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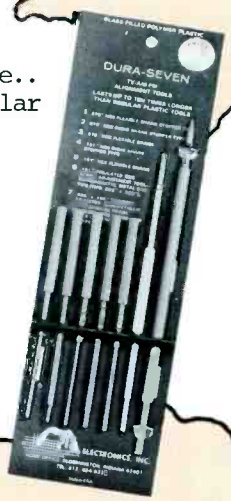

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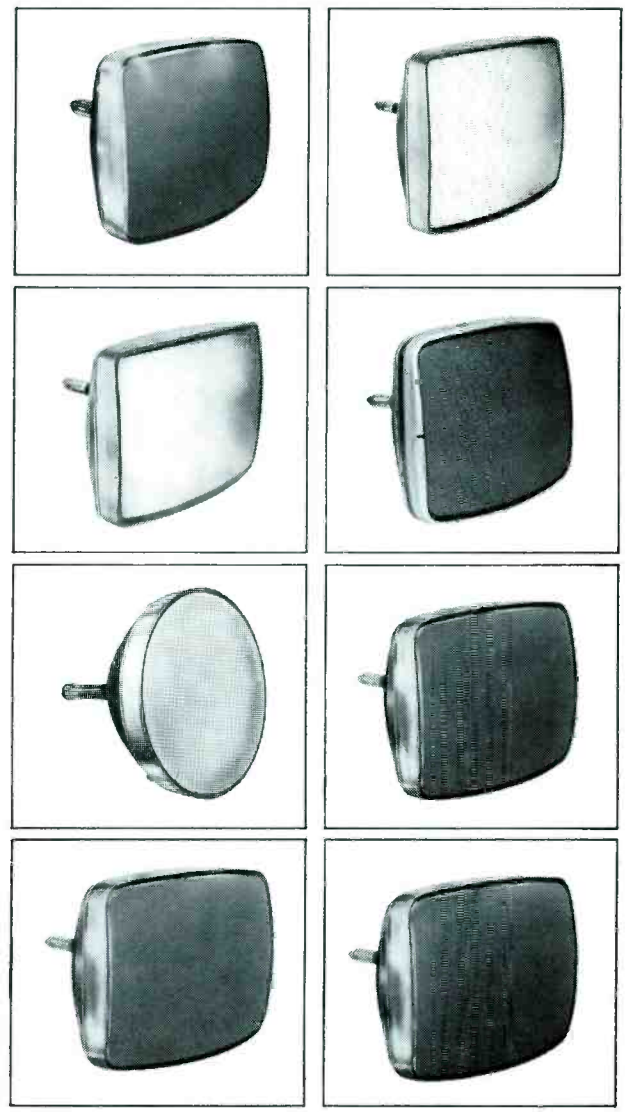
So why not give your customers the "Grade A" choice. Choose Colorama A at your RCA Distributor today.

Remember, RCA is the world-wide leader in picture tubes, with over 65 million produced to date.



RCA

RCA/Electronic Components/Harrison, N.J. 07029

electronicscanner

news of the industry

The Consumer Electronics Group of the Electronic Industries Association (EIA) has launched a $250,000 public service program for 1974-75. Included is a service technician development program, designed to insure continuing reliable service in the industry. The program consists of: career guidance via textbook, film, and a slide/cassette library; plus summer seminars and workshops for training vocational instructors. Radio public service announcements also will be used to attract potential technicians, provide consumer shopping tips, as well as tips to improve service and satisfaction.

Sony plans to unveil five audio components, including two vertical-FET amplifiers at the Consumer Electronics Show in New York. A 100-watt-per-channel power amplifier, and a 30-watt per channel integrated amplifier, will feature V-FETs in the output stages. The products reportedly offer the linear response and low distortion characteristic of vacuum tubes, according to **Home Furnishings Daily.**

Westinghouse has taken the first step toward a possible pocket-sized transistor TV with the development of a thin transistorized viewing screen. The screen is made of glass and is coated with layers of phosphor and microminiature thin-film transistor circuits, according to **Radio & Television Weekly.** Available by 1976, the "pocket TV" initially will be produced for industrial and military uses.

Newsday, a subsidiary of the Times Mirror Company, Los Angeles, plans to install 224 video-display terminals for use in its news and advertising department. Reporters will operate typewriter-like keyboards, with the news stories recorded on a video disc and displayed for observation or editing on the screen of an attached TV monitor. After editing, the disc is sent to the typesetting computer in the composing room. No typing paper or computer tape is used, reports the **Wall Street Journal.**

Dr. Ray Dolby of Dolby Laboratories has invented a noise-reduction device that changes the sound quality for use by FM radio stations. The Dolby encoder at the station boosts the high frequencies when the sound volume is low. Inside the FM receiver, the Dolby "B" circuit reverses the process by reducing the high frequencies during soft musical passages. Reduction of audible noise can be as much as 13 dB's, without any change of dynamic range. Seven FM stations now use the Dolby encoder for their broadcasts.

Teledyne plans to enter a new consumer electronics market—solid-state player-piano systems—and has scheduled deliveries for spring, 1975. The units are expected to retail between $2,000-$2,500, according to **Home Furnishings Daily.**

Sony will introduce a new 1/2-inch video-cassette recorder integrated with a 19-inch Trinitron color TV, reports **Home Furnishings Daily.** The system, SLX, features

(Continued on page 6)

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IF YOU WANT TO BRANCH OUT INTO THE TV TUNER REPAIR BUSINESS, WRITE TO THE BLOOMINGTON HEADQUARTERS ABOUT A FRANCHISE.

For More Details Circle (5) on Reply Card

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news of the industry

(*Continued from page 4*)

lower tape speeds, a simplified cassette-loading system, and resolution equal to Sony's 3/4-inch U-Matic machines used for the educational and commercial market. The system is priced between $2,500-$3,000.

RCA is demonstrating its video-disc system to Japanese home-electronics firms, according to an item in **Home Furnishings Daily.** Although the system is not yet complete, a spokesman said it will feature a total playing time of one hour.

WBTB-TV, the first TV station in the U.S. authorized by the FCC to broadcast subscription (pay) TV programming, recently conducted its first over-the-air test. A scrambled video signal was transmitted from West Orange, New Jersey and received/decoded in New York City. WBTB-TV is a station of the Blonder-Tongue Broadcasting Corporation.

RCA reportedly is considering a reduction of its one-year warranty on color TV sets to six months or 90 days. According to **Home Furnishings Daily,** RCA is seriously concerned with escalating costs of manufacturing color TV sets, but fears a loss of market share if it reduces its warranty while other manufacturers continue to maintain one-year warranties.

I/O Metrics is negotiating with an American TV manufacturer over the introduction of a home-video disc system, expected to retail for under $300. The system uses a 10-watt light bulb and should be in production within 12 months, reports **Merchandising Week.** An hour-long disc should retail for $5-$7.

The FCC plans to relax its restrictions on pay-CATV systems, which should allow pay-cable operators greater flexibility in competition with other broadcasters for exclusive rights to popular movies and sporting events. Pay-CATV systems currently have about 90,000 subscribers compared with 10 million subscribers for regular CATV, reports the **Wall Street Journal.**

New York City's TV license law, passed April 1, has been revised by the Department of Consumer Affairs because of angry response from service organizations. The law requires shops, not technicians, to be licensed at an annual cost of $100, and does not require shop managers nor owners to take tests of any kind. **Home Furnishings Daily** states that most dealers in New York believe the law will lower the number of unscrupulous businessmen in the industry, but disapprove of the law's accompanying regulations.

A new three-year contract has been ratified between the RCA Service Company and the International Brotherhood of Electrical Workers (IBEW). Approximately 2,800 striking members returned to work at the company's 179 service branches. □

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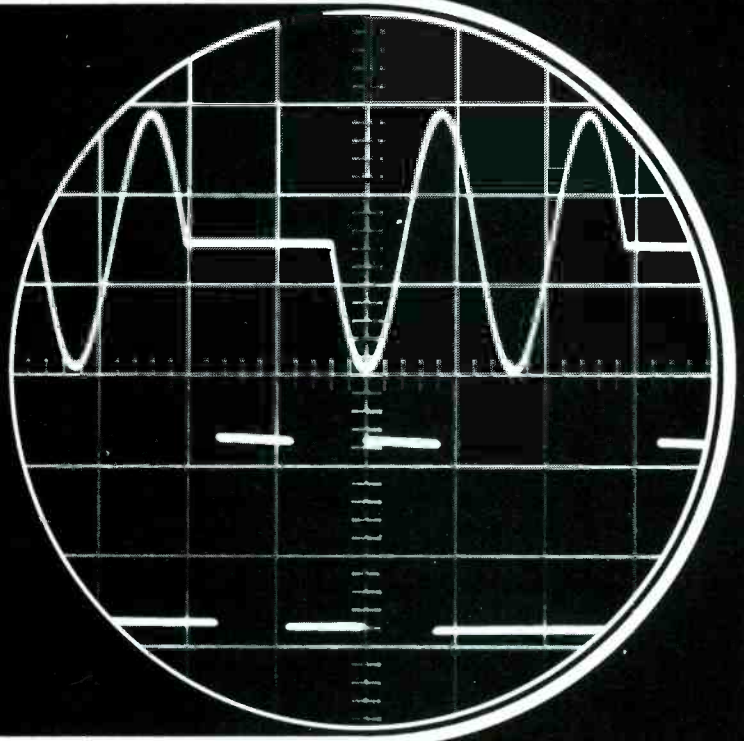

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Chassis—Zenith 17EC45 and 19EC45
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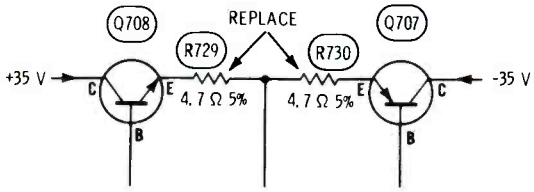
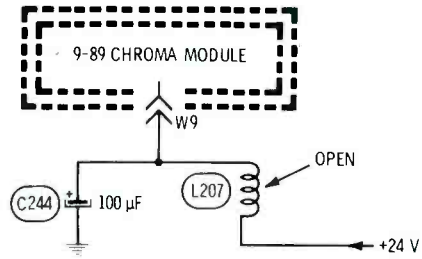


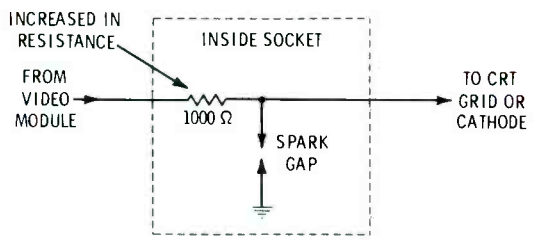
Symptom—No vertical; output transistors shorted
Cure—When replacing shorted vertical output transistors, also replace both emitter resistors (on the module)

Chassis—Zenith 17EC45 and 19EC45
PHOTOFACT—1377-3



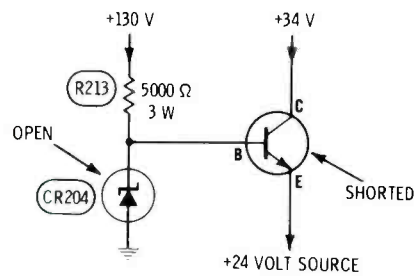
Symptom—No brightness; no raster
Cure—Replace L207 if there is no +24 volts at chroma module W9

Chassis—Zenith 17EC45 and 19EC45
PHOTOFACT—1377-3



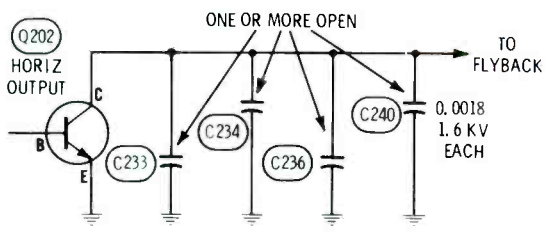
Symptom—Poor tracking of raster color, as though one gun of CRT is weak
Cure—Check all 1K resistors inside CRT socket for increased resistance

Chassis—Zenith 17EC45 and 19EC45
PHOTOFACT—1377-3



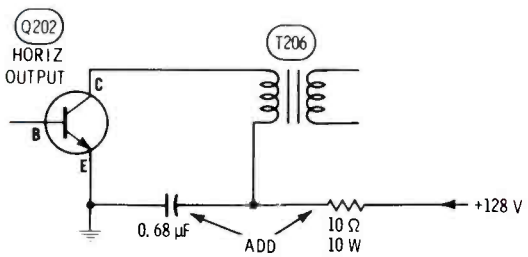
Symptom—120 Hz hum in picture, and failure of IC's or transistors
Cure—Check for excessive +24-volt supply, especially transistor and zener

Chassis—Zenith 17EC45 and 19EC45
PHOTOFACT—1377-3



Symptom—Excessive high voltage (normal 27KV for 17" and 29KV for 19")
Cure—Check for open .0018 capacitors; use only factory replacements; each open increases HV by 1.5 KV

Chassis—Zenith 17EC45 and 19EC45
PHOTOFACT—1377-3



Symptom—Slight bending of picture at high brightness
Cure—Add RC filter as shown to B+ supply for the flyback

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That means you don't have to watch a profitable repair job walk out the door just because getting the parts could make it unprofitable.

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Whether you need semiconductors, picture tubes or receiving tubes, you'll find them all at one electronic supermarket.

