, high-power communications systems, electric furnaces and other heavy duty items that have not previously been transistorized.

Samples of the experimental RCA transistor have been delivered to the military for their evaluation and testing.

This concept in transistor technology, which makes use of fusing or laminating of semiconductor materials, ultrasonic cutting rather than photo-etch techniques, and glass hermetic sealing, has been developed by RCA Electronic Components. ▲

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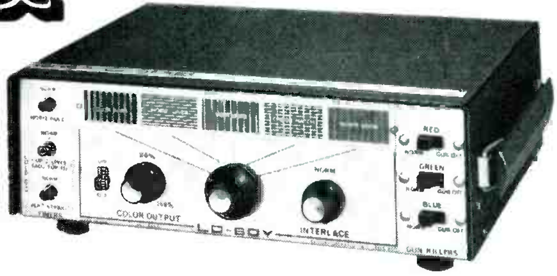

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Eliminating TVI . . . Methods of tracking

by Jack Darr

There are two types of television interference (TVI): temporary and permanent. The temporary kind comes from older cars without ignition-noise suppression and there is not a lot that can be done about it. The "permanent" type comes from such sources as home electrical appliances and power lines. This type of interference can be tracked down and eliminated.

Auto-Noise TVI

Modern cars have resistive ignition wiring and do not radiate ignition noise. However, an older car without noise-suppression is in effect, a transmitter with about 25,000 volts on the final. If a very sensitive TV antenna is used, such noise will be picked up along with the TV signal, since they are both electrical impulses.

From actual tests, it has been determined that practically all of this noise is picked up by the antenna itself. Thus, turning a highly directional antenna away from a busy highway, will eliminate most auto-generated noise.

Small Motor Noise

There is only one practical way to eliminate permanent noise—track it down and eliminate it at its source. There are two ways to eliminate noise: suppression and shielding. Usually both are required. Some permanent noise is radiated and some travel on the AC line. Stopping the noise at the source will prevent dispersion.

The source of most noise is an arc. Arcs generate purely random noise with frequency components in all bands up to and including the VHF TV channels.

The tiny arcs at the motor brushes of small home appliances are a common source of noise. Although most modern appliances have built-in noise-suppression devices, older or cheaper units do not.

The time period in which TVI occurs can be the best clue to its source. If the complaint is "This darn stuff always comes on just when I'm trying to watch the evening news," chances are the noise source is an appliance being used to fix supper: mixer, blender, toaster or electric oven. Conversely, if the noise appears only on washday, look for trouble in the washer or dryer.

In all cases, noise interference from appliances can be determined by turning them on and watching the TV screen. Fig. 1 depicts the result of a small-motor noise. In this case the noise is so severe that it has blocked out the sync and made the picture unstable. A "harsh-noise" in the sound can also accompany this symptom. A less severe case of small-motor interference is shown in Fig. 2. The noise source for this symptom was an old electric shaver, another item to check when hunting for noise sources.

Cures for Motor Noise

Dirty or worn motor brushes or a dirty commutator (or both) are the prime causes of noise. The cure is easy: Replace the brushes with new ones, and seat them well. Clean the commutator with extra-fine sandpaper and reduce the arcing at the brushes to a minimum. If the motor throws a "ring of fire" all the way around the commutator, it may have a bad armature. The only cure for this is a new motor.

Once the arcing has been reduced to a minimum, add a pair of small bypass capacitors (.01 mfd) from each brush to the motor frame, as shown in Fig. 3. Small ceramic units with at least a 200-volt working-volt rating can be fitted inside even the smallest motors. Use good braid spaghetti on the leads, and place them so they cannot get into any of the moving parts.

If the motor is so small that even little ceramic capacitors cannot be placed inside, use plug-in filters. These are LC filters with a plug on one end and receptacle on the other. Most of the better types have a ground terminal on the side of the case, as illustrated in Fig. 4. The filter functions better if this is connected to ground or to the case of the appliance. Most kitchen appliances have a three-wire line cord with the third-wire grounded to the motor-frame inside the appliance case. The ground terminal of a plug-in filter can be connected to this wire.

Fluorescent Lights

Older fluorescent lights of any size, can generate noise. This usually shows up as two horizontal bands of dots on the TV screen, as shown in Fig. 5. (This picture was taken on a blank channel to show the noise only; in bad cases, you can see this on the home TV without an incoming signal.) The noise shown in Fig. 5 has a basic 120-Hz characteristic. Fig. 6 is an illustration of how it would appear on a scope. The noise is concentrated in small bursts at each voltage peak,

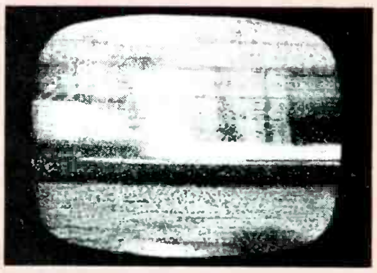

Fig. 1 Hash-noise from small motor appliance.

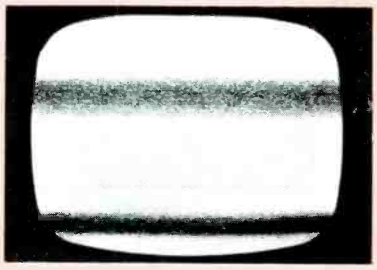

Fig. 5 Two bands of dots are typical of 120-Hz interference.

thus producing the typical two-bands-of-dots pattern.

Flourescent-light noise can be filtered out by a small LC filter like the one shown in Fig. 7. This is the basic circuit used in the plug-in filter shown in Fig. 4. It will work on the most severe cases of interference. Either end of this circuit can be used as the input, though it seems to work slightly better with the .001-mfd side as the input. This filter is also handy for small office machines. Such a filter also can be installed inside the housing of a light. The coils are wound with about 15-20 turns of enameled, #20 solid wire on an ⅛″ form. The capacitors can be paper or ceramic. For best results, the common connection should be securely grounded to the metal case of the light.

Line Noise

A noise similar to that illustrated in Fig. 5 can also be radiated from AC power lines. The basic cause is what is known as "hardware noise" on the poles. Each pole has a ground conductor fastened to the ground (top) wire, and an assortment of metal brackets to hold the pole assembly together. Even though these are not in contact with the line, they can pick up static charges and produce noise. A loose ground connection can corrode, developing an oxide layer between wires; this effectively forms a semiconductor diode that can generate "hash."

There is a simple method for locating line noise originating from such sources. With the car radio on, drive slowly around the neighborhood. Set the dial between stations at about 800 KHz and turn up the volume. For some unexplainable reason, this noise is loudest at about this frequency. When the loudest noise is heard, and covers the entire broadcast band, the source is near. Getting closer to the source, other high freqeuncy components become more audible. The strongest is at about 800 KHz. Once the source has been localized find the nearest light pole and tap it with a heavy hammer. If a pop is heard in the radio, or any change is evident in the noise, the offending pole has been located. Contact the local power company and report these findings to them. Such companies

Fig. 2 Less severe case of motor-noise from electric shaver.

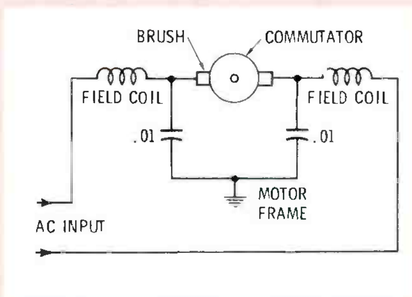

Fig. 3 Small bypass capacitors keep noise inside appliance.

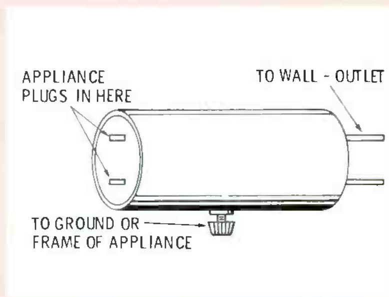

Fig. 4 Small plug-in filter for appliances with ground terminal.

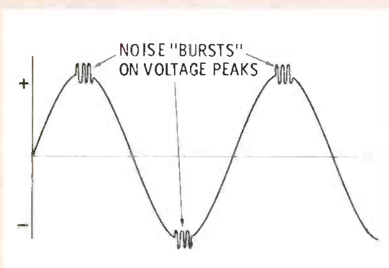

Fig. 6 Waveform of noise from flourescent light. Note small bursts of noise on voltage peaks.

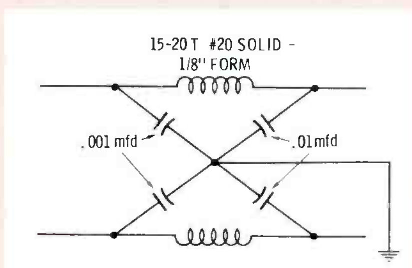

Fig. 7 Home-made filter for small appliances, flourescent lights, etc.

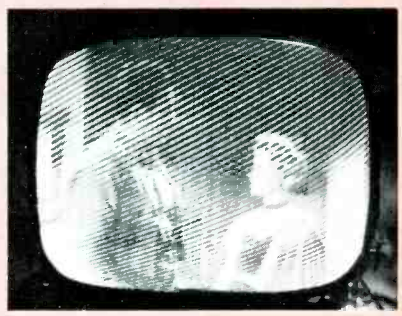

Fig. 8 Beat pattern on TV screen from RF signal.

have a crew which can eliminate the noise source. This is done by cleaning and retightening the hardware on the offending pole(s). Some REA crews have had to rework as much as three miles of rural power lines to get rid of this type of interference.

Radio-Frequency TVI

Any RF signal that can get into the TV set will "beat" with the picture carrier to produce interference like that shown in Fig. 8. Ham and CB operators get blamed for a lot of TVI. However, ham radios do not operate on or even near the TV bands, not even in the TV IF bands. If the transmitter is in good shape (not radiating harmonics, etc.) it should not cause TVI. The best check for RF TVI is to take a small portable TV to the suspected ham station, turn it on, and then key the transmitter. Another method for checking this interference is to telephone the suspected radio operator asking him to key his transmitter. If the characteristic wrinkly or wiggly beat-pattern is displayed on the TV screen, the source has been determined.

As previously mentioned, most RF TVI is due to an RF signal getting into the IF stages of the TV set. Police radios and many others operate in the 40-60 MHz FM band. If a policeman in a cruising police car happens to key his transmitter just as he's passing the customer's house, a pattern similar to that in Fig. 8 will probably be seen on the screen. Such interference is rare, but it can happen. However, if the customer is unfortunate enough to be located near the base-station of a police radio system, such TVI can be nearly continuous.

Since this is FM, the lines in the noise pattern will probably be wrinkly or S-shaped, and jittering. Such TVI is NOT the fault of the radio transmitter. The fault is in the poorly-shielded IF stages of the TV itself. The cure in cases like this is better shielding of the IF stages in the TV. A cage of copper screen can be tacked over the IF strip, and metal plates placed inside the cabinet under the IF. If this doesn't stop the TVI, the cure may require a new TV set with better shielding and design.

Antenna pickup of TVI can be reduced by sharply tuned traps made out of twin-lead cut to absorb the interferring signal. However, as pointed out before, most noise pickup like this seems to be in the IF, so antenna traps will usually not help. This can be checked at the shop: Use a sweep-generator set to the police-radio carrier-frequency as a simulated noise source and try different forms of shielding and traps.

Noise Tracing Around the Home

A transistor portable radio can be used to locate sources of interference around the home. Such sets are fairly directional, and any noise picked up can be pin-pointed by aiming the radio. This noise tracing method can also be used in the yard to locate the source of any noise that might be carried in on the service wiring from neighboring homes, small plants, or work shops. Powertools, such as bench saws and drill presses, seldom cause TVI because they use large induction or capacitor-start motors that have no brushes to arc. Small electric hand drills, sanders, etc., with brush motors can be quieted down with the LC filters described previously.

Diathermy Interference

In the past, when TV sets had IF's in the 20-MHz band, and diathermy equipment worked on about the same frequency, there was considerable diathermy interference. This caused a near-stationary band of wiggles right through the center of the picture. However, the FCC has banned this type of equipment. All diatherms now use microwave frequencies. If this type of interference is encountered, the offending unit should be traced and the operator informed that such equipment is no longer legal. If he persists, the situation should be reported to the FCC.

FCC Assistance

If the source of a very severe case of TVI cannot be located, the nearest FCC office should be notified. If the noise is bad, chances are it is also getting into important communication bands. The noise should be described as accurately as possible, giving times of maximum disturbance and type of noise (RF, hash, pulse, etc.). The FCC may be able to help, but they shouldn't be bothered for minor noises or suspected ham radio interference until such interference is checked thoroughly. ▲

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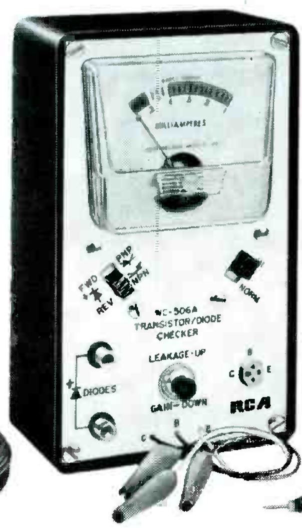

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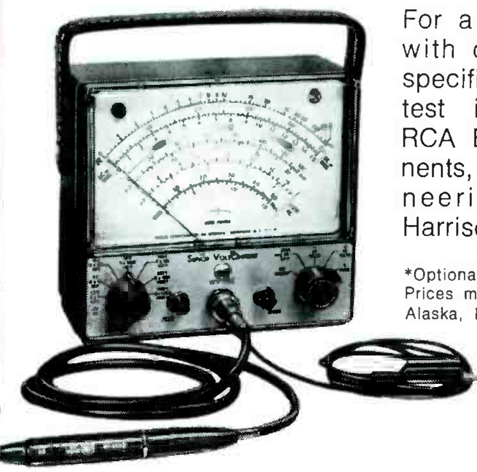

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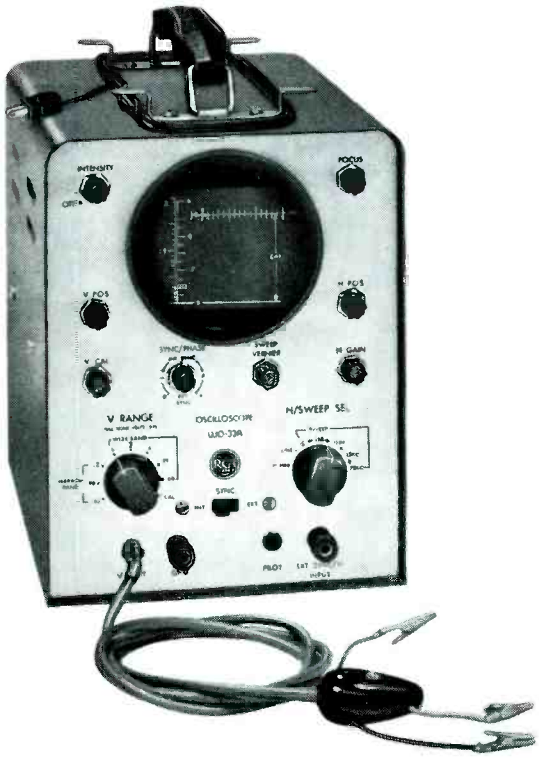

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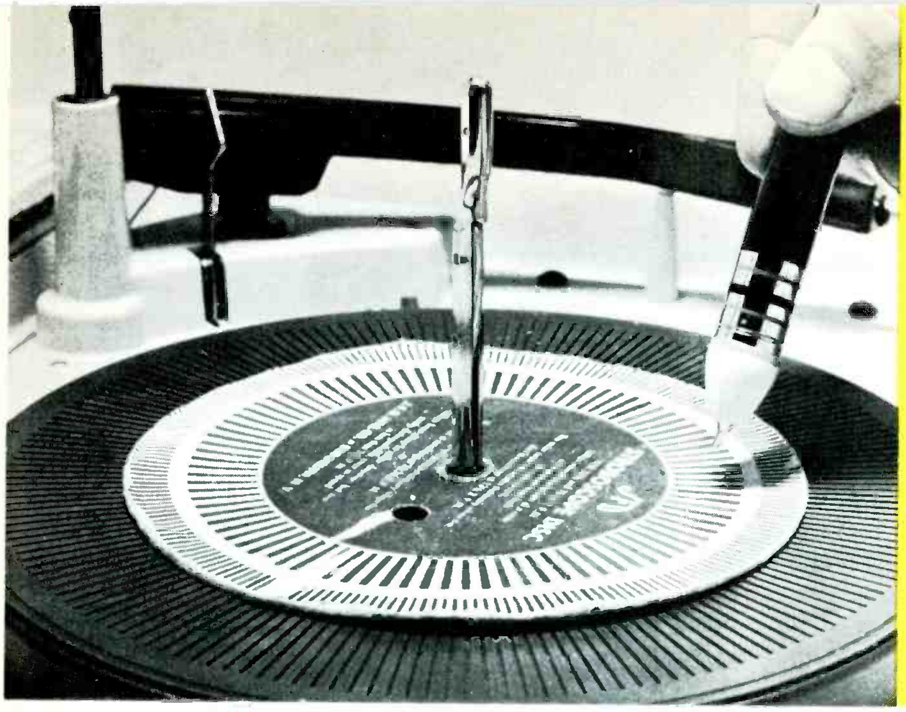

Fig. 1 Strobe disc is simple method for checking turntable speed.

Record changer repair

Troubleshooting procedures and solutions for a variety of common troubles

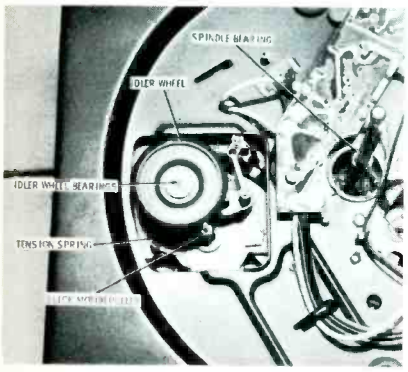

Fig. 2 Slick or worn spots on idler wheel can reduce turntable speed.

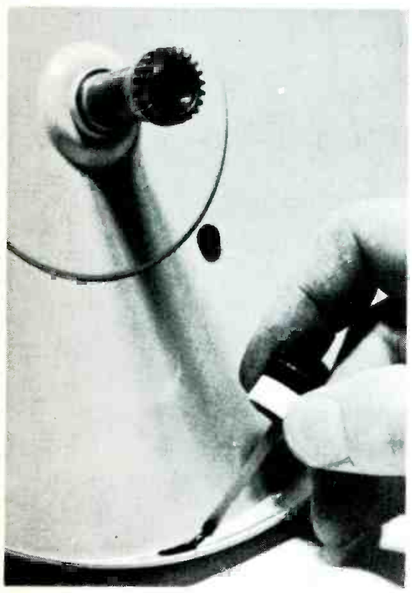

Fig. 3 Applying a non-slip dressing to inner surface of turntable.

by Homer L. Davidson

Most record changer troubles can be categorized as follows: The changer runs too slowly or stalls in cycling operation, won't shift speeds, has improper or erratic landing, fails to trip or keeps on tripping as the pickup arm sets down, fails to drop the records correctly, has wow or rumble noises or fails to shut off after the last record is played.

Speed Problems

The turntable speed can be checked with one of the speed indicators currently available. A simple, low-priced strobe disc will suffice (Fig. 1). Use either a neon or florescent light over the turning strobe disc. If the strobe lines are running backwards the turntable is running too slowly. At the correct speed the strobe lines appear to stand still. The properly adjusted turntable should run a little fast before the records are placed on it.

Slow Speeds

A slow turntable can be caused by a worn idler wheel, a slick turntable, insufficient lubrication, or an overheated motor. Check the idler wheel for slick or worn spots (Fig. 2). Even a minute drop of oil on the idler wheel will cause it to slip, reducing the speed of the turntable. Check for grease or oil on the turntable drive surface or motor drive pulley. Dry the turntable inner surface, then dress with liquid rosin or another non-slip dressing (Fig. 3).

If the turntable thumps as it revolves, check for a dent or flat side on the rubber idler wheel. A shiny idler wheel can be cleaned with alcohol and a soft cloth. Check the idler wheel spring for correct tension (Fig. 4). If loose, snip off a couple of turns with a pair of side cutters and replace. Idler wheel defects cause most slow-speed problems and should be replaced.

Slow-speed problems can also be caused by dry or gummed motor bearings. Check the motor mounting assembly for proper seats, the turntable for dry or excessively worn bearings and the drive surface of the turntable for oil or fingerprints.

Some automatic changers employ separate idler wheels for each turntable speed. Determine which idler wheel is associated with the speed affected, then replace it. For example, if the turntable is running slow in the 33⅓ RPM position and all other speeds are normal, replace the 33⅓ idler wheel. Many times an idler wheel bearing becomes dry, reducing the speed. Pry up the idler wheel to remove it, clean the bearing, then place a drop of oil inside it. Be sure to clean the bearing shaft before replacing the idler wheel. Too much oil will, in a few rotations, work out onto the rubber drive part of the idler wheel causing the idler wheel to slip.