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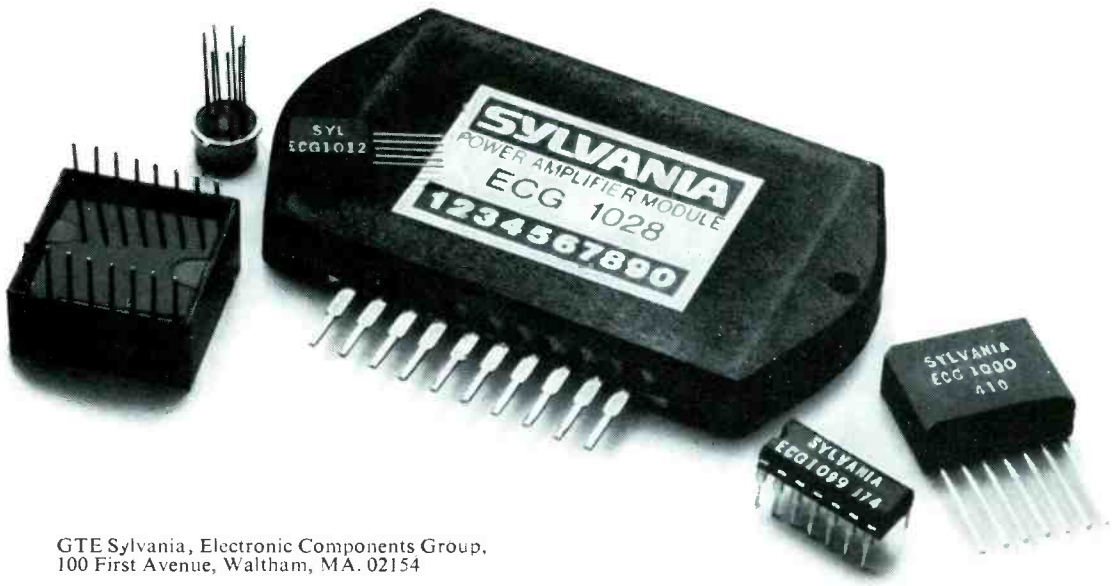


GTE Sylvania, Electronic Components Group,
100 First Avenue, Waltham, MA. 02154

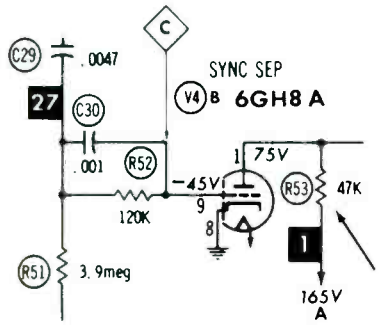
troubleshootingtips

*Send in **your** helpful tips—we pay!*

Loss of vertical sync
RCA KCS155 b-w
(Photofact 784-4)

When he brought the portable TV to the shop, the customer requested new antenna dipoles, and repair of the sound, which was dead. We gave him a firm-price estimate, but before the set was finished, two other problems almost made it a loss job.

While the dipoles were on order, we replaced a plate resistor of the sound IF amplifier tube, restoring good audio.



After two hours of cooking prior to return of the receiver to the customer, the vertical linearity spread at the top of the picture, and then the vertical would roll. A new 15KY8 vertical tube stopped the change of linearity. However, the locking was not very strong, and there was little range to the hold control.

Then we noticed that when loss of locking occurred, the picture rolled **upward.** This indicated the oscillator was running below the proper frequency. Now, the normal oscillator frequency is supposed to be slightly too slow, then the sync fires it at the proper time. Therefore, it seemed the problem was lack of sync, not a defect in the vertical sweep circuit.

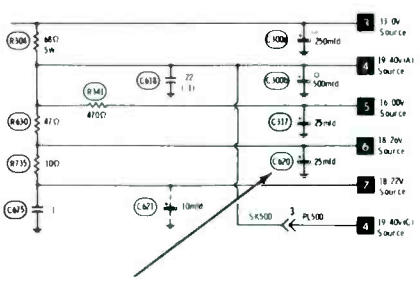
Armed with this information, we rapidly found that the plate resistor of the sync separator (V4B) had increased to about 120K, weakening the sync.

This time the TV passed the heat test with no problems.

T. Schilsky
Masonville, New Jersey

Left edge of raster was green
Sylvania D18 color chassis
(Photofact 1322-3)

The left two or three inches of raster showed a greenish hue on both b-w and color programs. I placed the "service/normal" switch in the service position and turned up one screen control at a time. The green horizontal line was about normal, but both red and blue lines were dark on the left.



Because filter capacitors sometimes cause such shading, I scoped all of the power supply sources, and also the waveforms around the 12MD8 matrix amplifier.

A higher amplitude of horizontal ripple was found at the 18.26-volt source. C620, a 25-microfarad 25-volt filter, was tested and found to be open.

Albert Sarhad
San Rafael, California

Trapezoidal picture
RCA color receiver

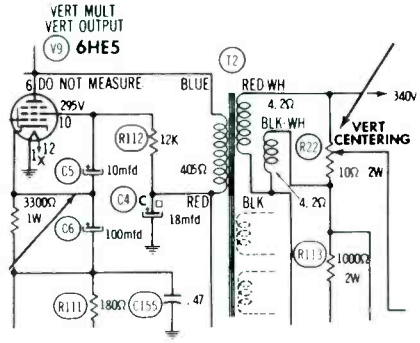
The symptom of trouble in an RCA color TV was a keystoned or trapezoidal raster, having the height reduced on the left edge.

In b-w sets, this symptom always proved the deflection yoke was bad, but other defects in color receivers also can cause a trapezoid. Before changing the yoke, I gave the chassis a good "eyeball" test and found that the tip of a wire connected to one terminal of the top-and-bottom pincushion control was touching the shell of the control. Clipping the end of the wire to clear the short repaired the trapezoidal raster.

Reg. Bartlett
Windsor, Ontario
Canada

Bounce at bottom of picture
Zenith 23XC36 color chassis
(Photofact 863-3)

After replacing the picture tube and several small tubes, I moved the receiver to the showroom for a few hours cooking before delivery.



Some of the other tech's claimed the set had a vertical jitter, or bounce, at the bottom of the picture. I didn't see it happen, but they were insistent, so I removed the chassis for operation on the test jig.

By some gentle shoving and prodding around the chassis, I discovered that the area around the high-voltage circuit was sensistive to movement. There seemed to be no connection, until I realized the vertical-centering pot was located just below.

Sure enough, a new centering control eliminated the bounce.

Gus Rubino
Paoli, Pennsylvania

Excessive brightness
General Electric KE-II
color chassis (Photofact 1177-3)

Originally, the complaint was that the picture had just died out. I checked and replaced the 6LB6 horizontal-output tube and the 3DH3 HV rectifier, but the HV did not come back, so I pulled the chassis for the shop.

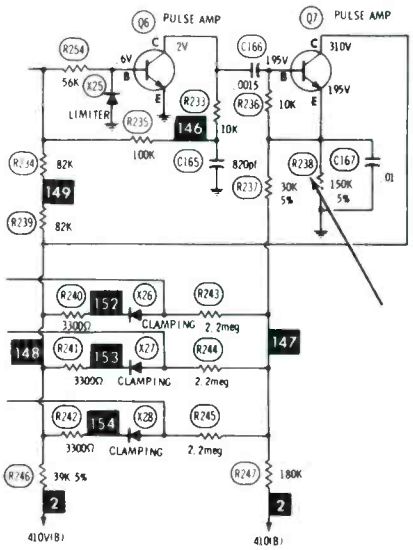
When the chassis was connected to my test jig, there was high voltage, but the brightness was

excessive and the picture would bloom out easily.

Problems of this kind are best located by measuring the DC voltages of all the control grids and cathodes of the picture tube to find out whether the trouble is coming to the grids (chroma circuit) or to the cathodes (video circuit). For a time, I was confused by checking the actual voltages against the schematic. Finally I realized the grid and cathode voltages had been accidently interchanged.

The cathode voltages varied about as they should with adjustments of the brightness control, but the grids measured much too positive.

This model has a special keyed DC restorer to prevent zero-line drift from color pulses of different widths. Because all three grids were affected, the DC restorer circuit seemed the logical place to start.



In circuit, transistor Q7 checked okay. All terminals of the transistor checked in excess of +300 volts; obviously wrong. Next, I tested R237, R236, and R238. The first two were alright. Then the trouble gremlin seemed determined to give me one more false trail, because when I first touched probe to R238, it showed about the normal 150K. But the reading slowly climbed as the charge was bled from the filters; the resistor was open.

I replaced the resistor, and found with much relief, that the brightness now could be controlled normally.

John Van Der Wall
Hawthorne, New Jersey □

MY FAVORITE

By Ron Meyer, CET

Most technicians remember longest the repair jobs that either were embarrassing because of mistakes, or gave pleasure because everything worked out just right. This collection of case histories are of the latter type, in which the technician's methods worked without a hitch.

Green Stripe

Symptoms

The raster of the Sears TV with a 529.72574 chassis showed a green stripe down the left edge of the screen, and there was a hint of a Barkhausen line at the side of it. With the service/normal switch in the service position, the blue horizontal line could not be seen until the picture-tube bias was increased to maximum setting, and the blue screen control completely turned up. Also, some of the blue line near the left edge was missing.

Diagnosis

First, I checked purity of the raster (one color at a time), but it was okay. All guns of the picture tube tested the same emission on a CRT checker, the picture tube was not at fault.

Low brightness of the blue seemed to be the most promising symptom, so I checked the DC voltages at the picture tube control grids. Red and green were about normal (+180 volts), but the blue CRT grid measured only about +100 volts. Also, the plate of the B-Y amplifier measured the same voltage (see schematic in Figure 1).

That grid voltage showed the blue gun had excessive cut-off bias, and it isolated the trouble to the B-Y stage. There seemed a good chance the wrong bias was related to the missing left end of the horizontal line.

Scope waveforms showed reduced-amplitude blanking pulses at the plate of the B-Y tube (Figure 2), and also a rounding of the base line just to the right of the pulses. Any negative-going part of the grid waveform reduces the brightness, so this would account for the reduced blue brightness on the left.

Such a change of waveform strongly suggested a defect that changed the time constant (resistance times capacitance); therefore, the plate voltage could not climb with the usual speed.

Resistances are easier to check in a hurry than capacitances are. I tested all the resistors in the B-Y stage and found R189 to be open completely.

In some stages, an open plate resistor would have reduced the plate voltage to zero. However, this B-Y amplifier has a feedback path through R187 to the plate of the "Z" demodulator, and it supplied enough voltage for partial operation.

Replacement of R189 restored normal brightness of the blue, and brought back the blue at the left edge, where it had been blanked out.

Comments

If the rounded corner of the baseline in Figure 2 had appeared at all three CRT grids, the left edge of the picture would have been missing. Although this might have appeared to be a loss of width, the gradual cut-off would have been proof it was not.

Other defective resistors and capacitors in circuits of this general kind also can cause either a tinted or a blanked edge at right or left. If all three colors are affected, the symptom appears to be a loss of picture at the edge. If the three colors are changed in different ways, the result is a tinted edge.

Poor Horizontal Locking

Symptoms

Horizontal locking of the Packard Bell Model MR623 was loose, and vertical lines were hooked near the top of the picture.

Diagnosis

These symptoms indicated a horizontal AFC (Figure 3) or a sync defect. Waveforms at the output of the sync separator showed normal negative-going horizontal pulses.

REPAIRS

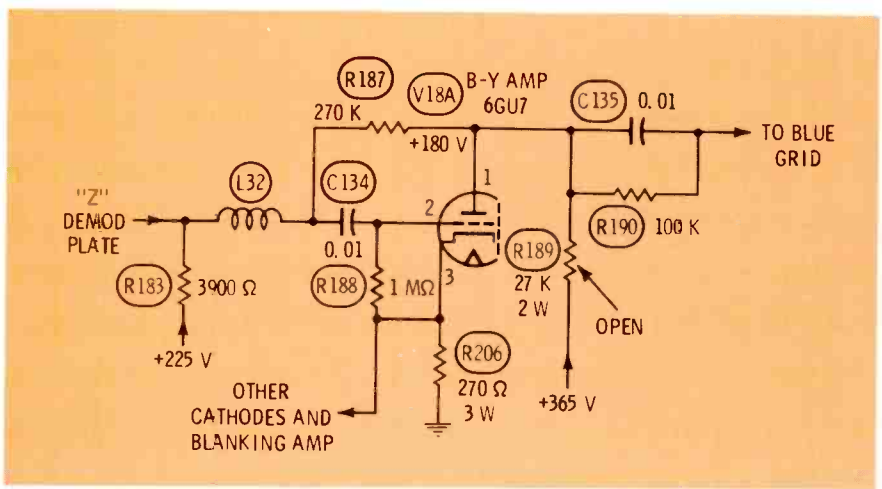


Fig. 1 An open resistor in this B-Y amplifier circuit caused loss of blue on the left and insufficient brightness of the blue field. The receiver was a Sears Silvertone with a 529.72574 chassis (*Photofact 965-2*).

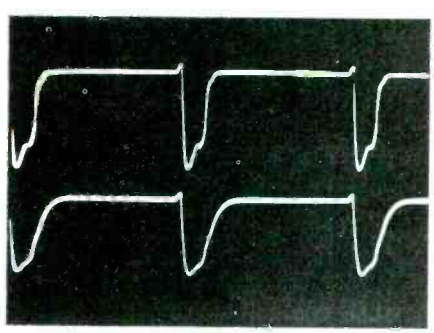


Fig. 2 Waveform at the top is correct for the red CRT grid, while the bottom blue-grid waveforms with rounded corners were produced by an open in R189 (*Figure 1*).

But at the anode of X3 (AFC diodes), were weak positive-going horizontal pulses instead of the normal strong sawteeth.

Pulses from the horizontal sweep circuit are supposed to be integrated into sawteeth by R57 and C64, and there was plenty of pulse amplitude at R57. Therefore, these two components were the chief suspects. R57 tested almost open; **installation of a new resistor tightened the horizontal locking** and straightened the vertical lines of the picture.

Comments

Trouble in the sync separator was not seriously suspected because the vertical locking was very normal. Defects in or before the sync separator usually affect vertical locking more than horizontal.

Always remember that **both** sync and the sample of sweep waveform must reach the AFC diodes, else horizontal locking can't be effective.

No Color Locking

Symptoms

There was no color locking in this color TV using a 6JU8 tube for phase detection (Figure 4). Defeating the killer action by rotating the control made the color visible as stripes.

Diagnosis

It's best with color locking that has a double-diode phase detector followed by a reactance control tube to determine whether the lack of locking is caused by an inability of the oscillator to tune to the correct frequency, or whether the phase detector is at fault.

Fig. 5 Socket extenders feed the wiring on through from plug to socket, and provide a lug for each pin so readings can be taken in-circuit. Connect a test lead between each lug in turn to the corresponding point on the circuit board to check for opens.

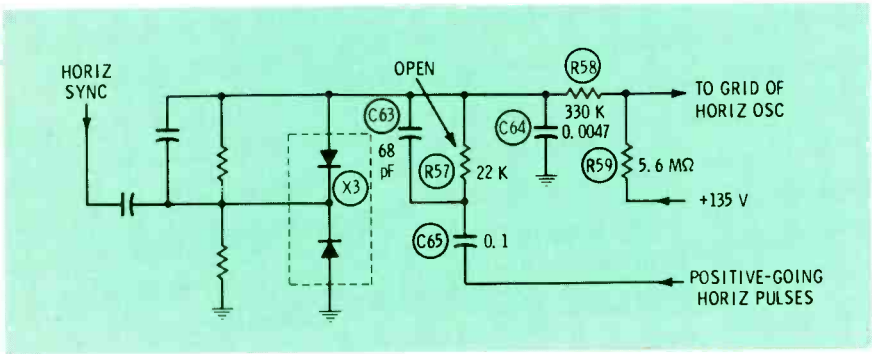


Fig. 3 Both strong horiz-sweep sawteeth at the anode of X3 and good clean sync pulses at the common cathodes are necessary for solid locking. An increased value of R57 degraded the horizontal locking in the Packard Bell Model MR623 (*Photofact 972-1*).