Wow and Flutter

Irregular motion of the turntable produces frequency deviations that distort the audio output of the phonograph. High-rate deviations in speed produce a type of distortion called flutter, while low-rate deviations produce another type of distortion referred to as wow. The jerky movements of the turntable that produce such distortion can be detected with the speed strobe disc.

Oil spots on the turntable drive surface or motor drive pulley, or an idler wheel that is not riding on the exact speed section of the motor drive pulley (Fig. 5), can cause wow or flutter. When the idler wheel is improperly positioned so that it periodically touches the higher speed section of the motor drive pulley, the speed will vary. This can happen when the motor rubber mounting grommets become old letting the motor sag out of position. A bent idler wheel assembly can also cause such variations in speed. Straighten the idler wheel for correct speed alignment on the motor drive pulley. After straightening, be sure the idler wheel sets in the correct position for each speed.

The Motor

A burned motor is easy to spot: The motor field windings will appear charred overall or will have burned spots. Also, shorted turns in the field winding can glow "red hot" and smell like a burned power transformer. In any event, replace the whole motor assembly.

Slow starting or reduced speed is usually the result of dry motor bearings. Often, gummed bearings will cause a motor to freeze. In some models the motor pulley becomes worn and can be replaced by removing a small set screw. If the motor gets "red hot" after running for several hours and then slows down, suspect a shorted field winding.

Normally, most motors run quite warm after a few hours operation. Experience will help you determine what is "normal hot" and "abnormal hot."

Motor Bearings

Dry bearings and an overheated motor will cause the armature shaft and bearings to freeze together. If frozen or dry motor bearings are found, disassemble the complete motor. Remove the motor bolts and nuts, laying the parts on the service bench in the order in which they were removed (Fig. 6). Now mark the bottom of the field winding with a felt pen so that the motor coil will not be mistakenly turned over during reassembly, causing the motor to run backwards.

Remove both top and bottom bearing assemblies and pull the armature out of the motor assembly. Thoroughly wash and clean the whole motor assembly. Wash out the top and bottom bearing assemblies with a cleaning fluid. Remove old grease deposits from shafts and armature.

Place oil in the felt motor bearing cups. Use a thin sewing machine oil. (Contact shield is good for cleaning and oiling motor bearings.) Do not apply an excessive amount of oil.

A noisy or screeching motor indicates dry and worn bearings. If the bearings appear scarred or excessively worn, replace the whole motor assembly.

Sometimes the motor bearing casing will loosen in the motor end piece, causing the motor to slow down or freeze. In such cases, the bearings can easily be replaced and tapped into position with a cold chisel and hammer. Be sure to line up the motor bearing pieces with the motor field assembly. Give the motor a spin before tightening up the motor bolts.

If the speed of a monaural or older type changer can not be properly adjusted by normal methods, replace the motor drive pulley spring. Some motors have a spring that serves as the drive surface on the motor shaft. Simply slip a larger spring over the motor shaft (Fig. 7). File and smooth down any rough ends. This will increase the speed of the turntable.

Speed Control Units

A new motor speed control unit is found in the RCA RP-228 changer series. The unit employs a special field winding and silicon diode to accurately control the speed of the motor. A neon light and strobe disc indicate correct turntable speed. Pushing down on the speed control knob illuminates a neon bulb that indicates the exact turntable speed. Rotating the speed control knob varies the speed. A circuit dia-

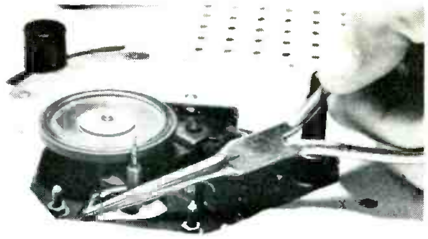

Fig. 4 Incorrect tension of idler wheel spring also can reduce the speed of the turntable.

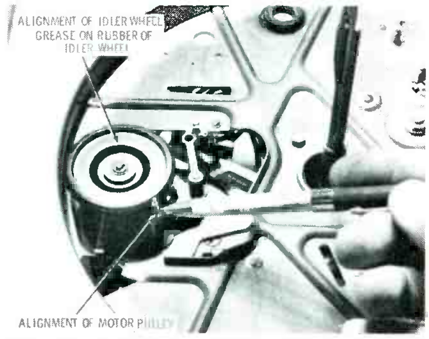

Fig. 5 Points to check for possible causes of wow or flutter.

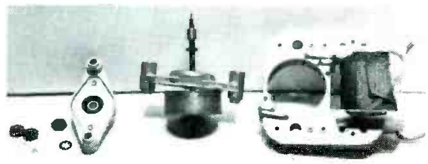

Fig. 6 Lay out parts in order of removal when disassembling motor.

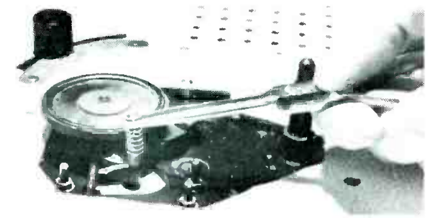

Fig. 7 Larger diameter spring will increase the turntable speed.

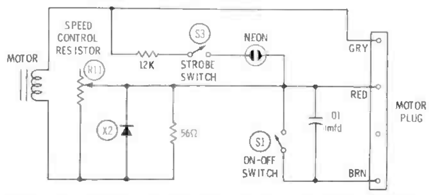

Fig. 8 Schematic diagram of the RCA motor speed control.

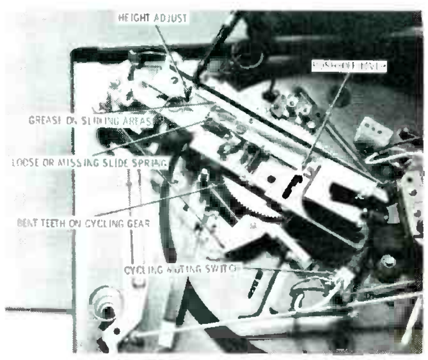

Fig. 9 Points to check for possible causes of tripping problems.

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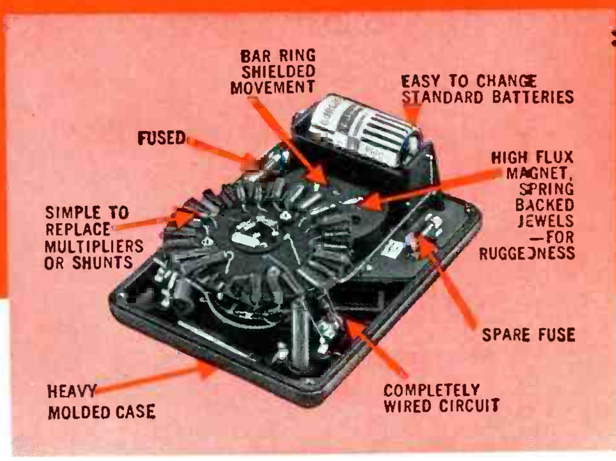

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gram of the motor speed control is shown in Fig. 8.

Cycling Problems

Tripping

When the changer refuses to trip and will not go through a complete cycle of operation, look for a bent clutch lever, cycling gear, or trip pawl assembly (Fig. 9). A bent trip pawl assembly usually becomes dry and binds, and cannot be pushed up far enough to cause tripping of the small hub on the turntable. A misaligned or bent cycling gear assembly should be replaced along with the trip pawl assembly since it is difficult to straighten jammed teeth on the cycling gear assembly.

If the changer keeps tripping and the pickup arm will not set down on the record, check the clutch lever and trip pawl assembly. On some changers the trip pawl lever will become stuck in the tripping position. Do not place oil on the trip lever assembly, as tripping action is done with friction movements. Check for grease between the clutch lever and the trip lever. It is also possible for the function knob to become locked in the select position, thus causing continuous tripping.

Record Selection

If all the records fall on the turntable at once, it is probably caused by a pulled up retainer slide. (Also check for excessively large center holes in the records.) If the retainer slide is in its correct position, only one record at a time can fall. Sometimes, when a full load of records has been played and they are pulled up to be played again, the operator inadvertently pulls the retainer slide up with them. With the retainer slide in the up position, all of the records will fall. The records should be pulled completely off the record spindle and then reloaded. Also, check for a bent or dry retainer slide lever.

If the pickup arm slides across the record grooves, check for a worn stylus or improper leveling of the changer. Also, it is possible to have a defective record; substitute another record and see if the trouble symptom persists.

Shut Off

Most automatic changers are designed to shut themselves off when the last record has been played. The stabilizer arm (Fig. 10) that holds the records down against the spindle determines the shut off point (usually when the last record is played). The thickness of the last record will hold the trip lever up so the last record will play. If the changer shuts off with one or more records still unplayed, check for a bent stabilizer arm. Often, the owner will pull up on the stabilizer arm at the spindle shaft bending the arm out of position. This will cause the shaft of the stabilizer arm to lag and shut off before the last record is played.

On some changers, if the stabil-

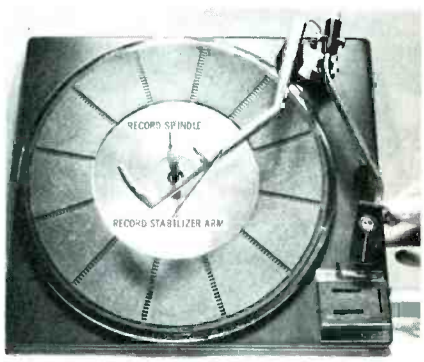

Fig. 10 Stabilizer arm determines the shutoff point.

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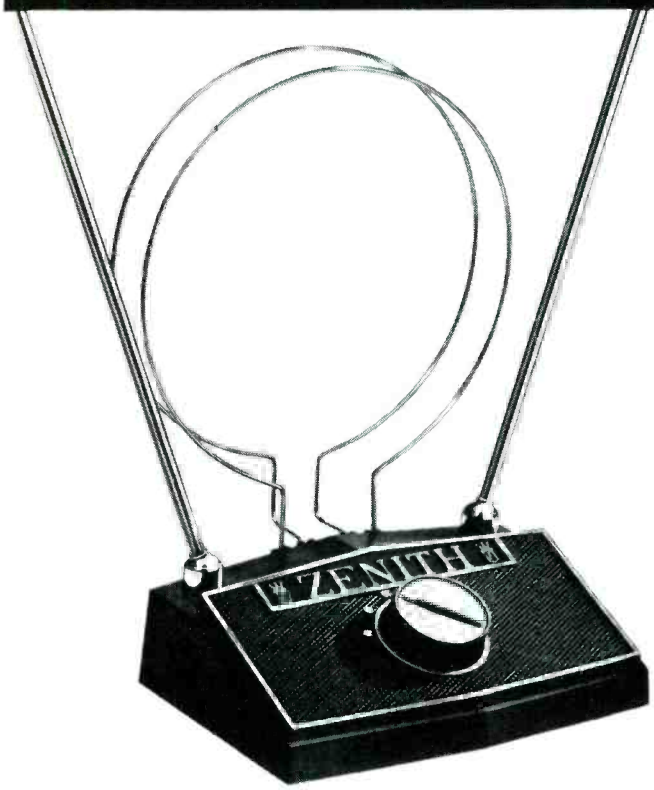

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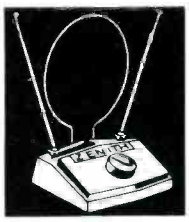

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izer arm is left to the right, out of normal playing position, the last record will play over and over again. Generally, the pickup arm will start over in the center of the record. This condition is normal with only one record on the turntable, since the index lever (pointed out in Fig. 11) must be tripped by a record or held back so the pickup arm will land at the beginning of the record.

Slow Cycling

When the turntable slows down and stalls during the cycling period, check for a bent or binding cycling gear, dry or binding turntable bearings, or determine if the cycling slide assembly is binding or is not properly lubricated along the slide points. Clean off all old grease and replace with new grease along all slide areas (Fig. 12). It is best to completely remove the cycling slide assembly from its position to do a thorough job.

Check for slippage between motor shaft, idler wheel and turntable. Slow motor speed will also cause slow or stalled cycling operation. Check for correct positioning of the height adjustment (Fig. 12). See if the sliding end of the pickup arm lift rod is smooth and properly greased, or it may be necessary to adjust the cycling slide tension spring.

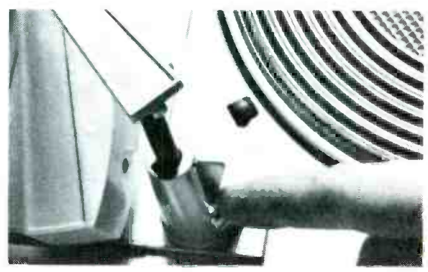

Fig. 11 Index lever must be tripped by record to correctly position pickup arm.

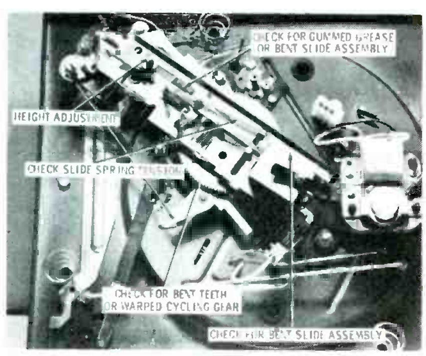

Fig. 12 Slide areas must be carefully greased to insure smooth cycling.

Adjustments

There are two important adjustments to be made on the record changer: the landing and height.

The landing adjustment determines where the pickup will drop at the beginning portion of the record. Set the landing adjustment so the arm drops approximately 1/16" from the edge of the record. This adjustment should be checked for all three record sizes. The location of the landing adjustment is usually located at the rear or bottom of the pickup arm (Fig. 13A), or underneath the turntable frame work directly under the pickup arm (Fig. 13B), depending on the specific model.

If the pickup arm lands too near the center of the record and will not adjust properly, check the landing lever for possible binding. For erratic landing, check for smooth operation of the cycling slide; also check for a clean and dry metal landing lever surface. Other defects that can cause erratic landing include improper height adjustments, a dull needle that skips several grooves or tight phono crystal wires that keep the pickup arm from landing properly.

Correct positioning of the height adjustment is to let the pickup arm go through a complete stack of records and not touch the records during the cycling period. The height adjustment screw is usually located under the back of the pickup arm. However, some changers have two height adjustments, one above the lift rod under the pickup arm and the other underneath the cycling slide assembly.

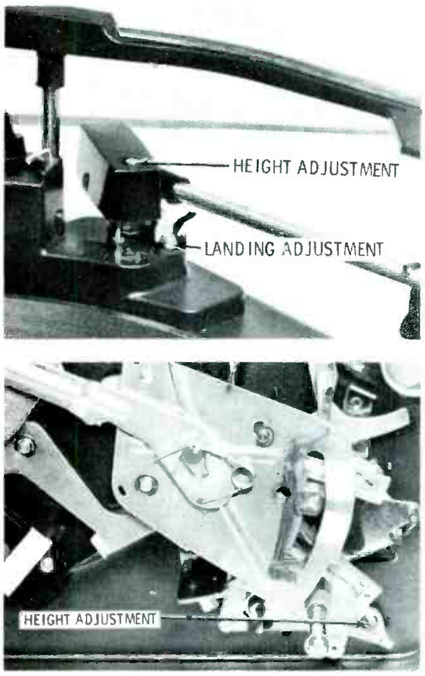

Fig. 13 Two common locations of the landing adjustment. Above, A, rear of pickup arm; below, B, under pickup arm.

Lubrication

If the changer has been in operation for two or three years, the turntable and motor assembly should be lubricated. First, clean off old grease and dirty oil with alcohol or a suitable cleaning fluid. It is best to remove the parts from the changer to do a thorough job of cleaning. Do not let the cleaning fluid come in contact with any plastic parts as it might cause a reaction.

Use lubrication sparingly; it is important that no oil or grease get into any friction drive surfaces. Wipe off any oil that is on the drive wheel, idler wheel, motor pulley and turntable drive surface. Also, do not oil the tripping assembly. (Fig. 14 illustrates the various points that should or should not be lubricated.)

Check the manufacturers' literature for the correct grease or oil to be used. For instance, RCA uses Rycon No. 0 oil on shift plate, all glide areas, cycling gear cam surfaces and turntable bearing assembly; Sylvania uses a thin bearing oil, Shell AB11, for motor centered bearings. As a general rule of thumb, use a non-gumming oil on all sliding and bearing contacts and an adhesive oil for turntable and drive wheel bearings.

After all adjustments are made and the changer has been properly lubricated, test operate the changer for an extended period before reinstalling it in the cabinet. Also, perform a turntable speed check with a strobe disc before returning the unit to the customer. ▲

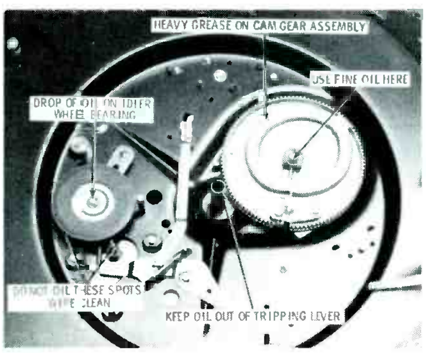

Fig. 14 Lubrication points on record changer assembly.

Troubleshooting a Multi-Trouble TV

Step-by-step analysis takes the confusion out of multiple troubles.

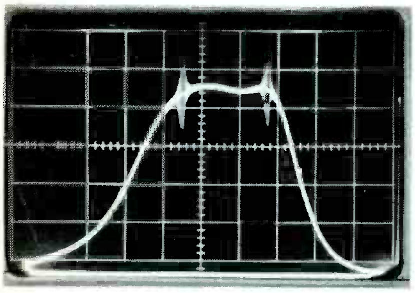

Fig. 1 Resultant waveform from an uncalibrated marker generator.

by **Stan Prentiss**

The multi-trouble-plagued receiver was an eight year old Emerson 1205 series chassis that had recently been traded in on a new color set. Sound and picture wouldn't hold very well on any station, particularly on channel 4, and after ten minutes of operation a slow vertical roll would develop. Also, the raster would occasionally slip out of sync, and the audio was noisy.

Preliminary Tests

First, all tubes were given a quick emission test, which uncovered a weak 6DT6 audio detector. All other tubes were normal. The weak audio detector was replaced, but the audio remained noisy and a buzz could be distinguished above the noise. B+ and high voltage were normal.

Step-by-Step Procedure

When the preliminary tests uncovered no clue to any of the trouble symptoms, it became necessary

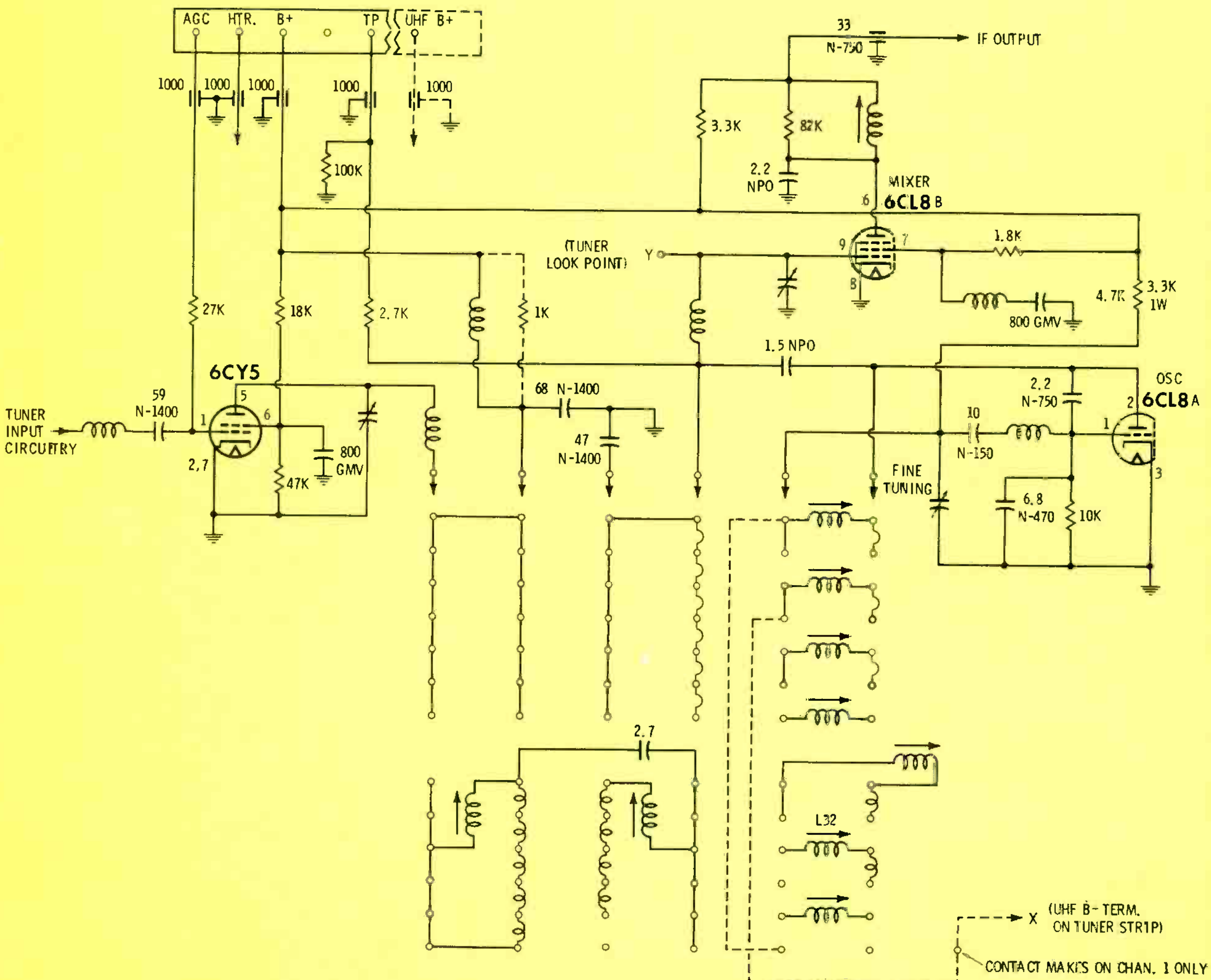

Fig. 2 Schematic diagram of oscillator circuit.

to decide which symptom should be tackled first.