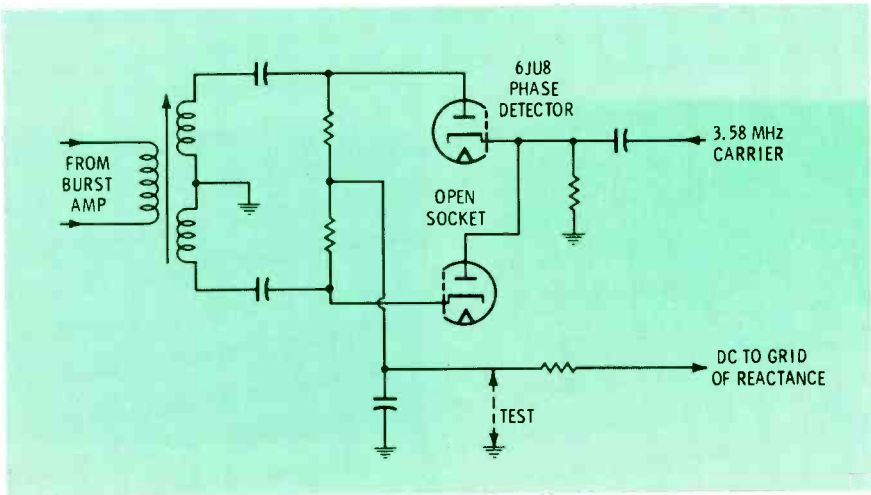


Fig. 4 Open circuits either at the socket pins or on the circuit board connecting to the sockets can be difficult to find. Ground the output DC signal from the phase detector and try to zero-beat the color oscillator. If this is successful, the defect is in the phase detector. Use a socket extender and clip leads to find opens in socket or wiring.

Because the control voltage should be zero for perfect locking, the best test is to cause a zero control voltage by shorting it to ground, as shown in Figure 4. Then, try to bring the color into "zero beat" (color bars upright or one upright color picture which can be drifting slowly sideways) with the reactance coil, or whatever adjustment is provided. If zero beat is obtained, the problem is not in the oscillator or reactance stages. If there's no zero beat, look for a trouble in reactance or oscillator.

One precaution, don't ground the grid of the reactance directly. A small-value resistor always is located between control voltage and grid, and the ground should be made at the end of the resistor away from the grid. Many sets have a test point there. Incidentally, the value of this resistor is quite critical. If the resistance is too low, the color locking can be too loose. Or, if the value becomes too high, the changed reactance characteristics can kill the oscillator.

In this case, the oscillator could be brought into zero beat when the control voltage was grounded. Therefore, the defect was before the reactance stage.

Phase detectors of this kind must have a continuous 3.58 MHz carrier at the common cathode/anode, and 3.58 MHz burst at the other cathode and anode. The burst should have from 3 to 5 times the amplitude of the CW signal.

Scope tests using a low-capacitance probe showed approximately the correct amplitudes at the 6JU8 socket. The 6JU8 checked okay, and a new one did not help the locking.

Of course, there are DC voltage tests designed to find opens and shorts, but I have had several cases of open sockets causing such troubles. So, I decided to try a shortcut to test the socket.

My favorite test for an open socket is to use a socket-extender and a test lead. (Figure 5). The tube is plugged into the extender, which is inserted into the original socket. Then I connect the test lead in turn between each lug of the extender to the corresponding conductor on the circuit board. Normal operation, or any major change of performance, is a good indication an open circuit has been bridged. Of course, two socket connections might be open, so two or more might require jumpering to obtain complete operation.

Addition of the test lead adds stray capacitance to the circuit, and this must be taken into consideration with some circuits. Also, the open might be in pins spread too far apart or it might be a hairline crack between socket and circuit board.

This time, connection of the test lead from one extender lug to the circuit board snapped the color into lock. **Replacement of the socket brought back normal color locking.**

Poor Height And "Pulling"

Symptoms

The Zenith (b-w chassis 14M23) had insufficient height plus some video "pulling", although the raster was straight at both edges.

Diagnosis

My snap diagnosis was: bad filter capacitors. I bridged the filters, one at a time, but there was no improvement. Scope waveforms of the power supply showed normal ripple. The power supply seemed alright, so I switched to the symptom of insufficient height.

All components and DC voltages in the vertical sweep circuits checked fine, except at the cathode of the vertical-output tube. At that point (Figure 6), instead of the usual upside-down parabolic waveform, a series of sawteeth were found.

With the scope still connected to the cathode, I paralleled the cathode capacitor (C2A), but could see no significant change either of the height or of the waveform.

Undoubtedly, you know that rounded sawteeth are normal for this cathode when the bypass capacitor is open. But, it wasn't open.

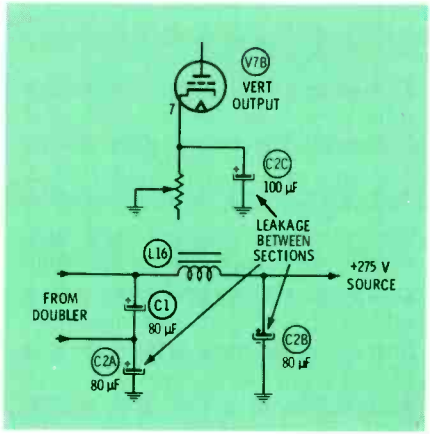
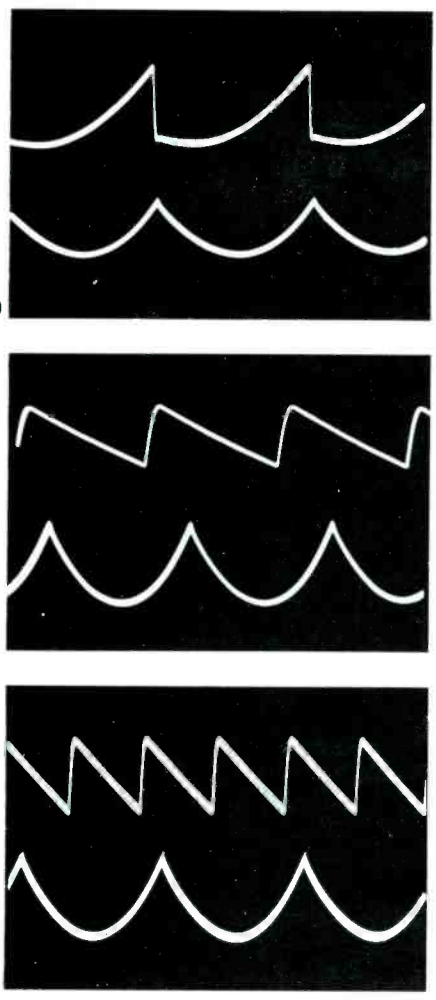


Fig. 6 A defective multiple filter capacitor can feed some of the sawteeth power supply ripple to the cathode of the vertical output tube. That's what happened in this b-w Zenith with 14M23 chassis (*Photofact 739-4*). A new capacitor unit cured the height and pulling problems.

Fig. 7 These are simulated waveforms for the circuit in Figure 6. (A) Trace at the top shows the distorted sawteeth obtained at the cathode of a vertical-output tube when the bypass capacitor was open. The parabolas of the bottom trace are the normal waveform. (B) At the top are 60-Hz sawteeth from a half-wave power supply, and the parabolas at the bottom are the correct cathode waveform. There is one sawtooth to every parabola; both are 60 Hz. (C) The 120-Hz ripple from a full-wave rectifier (top trace) has two sawteeth for each cathode parabola (bottom trace). Note: actual mixing of these waveforms produces a composite waveform which (during color broadcasts) would change constantly.



After other unproductive tests, I concluded that the filters **must** be at fault. I disconnected all wires from the three sections and substituted individual tubular filters. The height increased and the picture pulling was gone. **Installation of a new triple-section electrolytic permanently cured the symptoms.**

Editor's Note: *Picture pulling without the height problem can be caused by an open filter, the one bypassing the B+ to the horizontal-output stage. If it's completely open, one side of the picture is darker than the other. In this case, we assume the power supply sawteeth were reaching the cathode of the vertical output by way of the filter capacitors because they were physically in the same can. However, it's unlikely leakage between*

sections was the cause, because such leakage would have burned up the linearity control in the cathode circuit. Chances are the defect was the equivalent of a resistance in series with the common negative lead of the three sections. The waveforms in Figure 7 are simulations of correct waveforms under the conditions stated.

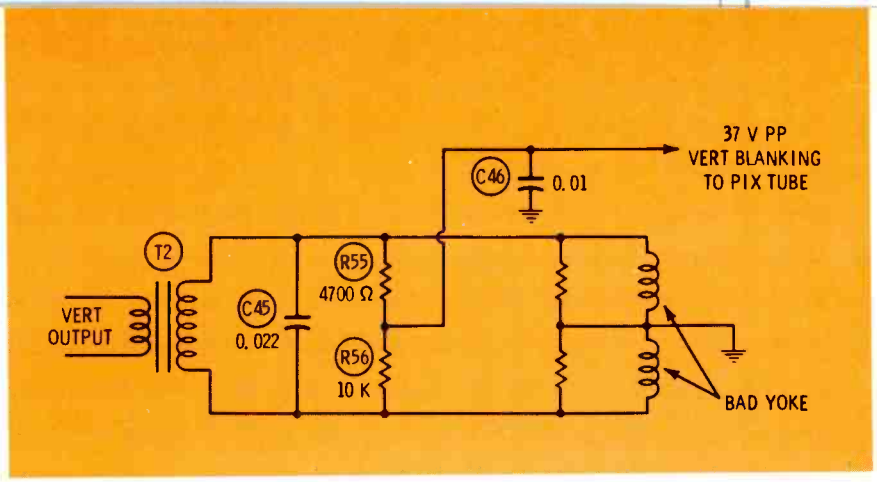


Fig. 8 Insufficient amplitude of vertical pulses in this Emerson (*856A chassis, Photofact 866-2*) caused retrace lines at the top of the picture, without reducing the height any large amount. A new yoke cured both problems.

Retrace Lines

Symptoms

Retrace lines appeared at the top of the raster of the Emerson with chassis 856A.

Diagnosis

Either a defective vertical output transformer or yoke was suspected, because it seemed likely the retrace lines would have covered the whole raster if the trouble was in the blanking circuit (Figure 8).

Scope measurements showed 50 volts p-p at the top of the yoke winding instead of the normal 100 volts. With the yoke disconnected, the amplitude rose to about 100 volts p-p, so a new yoke was ordered.

Installation of the new replacement yoke cured the retrace lines and also increased the height.

Comments

Although the analysis based on pulse amplitude worked fine this time, in later tests I found the amplitude to have no definite relationship to height or linearity.

Loss Of AGC

Symptoms

Picture on the Sears TV (chassis 456.61580) had excessive contrast, showed picture pulling, and the vertical rolled often; the usual symptoms of insufficient AGC causing overload.

Diagnosis

I connected a bias box to the IF AGC, and could adjust the voltage for normal operation. This was proof of AGC trouble.

DC voltage tests of the AGC keyer (Figure 9) proved to be nearly normal, although the suppressor was 10 volts less positive than specified. Pulse amplitude at the plate was correct, but there was no rectified negative voltage.

R27 and R48 form a voltage divider to reduce the video AC and DC voltages that are applied to the suppressor grid. I suspected R48 of increasing in value, because neither resistor appeared burned, and such resistors often increase rather than decrease in resistance. That was a good guess, because R48 measured about 3 megohms after it was removed from the circuit.

Installation of a new R48 (560K) resistor eliminated the AGC overload.

Bad Purity And Focus

Symptoms

Purity was terrible (green patches around the edges of the red field), and the picture was badly out of focus. The TV receiver was a Motorola with a TS914Y chassis.

Diagnosis

The focus voltage was checked using a HV probe, and found to be about 7 KV; much too high. Temporarily, a resistor was added from focus control to chassis to reduce the focus voltage. Now the focus control could be adjusted for sharp scanning lines. Of course, the purity still remained poor.

After examining the schematic (Figure 10), I decided the degaussing circuit must be open. Such an open circuit could happen in the connectors, the manual degaussing switch, or the coil itself.

A fast ohmmeter test proved the degaussing switch was open, and **installation of a new switch permitted adjusting for good focus and purity.**

Comments

Here's a brief description of how this degaussing circuit works. Except during degaussing, the focus control returns to ground through R151 and the degaussing coil. To the focus action, this is the same as grounding the focus control, and a correct range of focus voltages can be obtained. Current through the degaussing coil is negligible, and has no degaussing effect. When degaussing is desired, the degaussing switch is moved to the "open" position for a short period of time. During this time, the focus voltage rises, because the focus control now returns to ground through the 22 megohm resistor and C103. The increased voltage across R151 charges C103 (2 microfarad), then when the switch contacts are closed, the charge of C103 is connected to the degaussing coil. C103 and the degaussing coil form an LC tuned circuit, and the shock of the DC voltage being applied to the coil starts the circuit into a damped wave-train oscillation.

Any damped wave train is a series of sine waves gradually diminishing in amplitude to zero. Of course, such a waveform is ideal for degaussing purposes. Now that the switch is closed, the focus voltage decreases to normal until the next degaussing. In the previous case, the open switch increased the focus voltage and made degaussing impossible.

Intermittent Color Locking

Symptoms

Intermittently, the color part of the picture would break up into

stripes (lose color lock) on the screen of the 18QT85 chassis Philco color set.

Diagnosis

As in repair #3, the source of the intermittent locking was isolated to the phase detector by grounding the control voltage DC output from the phase detector (Figure 11), and zero-beating the oscillator.

Scope measurements showed sufficient burst and 3.58 MHz carrier amplitudes at the detector diodes.

Capristor units (assemblies containing both capacitors and resistors) in the past have proved to be the source of many difficult-to-find problems. What's more, they are hard to test because often the leads are not all brought to the outside of the package.