Checking the Tuner

Since both sync and audio were affected, it was logical to suspect a defect in a circuit or circuits common to both—either in the RF stage, video IF's, video detector or video amplifier. The video IF's, video detector and video output were temporarily ruled out because the picture quality and sound was relatively good on some channels. This left the tuner as the most logical suspect.

The tuner oscillator-mixer and RF tubes were then rechecked for both mutual conductance and gas. The RF amplifier passed both tests, but the oscillator-mixer (6CL8) displayed an astounding 10 microamps of current during the gas test.

After the gassy oscillator-mixer tube was replaced, the picture was much better on all channels except channel 4; although there was still some tuner drift evident. The audio noise had also diminished, but the buzz could be eliminated or reduced only by periodically adjusting the audio takeoff transformer, audio IF and the detector coil.

Since further testing of the tuner was required, the tuner was removed from its mounting plate on the inside front of the cabinet and exposed for servicing.

A tuner response curve was

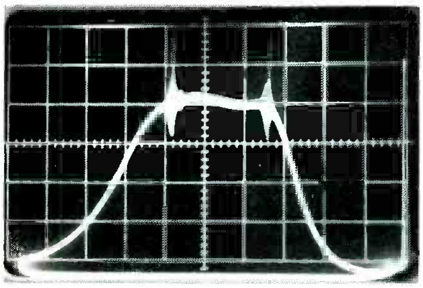

Fig. 3 Waveform shows a slight decrease in amplitude.

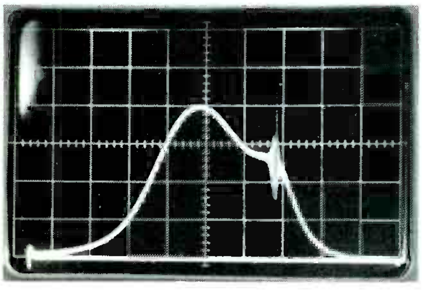

Fig. 4 Resultant waveform after 4-volt increase of the AGC bias voltage.

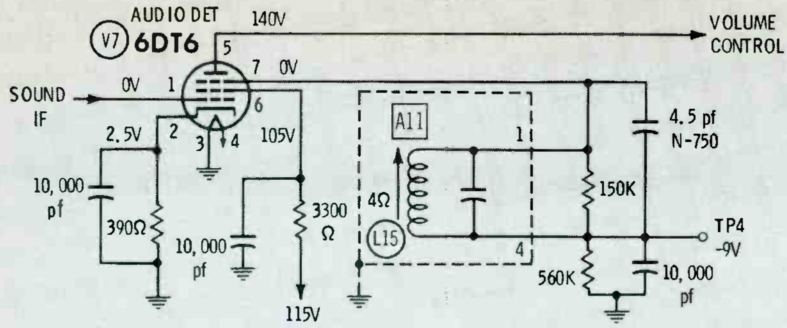

Fig. 5 Schematic drawing of the audio detector.

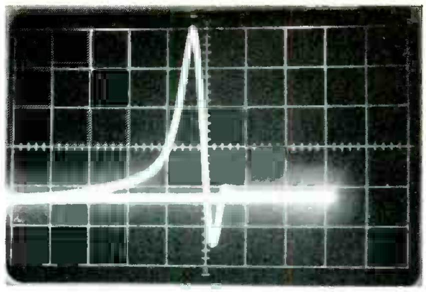

Fig. 6 Waveform produced by beating the marker of the sweep generator output, set at 4.5 MHz, against a 4.5-MHz crystal.

needed to determine if the unit needed alignment and to see if there was any change in the original response after repairs. The sweep and marker generators and oscilloscope were allowed to warm up for 20 minutes before the test was made. The tuner was set on channel 4, and a bias of approximately —3 volts was applied to the tuner AGC line. The sweep generator output was connected to the antenna terminals and the vertical input of the scope to the IF output of the tuner. The resultant waveform is shown in Fig. 1 and was obtained with an uncalibrated marker generator. The left marker was at 71 MHz and the right marker at 66 MHz. Had the generator been calibrated, the sound carrier would have been positioned at precisely 71.75 MHz and the picture carrier at 67.25 MHz. The flat-top response and position of the markers indicated that the alignment of the tuner was basically okay. Thus, testing might cure both the picture and sound drift.

Before further testing was attempted, the tuner was cleaned. A spray cleaner took off any film and corrosion and left sufficient lubrication to prevent excessive contact wear. A toothbrush made the job much easier.

After cleaning, a visual inspection was made to see what might be worn or damaged. All contacts were clean and not excessively worn. The 4.7K-ohm and 10K-ohm resistors in the oscillator circuit (Fig. 2) were within tolerance. The 1.8K-ohm resistor in the screen circuit of the mixer, however, was slightly burned, indicating that it had suffered from a surge of excessive current, so it was replaced.

Next, the small capacitors in the grid-plate circuit of the oscillator were checked. These tiny units, with

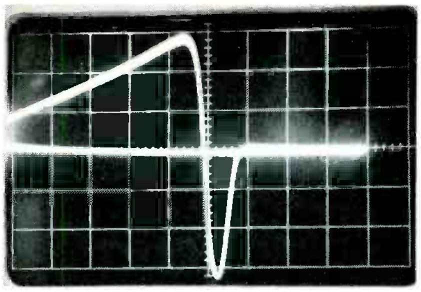

Fig. 7 Rounded "S" curve after a touchup of the transformers and detector coils.

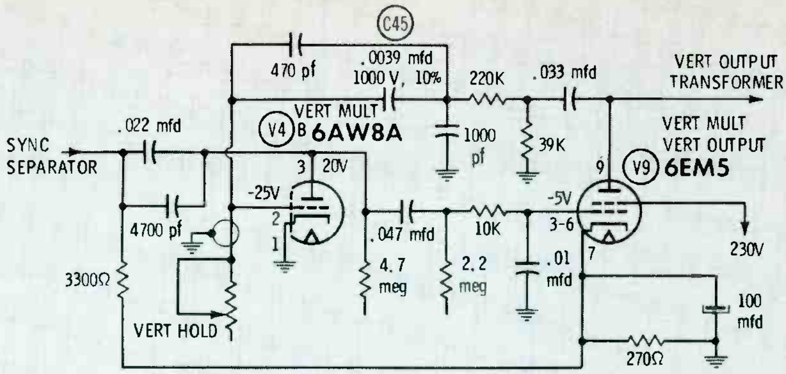

Fig. 8 Schematic diagram of the vertical circuit.

values of 2.2, 6.8 and 10 pf, tune the plate-grid circuit of the oscillator so it will track at a selected frequency. This produces a signal that the mixer can beat with the individual TV channel frequencies to give an IF mid-frequency of 45 MHz. (In the alignment instructions for this particular tuner, is a warning against setting the low channels before adjusting the higher ones since the higher frequencies have an immediate effect on those in the lower bands.) These capacitors have negative temperature coefficients of N-750 or N-150 parts per million, respectively, to correspond to the values and tolerances demanded by the circuit. DC leakage in these ceramic capacitors will increase with age. The dielectric constant will change by chemical action over long periods, and any internal contamination will help degrade the dielectric.

A solder sucker and a hot-tipped iron was used to remove the defective capacitors from the printed-circuit board. These little ceramics were not easy to remove, but the new ones literally slid into place. When they were all soldered into the plate circuit, the tuner barrel and cover were replaced.

Now, there was no popping in the sound when the set was turned on. All channels, except 4, had a good picture when power was applied and, with a little tuning of the local oscillator slug, gave a bright, stable contrasty picture on every station including channel 4. The problem had been caused by the defective capacitors and by the 1.8K-ohm screen resistor of the mixer which was a current divider and, therefore, also a voltage divider.

But what about the response curve of the tuner? With neither the sweep nor scope controls readjusted, the response curve appeared as in Fig. 3. There was a slight decrease in amplitude. The top of the signal appeared broader but was handling signals with more than 5 MHz difference. Just for curiousity the AGC bias voltage was increased to more than 4 volts. The resultant waveform is shown in Fig. 4. The right side of the response curve was immediately distorted, decreasing the amplitude and making the general configuration of the curve completely unacceptable—an example of the effects of excessive bias. When performing any IF or tuner alignment, the technician must maintain the bias voltages exactly as given in the manufacturer's instructions. When a 3- or 4-volt bias is specified, this voltage should appear at the tuner terminals and not simply be the value of the raw supply furnished by the bias box. Negative DC voltages add, just as two in-phase positive AC waveforms combine to provide a single signal that is larger in amplitude than either.

Checking the Audio

There was still a slightly rolling

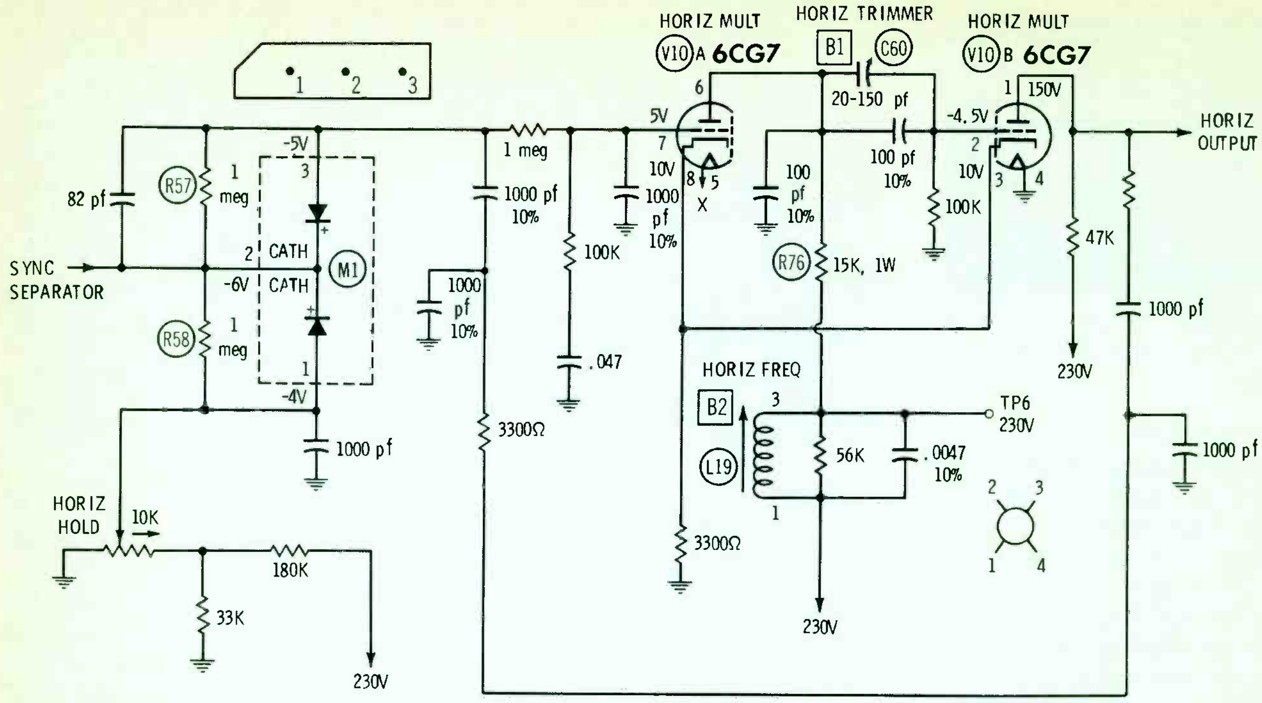

Fig. 9 Schematic diagram of the horizontal circuit.

picture and intermittent horizontal sync, but how about the audio? When the volume level was increased, the sound remained relatively good on all channels, but it did deserve a check.

V7, the audio detector (Fig. 5) is often described as a locked-grid detector classified, with all other FM detectors, as a discriminator.

Passage of the signal is limited by the control grid (as in the gated beam detector). The action is approximately the same, since L15 and the parallel resistors and capacitors at the screen form a quadrature circuit that is resonant at 4.5 MHz. When the incoming signal is exactly at carrier frequency (4.5 MHz), it, and the quarature coil, are precisely 90 degrees out of phase. Signal excursions above 4.5 MHz result in a phase lag greater than 90 degrees. These leads and lags are proportional to the FM frequency deviations and induce varying surges of plate current that are applied to integrating components C33 and R37, and constitute the actual audio signal.

The basic difference between this circuit and the gated beam detector is the type of tube. The gated beam detector employs a sheet beam tube that uses electron optics to guide carriers through signal processing, whereas the 6DT6 is a sharp cutoff pentode with low internal capacitance.

Under rushed circumstances, such as a quick field job, it would not be necessary to check the coupling transformer and the quadrature coil. But, here, the sweep and marker generators were already on and the injection of a signal at the plate of the video amplifier and the checking of the result at the top of the volume control would be little effort.

Tuning the sweep generator output to 4.5 MHz and momentarily beating the marker against a 4.5-MHz crystal in the sweep generator for calibration produced the waveform shown in Fig. 6. This waveform is similar to the "S" curve for the Foster-Seely discriminator and ratio detector. A touch-up of the transformers and detector coil rounded the "S" curve into the shape shown in Fig. 7. It is necessary to place the 4.5-MHz marker exactly on the center portion of the waveform for uniform audio tracking. A high amplitude marker is required, as is a sweep generator fitted with a post-injection marker system. This superimposes the marker on the waveform after it has passed through all tuned circuits. Any antenna connection should be detached and the receiver channel selector turned to a position between channels to avoid RF interference and spurious signals in the marker and sweep waveforms. A final on-the-air check confirmed proper alignments.

This concluded the tough part of the repair job. The remainder was relatively routine. A quick check with a DC scope showed that all DC voltages in the vertical circuit (Fig. 8) were within tolerance and that all waveforms had sufficient amplitude.

Since $T=1/f$, and the horizontal rate is 60 Hz, the total time constant of the vertical circuit is 16.7 milliseconds. To simulate approximately half this rate, the value selected for capacitor C45 was 0.0039 microfarads and the vertical hold value was 1.5 megohms. The linearity control added 500K-ohms and brought the series total resistance to 2 megohms. The time constant here, then, was $2 \times 10^6 \times 0.0039 \times 10^{-6}$, or 7.8 milliseconds. If the ratio of this circuit is changed in either direction, the picture will roll.

C45 had become leaky as the ambient temperature increased upsetting the time constant. C45 is subject to constant charge and discharge and will deteriorate faster than most other capacitors in the vertical circuit. Identifying C45 as being defective wasn't difficult since it was clearly evident. Applying heat to the capacitor for a minute caused the picture to roll. After C45 was replaced, vertical sync locked in and the vertical linearity peaked as it should. Thus, another trouble was diagnosed and repaired.

Checking Sync Stability

A check of the sync stability was made by shorting test point 3 (Fig. 9) to the chassis, jumpering L19, setting the horizontal hold control to center range and adjusting horizontal trimmer C60 for momentary lock-in. This rendered a stable picture only at the center of the horizontal locking range. Further adjustment of the stabilizer control brought no improvement. Using the oscilloscope, the top trace (Fig. 10) now corresponded to the waveform exhibited at point 29. The DC level was approximately 10 volts and the AC amplitude was 9 volts peak to peak. The lower trace was at the anode connection (pin 3) of M1 and rode at a DC level of 9 volts. (All AC-DC voltages are measured with signal coming in rather than no signal as shown on the schematic.)

At first, the configuration of the waveforms matched those of the schematic fairly well, but the amplitude of the lower trace wasn't much over 15 volts; it should have been approximately 25 volts. (Any such deviation bears prompt investigation since these cathode-to-cathode diodes are constantly comparing the phase of the differentiated pulse waveform from the flyback transformer to the incoming horizontal sync pulses.) This caused the M1 diodes to generate a DC correction voltage across R57 and R58. This voltage controls the first section of the cathode-coupled multivibrator and speeds up or slows down the relaxation oscillator.

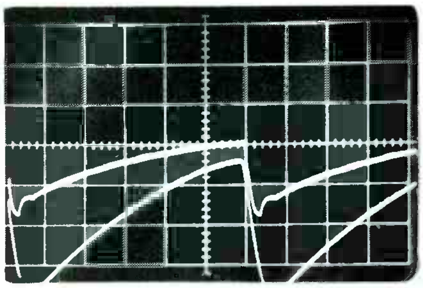

Fig. 10 Waveform with DC level at approximately 10 volts and AC amplitude at 9 volts p-p.

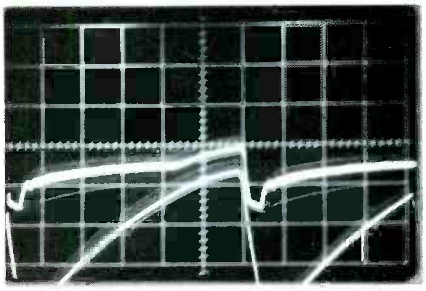

Fig. 11 Corrected waveform shows decrease in amplitude, slight non-linear notch and slightly longer cutoff time.

The waveforms at the grids of the horizontal multivibrator and horizontal output indicated that the AC signals at these two points were adequate. As a final test the anode of M1 (terminal 3) was shorted to ground to see if the horizontal sync could be adjusted almost stationary without the effect of the AFC diodes. It could. The AFC diodes needed to be changed because, like the ceramic capacitors, the selenium in these diodes develop leakage with age and deteriorate.

A pair of diodes in a 3-lead casing was needed for replacement. The old plastic diode package from the receiver was clipped out, leaving enough leads on which to solder the new part. In a few moments the new AFC package was in, the set turned on, and the adjustment procedure repeated.

This time the horizontal hold locked 90 percent of the way across its total range, and the channel selector could be flipped without disturbing the horizontal sync. Fig. 11 shows the corrected waveform. Note that the upper trace had decreased in amplitude, had a slight non-linear notch, and had developed a slightly longer cutoff time, while the lower trace had simply increased considerably in amplitude. It now measured well over 20 volts, as specified. The upper trace amplitude could be increased or decreased by adjusting the horizontal hold control, which provided proper holds in the center of its range.

Time and Labor Costs

The following is a breakdown of the cost: about 15 cents worth of tuner cleaner, $1.90 for the 6CL8, $1.10 for the 6DT6, 12 cents for the 1.8K-ohm resistor, 48 cents for the diodes and 45 cents for the three tuner capacitors. The total parts cost was $4.20, with 2 hours of labor. Labor and parts cost considered, this was a small price for a reconditioned receiver.