In this case, two resistors and two capacitors were in PC3. The capristor was not available immediately, so I made up one from capacitors selected to be within 10%, and resistors matched to within 2%. **Installation of the home-brew capristor cured the intermittent color locking.**

Comments

In phase-detector circuits, such as this one, the precise values of the components are not particularly important. However, **the parts should be matched**. In other words, the 1 megohm resistors both could be only 910,000 ohms (or both 1,200,000 ohms) and yet work perfectly just so long as they are within 2% of each other.

A positive voltage is generated by rectification at the cathode of X17, and a negative voltage at the anode of X18. These voltages should be precisely equal in voltage, and the 1M resistors also should be exactly equal, so that at the correct frequency and phase the output DC voltage to the reactance stage measures zero.

Summary

All of these repairs have **one** similarity: no parts were replaced before all possible proof could be obtained from both instruments and logic. I believe such precision servicing is imperative, especially with solid-state circuits. □

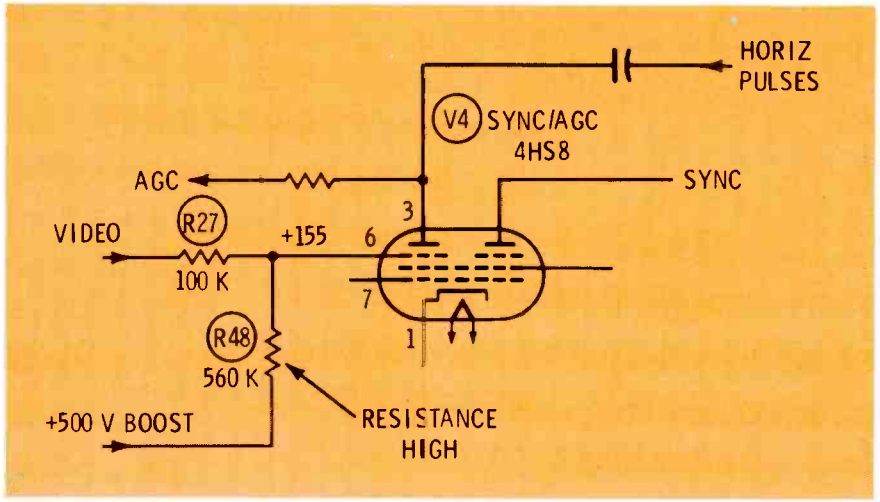


Fig. 9 Complete loss of AGC in a Sears Silvertone with chassis 456.61580 (*Photofact 841-2*) was produced by loss of sufficient positive voltage from the B-boost supply to the suppressor grid of the AGC keyer. Grid/cathode bias of any AGC keyer is very critical.

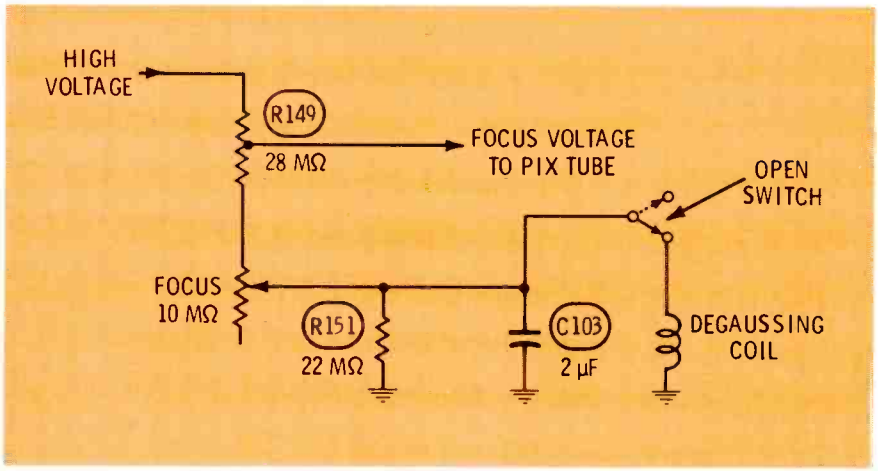


Fig. 10 An open manually-operated degaussing switch prevented operation of the degaussing (causing bad purity), and also increased the focus voltage too much, preventing normal focus. The receiver was a TS914 chassis Motorola, covered in Photofact 798-2.

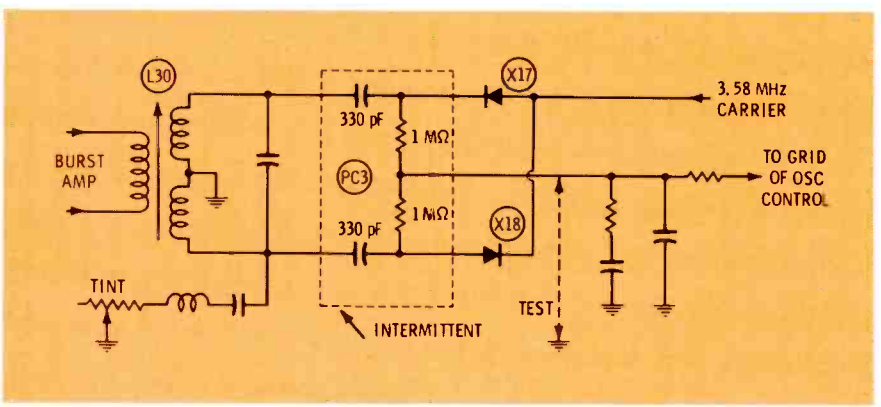


Fig. 11 Always suspect capristor units; many cause intermittent problems. PC3 in the Philco with a 18QT85 chassis (*Photofact 954-2*) produced intermittent color locking. If you can ground the DC output of the phase detector and zero-beat the color oscillator, the defect is in the phase detector or burst separator.

readerchuckles

Share with other readers one of your amusing incidents. Send a short write-up to the editor.

How NOT To Repair Tuners

By Mort Gordon

At breakfast on October 29th, 1974, I listened idly to a news commentary on the anniversary of the 1929 stock market crash as an eye-witness told how he had seen a broker climb out on the ledge of a Wall Street building and then jump. I little knew that before the end of this day, I would seriously contemplate emulating this long-departed broker by jumping from a two-story ladder.

At about 11:30 AM, I arrived at my customer's house to re-orient an existing antenna to minimize ghosting, which was especially troublesome on Channel 2. The dealer who had sold her the RCA black and white set had installed an excessively-large fringe type VHF-UHF antenna which had shifted following a recent storm. Furthermore, the construction of twin 24-story towers a half-mile away compounded the reception problem.

I set up the 32-foot ladders, lowered the antenna, tightened its "U" bolts, reworked the wiring, and set it in what I believed to be optimum orientation. I came down to check the set, and found all channels improved and working beautifully, except Channel 7 (WABC). At that position, I received an unbelievable combination of snow, some adjacent Channel 9, a little RF herringbone, and a windshield-wiper effect from some other channel. I turned to Channel 8, hoping that the tuning range would be broad enough to capture Channel 7; no luck! I went up the ladder, muttering unhappily about overly-large antennas with excessive gain that would blank out only one channel; returned the unit to its original position, scrambled back to the set, and lo and behold—still no Channel 7!

I unhooked the outside antenna connection from the rear of the set and connected two clip leads to simulate a rabbit-ears, but still the same symptom. I concluded that loss of Channel 7 was not an antenna problem, and so returned to my original project on the roof to finish that job. Cautiously, I left the ladder extended to the housetop until I could conclude this call.

Now, I returned to the set with my tools and caddy to work on this unusual tuner problem. I replaced the tuner tubes and then the IF tubes, but still no change in the symptom. I did a careful visual of the tuner and surrounding area and noticed a chemical residue on the tuner cover. Of course! Someone had used too much of our new space-age chemicals. Some of it must have dripped on a critical capacitor, and presto! Oscillation on Channel 7! I pulled the appropriate knobs, removed the three screws holding the tuner cluster, and then loosened the tuner cover enough to do an internal inspection. Sure enough, too much chemical gook was on the critical components and wafers due to an excessive and indiscriminate application from a pressurized can.

Using a good quality degreaser, I meticulously cleaned the tuner, lubricated the contacts, reassembled, and expectantly turned on the set. Still the same symptom!

At this point, some 45 minutes beyond the time I had programmed for the job, I decided to tell my slightly-hysterical customer that the tuner would have to be taken to the shop for examination and repair, at considerable additional cost. However, I recalled that the customer had elsewhere in her house a small portable TV, and therefore decided to check that set on the improbable chance that Channel 7 had gone off the air. I tried this set in its usual location, and much to my surprise and joy, there was no Channel 7! Excitedly I hooked the portable set to the antenna outlet that I was working on to demonstrate to my customer that the "impossible" was indeed true; Channel 7 was off the air!

Gloomily, the customer insisted on exploring the action to be taken, and the cost, in the event that Channel 7 **was** on the air and the tuners in the two sets had to be repaired in the shop. The customer at this point, when presented with the bill for the antenna orientation, recalled that she didn't have enough cash on hand to pay for the job but instead would mail to me a check.

Prior to removing the ladder and loading it on the truck I considered whether, like the 1929 broker, I should jump off. But, I decided that the news media would not draw a parallel to 1929, and besides it was an hour past lunch time; better I should eat first.

Upon arrival at the shop I turned on the two sets and, sure enough, no Channel 7. I turned on a third set and went to wash while it warmed up. When I returned, Channel 7 was playing beautifully on that set and in the midst of a program. I turned on the first two sets again, and Channel 7 gave a normal display on all three units. I fought back my ulcers and sat down to lunch, turning on the radio as I did so. The news commentator announced that, due to an "electrical failure," Channel 7 had been off the air for two hours, and their switchboard had been swamped with 5,000 inquiries about the problem. I considered extending the ladder again for that long-delayed jump, but hunger overcame me.

Since the customer's antenna appeared to have a range of approximately 150 miles, it was probably pulling a snowy signal from a channel 7 or 8 from some distant city which, together with spillover from Channel 9 and some pick-up from a local "Doctor Call Service," resulted in the odd display on Channel 7 tuner position while that channel was off the air.

Anybody want to buy a 32-foot ladder? □

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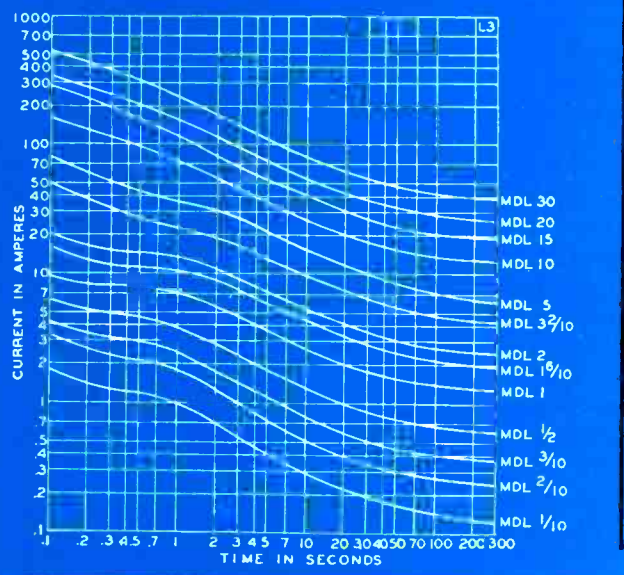
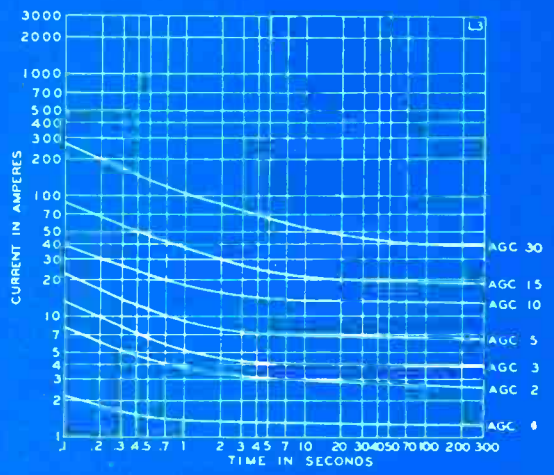
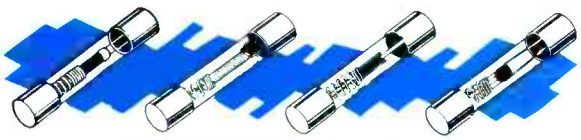


Time-current characteristics of BUSS® fast-acting fuses





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250 or less	**MDX**	1-1/4, 1-1/2, 1-6/10, 1-8/10 or 2
125 or less	**MDL**	1-2/10, 1-1/4, 1-1/2, 1-6/10, 2, 2-1/2, or 2-8/10
125 or less	**MDX**	3, 3-2/10, 4, 5, 6-1/4 or 7
32 or less	**MDL**	3, 3-2/10, 4, 5, 6-1/4, 8, 10, 15, 20, 25 or 30

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250 or less	**MGB**	1/16 or 1/8
		MBW & MBB fuses now called AGC.
250 or less	**AGC**	2-1/2, 3
250 or less	**MTH**	4, 5 or 6
		For 250 volt fuses above 6 amperes—See ABC fuses.
125 or less	**GLH**	7, 8 or 10
32 or less	**AGC**	4, 5, 6, 7, 7-1/2, 8, 10, 15, 20, 25 or 30

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Answers about MATV amplifier specs

By James E. Kluge, Technical Editor, Winegard Company

The MATV amplifier specifications most difficult to interpret probably are the ones listing the input and output signal levels of broadband amplifiers. Each manufacturer seems to have a different way of saying the same thing. Although such specmanship is not designed to confuse, the result often is total misunderstanding on the technician's part of how to use these important ratings. A cure for the confusion can be found in the facts behind the specs.

Broadband Means Multi-channel

MATV broadband amplifiers are designed to provide nearly-equal gain for signals of many TV channels. Depending on the purpose, the bandpass probably would include coverage of VHF-low, FM, VHF-high, CATV, and UHF band (about 50 to 900 MHz, as shown in Table 1).

Broadband amplifiers for cable (CATV) usually have continuous coverage from 50 to 300 MHz. They do not include UHF, because in CATV systems, all UHF channels are converted to VHF before distribution.

UHF channels 70 through 83 have been allocated by the FCC for translator use only. Therefore, many newer broadband MATV amplifiers cover only the UHF channels of 14 through 69. To make these amplifiers compatible with CATV systems, the special CATV midband and superband VHF frequencies are included.

Maximum Number Of Channels

In the MATV industry, it's commonly agreed that broadband amplifiers seldom will be required to handle simultaneously more than 7 VHF and 5 UHF channels. This is in line with the FCC allocations of channels.