With some of the well-marked receiver chassis, the entire job can be done by simply taking off the back or bottom cover. In this case, it was not necessary to remove the chassis or the CRT from the cabinet—a definite advantage of printed circuits. ▲

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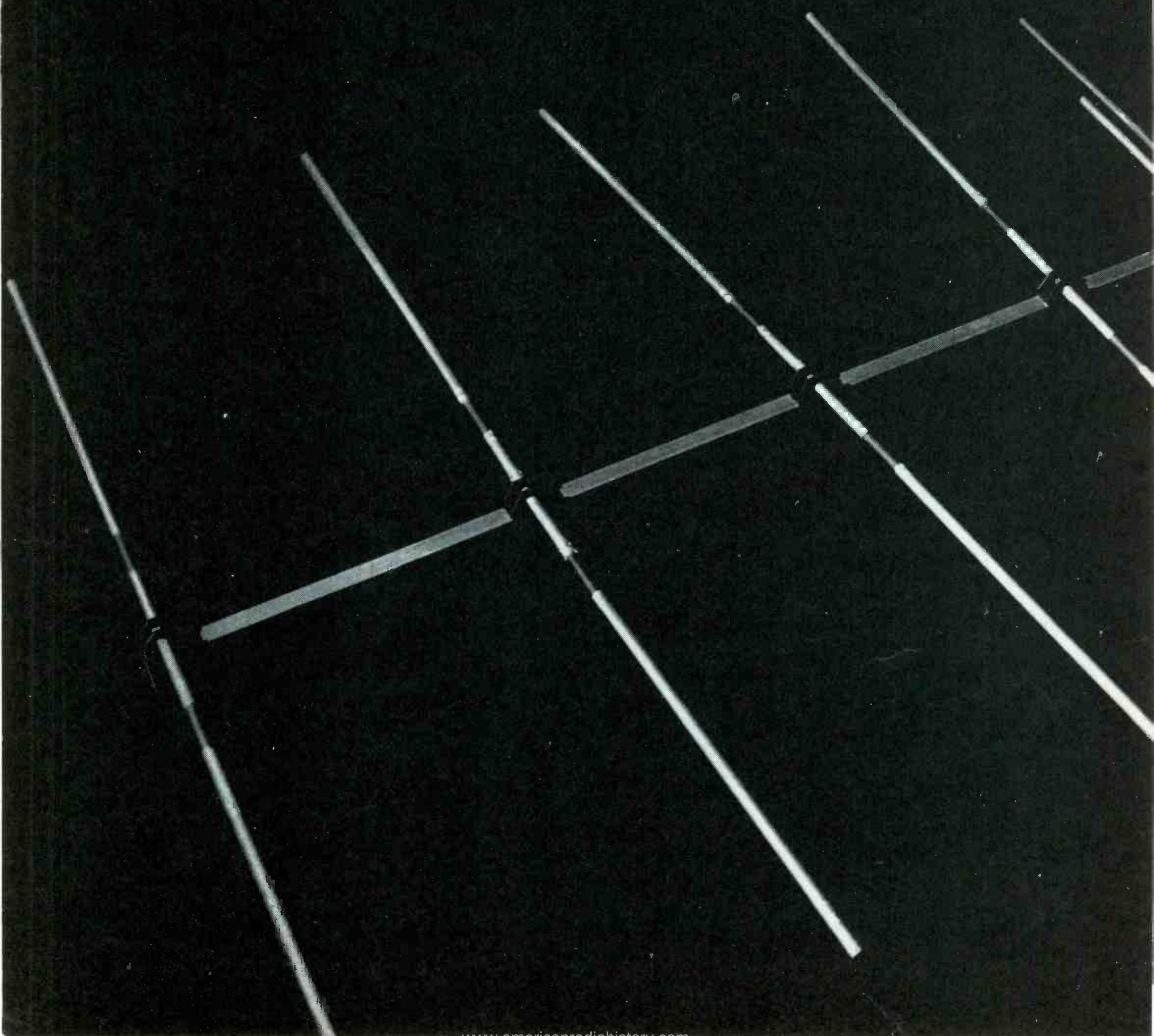

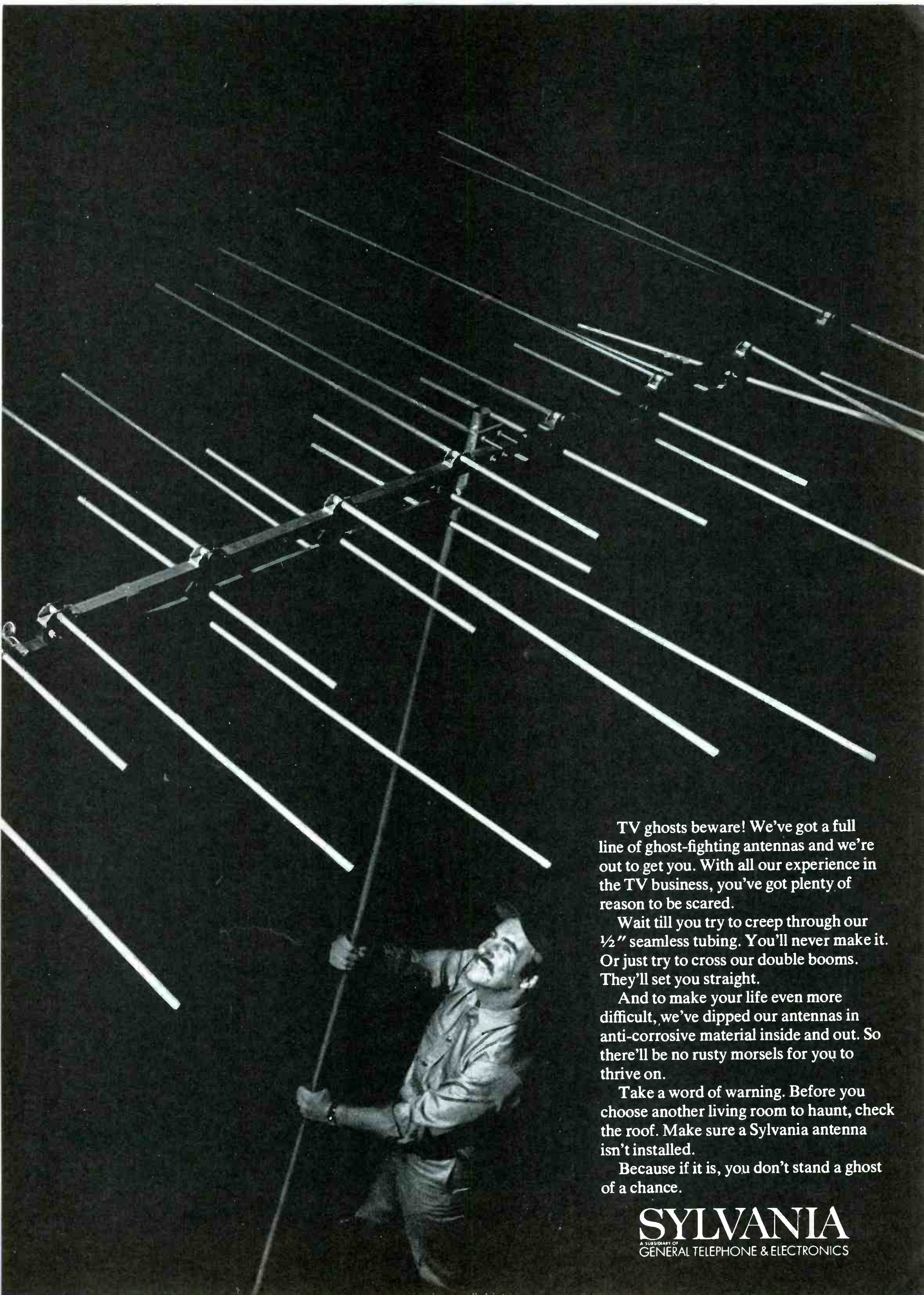
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TYPICAL CLOCK-RADIO TROUBLES

by Jim Houseknecht

Case histories of AM/FM clock-radio troubles and their solutions.

The following clock-radio troubles and related service hints apply to nearly all brands and models as the various designs are similar.

Intermittent Operation

The customer had said, "Sometimes it works if I turn it on and off several times." The on and off procedure was tried and, sure enough, the radio came on. Could the power switch be defective? The chassis was removed from the cabinet and the switch turned several times. When the radio failed to operate, a slip lead was connected from one switch terminal to the other. The radio came on and stayed on. The defective power switch was confirmed. This slide-type power switch is mounted on the clock assembly as shown in Fig. 1. A thorough cleaning of the switch cured the defect.

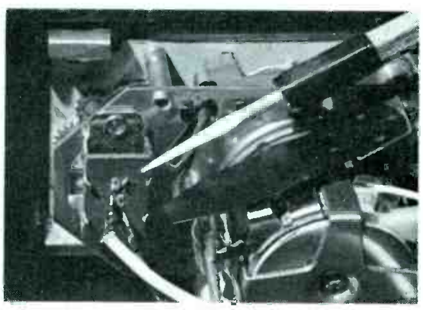

Fig. 1 Slide-type power switch mounted on clock assembly.

Switch Cleaning Procedure

Slide switch contacts tarnish and can cause the switch to become intermittent or completely inoperative. To clean the switch, first observe the way the parts fit together and mate with the clock assembly as in Fig. 1.

Carefully straighten the metal fingers at each side and lift the back off the switch being careful that the spring does not fly out (Fig. 2).

Spray contact cleaner on a cloth and rub all contact surfaces. Then, clean all contact surfaces with an eraser until bright and shiny. In cases of severe tarnish, use crocus cloth instead of the eraser.

Brush out all bits of foreign material. Again rub with contact cleaner and apply a thin coat of contact grease to all contact surfaces.

Before reassembling the switch, apply a small amount of contact grease to both ends of the spring to temporarily hold the small parts in place.

Fit the parts back together, making sure that the switch properly fits into the clock assembly. Then, carefully bend the metal fingers back into position.

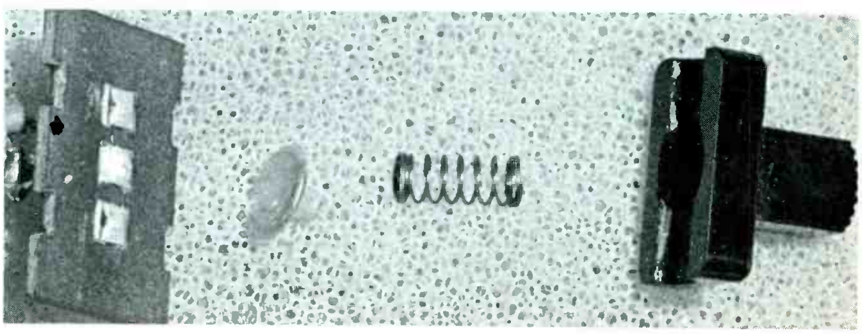

Fig. 2 Do not allow spring to fly out when straightening metal fingers.

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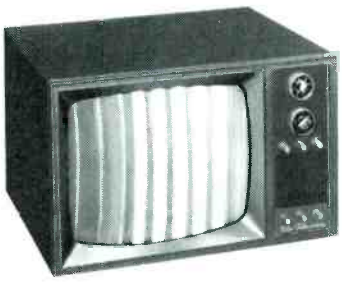

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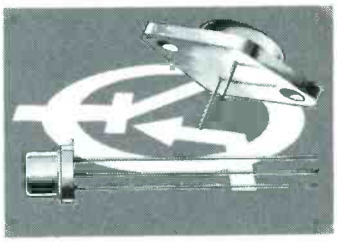

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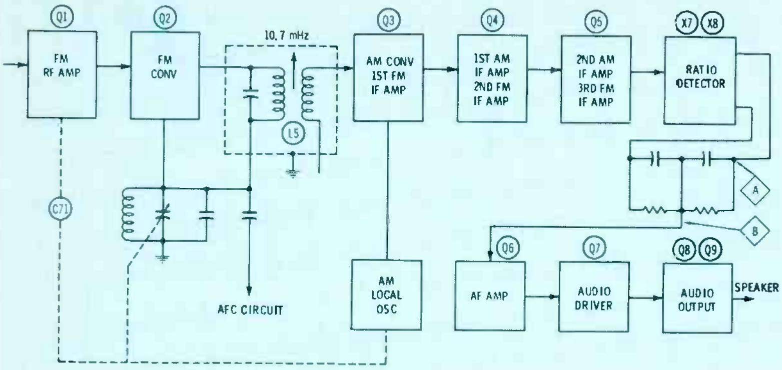


Fig. 3 Block diagram of clock-radio circuitry.

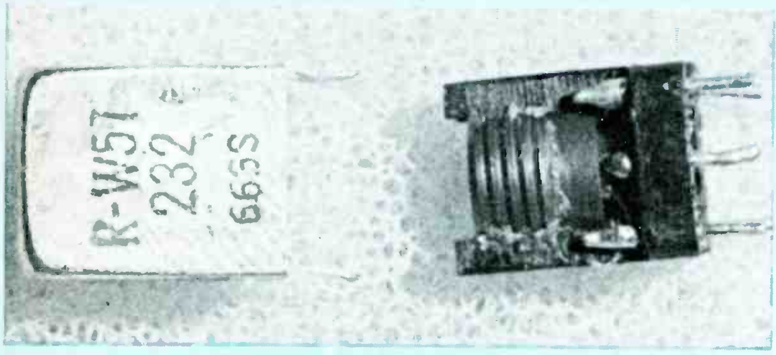


Fig. 4 L5 removed from PC board and disassembled.

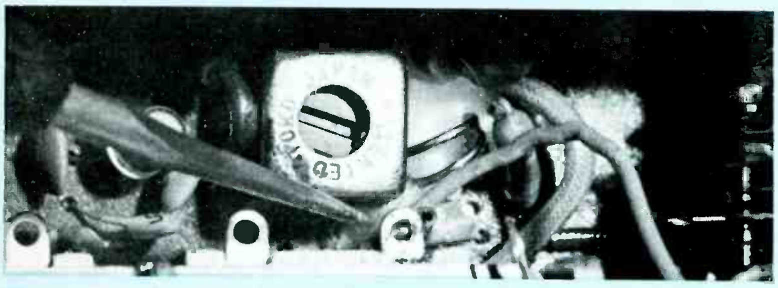


Fig. 5 Defective solder joint at terminals on FM oscillator section of C71.

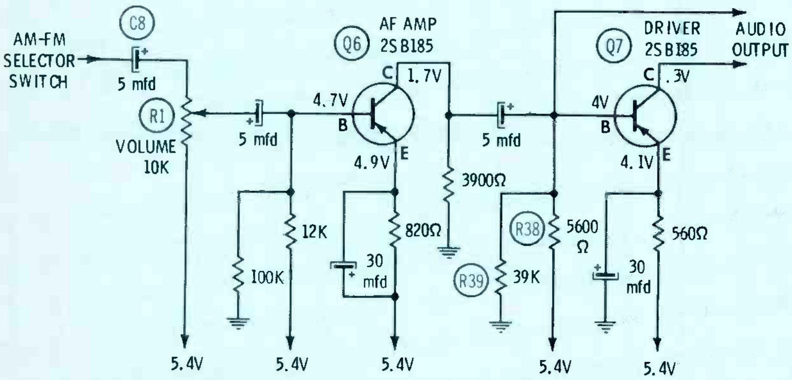


Fig. 6 Schematic diagram of AF amplifier and audio driver circuitry.

Dead FM

An AM-FM clock radio operated normally on the AM function but failed to receive anything on the FM mode. Since all stages following the FM converter (Q2 in Fig. 3) function during both AM and FM reception, it was decided that the trouble must be located in either the FM RF amplifier or the FM converter stage. Voltage measurements on the elements of these two stages indicated that all voltages were within tolerance.

Next, the gain of each FM IF amplifier stage was checked by connecting the DC probe of a VTVM to test point A, and the VTVM common lead to test point C. Connected in this manner, the VTVM functions as an FM detector output indicator.

An RF signal generator was adjusted to 10.7 MHz (unmodulated), and the ground lead attached to the common ground of the receiver. After connecting a .0001-mfd capacitor in series with the generator output cable, the generator signal was injected at the base of Q5, the 3rd FM IF amplifier; and the generator output control adjusted to obtain a .3-volt reading on the VTVM. The signal was then injected at the base of Q4, the 2nd FM IF amplifier. The meter reading increased to .8 volt, indicating a signal voltage gain within that stage.

Next, the signal was injected at the base of Q3, the 1st FM IF amplifier, and a reading of 1.4 volts was obtained on the meter. When the generator lead was moved to the input element (emitter) of Q2, the FM converter, the meter reading decreased to .8 volt. This indicated a decrease in gain (about 50%) within the converter stage.

At this point, a decision was made to align L5, the 1st FM IF transformer, and the meter reading gradually increased to .85 volt. A peak reading should have occurred somewhere between the extremes of the adjustment; therefore, it was suspected that the transformer was defective.

L5 was removed from the PC board and carefully disassembled (Fig. 4). Upon inspection of the solder joints, it was observed that one wire from the primary capacitor was wrapped around a terminal, but had not been soldered. The connection was carefully soldered and the transformer was assembled and reinstalled on the PC board.

Again the generator was attached to the emitter of Q2, and L5 was realigned. This time a definite peak meter reading of 1.5 volts was obtained with the slug near the center of the transformer adjustment.

It is evident from the preceding analysis that alignment not only can improve receiver performance, but will often pinpoint a defective stage.

Intermittent FM

FM reception was intermittent, and tapping the chassis affected the condition. When the signal disappeared, the volume was turned up and a local FM station was faintly heard all across the dial. This symptom suggested a dead FM oscillator circuit.

The components in the oscillator circuit were gently tapped in the process. A defective solder joint (Fig. 5) was discovered at one of the terminals on the FM oscillator section of the tuning capacitor, C71. After the connection was resoldered, the overall FM alignment was touched up, and the receiver restored to normal operation.

Low Volume on AM and FM

The volume was inadequate on both the AM and FM bands. A harmonic generator was used in the following manner to locate the defective component: The generator was switched to AF output and one lead connected to the receiver ground. When the other lead was attached to the base of the AF driver transistor (Q7 in Fig. 6), a tone was heard in the speaker. The generator was removed from Q7 and attached to the base of Q6, the 1st AF amplifier transistor, and the speaker tone increased in volume. This increase indicated that Q6 was amplifying the signal.

The volume control was turned up and the generator lead connected to the center terminal of this control. The volume level from the speaker remained about the same as in the previous test. Next, the generator lead was moved to the input side of C8, the 5-mfd coupling capacitor, and the speaker volume decreased considerably. A substitute capacitor was bridged across C8 which was open, and the volume increased to normal. Replacement of the capacitor cured the low volume. ▲

Troubleshooting Stereo

Logical approaches to common troubles. by Norman Crowhurst

Many troubleshooting methods used for stereo are identical to those employed in troubleshooting other electronic equipment. If the set isn't working, the same sequence of checks should be followed: Is power reaching the set? Are the supply circuits providing working voltages? Then signal trace to find the circuit failure.

If only one channel is not working, similar advice applies: Signal trace the faulty circuit, starting at the output, until you find where the signal ceases. Whether the stereo amplifier uses tubes or transistors, it has a signal path from input to output that can be traced just like any other electronic equipment.

Distortion

If the circuit is working, but the sound seems distorted, you must be prepared to spend a little more time analyzing the symptom. What does the distortion sound like? Most distortion sounds give an impression characteristic of their origin. But such impressions can mislead.

Electronic or Mechanical?

Knocking or scraping sounds, like the voice coil hitting or rubbing, could be just that. But such sounds could also have an electronic origin. A clue that will partially resolve this is the question: Can you hear the distortion in both the left and right channels or only in one? If the same distortion is noted in both speakers, look in the electronics as it is unlikely for both speakers to be faulty.

A more probable cause is a defect in the supply circuit that affects both amplifiers identically. For example, a faulty electrolytic can decrease the output of the low-voltage supply, causing an inadequate working voltage to be supplied to both amplifiers.

When only one channel produces distortion, the inherent design of the stereo itself provides a simple method of checking whether the trouble is electronic or mechanical. Switch speaker systems, left with right, to see if the distortion remains on the same side or moves to the other. If the distortion moves to the other side (Fig. 1), the speaker is not faulty and you should troubleshoot the faulty amplifier. If the distortion stays with the same side, or speaker, the speaker then is the faulty part and should be replaced.

Most, if not all, forms of distortion that occur in amplifiers are accompanied by some change in the working voltages. When one side is normal and the other side distorts, check the voltages of the distorted side against the corresponding voltages of the normal side, looking for a significant difference.

Another useful check, where a stereo uses a number of input sources—radio, phono and tape, for example — is to determine whether the same thing happens to the inputs from all sources. This is a quick means of signal tracing.

If the same distortion occurs in all positions of the function switch, obviously it originates in the part of the amplifier system that is common to all functions. If it happens on only one position of the function switch, then look for the fault in the related circuitry before the function selector switch.

Trouble at the Input

Here, common things can be overlooked. If the phonograph reproduction is distorted, look for an accumulation of lint under the stylus. You would think the customer would have found it, but sometimes it builds up in a solid pad that is

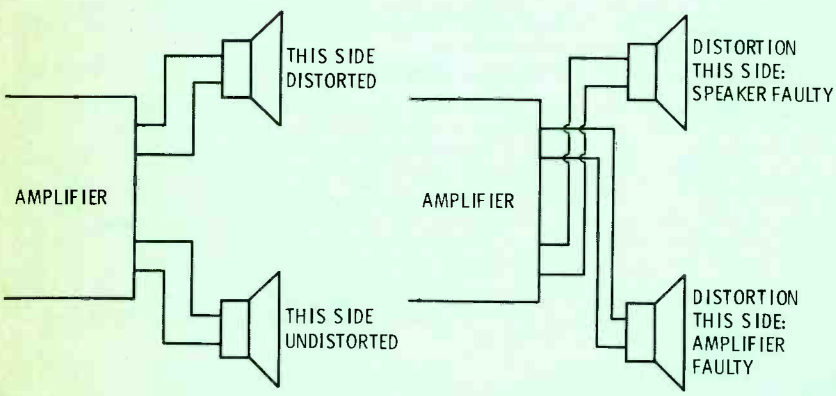


Fig. 1 Changing speaker connections will help you determine whether the speaker or the amplifier is faulty.

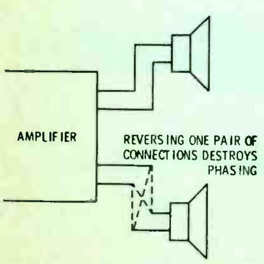


Fig. 2 How the effect of stereo can be lost by incorrect phasing.