Why should we be concerned about how many channels an amplifier is required to handle? The reason is simple. The more channels amplified, the smaller output amplitude **each** channel can have without distortion.

Amplitudes of all signals at the input **add** together to make up the total instantaneous voltage that the amplifier is required to amplify and deliver to the output. Every amplifier has a maximum signal-handling ability, and the quality of the various signals will be degraded if this limit is exceeded.

One result of excessive signal amplitudes is cross-modulation distortion which might cause the video of another channel to be seen superimposed on the desired picture. The exact symptoms vary according to the severity of the overload (Figures 1 and 2).

When single-channel amplifiers overload, the main symptoms are excessive contrast, or poor vertical and horizontal locking of the TV (Figures 3 and 4).

Maximum Output Signal

Output from a broadband amplifier is specified in one of two ways, either as a total voltage, or as a "per-channel" voltage for each of a specified number of channels. It's logical (and true) that the more channels you have, the lower each "per-channel" voltage must be to avoid exceeding the specified output level.

This maximum output voltage might be stated in volts, volts-per-channel, dBmV or dBmV-per-channel. In addition, the manufacturer might or might not specify the amount of amplifier distortion at the maximum output level, or how many channels should be applied simultaneously to the input. Without such important information, the rating of output level will be virtually meaningless, thus adding to the confusion.

Typically, an excellent specification for broadband amplifiers gives the output in dBmV-per-channel at 0.5% cross modulation for 7 channels of VHF and 5 channels of UHF. Some new models amplify VHF and UHF bands separately, giving maximum output level with minimum distortion.

If you customarily work with dB's, remember that you can't multiply dBmV levels, but instead multiply the voltages. To do this, first convert the per-channel dBmV level to volts, multiply by the number of channels, and convert the voltage back to dBmV.

Take Advantage Of Maximum Output

What should you do if there are fewer than the maximum number of channels in your area? This might be a bonus. The amplifier could be driven to a much-higher per-channel voltage than specified. Refer to Chart 1 for the new ratings according to the number of channels.

In some MATV systems, the extra output capability made possible by fewer channels might allow you to select a smaller distribution amplifier, or perhaps to eliminate one or more line amplifiers, resulting in a substantial saving of costs.

Why "Per-Channel"?

The reason for specifying amplifier output on a "per-channel" basis rather than in total voltage is simple and practical. These levels are measured by tunable RF voltmeters called signal-level meters (sometimes wrongly called field-strength meters). By its very nature, signal-level meter measures the amplitude of each individual carrier in succession, not all channels at once.

In a properly designed and installed MATV system, all picture-carrier levels should be balanced to within 1 dB. Knowing how many channels there are and their individual voltage levels, you can calculate the amplifier input voltage by multiplying the two numbers. This product should not be allowed to exceed the amplifier input-per-channel spec times 7 VHF or 5

Over-The-Air TV Channels		Cable-TV Channels	
VHF Low Band	Channels 2 through 6 54 to 88 MHz	***Subchannels***	Channels A through E 17.75 to 47.75 MHz
VHF High Band	Channels 7 through 13 174 to 216 MHz	***Midband***	Channels A through I 120 to 174 MHz
UHF Band	Channels 14 through 69 470 to 806 MHz	***Superband***	Channels J through S 216 to 276 MHz
UHF Translators	Channels 70 through 83 806 to 890 MHz	***FM Band***	Channels 201 through 300 88 to 108 MHz

Table 1 Except for the cable subchannels, a broadband MATV amplifier should have flat response over these channels and frequencies.

Fig. 1 Excessive input signals to a broadband amplifier often result in a faint negative picture from another channel appearing with the desired picture. When the horizontal blanking and sync pulses move sideways, the effect is called "windshield wiper".

Fig. 2 A more-severe overload than that of Figure 1 might show an image of the other program. Notice the negative image of a woman's face just to the right of the man.

Fig. 3 Excessive input signal, that overloaded a single-channel amplifier, might cause clipping of the sync tips, thus fooling the AGC into increasing the contrast too much.

Fig. 4 Sync clipping in a single-channel amplifier might cause the vertical locking to flip.

Fig. 5 Under certain combinations of channels and signal strengths, a strong beat pattern, similar to sound bars in a color set, are produced.

UHF channels (or however the amplifier is rated).

A specification of minimum input but without a maximum, or one of a certain maximum input at some unstated reduced-gain setting, is of little use to anyone. Yet these partial specs sometimes appear.

Last Stage Limits Output

In all correctly-designed amplifiers, the output transistors limit the level that can be handled without overload; that is, the final stage should overload before any other.

Before knowing the maximum output level, you can determine the maximum input level by subtracting the amplifier gain. If the gain is not stated, there is no way of knowing the maximum permissible input level. When it is specified, the input plus the gain should equal the output level.

If the gain control attenuates the input signal before the first amplifier stage, the maximum permissible input level increases by the amount of the gain reduction. However, if the gain control follows the input stage, it's possible at reduced settings to overload the input stage before the output stage overloads.

The maximum output level is fixed by the design of the output stage. Nothing the customer can do alters that. But maximum input level is affected by the gain-control setting.

Amplifier Distortion

Generally, MATV overload is defined as the level at which 0.5% compression, occurs. This amount of distortion is invisible to trained eyes looking at the picture, and is considered to be acceptable.

Any increase of level beyond this point rapidly increases the distortion, causing ghost images from other channels, windshield wiper, or unstable horizontal or vertical locking.

Minimum Input

Some manufacturers specify minimum input levels for their broadband amplifiers. This has nothing to do with overload, but is related to the signal-to-noise ratio. It tells how weak the input signal can be without causing excessive snow and noise.

Look at it this way: With no signal, the picture is **all** snow. As the signal is increased, it appears in the snow with the picture getting stronger and the snow less noticeable. At a certain level, the snow disappears entirely. This is termed a grade-1, excellent picture by Television Allocation Study Organization (TASO) standards.

Minimum input signal level is defined as that required to produce a grade-1, excellent picture with no snow. According to TASO, this is a signal-to-noise ratio of 45 dB.

Dynamic Range

Additionally, a minimum-input spec defines the dynamic input range. It's the difference between maximum and minimum input. In other words, it marks the points of overload or snow.

Amplifiers should be operated as near maximum input level as possible to obtain the best signal-to-noise ratio at least cost, so the dynamic-range specification is not important in small systems. In large systems where many amplifiers are cascaded, the dynamic range of the system is compressed by each successive amplifier, making it advisable to use amplifiers capable of a wide dynamic range.

Single-Channel Amplifiers

Although single-channel amplifiers are narrow band, their specs are much the same as for broadband ones. Because there is only one channel to be amplified, cross-modulation distortion is not a consideration. Instead, the limitation is the amount of sync clipping or compression.

Adjusting The Levels

All this discussion about maximum and minimum levels, overload, etc., is fruitless unless you have the capability to measure and adjust these levels accurately. Such capability is possible only by use of a quality signal-level meter. Don't be tempted with a "bargain" that might not do the job. Carefully compare the specifications of accuracy, bandwidth, and input-voltage range before you buy.

Summary

If you don't understand the input or output level specifications of an MATV broadband amplifier you are buying, ask the distributor or the manufacturer to explain them. Much of the success of an MATV installation depends on the correct signals at the amplifier. □

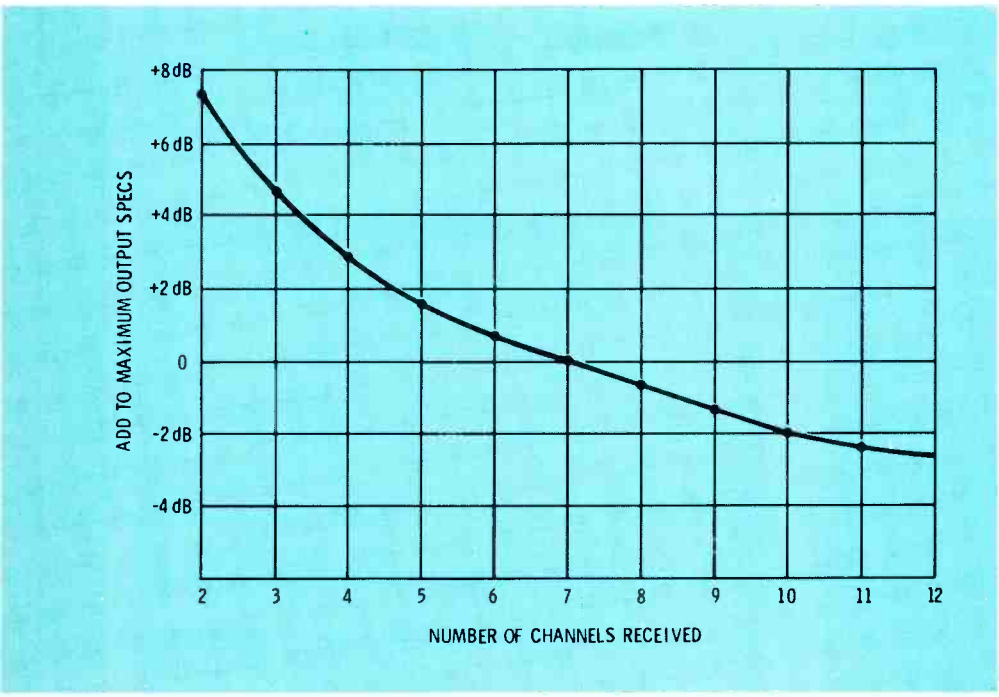

Chart 1 A broadband VHF amplifier, rated at a certain output signal with 7 channels, should have the output spec changed according to this chart. For example, for only three VHF channels, the output could be increased 4.8 dB, without exceeding the rated distortion.

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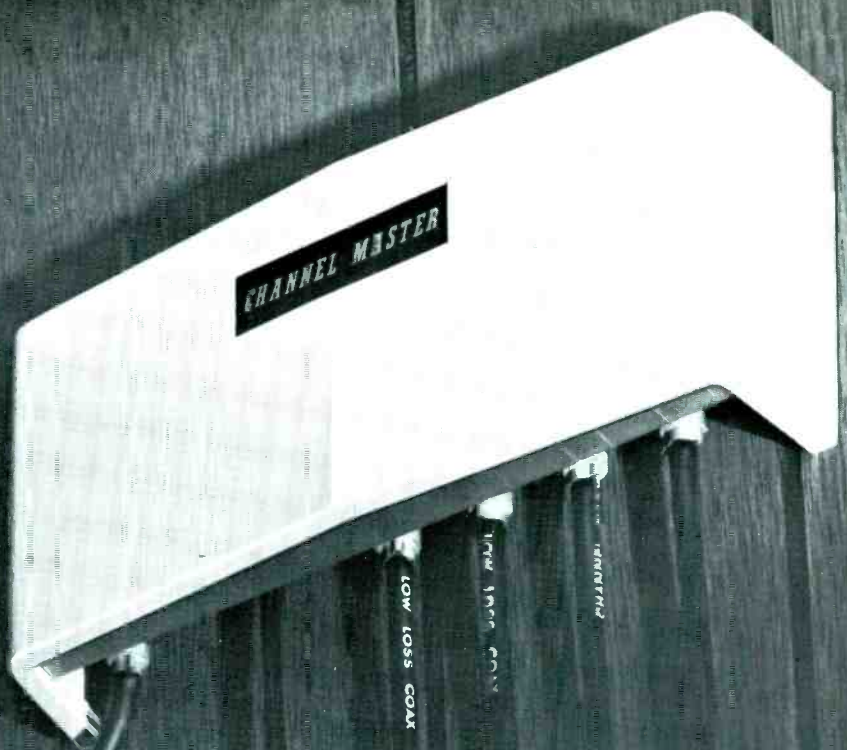

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Fig. 1 The Jerrold TRC-12 remote control easily can be installed on any television receiver. Converter and pushbutton remote units are connected by a 25-foot cable. (*Courtesy of Jerrold*)

Reports from the test lab

By Carl Babcoke

Usually in this column, we report our findings about test equipment examined in the Electronic Servicing laboratory. This month the subject is an unusual remote channel selector by Jerrold. There are no motors, and the remote can be used with any model of TV, because the only connection is to the antenna terminals.

Perhaps you remember, a dozen years or so ago, when a few TV manufacturers tried to supply remote-control kits for after-the-sale installations in a few consoles of their own brands. Usually such installations were a pain, requiring extensive mechanical and electrical modifications to the receivers. And, often the labor costs were excessive, because the few kits sold did not permit technicians to become efficient in the installations. In short, the kit idea at that time was too complex to be practical. Now there is a new kind of remote, requiring only a simple installation.

Converters Are The Answer

The only type of after-the-sale remote-tuning system that can work well with **all** brands and models, both b-w and color, and without wiring changes inside the TV, is a frequency converter. Also, a push-button action is faster and more convenient to use than is a rotary motion of the selector. These two features are the basis of the Jerrold Model TRC-12 remote control system.

Installation consists of minor changes to the antenna wiring, plus plugging in two power cables. No motors are used, no adjustments are required, and it's not necessary even to remove the back from the TV.

There are a few small limitations, to be discussed later, but also there are several benefits not obtainable with conventional systems.

Typical Installation

Two major units make up the Jerrold TRC-12 remote-control system: the converter containing the power supply and electronic circuits; and (at the other end of a small-diameter 25-foot cable) the remote control box with 12 channel buttons, an on/off switch, and a fine-tuning control (Figure 1).

Input and output signal circuits both have 75-ohm impedance, for cable using "F" connectors (Figure 2). If the present antenna system is a 75-ohm type, only a short length of cable and two "F" connectors are required. With 300-ohm systems, add two 300-to-75 ohm matching transformers with the 75-ohm side toward the converter.

Insert the power plug of the converter into a wall outlet, and plug the AC cable of the TV receiver into the outlet (500 watts, maximum) on the back of the converter (Figure 3). Inside the converter, a relay operated from the DC power supply (which eliminates relay AC buzz) in series with an AC switch in the remote, turns on or off the power to the TV receiver.

Of course, the AC switch on the receiver must be left on at all times, and there is a continuous drain of about 8 watts to power the remote. This defeats the instant-on feature of those sets that have it; however, instant-on has fallen into disfavor in this era of power shortages. Most new sets don't have instant-on.

Lugs on the converter unit permit

it to be fastened to the back of the TV receiver where it's out of sight. The converter runs cool, and the remote unit has no heat (or signal) at all.

The cable that's between the converter and the remote units can be run under a rug, or around the wall. I have a similar unit with my cable TV service, and I just carry the remote to my chair for the evening, with the cable stretched across the floor, then return it to the top of the set when I'm through watching the programs.

That's all there is to the installation: connecting the antenna to the converter, and cable from converter to antenna terminals of the receiver; plugging in the power cables; and moving the remote where desired.

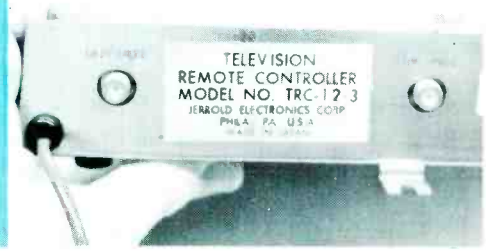


Fig. 2 Shielded "F" connectors are provided on the rear panel of the converter for the 75-ohm antenna wiring.

Fig. 3 An AC socket on the rear of the converter supplies switched power for the receiver.

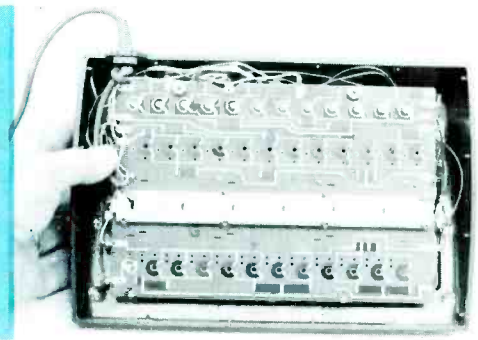


Fig. 4 When the bottom plate of the remote unit is removed, the 12 pots can be seen along the top edge of the circuit board, with the rods of the pushbutton switches inside the metal bracket just below the center.

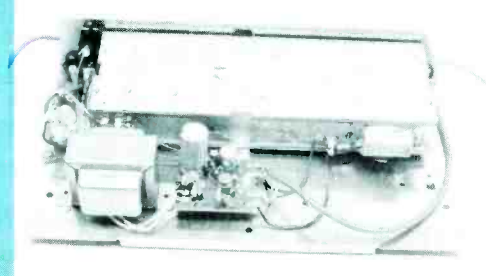


Fig. 5 The power transformer of the converter (top removed) is shown at the lower-left corner, with the DC relay just above it, and the board for the rectifiers and voltage regulation located to the right. Along the top of the picture is the shielded compartment housing the active circuitry.

The Remote Unit

Wiring on the inside of the remote unit hardly could be more simple (Figure 4). One circuit board contains the 12 pushbuttons, and the 12 pots that determine the DC voltage to tune the desired channels. At one side is the on/off rocker switch, and the fine-tuning pot is located at the other edge of the panel. I suppose you could touch-up the adjustment of the pots so no adjustment of the fine-tuning control would be necessary when you change channels. However, our test sample really didn't need any trimming; it was quite accurate.

No shock hazard is possible, either from the connecting cable or the remote-control box, for the voltages there never exceed 20 volts DC. No signal or AC power voltages go to the remote unit.

Converter Features

Figure 5 pictures the inside of the converter unit with the top removed. On the small board are the power supply and regulator components. The critical parts and solid-state components are inside the shielded compartment.

A fairly-sophisticated circuit is indicated by the block diagram of Figure 6. Certainly, it's too complicated for anyone to try to build at home.

DC voltage, determined by the remote channel switch and pot that's in use, controls a varactor diode in the variable-oscillator. The exact capacitance of the varactor diode depends on this control voltage. Thus tuning is possible at some distance without problems from the tuned circuit.

Oscillator and antenna signals are combined in the first mixer, the resulting IF signal is tuned and amplified before it and the fixed-oscillator signal are heterodyned in the second mixer. Output of the second mixer is a signal on channel 3 (or channel 2, if your area has a channel 3), which goes to the receiver. **The channel selector of the**

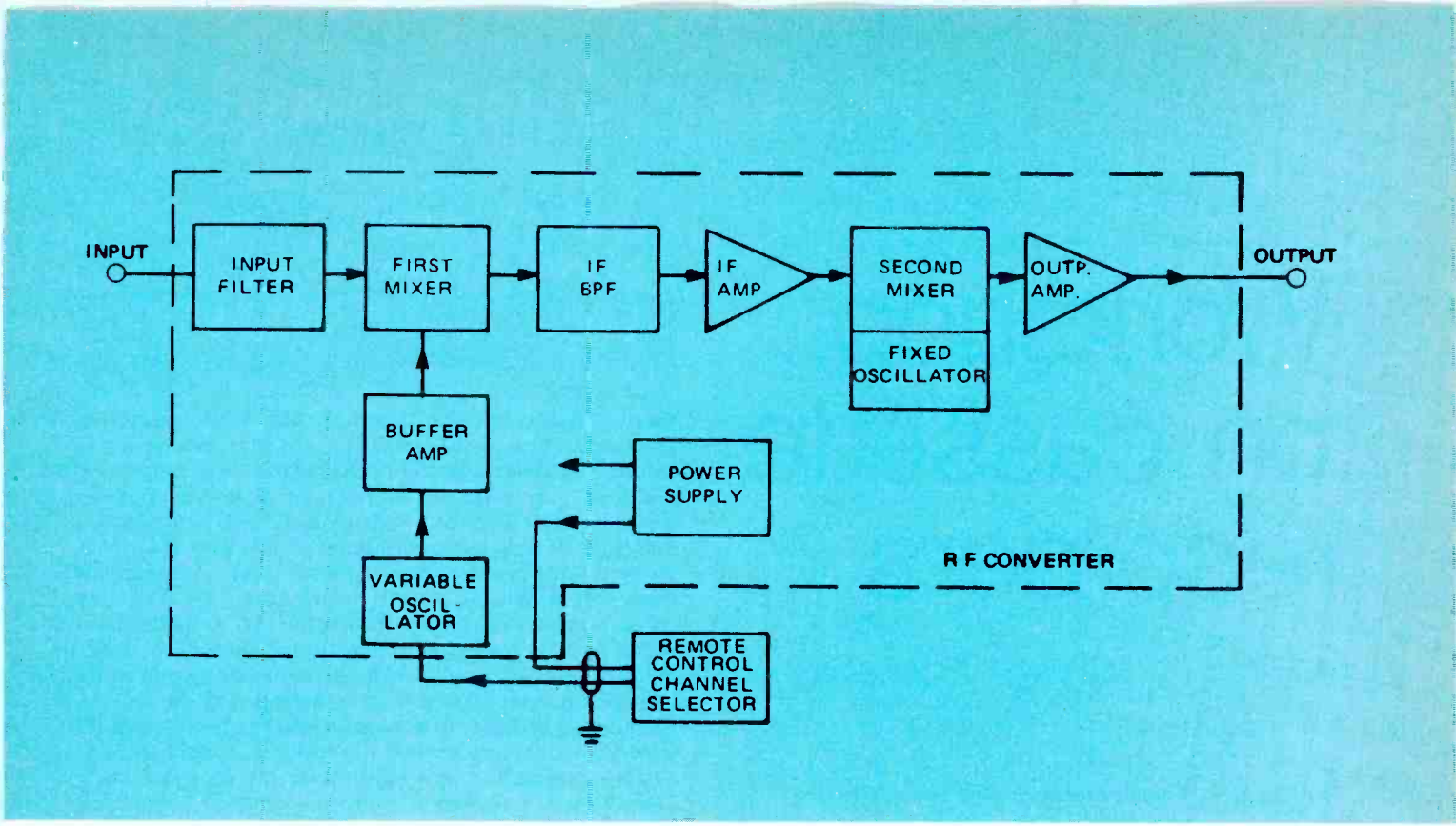


Fig. 6 Block diagram of the TRC-12 shows many more parts than just a mixer and oscillator. (*Courtesy Of Jerrold*)

receiver remains tuned to that channel at all times.

Eliminates Leading Ghosts

One possible problem with MATV systems is that direct pickup of station signals by the wiring of the TV receiver can produce ghosts located to the left of the desired picture. There is a small delay when signals go through any CATV or MATV system; therefore, the unwanted direct signals get there first (to the left).

A remote control of the converter type eliminates all direct pickup, because **all** channels are tuned-in by the receiver either on channel 2 or channel 3. This can produce an important improvement of signal quality, especially in apartments on the station side of the building.

Comments

Although no provision is made for UHF reception, there are two methods of obtaining it. One is to use a UHF/VHF splitter (such as the Jerrold FCO-375) to feed the UHF to the UHF receiver terminals and the VHF to the converter. Then, the UHF can be tuned by rotation of the receiver channel selector to the UHF position. The deluxe way is to convert all active UHF channels to VHF (as is done in CATV systems) and supply them to the remote control converter along with the VHF signals from the antenna.

We have no instruments to check the exact specifications of products such as this remote control. Therefore, we tested the TRC-12 by actual usage under several kinds of typical conditions. From these tests, we arrived at several general impressions.

Color picture quality was the same with the converter as it was with the antenna signal connected direct to the receiver.

No noticeable snow was added, even when rabbit-ears were used for local reception. Before the test, the possibility of added snow had been a question, because of the experience I had with more snow on CATV than with my own antenna during tests of the Winegard Cablemate (Electronic Servicing, page 50, May, 1974).

Specifications call for a converter gain between 4.5 dB and 11 dB. It should be possible to operate two or three TV receivers from one remote control, if desired. The extra gain might be an advantage with older sets which have only moderate RF gain.

Fine-tuning drift of both the converter and receiver appeared to be the same as the drift of the receiver alone. If the converter drifted it was not noticeable.

Other remote functions, such as volume control and brightness adjustment, are not handled by the Jerrold remote. However, under test conditions with several receivers, I did not find any need for those two controls.

Most uses for the remote control are obvious, such as in sick-rooms or hospitals, and in homes, schools and motels. But the two that impressed me most were with MATV to eliminate leading ghosts, and uses in receiver locations that make manual channel changing difficult, such as above a bar, or a cabinet in a restaurant.

The pushbuttons provided instant channel changes, and the button in use stayed down to give a visual indication of the channel selected.

The Jerrold Model TRC-12 remote control performed very well on all the functions for which it was designed. □

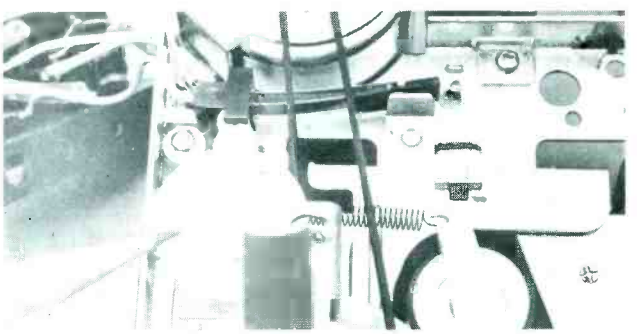
Workshop on cassette recorders

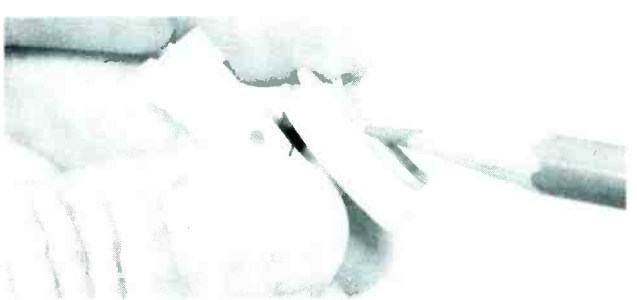
Part 3

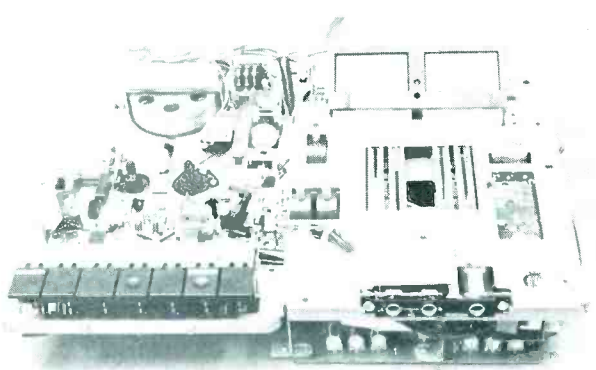
By Dewey C. Couch, Forest H. Belt Associates

The first two sessions of this Cassette Workshop illustrated ways to clean and adjust cassette assemblies, and how to inspect and test typical mechanisms. For complete servicing, you need to understand three basic mechanisms: pushbutton switched; selector-cam switched; and slot-loading [Staar]. Part 3 takes you through the assemblies and operation of pushbutton machines. Features of several machines have been included so you can deal with many different brands and models.

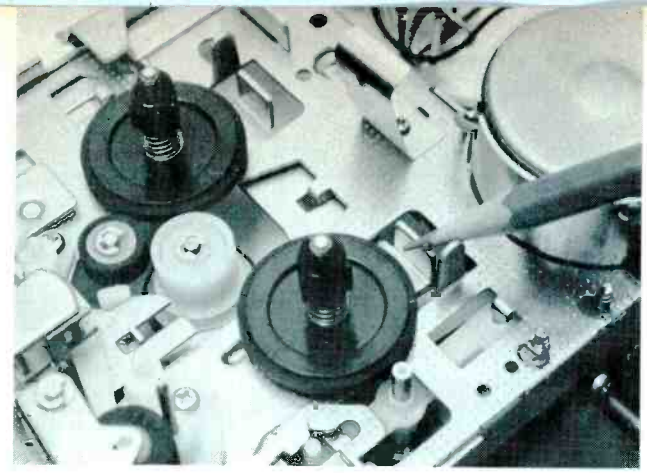
Step 1. Every cassette machine has three tape-drive functions: Fast-Forward, Rewind, and Play. Recording is just an electronic variation of Play. To analyze faults in a machine, you must concentrate on which assemblies work in each function. Perhaps you can pinpoint the defective assembly without having to tear into the whole mechanism. Consider Play operation first. Pressing the Play button affects several assemblies: (1) a power switch closes, energizing the motor; (2) a brake plate slides back, releasing both supply and takeup spindles; (3) erase and play heads move into the cassette and press against the tape; (4) the pinch roller presses the tape to the rotating capstan, to draw tape past the heads; and (5) a drive idler presses against the forward (takeup) spindle, which winds up the tape as it leaves the capstan. If any one of these movements is wrong, correct it before you look for other troubles.