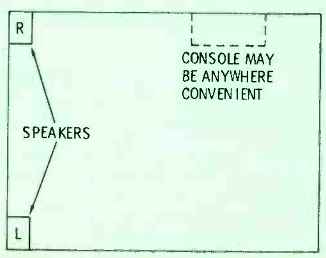
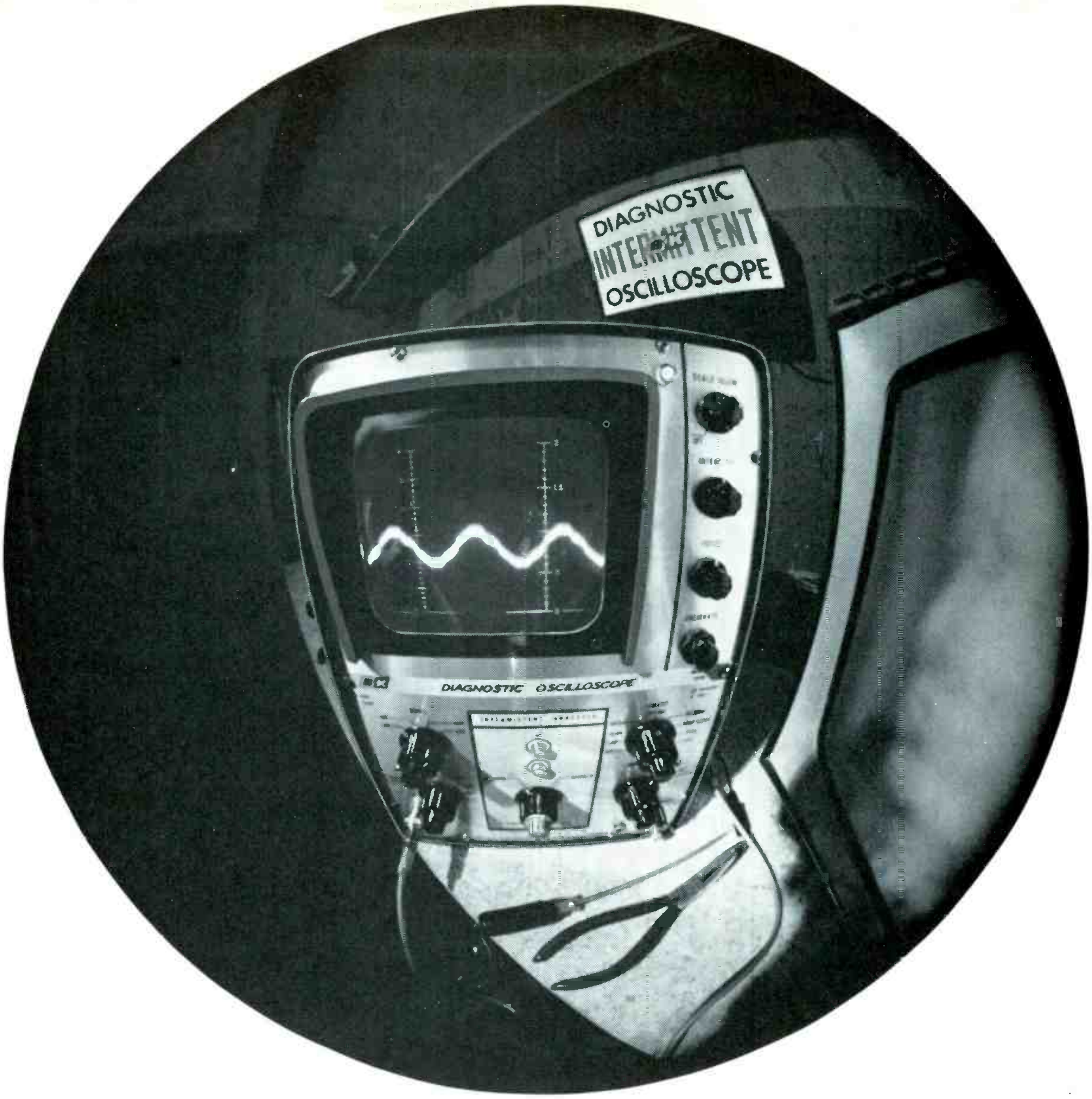


Fig. 3 A good basic placement in a rectangular room of average furnishing.



Another benchwarmer?

Not this one. Our new B&K Diagnostic Oscilloscope is more than re-engineering of an old model to keep pace with TV technology. It is instead a basic departure from all other oscilloscopes. A departure that has simplified a complex instrument to make it easier for you to use. But there's something else.

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Automatic synchronization locks in all patterns at any signal level or frequency. There are also fewer controls and these are positioned for easier operation.

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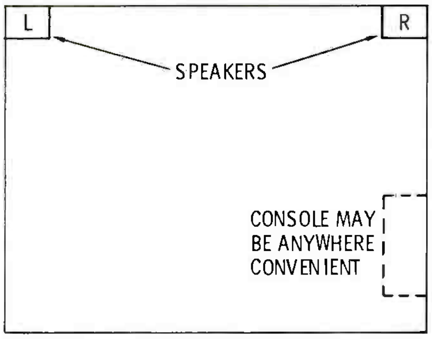


Fig. 4 In an especially 'dead' room, that gives the impression of "active silence" to your voice and other sounds produced or reproduced in it, this arrangement may be better.

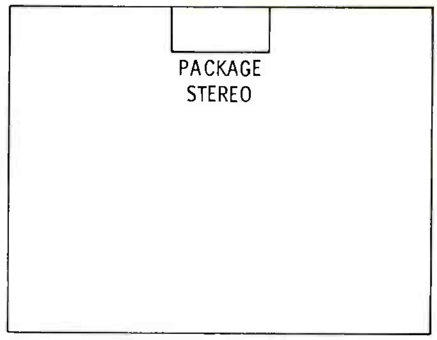


Fig. 5 The best lay-out for the typical recreation room.

not easily removed, or he may have just forgotten to check that. The stylus could also be worn or, less likely, chipped. This you will have to verify with a microscope.

If the trouble is in the tape section, the tape head may be out of alignment and lost its high-frequency response. If the loss is minimal, i.e., only above 3,000 Hz, it may not be noticed as a loss-of-highs but as a loss of character in certain instruments, such as violins, which may sound more like distortion than a loss-of-highs.

Loss of 'Stereo'

With both channels working, this can happen through incorrect connections. A wrong connection at the input may ground out one channel, or may parallel them so both channels are identical instead of properly separated. Incorrect phasing, usually at the output, can lose all sense of location, so realism disappears. Reversing connections to one channel can cause this (Fig. 2). This may have happened when the customer was trying some changes of his own and didn't get the connections replaced as they originally were.

The Intangible Faults

The faults discussed in the preceding paragraphs demand only well established troubleshooting techniques, in which the difference from any other system is the convenience of having two identical systems in one. Many of your stereo service calls will use these techniques, although improved reliability of modern equipment is making such service calls less frequent.

This last fact leads to an increasing proportion of calls where the trouble isn't in the **tangible** part of the set. It may call for some tact on your part in tracking it down. The complaint will often be derived from comparison: "My neighbor has a set just like this, but when he plays this very same tape (or disc) it sounds quite different. It sounds much cleaner on his set." You may or may not have the opportunity to verify this. If you can conveniently do so, you may be able to judge first-hand the cause of the difference. If not, you may have to play detective with your customer.

The mere statement that it doesn't sound as good does not tell you the cause of the difference. You must know in what way the sound differs. Does it lack something specific? What made your customer notice the difference?

Perhaps the violins sound like violins on the neighbor's set, but on his set they're just a screech. Listen for yourself. Is the set distorting (you can tell that by listening with your ear fairly close to each speaker in turn) or could it be the room acoustics? The neighbor may have a well-furnished living room, carpeted floor, drapes, well-stuffed furniture, which the customer's room lacks. That can make violins sound quite different.

If this is the reason for the difference, it didn't just happen. It's been there all along. But your customer may insist he's only just heard this difference.

This circumstance can be difficult to diagnose with any certainty. It may be something that has developed in the system, such as a tape head slightly out of alignment, which requires professional correction; or the fact may be that the difference was there all along, but was only recently noticed. In fact, the difference may be so subtle that only he can hear it which would

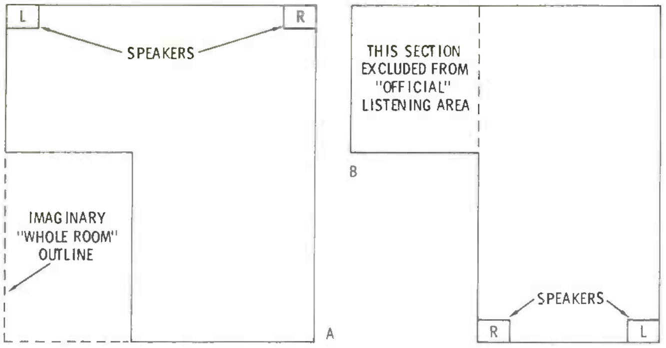


Fig. 6 A more common American room — L-shaped. A: the wrong way, regarding the room as part of a larger one that is rectangular; B: the right way, considering part of the room to be rectangular and using that part as a primary listening area.

lead you to believe he was imagining something.

Studies of human hearing have ascertained that the sounds we are aware of are so complicated that we never hear all of what we think we hear, even when trying. By concentration and practice we can make sounds audible that we didn't hear before, though they were always there. For this reason never assume your customer is hearing things. And even if you can't hear the distortion he complains about, don't assume that it isn't there. In this kind of situation, always recognize that your customer must be hearing something and try to identify what it is.

If your customer is a musician or a layman with some musical appreciation, he may complain about a non-musical sound. With your electronic background you think of noise as non-musical but to your customer the sound of a tinkling bell that shouldn't be there is equally non-musical. The same sounds convey different impressions to different people.

Acoustic Environment

When you conclude that the customer's dissatisfaction comes from his system not being suited to his acoustic environment, you may need to advise him on this. Could a change of position help? The lady of the house may not like this, but it's a choice that must be made: Do they want better listening, or the stereo set in the position they fancy?

Much about placement seems contradictory because changing factors make the situation different. A question is often asked about which side of a rectangular room should be used: Should the stereo be placed on a short side or a long side?

Where the acoustics are good and the speakers are separate from the operating console, the short side is usually best for the speakers. The control console can be anywhere that's convenient (Fig. 3).

Where the acoustics are too dead, which isn't often, the long side may be better (Fig. 4). A room with heavy carpeting, acoustic tile ceiling and highly absorbent walls will be almost as dead as an anechoic chamber. The widest possible spacing of speakers is desirable in such a room.

In a highly reverberant room, such as the recreation room with no floor covering, hard walls and ceiling; a packaged set with the speakers built in placed against one of the longer walls (Fig. 5), would usually be the best arrangement.

Of course, the rectangular room is, in a sense, somewhat of an ideal. So many American homes come today with a combination room that is L-shaped. In such circumstances, the customer should determine which is the primary listening area. If you regard the room as rectangular with a piece cut out (Fig. 6-A) and try to fill the imaginary 'whole room' you may not get good listening anywhere.

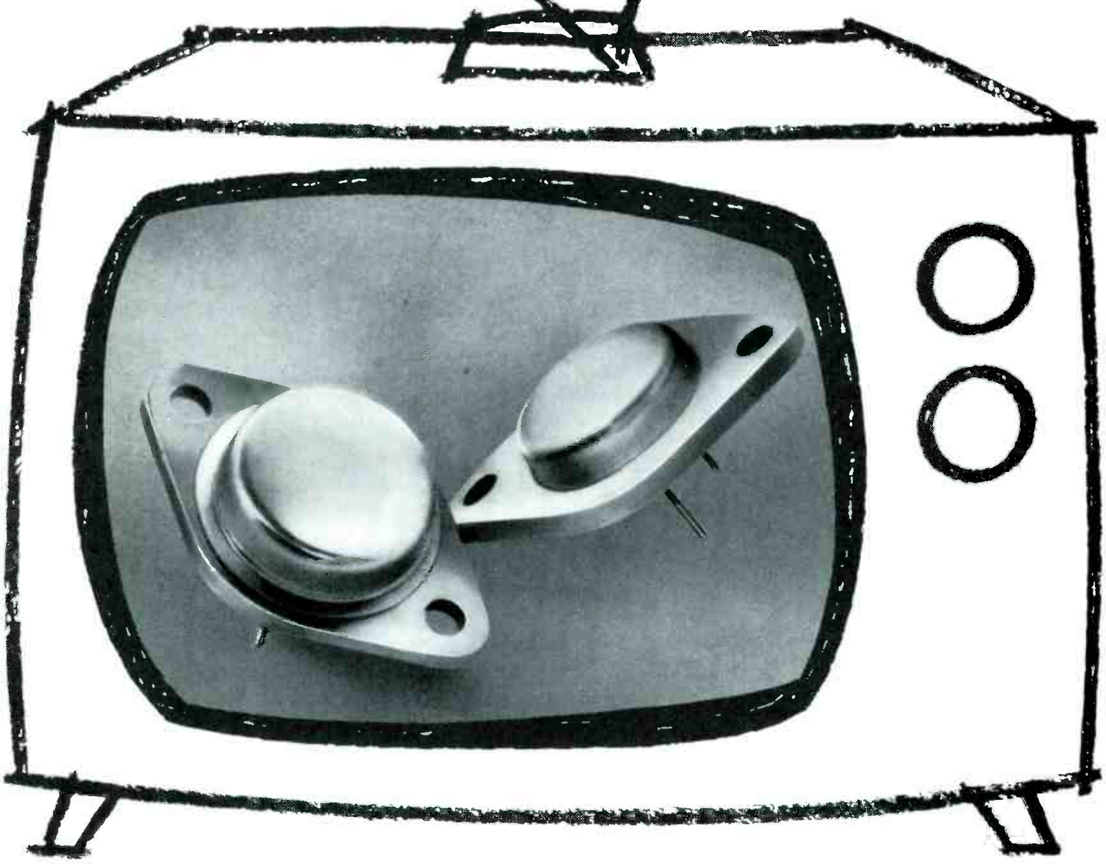
It's better to think of one leg of the 'L' as being the primary listening area, and place your speakers or set to feed that area.

This kind of advice and help hardly seems like troubleshooting, in the accepted sense, yet really it is. Where else will your customer get the correct advice on such matters? The demonstration in a dealer's showroom merely shows him what sounds good in that acoustic environment, which may well be quite different from his own. The service technician is the man who gets called in where the trouble can really be diagnosed.

Don't be afraid to charge for your services. Even though you did not do anything to the electronics, you used your know-how, and acoustic experts charge rates for their time at least equal to yours. If your name gets around as a man who knows how to make stereo sound its best, you'll make better money than by working much harder on the service bench. And the service you give your customer will also be much more valuable to him.

It seems silly to be called because the set doesn't work at all, to find that it was unplugged during house cleaning, and nobody had checked to see if it was plugged in again. We've all had that happen with TV's, refrigerators and everything else. Stereos aren't exempt. Customers often grumble about paying your minimum service charge for finding that out. But such oversights still happen—and if plugging in a power cord restores a set to normal operation, you have performed a service to the customer just as if you had replaced a transistor. ▲

Two New SK Devices Simplify Servicing of TV Deflection Circuits



More than a dozen solid-state TV sets—RCA and others—can use these two new RCA SK-Series transistors—specifically designed for replacement use in deflection circuits.

The RCA SK3034 is for replacement use in horizontal driver and in vertical-deflection-output circuits; the SK3035 is for replacement use in horizontal-deflection-output circuits.

Both units are germanium p-n-p devices in hermetically-sealed TO-3 packages, and are for use in domestic and imported TV sets with anode voltages to 18 KV and with picture tubes having deflection angles up to 114°.

Add both to your stock of RCA "Top-Of-The-Line" SK-Series replacement transistors. See your RCA Distributor today about your supply of RCA SK-Series replacements . . . 33 individual units that can replace approximately 11,800 solid-state devices.

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Now available . . . a comprehensive and accurate source of solid-state replacement information! It's RCA's Solid-State "Top-of-the-Line" Replacement Guide, SPG-202F. Cross-referencing RCA SK-Series Transistors, Silicon Rectifiers, and Integrated Circuits, the Guide provides replacements for nearly 12,000 solid-state devices —including U.S. industry standard EIA types, foreign types, and types identified only by device-manufacturers' or equipment manufacturers' parts numbers. SPG-202F is available through your RCA Distributor. Ask him about it. Today.

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RCA

Time-saving techniques for transistor radio repair

Service methods for profitable repair

The following case histories of transistor radio troubleshooting experiences were chosen to illustrate deceptive servicing problems. In each case detailed step-by-step procedures are given for locating the faulty component or components. The approaches taken in each instance are as direct and time-saving as possible.

Hissing, Frying, Static-Like Noise

The noise is not noticeable until the radio plays for a few minutes, then it grows louder and the station grows weaker. Such noise is nearly always caused by leakage between conductors on the printed board (likely due to battery chemicals), or by a leaky capacitor (most often ceramic, but sometimes electrolytic). On rare occasions, transistors, transformers, and even resistors may cause this trouble. The first step is to localize the noise.

Step 1: Connect radio to power supply, measure current drain. Wait for noise to begin, measure current drain again.

Result: Current drain normal until noise begins (in about three minutes). Then current increases as noise becomes louder.

Decision: Current increase means nothing, since noise will cause class-B output stages to draw more current. Localize noise to audio or other stages.

Step 2: Turn volume control to minimum.

Result: Noise remains.

Decision: Since noise does not decrease as volume is reduced, it must be in audio stages (Fig. 1).

Afterthoughts: At this point, two or three approaches to testing are possible. A voltmeter will show a fluctuation if the noise is severe. A drawback to this approach is that the current in the class-B stages varies with the noise in the signal circuit. Thus, voltages around the

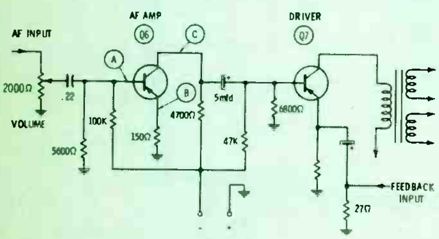

Fig. 1. Varying emitter voltage causes noise unaffected by volume control.

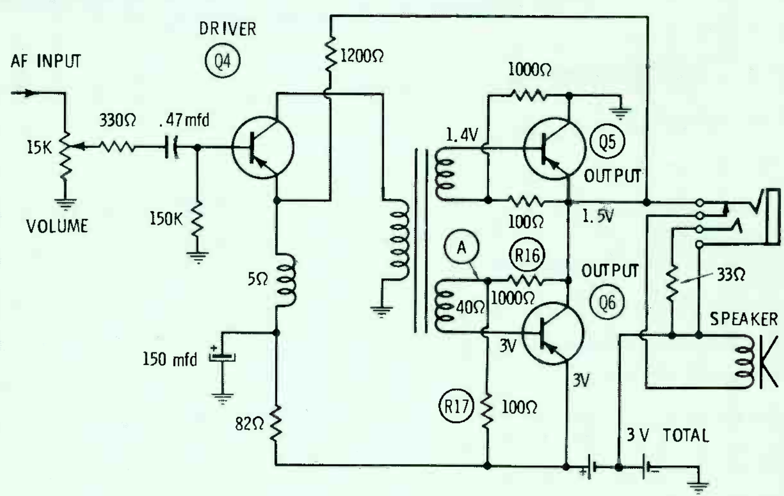

Fig. 2. Improper bias in audio stages causes distortion at low volume.

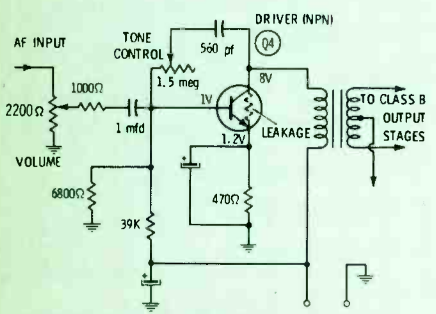

Fig. 3. Excessive transistor leakage in driver stage causes reverse bias.

audio stages will fluctuate somewhat, making it hard to pinpoint the trouble. An audio signal tracer can be used, but the noise pulses so often upset the current in the whole radio that a tracer may detect pulses far from the source of the trouble. Used wisely, however, the audio tracer will usually suggest the source if the noise is traced back through each stage until it diminishes drastically. Step 3 indicates the most foolproof way to isolate noise.

Step 3: Zero-bias Q7 (Fig. 1) by shorting base to emitter with a jumper, wire, or screwdriver.
Result: Noise stops.

Step 4: Zero-bias Q6 in the same manner.
Result: Noise stops.
Decision: Noise must be in input stage of Q6 because volume control is turned to minimum.

Step 5: Measure voltage at point A (base of Q6).
Result: About —.2 volts, fairly steady.

Step 6: Measure voltage at point B (emitter of Q6).
Result: Voltage fluctuates from —.1 to —.9 volt.
Decision: Noise voltage originates in emitter circuit. No capacitor in emitter circuit. Transistor may be defective.

Step 7: Unsolder collector lead at point C. Measure emitter voltage again.
Result: Still fluctuating.
Decision: Fluctuating emitter voltage rules out transistor leakage. It can't be base-to-emitter leakage either, since base stays near —.2 volt whereas emitter rises to as much as —.9 volt on peaks, nor can it be collector-to-emitter leakage, since collector voltage is disconnected. There is only one conclusion: leakage between printed conductors. A look at the board shows that the —6-volt conductor is adjacent to the emitter conductor —an ideal setup for leakage.