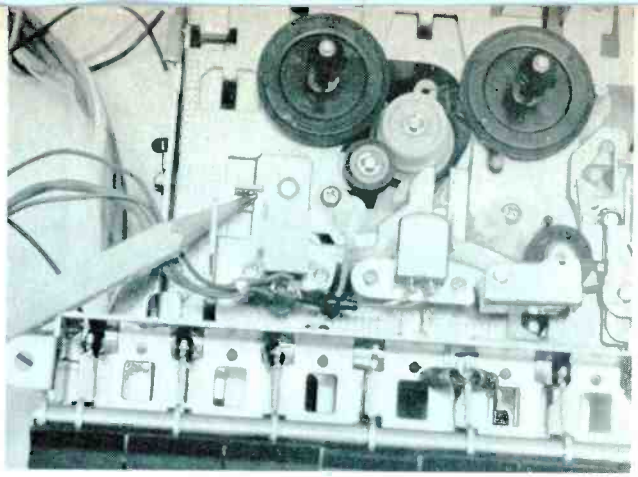


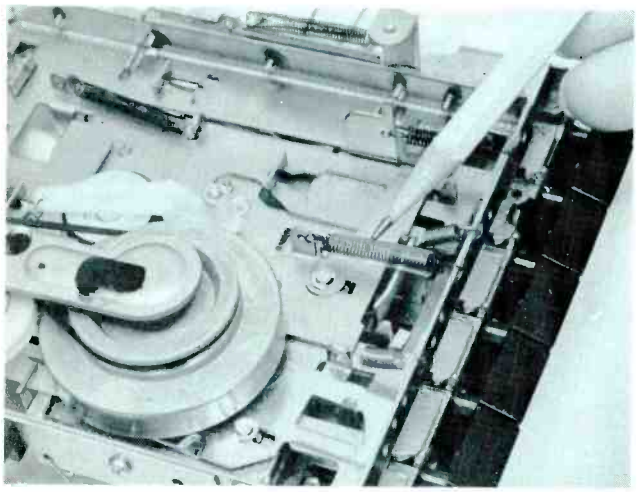




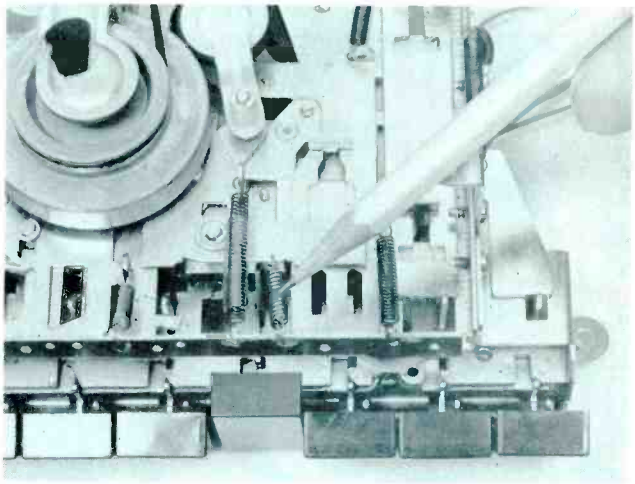
Step 2. A rubber belt from the motor pulley drives the fly-wheel. Usually, it also passes over and turns the takeup-clutch pulley assembly. This drive tries to turn the forward spindle slightly faster than the tape reaches it from the capstan. But a clutch system allows slippage, so the tugging doesn't stretch or break the tape. To assess takeup clutch operation, grasp and hold the turning spindle momentarily. Then turn it loose and see if it takes up the slack tape smoothly and without bouncing. If takeup seems erratic, the tension spring that holds the takeup pulley against the drive belt might be weak. Or, the felt clutch might be worn or matted. Try a new assembly (this one doesn't come apart). The cause of excessive takeup bounce probably is binding of the takeup-clutch pulley; again, a new one is the best cure.



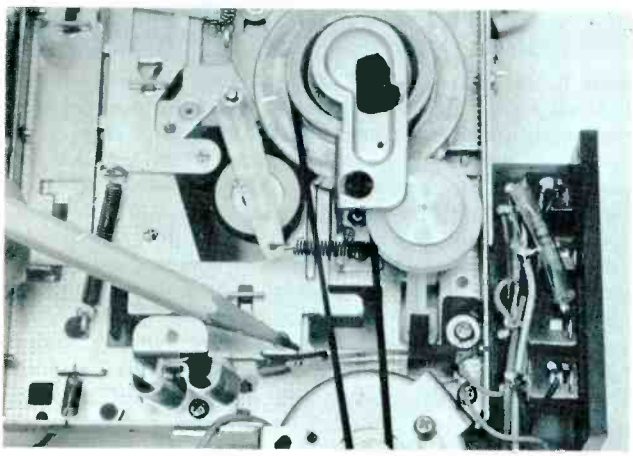




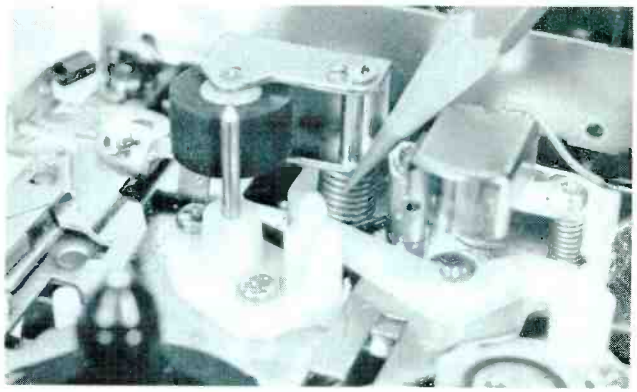
Step 3. Here's a brake plate that hangs **below** the base plate (they're usually on top). Two tabs protrude above the baseplate. A spring holds the plate so the tabs normally press against the spindles. Any one of three levers, pivoted by the button for either Play, Fast-Forward, or Rewind, forces the brake plate back to move the tabs away from the spindles. Braking can be checked best from Fast-Forward or Rewind, since the spindles turn faster than in Play. With the machine running in either fast-wind mode, punch the Stop button. If the spindles don't stop instantly, the brakes are not doing their job properly. The spring could be weak or slipped, or the plate might be binding on its mountings.



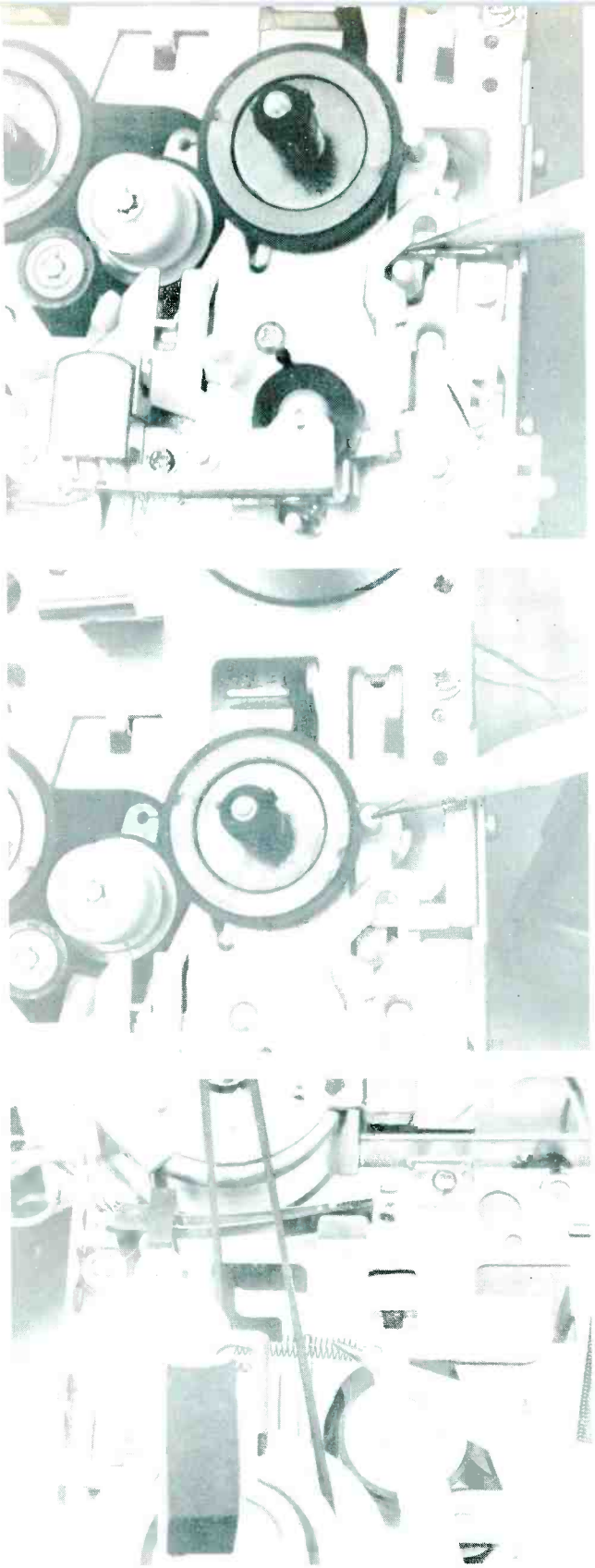
Step 5. The Play-button lever pushes the head plate, pressing the heads in against the tape. Suspect that the heads go too far into the cassette, if you find one of these symptoms: (1) tapes squeak; (2) tapes twist or break; (3) cassettes feed erratically; or (4) pressure pad and spring in cassettes repeatedly become damaged. Heads also wear out fast, but that takes a while to spot. On the other hand, the head plate might not move in far enough for good head-to-tape contact. Volume on playback is weak, and recording erase is poor. The fault could lie in a bent head plate or guides (or a bent Play slide, on some machines). The head-plate spring might be missing or unhooked.



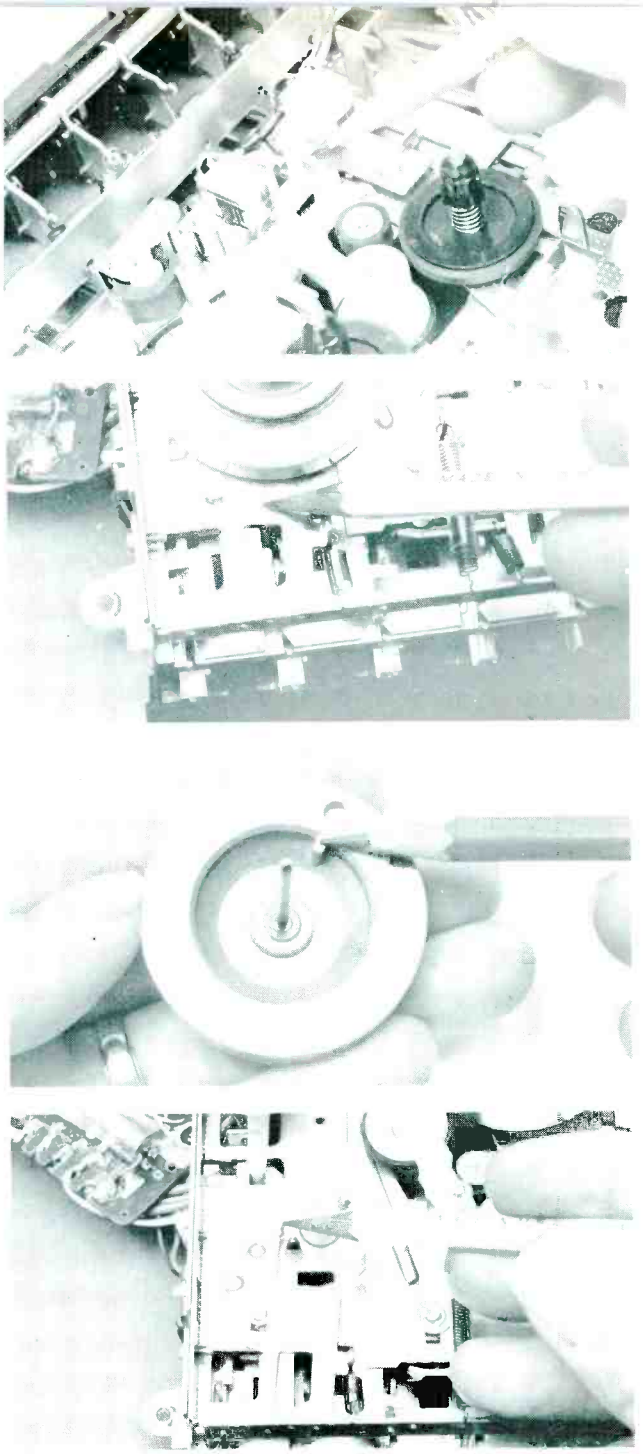
Step 4. On this machine, the brake plate also presses against the power switch when you select Play, Fast-Forward, or Rewind. If the plate doesn't move back far enough, the switch might not close; the motor won't start. Check the button-lever tabs for wear. Also, see that the switch leaves haven't been bent.



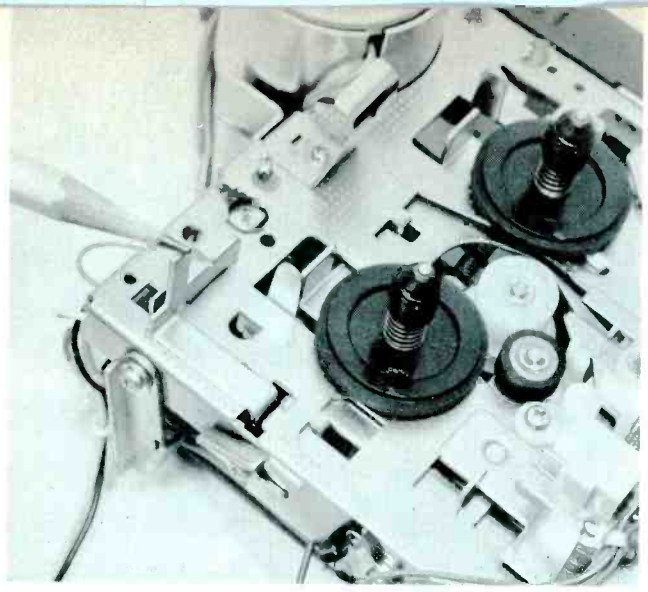
Step 6. The pinch roller, mounted on the movable plate with the heads, moves forward for Play and presses against the rotating capstan. A spring determines the pressure. With tension too light, the tape can pull through erratically, or not at all. If the roller presses too hard, the capstan digs into the rubber surface, soon ruining the roller. In either case, adjust the roller-tension spring (explained in Session 2).