Step 8: While reading emitter voltage, scratch a line (use the point of a knife or corner of a screwdriver blade) on printed board, between conductors.
Result: Voltage reading on emitter terminal disappears. (Collector is disconnected.)
Decision: Leakage occurred between two conductors on the printed board. Perhaps battery chemicals or other acids have accidentally been spilled on the board.
Afterthoughts: In some sets, even scratching a deep line between conductors will not eliminate all traces of leakage. The only alternative is to completely pry the leads from the printed tie point and leave them suspended in midair. Generally, though, such drastic measures are not necessary.

Distortion Most Prevalent at Low Volume

Distortion that is most noticeable at low volume is usually caused by improperly biased output or drive stages, or by a defective speaker.

Step 1: Connect radio to power supply (Fig. 2). Check current drain with volume turned down.
Result: About 4 ma.
Decision: Seems too low; should be about 8 ma for this model. Check speaker before disassembling radio.

Step 2: Plug test speaker into earphone jack.
Result: Same distortion level is present.
Decision: Speaker in radio is okay.

Step 3: Check bias (between base and emitter) on each output stage.
Result: Bias on Q5 is about .1 volt, which seems about right. Bias on Q6 is zero; should be same as bias on Q5.
Decision: Driver transformer open, R16 or R17 open, or Q6 shorted. Make tests to narrow down trouble.

Step 4: Check voltage at point A (junction of R16 and R17).
Result: Zero voltage.
Decision: Driver transformer isn't open; if it were open, voltage would be normal at point A. Transistor isn't shorted (base to emitter). If it were shorted, there would be some voltage at point A since the 40-ohm resistance of the transformer would prevent a complete short circuit. Therefore, R16 or R17 must be open. (Further inspection revealed R16 was cracked. Evidently the radio had been dropped.)

Weak and Distorted Audio

In this radio, distortion is the dominant problem; once the distortion is removed, the volume will probably return to normal.

Step 1: Connect radio to power supply (Fig. 3). Check current drain with volume down and the set tuned off station.
Result: About 7 ma of current flow.
Decision: Current drain approximately correct.

Step 2: Check current drain with volume turned up and set tuned to station.
Result: Current drain about 15 ma maximum on a strong station. Audio now very distorted.
Decision: Not enough current. This model should draw 50 or 60 ma on peaks at full volume on a strong station. The reason for low current is loss of volume. The class-B output stages are not being driven hard enough to draw higher current. Since the current at no volume seems about right (indicating correct bias on the output stages), suspect the driver stage.

Step 3: Check bias (from base to emitter) on driver stage.
Result: Voltage on base is about —.2 with respect to emitter.
Decision: This is approximately the correct bias level, but the schematic shows the driver is an NPN transistor. Remembering the rule that the middle letter of the type of designation indicates the polarity of the base and collector voltages, we realize the voltage reading from base to emitter should be **positive.** In other words, the transistor is reverse biased. How can this be? The base circuit can be ruled out, since the only source of voltage across the emitter normally is the collector current which can flow only if the transistor is conducting. But reverse-biased transistors don't conduct. So the voltage source must be the transistor itself or a leak across the printed circuit board.

Step 4: With soldering iron, heat emitter connection to printed conductor. Blow away excess solder with a soda straw. With solder gone, break emitter loose from printed conductor. (You need not remove lead from the hole in the board; just center it so it doesn't make connection to the conductor).
Result: Voltage goes to zero on printed conductor.
Decision: Transistor must be excessively leaky. However, since emitter and collector were on adjacent printed conductors, heating and blowing away solder may have also removed unwanted path between conducting strips on the printed board. Still, most likely suspect is transistor.

Step 5: Remove transistor and check for excessive leakage, or, temporarily restore emitter connection. If original trouble persists, transistor is defective.
Afterthoughts: Although printed boards develop leakage paths that can cause such troubles, the transistor in this example **was** defective and a new one cured the trouble. Be sure the replacement driver transistor is neither too high nor too low in gain. When universal transistor replacements are used, the bias

must sometimes be juggled slightly in order to get maximum gain and minimum distortion.

Dead Radio

Since dead radios can be caused by many things, a systematic troubleshooting procedure should be followed in diagnosing them.

Step 1: Connect radio to power supply, and check current drain.
Result: Checks about 10 ma.
Decision: Probably about normal. Output stages seem all right.

Step 2: Turn volume control back and forth, and listen carefully to speaker.
Resut: "Scratching" noise is heard in speaker.
Decision: Speaker and audio stages probably all right since sound is getting through them.

Step 3: Hold set close to fluorescent light, and listen for any noise in the speaker.
Result: No noise.
Decision: No signal getting through IF's.

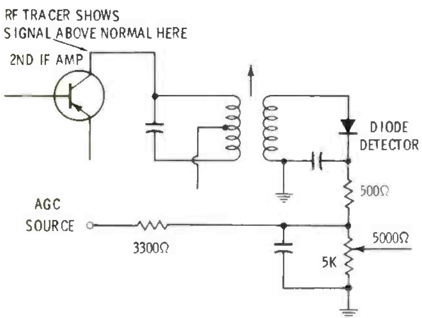

Fig. 4. An open detector diode results in no audio output and no AGC.

Step 4: Check with RF signal tracer or by signal injection.
Result: Signal at converter collector and first IF collector is normal. Signal at second IF collector is also good, except it is stronger than usual (Fig. 4).
Decision: Diode detector is probably open. Tipoff is that signal, although somewhat stronger than normal, is good up to second IF amplifier. This condition indicates no AGC action. Since AGC voltage nearly always originates at diode detector, diode must be at fault.
Afterthoughts: An open detector diode is fairly common. An in-the-circuit ohmmeter check will spot the trouble. A good diode reads about 100 ohms forward and from 2K to 10K in the reverse direction. ▲

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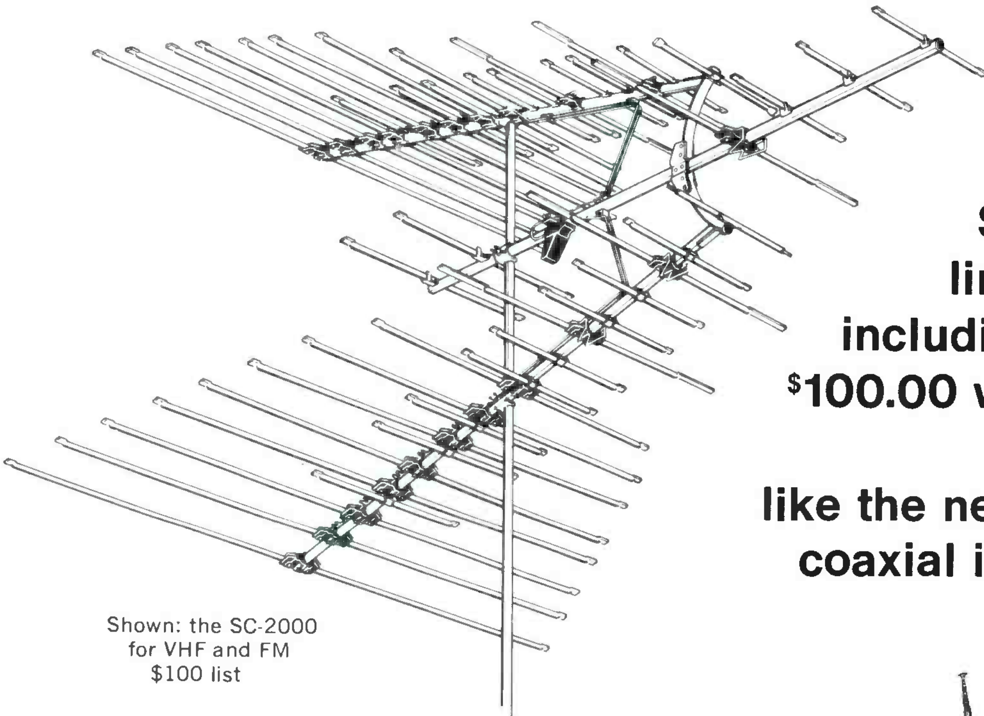

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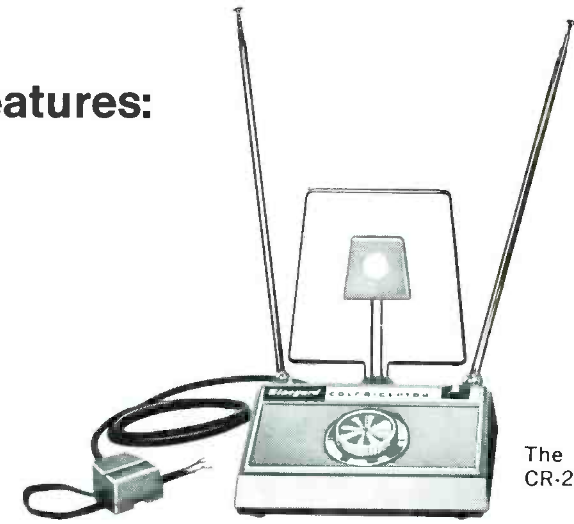

The
CR-200

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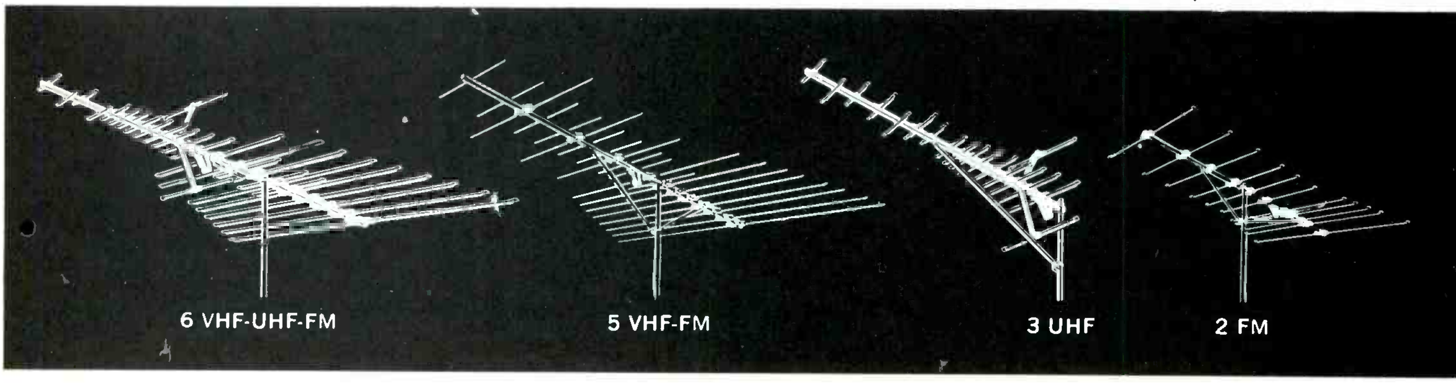
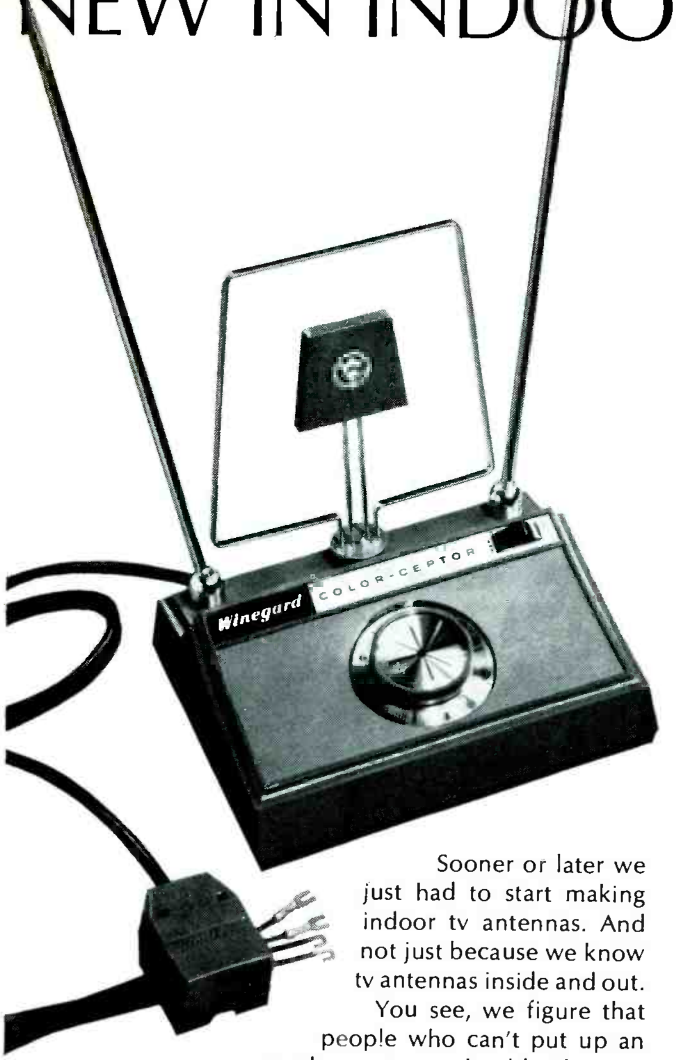


WINEGARD PRESENTS SOMETHING NEW IN INDOOR TV ANTENNAS



featuring the CR-200... The Coaxial Indoor Antenna for color tv with exclusive ghost rejection color cable and built-in VHF/UHF signal filter!

Sooner or later we just had to start making indoor tv antennas. And not just because we know tv antennas inside and out.

You see, we figure that people who can't put up an outdoor antenna shouldn't have to put up with anything less than the best reception. Especially in color.

And we can't understand why an antenna created to make color television look more colorful should make a room look drab.

So what we've done is create a complete line of low profile indoor antennas in decorator colors like avocado green, walnut brown, flame orange and shadow brown.

So much for the drab rooms.

As for the best possible reception (in color and black & white—and on all channels, 2 to 83) you'll find that our Color-Ceptor and Power-Beam antennas have what it takes to outperform and outsell everything else around.

Just what you'd expect from Winegard.

Exclusive ghost rejection color cable with built-in VHF/UHF signal filter. Our ultra-low-loss coaxial cable is electrically shielded to actually "shut-out" ghosts and to effectively eliminate electrical interference from cars and airplanes and appliances, among other things. The built-in signal filter eliminates the need for separate wires from the antenna to the VHF and UHF terminals on the back of the set; and automatically filters the VHF and UHF signals to help deliver the best possible color reception.

Then there's the *chrome-plated UHF driven element.* It's precision tuned to capture and deliver more signal to all UHF channels, 14 to 83. It rotates (without moving the antenna) to pick-up maximum signal. And its unique configuration assures the best color reception.

Our *VHF/UHF isolation switch* automatically separates VHF and UHF signals to help eliminate signal loss and interfering feedback common to color tv reception.

And there's the *12-position fine tuning signal control switch* which allows for fast, accurate control of the color picture quality (black & white, too) on all VHF and UHF channels.

All those features, plus 45″ long telescoping chrome-plated VHF dipoles; rubber cushioning pads; and, of course, colors and styling make our Color-Ceptor (CR-200) the finest indoor color tv antenna made.

List price is $14.95, Fair Trade.

The CR-100 Color-Ceptor has most of the same matchless features, except for the color cable, signal filter and isolation switch. Plus a list price that's hard to match. $11.95, Fair Trade.

The two antennas in our Power Beam series (PB-60 and PB-40) are designed for outstanding all channel reception (2 to 83) VHF and UHF.

They offer a bit less in the way of features, and a lot less in the way of price. The PB-60 is $9.95, Fair Trade. Only $6.95 Fair Trade for the PB-40.

We believe you'll think a lot of our Color-Ceptor and Power-Beam antennas. We do.

So much, in fact, that we're advertising them in Life and Look. And unconditionally guaranteeing them with a 10-day money back guarantee.

We don't expect to get any of them back. But if you expect to get any of them to sell, we suggest that you call your Winegard distributor or write for complete information today.

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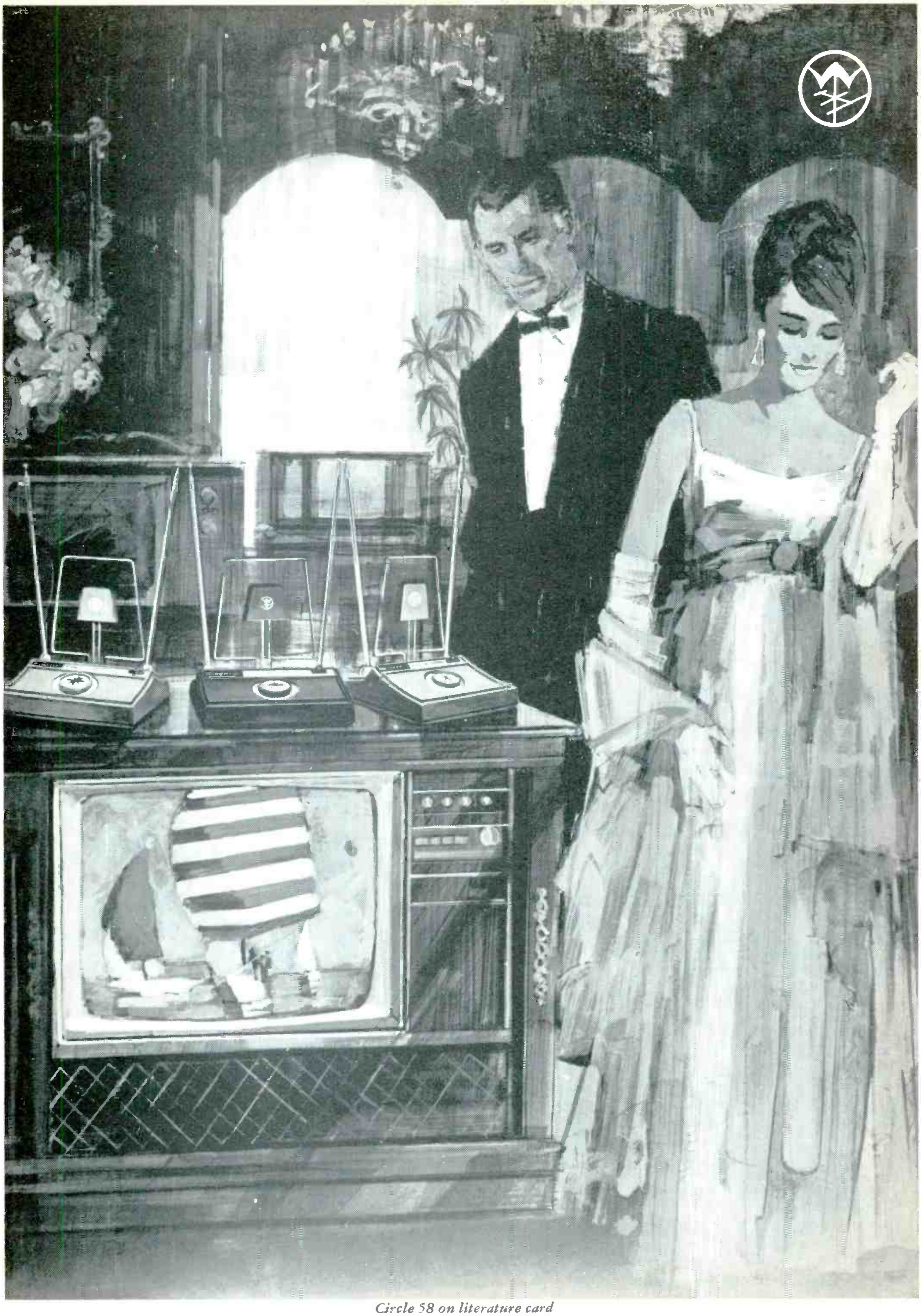
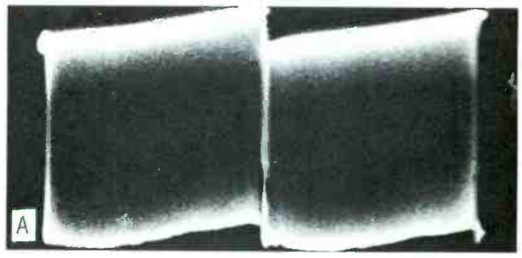


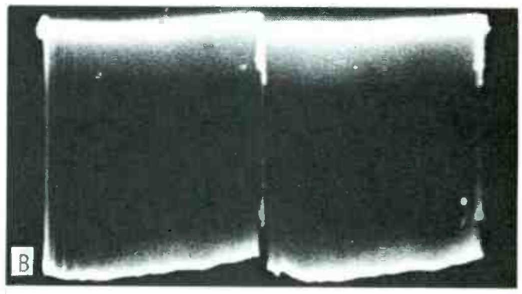
Circle 58 on literature card

Waveform Quiz

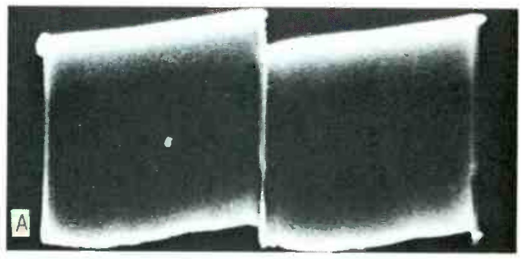
Here is a short photo quiz to test your skill at interpreting scope waveforms. Six different waveforms are shown in pairs. One waveform in each pair is normal and the other is abnormal. Select the abnormal waveform in each pair, and from your own analysis determine what trouble symptom is most likely to appear on the screen of the receiver. The answers appear on page 60.

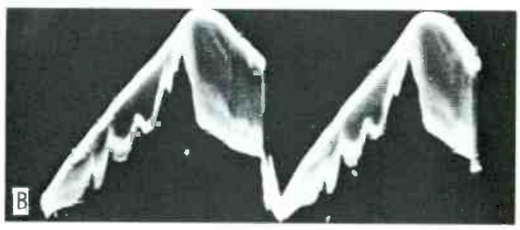
Scope point: output of sync separator



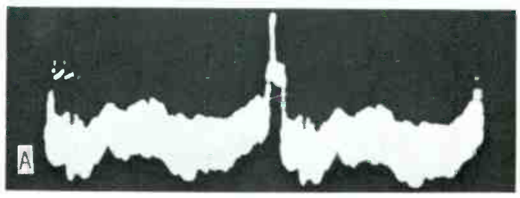


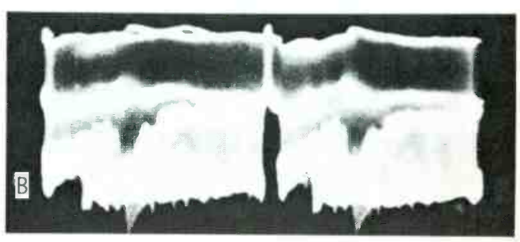
Scope point: output of sync separator





Scope point: video input to sync separator





Circle 39 on literature card

analysis of test instruments . . . operation . . . applications

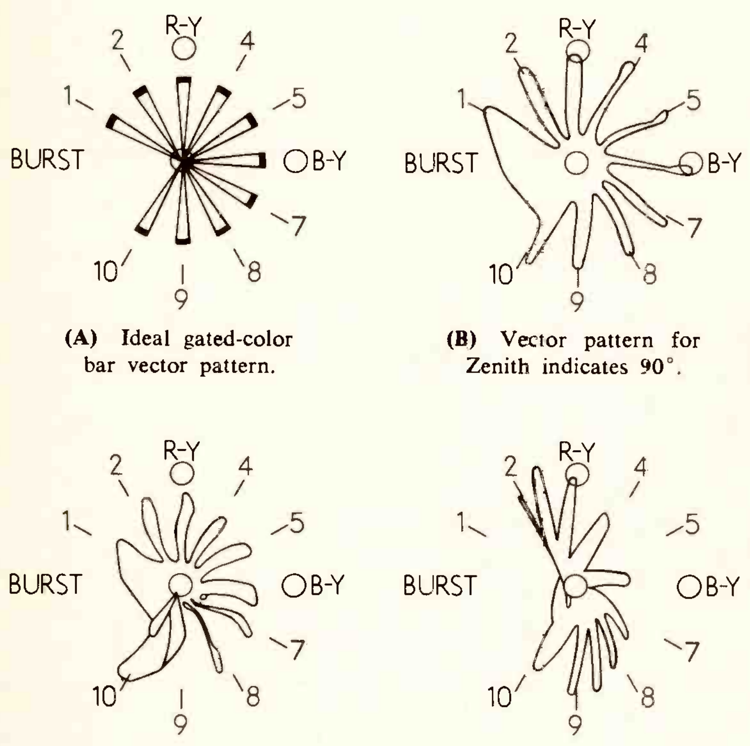
NOTES ON TEST EQUIPMENT

by ELLSWORTH LADYMAN

Vectorscopes

The vectorscope promises to take a lot of the mystery out of chroma circuits. Vectors, phase angles, etc., have always seemed a cloudy issue to the majority of service technicians. The ability of the vectorscope to display a vector pattern on the scope screen allows the service technician to develop a variety of new service techniques to provide faster and more efficient service. It can be used for alignment and troubleshooting procedures throughout the chroma circuitry. By viewing the "petals" displayed on the screen, color alignment, tint range and possibly bandpass touch-up can be performed.

Fig. 1 Vectorscope patterns.



(A) Ideal gated-color bar vector pattern.

(B) Vector pattern for Zenith indicates 90°.

(C) Pattern for G.E. set indicates 105°.

(D) Vector pattern for Motorola chassis.

Vector Pattern

The vector pattern is obtained by connecting a color bar generator to the receiver in the conventional manner. R-Y and B-Y signals from the receiver CRT grids are then applied to the vectorscope. The pattern obtained is dependent upon the color bar system used. This discussion will be concerned with the gated color bar system, although, if the operator understands the system he is using, other systems may be used.

The gated color bar system produces the vector pattern illustrated in Fig. 1. This is an ideal pattern for demonstration purposes and will seldom be displayed under practical conditions. The ten petals indicate the ten color bars generated by the color bar generator, amplified and demodulated by the receiver circuitry. The vector pattern provides visual evidence of how effectively the receiver circuitry is responding to the input signal. The positions of the petals on the screen indicate the angle of demodulation. If the third

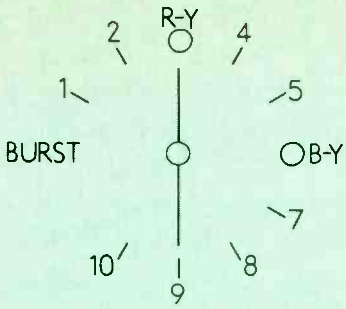


Fig. 2 Pattern for loss of B-Y signal.

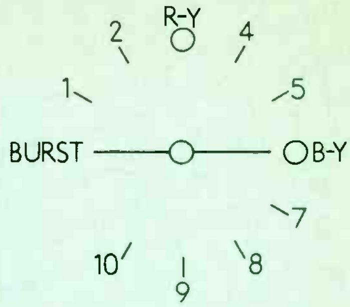


Fig. 3 Pattern for loss of R-Y signal.

and sixth petals fall on the R-Y and B-Y points on the graphs, respectively, the demodulation angle is 90 degrees. Should the sixth petal fall approximately halfway between the B-Y and the No. 7 point on the graph, the demodulation angle is 105 degrees. This knowledge of petal position on the vector display provides the service technician with a simple and fast method of adjusting the demodulation angle. This is accomplished by adjusting the injection transformer slug while viewing the vector display. The demodulation angle can be varied from 90 to 116 degrees and should be adjusted to conform to the manufacturer's specifications.

Tint Range Control Adjustment

The tint range of a specific color receiver can be easily checked using the vectorscope. While viewing the vector pattern on the scope, rotate the tint control. The third petal should move in accordance with rotation of the tint control through an arc 30 degrees each side of the R-Y point on the graph. Should the third petal fail to move in the arc as outlined, the tint range should be adjusted as follows: Set the tint range control to the exact physical center of its range and adjust the tint or hue transformer slug until the third petal is centered on the R-Y point of the graph.

3.58-MHz Oscillator Adjust

While viewing the vector pattern, short out the chroma reference oscillator control signal. If the vector pattern rotates in the manner of a wheel turning, the 3.58-MHz oscillator requires adjustment. Adjust the oscillator slug until the vector pattern "locks-in" or slows to its slowest rotation. With some types of oscillator control circuits, the vector pattern will not rotate as a wheel turns but will pulsate from a minimum to a maximum.

Symptoms

Loss of B-Y signal is illustrated in Fig. 2. This straight vertical line indicates a loss of blue, and trouble can be expected in either the B-Y demodulator circuit or in the matrix system.

Loss of R-Y signal is illustrated in Fig. 3. The indication is a straight horizontal line across the screen. Trouble can be expected in either the R-Y demodulator circuit or in the matrix system.

The G-Y signal is not used in obtaining the vector pattern. Therefore, when a complete vector pattern is visible on the screen and the complaint is "loss of green," it fol-

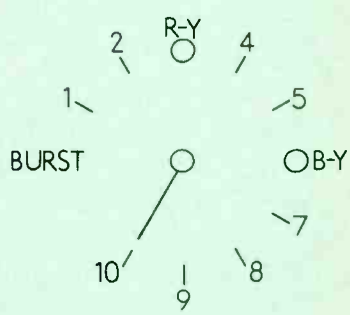
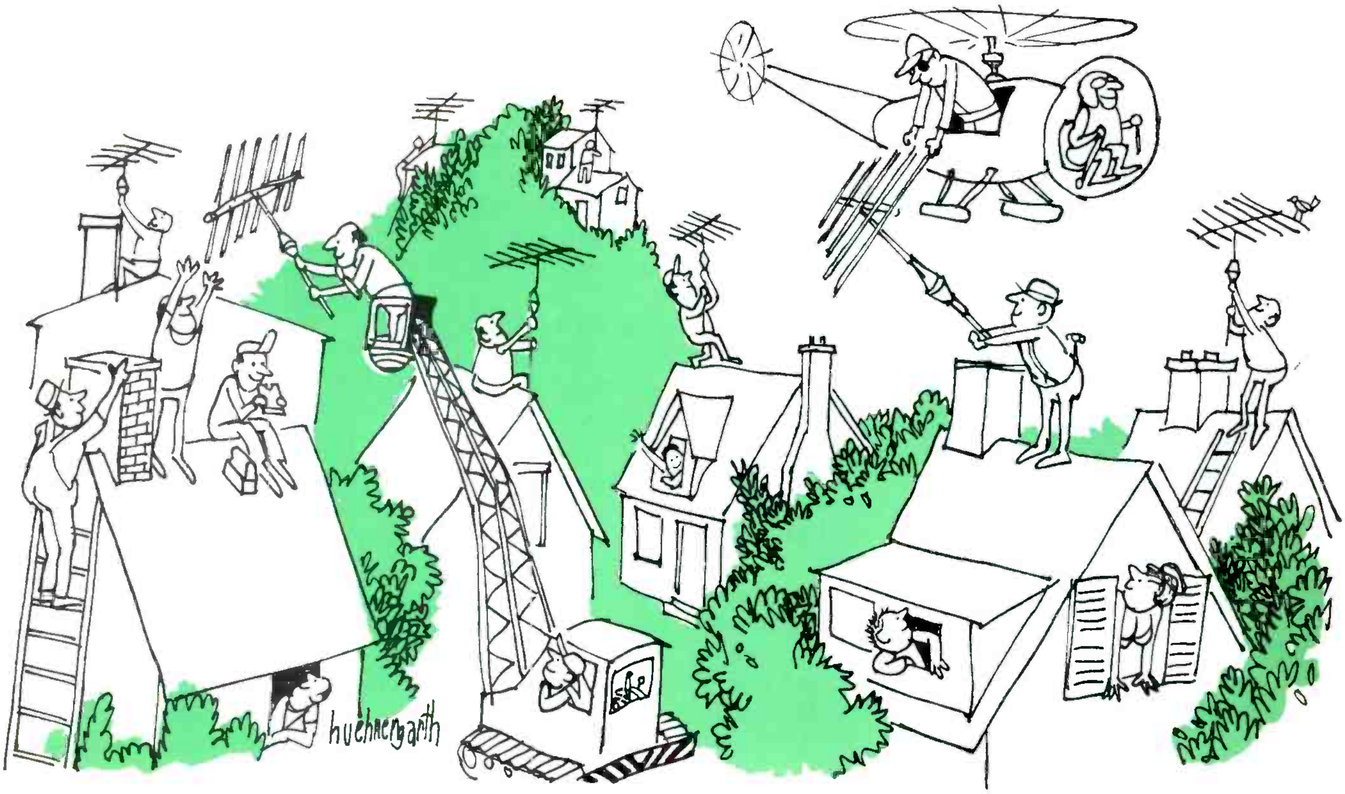


Fig. 4 Pattern indicating no color.

Join the rotor revolution...



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Orders are rolling in for the new Jerrold DYNA-ROTOR—fast. We're not surprised, for here . . . at last . . . is a profit-making rotor you can rave about:

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Circle 38 on literature card

lows that trouble can be expected in the G-Y demodulator or matrix system.

There are still many service problems that a vectorscope will not isolate. A good wide-band scope will still be required in color servicing. However, the addition of a vectorscope to your equipment inventory will cut service time on many jobs, resulting in faster, more efficient and more complete repair jobs.

Sencore Model PS-148

The Sencore Model PS-148 is a dual purpose instrument, combining the features of a wide-band and vector scope in a single unit. Very quick conversion from a wide-band oscilloscope to a vectorscope is accomplished by flicking two slide switches located on the rear apron of the cabinet. The test leads can be connected to the R-Y and B-Y chroma circuits or directly to the red and blue grids of the CRT. Circuit loading is kept to a minimum, preventing undue distortion of the vector pattern. Lead lengths and proximity capacitance are reduced to a minimum through the use of the rear vectorscope connections. The wide-band scope utilizes the features of the Sencore Model PS-127 previously covered in the May '65 issue of PF Reporter. Price of the unit is $219.95. ▲

Sencore Model PS-148 Features

Peak to Peak Voltage Measurements
Peak to peak voltages are read directly.

Frequency Response
Vertical amplifier frequency response is from 10 Hz to 5.2 MHz ± 1 dB. Rise time of .055 microseconds.

Sensitivity
0.17 volts RMS per inch vertical deflection.

Horizontal Sweep Freqencies
Horizontal sweep ranges 5 Hz to 500 KHz in 5 overlapping ranges. TV horizontal and vertical ranges are preset on coarse control.

Input Impedance
27 megohms shunted by 9 pf (Lo-Cap probe)
2.7 megohms shunted by 99 pf (Direct probe)

Horizontal Frequency Response
3 dB from 10 Hz to 650 KHz

Standby Switch
Cuts instrument to half power when not in use and provides "instant on" when required.

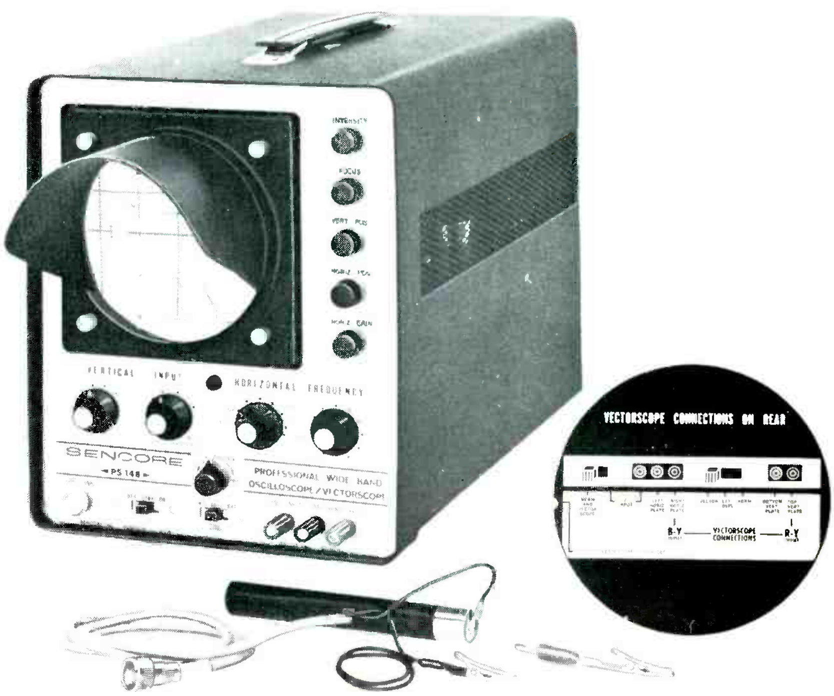

Fig. 5 Sencore Model PS148 vectorscope.

How to get into one of today's hottest money-making fields—*servicing 2-way radios!*

More than 5 million two-way transmitters have skyrocketed the demand for service men and field, system, and R & D engineers. Topnotch licensed experts can earn $12,000 a year or more. You can be your own boss, build your own company. And you don't need a college education to break in.

HOW WOULD YOU LIKE to earn $5 to $7 an hour...$200 to $300 a week ...$10,000 to $15,000 a year? One of your best chances today, especially if you don't have a college education, is in the field of two-way radio.

Two-way radio is booming. Today there are more than *five million* two-way transmitters for police cars, fire trucks, taxis, planes, etc. and Citizen's Band uses—and the number is growing at the rate of 80,000 new transmitters per month.

This wildfire boom presents a solid gold opportunity for trained two-way radio service experts. Most of them are earning $5,000 to $10,000 a year *more* than the average radio-TV repair man.

Why You'll Earn Top Pay

One reason is that the U.S. doesn't permit anyone to service two-way radio systems unless he is *licensed* by the FCC (Federal Communications Commission). And there aren't enough licensed experts to go around.

Another reason two-way radio men earn so much more than radio-TV service men is that they are needed more often and more desperately. A two-way radio user *must* keep those transmitters operating at all times, and *must* have them checked at regular intervals by licensed personnel to meet FCC requirements.

This means that the available licensed expert can "write his own ticket" when it comes to earnings. Some work by the hour and usually charge at least $5.00 per hour, $7.50 on evenings and Sundays, plus travel expenses. Others charge each customer a monthly retainer fee, such as $20 a month for a base station and $7.50 for each mobile station. A survey showed that one man can easily maintain at least 15 base stations and 85 mobiles. This would add up to at least $12,000 a year.

How to Get Started

How do you break into the ranks of the big-money earners in two-way radio? This is probably the best way:

1. Without quitting your present job, learn enough about electronics fundamentals to pass the Government FCC License. Then get a job in a two-way radio service shop and "learn the ropes" of the business.

2. As soon as you've earned a reputation as an expert, there are several ways you can go. You can move out, and start signing up your own customers. You might become a franchised service representative of a big manufacturer and then start getting into two-way radio sales, where one sales contract might net you $5,000. Or you may be invited to move *up* into a high-prestige salaried job with one of the same manufacturers.

The first step—mastering the fundamentals of Electronics in your spare time and getting your FCC License—can be easier than you think.

Cleveland Institute of Electronics has been successfully teaching Electronics by mail for over thirty years. Right at home, in your spare time, you learn Electronics step by step. Our AUTO-PROGRAMMED™ lessons and coaching by expert instructors make everything clear and easy, even for men who thought they were "poor learners." You'll learn not only the fundamentals that apply to all electronics design and servicing, but also the specific procedures for installing, troubleshooting, and maintaining two-way mobile equipment.

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By the time you've finished your CIE course, you'll be able to pass the FCC License Exam with ease. Better than nine out of ten CIE graduates are able to pass the FCC Exam, even though two out of three non-CIE men fail. This startling record of achievement makes possible our famous FCC License Warranty: you'll pass the FCC Exam upon completion of your course or your tuition will be refunded in full.

Find out more. Mail the bound-in post-paid card for two FREE books, "How To Succeed In Electronics" and "How To Get A Commercial FCC License." If card has been detached, send your name and address to CIE at the address below.

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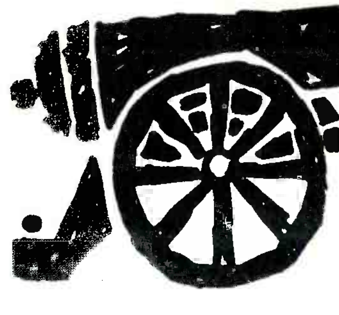
1776 E. 17th St., Dept. PF-52
Cleveland, Ohio 44114

He's flying high. Before he got his CIE training and FCC License, Ed Dulaney's only professional skill was as a commercial pilot engaged in crop dusting. Today he has his own two-way radio company, with seven full-time employees. "I am much better off financially, and really enjoy my work," he says. "I found my electronics lessons thorough and easy to understand. The CIE course was the best investment I ever made."

Business is booming. August Gibbemeyer was in radio-TV repair work before studying with CIE. Now, he says, "we are in the marine and two-way radio business. Our trade has grown by leaps and bounds."

Circle 36 on literature card



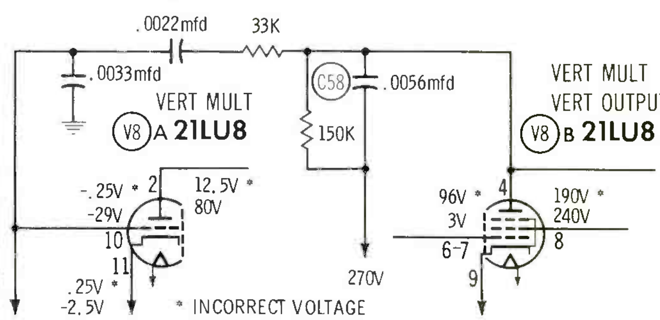
THE TROUBLESHOOTER

Multiple Troubles In a Sylvania

I recently ran across the following troubles in a Sylvania DO5-1 chassis:

1. The raster was reduced an equal distance from both top and bottom. Replacing the vertical output tube did not cure the trouble, so the chassis was pulled. Troubleshooting uncovered the incorrect voltages shown in the illustration here. The particularly unusual voltage on the grid of V8A focused attention on the feedback line. It was soon discovered that C58 was defective. Replacing this capacitor restored the full raster.

2. After operating for 15 minutes, the sound became distorted and the bottom portion of the picture turned excessively light and appeared to be "washed out." Also, a slight vertical roll and horizontal wiggle developed. A scope check of the composite video signal at the grid of the first video amplifier revealed the presence of hum riding on the signal. The video IF tubes were replaced one at a time. The hum and trouble



symptoms disappeared when the first video IF tube was replaced. This tube had previously checked normal on a tube tester.

3. Red was missing on the color-bar generator test pattern. Attaching the scope probe to the plate circuit of the R-Y amplifier showed that the R-Y signal was present and normal at this point. Probing the CRT base cap uncovered a loose connection.

R. J. HORSLEY

Buffalo, N. Y.

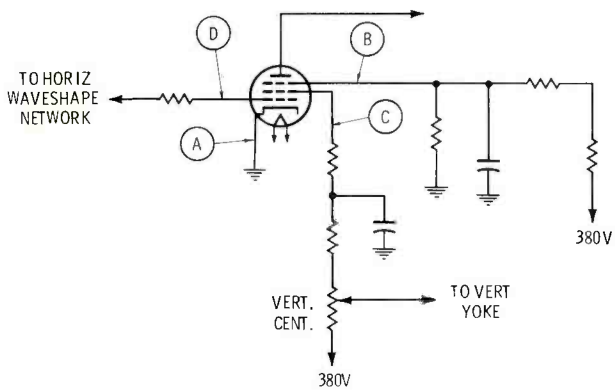
Horizontal Sweep

My problem is with a Hotpoint Model 21S407 (Photofact Folder 387). The receiver works well for about 20 minutes, then the high voltage starts decreasing and the picture narrows. After approximately 45 min-

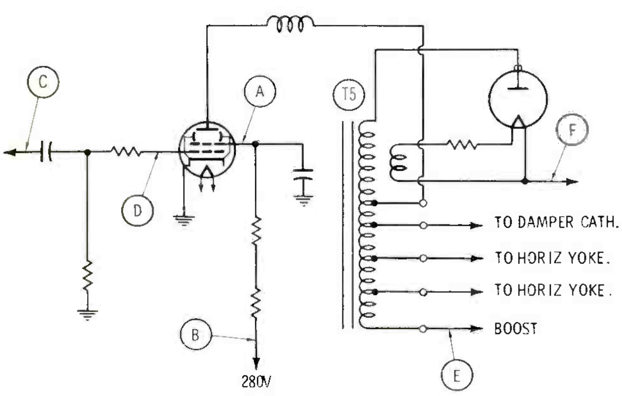
utes, high voltage is down to about 10KV and the flyback overheats. Boost voltage at this time measures low, also. Screen grid voltage, control grid voltage and the drive voltage waveform remain normal. B+ voltages also remain within tolerance. Yoke and CRT were substituted. Initially the chassis was brought in for a defective flyback and a new one was installed. I have tried everything I know and would appreciate your help.

A. W. KIPP

Glendale, Calif.



(A) CURRENT DRAIN EXCESSIVE WHEN TURNED "ON".
(B) CIRCUIT CHECKS "OK".
(C) CIRCUIT CHECKS "OK".
(D) IF HORIZONTAL OSCILLATOR DOES NOT FURNISH DRIVE VOLTAGE IN A REASONABLE LENGTH OF TIME, TUBE WILL DRAW EXCESS CURRENT.



(A) VOLTAGE REMAINS NORMAL
(B) VOLTAGE REMAINS NORMAL
(C) DRIVE VOLTAGE REMAINS NORMAL
(D) BIAS VOLTAGE REMAINS NORMAL
(E) BOOST VOLTAGE DROPS
(F) HI VOLTAGE DROPS

This happens very, very rarely, but it happens, and I think it has happened to you. You have installed a defective new component. This can be about the most exasperating experience in the service business. My suggestion: Replace the flyback again.

A Real Intermittent

I have an Admiral chassis D11 (Photofact Folder 785-1) that is giving us a problem and, in spite of all we have tried, we end up with the same problem. The horizontal output tube draws current in excess of 500 ma. The receiver can then be turned off, then *on again, and horizontal output current will stabilize at 210 ma and remain constant for days or even weeks.*

We have checked the output circuit completely, monitored it with meters, and substituted components. The trouble symptom only occurs when the receiver is first turned on. We have disconnected the degaussing coil and shorted the thermo switch. This has no effect.

C. B.

Redwood City, Calif.

Your description of the trouble symptom was long on remedial action, but extremely short on symptom evidence. However, here is a suggestion that might be of some help. It appears that your horizontal oscillator is slow in taking off. You didn't say whether or not you had drive voltage on the output tube at the times it was drawing excessive current. I'm betting that the off-on action that seems to remedy the current drain on the output tube is accomplishing this by shocking the horizontal oscillator into oscillation.

Arcing CRT Solved

While reading The Troubleshooter column of the August PF Reporter, I came upon the call for help from Mr. H. Gustafson, relating his trouble with an old Muntz TV set. The trouble is neither the fishpaper nor a gassy CRT. If Mr. Gustafson will open the high-voltage cage, he will find that the 1B3 is standing on a porcelain insulator. Replacing this insulator will solve his problem.

Such insulators eventually pick up enough moisture and dust to cause intermittent arcing, with the result that the whole chassis is hot with respect to the CRT. You can actually burn holes in the aquadag with the grounding springs.

I first encountered this particular problem when I entered the electronics servicing business in 1954. Three of us wasted a lot of time on this problem. We went so far as to change the yoke and flyback with no results other than a knowledge of what was **not** the trouble. I have since run across this same trouble twice and each time the trouble became evident after the CRT had been replaced.

RANDAL W. HOWARD

Dover, N. J.

(Answers to Waveform Quiz)

1. B is the abnormal waveform; A is normal. The prime clue is the attenuation of the vertical sync pulses in B (large white area at lower right of each portion of waveform represents the vertical sync tips). Critical vertical sync would be the screen symptom.

2. B is abnormal waveform; A is normal. The most obvious clue here is the distorted base line in B and the fact that the amplitude of the horizontal sync varies with the level of the incoming video signal. Horizontal sync would be unsteady.

3. A is abnormal waveform; B is normal. There is virtually no visual indication of horizontal sync in this waveform, although vertical sync is present. Very unstable horizontal hold action would result from the defect associated with waveform A.

PHOTOFACT BULLETIN™

PHOTOFACT BULLETIN lists new PHOTOFACT coverage issued during the last month for new TV chassis. This is another way PF REPORTER brings you the very latest facts you need to keep fully informed between regular issues of PHOTOFACT Index Supplements issued in March, June, and September. PHOTOFACT Folders are available through your local parts distributor.

Arvin

Chassis 1.48101 989-1

Bradford

CATV-55335 990-1

Catalina

122-741A, 122-732A,
122-774A, 122-775B 988-1

Coronado

TV2-7109A 987-1

Curtis Mathes

Chassis CMC21 Series (AFC,
Remote Version) 990-2

Electrohome

Chassis C4 991-1

RCA

Chassis CTC22AA, CTC22D 988-2
Chassis CTC28E/F 991-2
Remote Control Receiver CTP12C,
Transmitter CRK10A 991-2A
Chassis CTC31C/D 987-2
Remote Control Receiver CTP11H,
Transmitter CRK9A 987-2A
AL266W (Chassis KCS175A) 989-2

Sharp

CJ-45P 990-3

Truetone

WEG2865A-96/67A-96 988-3

Product Report

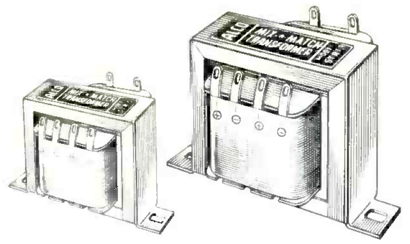
For further information on any of the following items, circle the associated number on the reader service card.

Mixing Transformer (60)

Alco has introduced a "mix-n-match" transformer for installing monaural remote speakers to an existing stereo system.

The transformer receives audio signals from both the left and right stereo channels and mixes them together to provide a single monaural output without upsetting the original stereo separation. The balanced monaural signal can then be distributed to individual extension speakers throughout the house.

The transformer can also be used as a means of adding a center channel to an existing stereo system providing monaural sound to any outside location such as patios or pool areas where stereo sound is not effective. In addition, it may be used for matching low impedences and for phase reversal purposes.

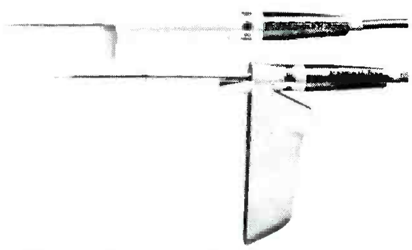


Specifications: frequency response 10-30,000 Hz (-3 db), impedance 8 ohms, ratio 1:1:1.

There are two models: STR-5 (5 watts RMS) at $3.95 and STR-10 (10 watts RMS) at $5.95.

Miniature Soldering Iron
(61)

Caig, Inc. has added the Model 170, a miniature soldering iron, to their line. The unit is designed for printed circuits, micro soldering operations, plugs, relays, etc. It is equipped with a flexible cord, approximately 5 feet, pistol grip and table rest spacer.

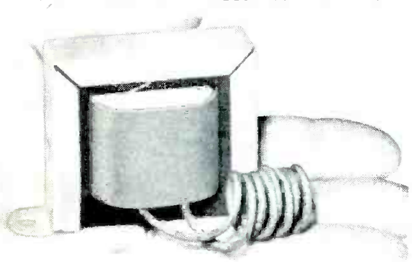


The unit comes in three sizes and two voltages: 8, 15, 25 watts each in 6 volts or 115 volts. Weights, less cord, range from 18 to 26 grams and heating time is from 60 to 90 seconds. Approximately eight different tip configurations are available in each wattage. Price ranges from $4.87 to $6.67.

Transformer
(62)

A new Stancor standard isolation /power transformer is available from **Essex Corp.,** Controls Division. The Stancor P-6411 reduces shock hazard by isolating equipment from the power line.

It is rated 117 volts to 117 volts

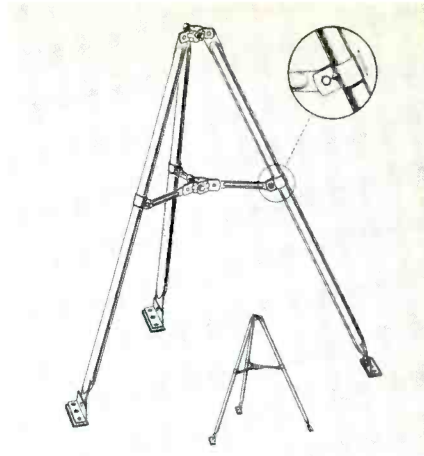


at 15 volts amps and is 2″ x 3¼″ x 1⅞″. The unit is priced at less than $6.00.

Roof Tower Line
(68)

South River, Inc. announces a new line of HDT tripod roof towers designed for color TV, FM and ham beam antenna installations. Suitable for mounting on either peaked or flat roofs, these heavy duty 1¼″ O.D. tubular steel towers have adjustable slides to alter the tripod stance of each tower. The HDT tower line includes pitch patches for each tripod foot for a watertight, leakproof installation.

Scientific metal form blending at the flattened ends of each HDT tub-



Circle 14 on literature card

ular tower leg acts to take up maximum stress and strain. Connector links are of embossed, heavy gauge steel. According to the manufacturer, each HDT tower will support a 10-foot mast and antenna without guy wires.

HDT towers are available in either a hot-dip galvanized or gold, baked enamel finish. Sizes available are: 2′, 2½′, 3′, 5′, 7½′ and 10′. Shipped preassembled the price ranges from $7.35 to $29.20.

Pressure-Sensitive Truck Signs
(63)

New self-adhesive, weather-proof truck door signs in a choice of a round design or rectangular design are offered by the **Seton Name Plate Corporation.**

These signs are printed on pressure-sensitive vinyl or mylar. To apply, peel off the backing sheet and press into place. They are wash-

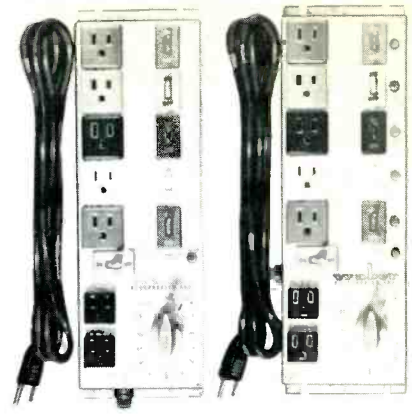
able, won't wrinkle or buckle and resist oils, solvents and acids. Special style lettering can be reproduced at no extra charge.

Outlet Boxes
(64)

New heavy-duty power electrical outlet boxes, featuring individual timers have been developed by **Waber Electronics, Inc.**

Models 26 and 27 enable the user to set the timer for any period up to 12 hours. The timer in Model 26 turns power on at the end of the pre-set time, while Model 27 is designed to turn power off following the pre-set period.

Both units provide five color-keyed outlets, each with its own pilot and on-off switch. A master on-off switch controls the entire box. In addition, the units are available with individual pilot lights for each switch-outlet set.



Waber models are pre-wired and ready for use, and are rated at 15 amps, 130 volts continuous duty. The units are priced from $24 to $30 depending on customer requirements and length of cord-set.

Transistor Analyzer
(65)

A new, compact transistor analyzer capable of doubling as a sensitive DC voltmeter has been developed by the **Amphenol Corp.** Designated Model 830 "Transistor Commander," the new test instrument combines semi-conductor checks with ability to measure supply voltages to 100 volts DC.

The unit can be employed for troubleshooting all solid-state equipment. It contains a current-limiting circuit for protection against accidental burn-out of transistors and diodes.

A high-impedance DC voltmeter input permits the technician to make accurate measurements to 100 volts DC with the same probes used in other checks.

The unit measures 5¾″ x 9¼″ x 6⅜″ and weighs 3 lbs. complete with a built-in 117-volt AC power supply. It sells for $79.95.

Drive Socket Set
(66)

A new 15-piece set of ¼″ drive sockets, handles and accessories, designed for electronic and appliance assembly and repair, has been introduced by **Kraeuter Tools.**

Set No. 30115 features a close-acting Kraeuter ratchet plus 11 thin-wall sockets, ¼″ through ½″. Also included are a 2″ extension and 6″ spinner handle. All components are double-nickel chrome-plated and plastic-sealed in a compartmentized tray contained in sturdy metal box that measures 6½″ long. The price is $13.25.

Portable Analyzer
(67)

A completely solid-state and portable vacuum tube analyzer that accommodates all types of industrial tubes has been developed by the **Triplett Co.** The unit applies a true Gm small signal test and has a 60,000 Gm range.

Designated Model 3444-A, Type 1, it is equipped with 16 built-in sockets of which two are multiple, giving the operator the equivalent of 19 sockets. CRT's can be tested with an optional adapter.

The gray, leatherette-covered wooden case measures 15 3/16″ x 18 13/16″ x 7¾″ and has a hinged removable lid, a sloping etched aluminum panel, a compartment for line cord, leads and a removable roll type tube chart. Weight is approximately 30 pounds. Price: $470.

Erratum

The price quoted for Perma Power's Liftmaster 600 garage door opener in the August, 1968 Product Report department was wrong. The price is not $50.00. Instead, the release should have read, "Price is reportedly $50 less than other openers with comparable features."

Book Review

Understanding Electronic Test Equipment: Joseph A. Risse, Howard W. Sams and Co., Inc., Indianapolis, Indiana, 1968; 192 pages, 5⅜" x 8½", soft cover, $4.25.

This text provides a practical understanding of the design and applications of the most common types of test instruments used in electronic servicing. The natural progression of subject matter from basic measuring circuits to specific equipment designs makes this book equally suitable for both beginners and experienced electronic service technicians.

In-depth analysis of circuit action and equipment operation and applications are supplemented by examples of typical instruments currently in use. Equipment types discussed include VOM's; VTVM's; battery, tube and semiconductor testers; signal generators and basic and advanced oscilloscopes.

RCA Receiving Tube Manual, RC-26: RCA Electronic Components, Harrison, New Jersey, 1968, 656 pages, 8" x 5⅜", soft cover, $1.75.

This revised and expanded edition contains up-to-date information on tube types and technology. Detailed descriptive data and application information are provided on the complete RCA line of home entertainment types of receiving tubes, picture tubes for b-w and color television, and voltage-regulator and voltage-reference tubes.

Servicing Transistor Equipment: Gordon J. King, Hart Publishing Co. Inc., New York, 1968, 151 pages, 6¼" x 9", hard cover, $7.95.

The text discusses transistor fundamentals, circuit application and testing without comparing the transistor to a vacuum tube. Chapters 1-3 are devoted to fundamentals, circuit applications and tests, respectively. Specific troubleshooting techniques in audio, video, RF and oscillator stages are presented in Chapters 4-6. Chapter 7 discusses techniques that relate to transistor radios and hi-fi amplifiers. Test equipment requirements and repair procedures are outlined in the final chapter.

Advertisers' Index

October, 1968

FREE CATALOG & LITERATURE SERVICE

COMPONENTS

100. *Allied Electronics*—600-page 1969 catalog lists prices, specifications, descriptions, illustrations for all products including components, test equipment and technical books.
101. *Allied Radio*—536-page 1969 catalog includes hi-fi components, monitors and cameras, portable TV's, CB 2-way radios and accessories, antennas and towers, and electrical accessories.
102. *Carborundum*—Bulletin lists product information and applications for VDR's (varistors).
103. *Robins*—12-page brochure includes information on patch cords, adaptors and connectors.

SERVICE AIDS

104. *Alpha Metals*—6-page bulletin describes 17 common soldering faults and their remedies.

SPECIAL EQUIPMENT

105. *AMCO*—Brochure describes "Style Pak" line of small equipment enclosures.
106. *Dialight*—24-page catalog, CR680, provides data, illustrations and military designations for Lens Cap Assemblies (LC11-LC37) and Base Assemblies (LH50-LH92).

TECHNICAL PUBLICATIONS

107. *Sams, Howard W.*—Literature describing popular and informative publications on radio and TV servicing, communication, audio, hi-fi and industrial electronics, including special new 1968 catalog of technical books on every phase of electronics.*

TOOLS

108. *Oncida*—Bulletin PF-68 describes with illustrations the use of the patented Flogun.
109. *Upson*—Catalog page describes the 4-in-1 Ball End and Reversible Screwdrivers and other tools.

TUBES AND SEMICONDUCTORS

110. *Amperex*—Catalog/brochure contains listings of entire line of semi-conductors available in micro-miniature Leadless Inverted Devices package with primary electrical characteristics.
111. *ITT*—12-page brochure describes line of special purpose tubes listing characteristics and type numbers.
112. *Metropolitan*—Directory lists 5000 tube types in alpha numerical order with quantity discount prices and list of manufacturers.
113. *Motorola*—Catalog MHA-27-4 lists 175 semiconductors, books and accessories, and a replacement series for devices including zener diodes.

Got A Troubleshooting Tip?

If you've recently run across an unusual trouble symptom and have determined what caused it, why not pass the info on to the other readers of PF REPORTER. You'll not only be saving other service technicians valuable troubleshooting time, you'll also be making a little extra change yourself. Send a thorough description of the trouble symptom and the solution along with a brief discussion of your troubleshooting technique to:

Troubleshooting Tip
PF REPORTER
1014 Wyandotte Street
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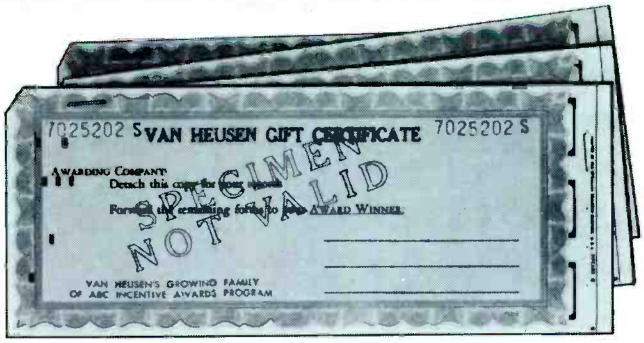
Van Heusen Gift certificates are Available with your purchases of RCA Entertainment Receiving Tubes!



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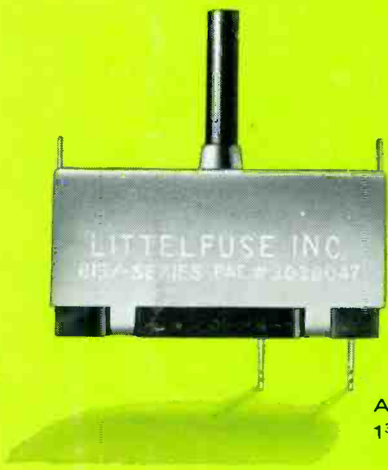
See your local participating RCA Distributor today for complete details on RCA's "Growing Family" Clothing Award Certificates. RCA Electronic Components, Harrison, N. J.

RCA

Introducing a Complete Line of Littelfuse Quality Circuit Breakers



Actual Size
1¾" x 13⁄16" x ½"

Exact replacement from factory to you

Designed for the protection of television receiver circuits, the Littelfuse Manual Reset Circuit Breaker is also ideally suited as a current overload protector for model railroads and power operated toy transformers, hair dryers, small household appliances, home workshop power tools, office machines, small fractional horsepower motors and all types of electronic or electrical control wiring.

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Circle 56 on literature card