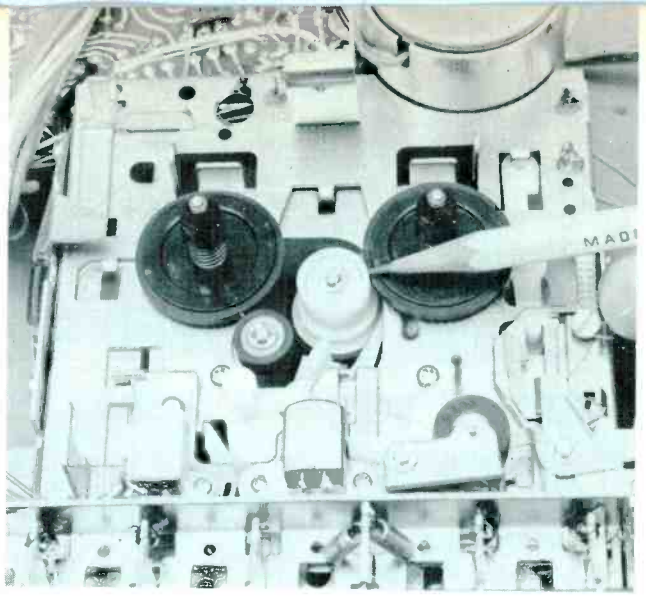


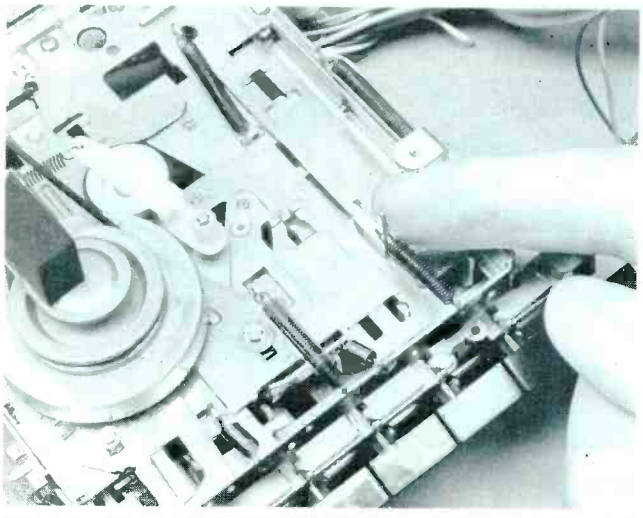
Step 7. In playback operation, a cam surface that's part of the head plate allows a spring-loaded arm to pivot, pressing the takeup idler against the rubber rim of the forward spindle. On this machine, one spring applies idler tension for both takeup and fast-wind assemblies. In fact, it stretches between the two. If the takeup idler fails to press hard enough on the spindle, the tape might not wind up fast enough and can spill out of the cassette. The cure is a new spring. Don't try to cut and bend the old one. You'll never get idler pressure right that way.



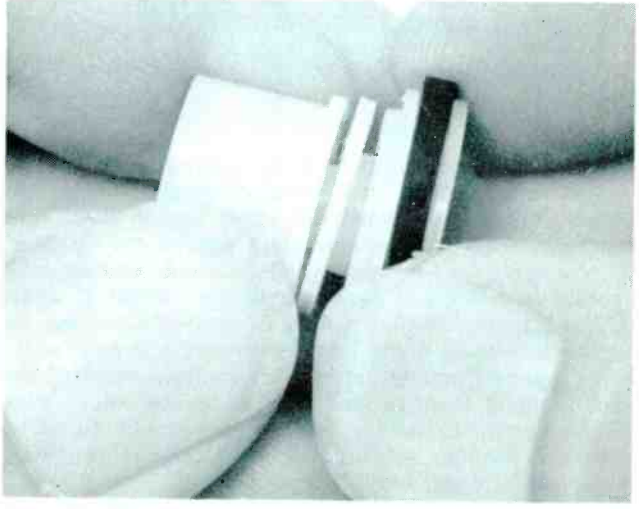
Step 8. An automatic-shutoff actuator also mounts on the head plate of some models. The tape, moving past the heads, presses against the actuator. The tape is not very taut, and bends inward slightly. When the tape has played out, the supply spindle stops rotating. Yet, the takeup spindle keeps pulling on the tape. This increased tension of the tape (how taut is determined by takeup-clutch slippage) pivots the actuator, moving a shutoff slide below the baseplate. A protrusion on the turning flywheel catches a tab on this shutoff slide, pulling the slide well forward. The other end of the slide catches and tugs on the Stop-button lever. The latch plate releases the depressed Play button, and the mechanism returns to Stop. To analyze automatic shutoff operation, momentarily push the actuator back toward the pushbuttons. If the machine doesn't shut off, hunt for binding in the actuator or shutoff slide. The slide might be bent or otherwise damaged. Remove the flywheel and check the tab on the shutoff slide; sometimes it gets bent or broken off.



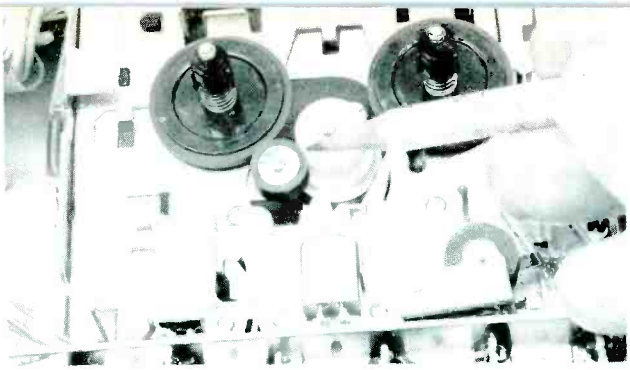


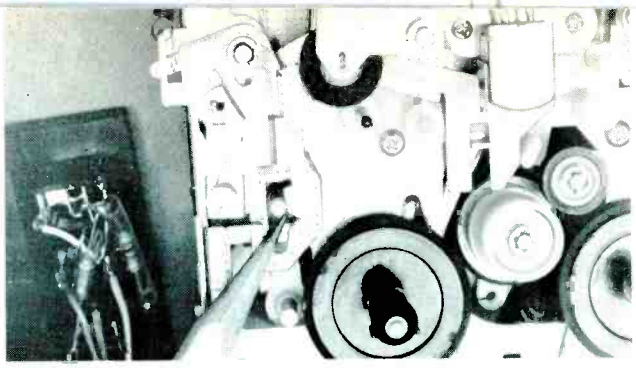


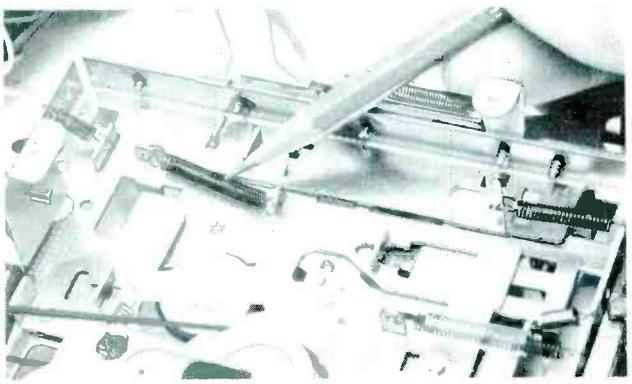
Step 9. The anti-record feature prevents accidental erasing and recording of a prerecorded tape. An anti-record lever has to pivot (or slide) backward before you can push the Record button down. Blank cassettes push the anti-record lever when you put the cassette in position. That moves the other end of the lever out of the way of the Record slide. If tabs on the rear of the cassette have been punched out (prerecorded cassettes come with them out), a spring keeps the anti-record lever in the safety position, blocking the Record slide. Thus, you can't record the tape. If you can push the Record button down with no cassette on the machine, the anti-record lever is not doing what it's supposed to. Suspect its tension spring, or a bent or binding lever.

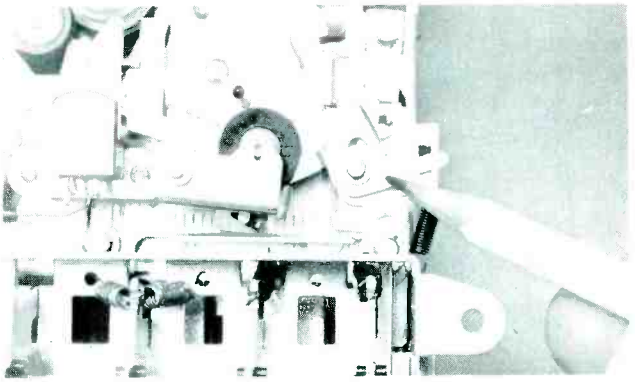


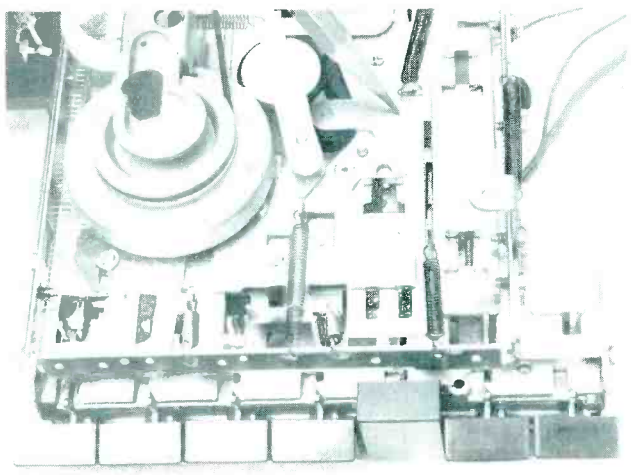
Step 10. The fast-wind drive wheel of this machine contains its own clutch assembly. A felt ring fits between a rubber-rimmed inner spindle and a long, cylindrical wheel. When you push the Fast-Forward button, a takeup/fast-wind spring holds the rubber-rimmed idler against the flywheel. The cylindrical idler presses against the forward spindle (which is above the baseplate) and turns it. If the takeup spindle turns erratically or too slowly, look for one of these possible faults: (1) tension spring weak or unhooked; (2) worn felt; (3) dirty or greasy surfaces on flywheel or clutch; or (4) binding slide on which the clutch assembly mounts. If the felt clutch is to blame, replace the whole assembly. You can't disassemble it.

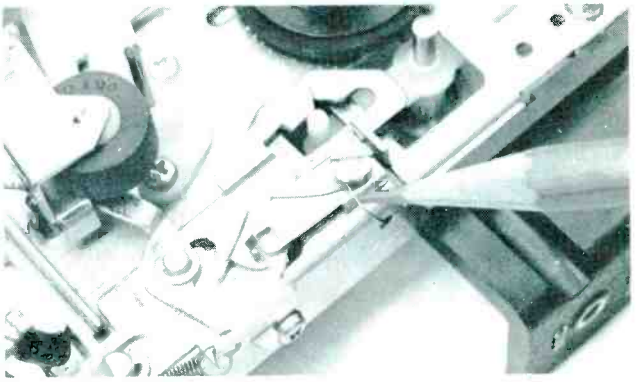


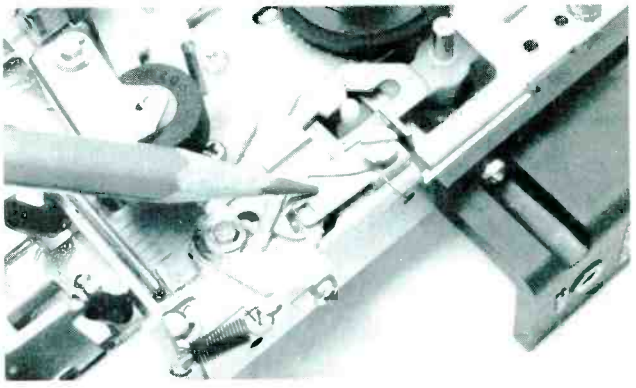












Step 11. The fast-wind clutch assembly for fast-forward operation works also for Rewind. When you depress the Rewind button, the cylindrical wheel doesn't move, but the lower rubber-rim spindle stays against the flywheel. At the same time, a spring pulls a rubber-rimmed idler (above the baseplate) against both the cylindrical wheel and the supply (rewind) spindle. This turns the spindle rapidly backward. If you find fast-forward operation okay, but the supply spindle rotates erratically for Rewind, the pull-in spring could be weak or missing, the rewind slide might be stuck, or the rewind idler could be dirty, greasy, or binding. Any other defect would likely show up with Fast Forward, too.

Step 12. Pause controls work only during playback or recording. Pressing the Pause button on this machine moves a slide that pivots the takeup drive idler away from the forward spindle. At the same time, the slide pivots another small lever that pulls the pinch roller back from the capstan, releasing the tape. The heads and brake tabs usually stay in playing position. A spring and plate latch the Pause slide. When you press the Pause button again, the spring toggles the latch plate the other way, releasing the slide. The mechanism returns to playback or recording position. If the Pause button doesn't latch down, or doesn't pop back up when you push it the second time, the latch-plate spring is probably the culprit. A warped cam on the Pause slide might miss pulling the takeup idler away from the spindle. The pinch roller can't pull back properly if the pivot lever is bent.

Next Month

In Part 3 of the Cassette Workshop, you've learned how the assemblies of the pushbutton (piano-key) machine work. Details of the other two common types of cassette mechanisms will be presented next month in the final session. □

reader's exchange

Needed: *Recording-and-playback head for a Webcor Model EP 2001-1C tape recorder.*

R. C. Spence
2407 Brooklyn Avenue
Parkersburg, West Virginia 26101

Needed: *A power transformer for Magnavox CT-277, part number 300059-1.*

Stan's TV
223 South Virginia Lee Road
Columbus, Ohio 43209

Needed: *Six 1L4 tubes.*

Charles Anding
Box 87
Bolton, Mississippi 39041

Needed: *Operating manual for Amphenol Model 880 Stereo Commander generator.*

Philip Kennedy
5520 Fenmore Road
Indianapolis, Indiana 46208

For Sale: *Antique Grunow radio Model 1151, Chassis 11A. Would like schematics and parts for old radios. Does anyone know of a club for antique-radio buffs?*

W. B. Marlar
227 Griffin Road
Helena, Montana 59601

Needed: *Operating manual and schematic for a 3-band Sparton AC radio model number 7BW46PA with type 7-46PA chassis. Will buy, or copy and return.*

Joseph A. Owens
918 Gorsuch Avenue
Baltimore, Maryland 21218

Needed: *A 25-inch color picture tube mask. Also need dial, cabinet, and parts for Hallicrafter S-47 broadcast receiver. Dial part number 22B193 and dial glass part 22B184 and frame preferred.*

Don Setliff Radio
Route 1 Box 2902
Culloden, West Virginia 25510

Needed: *A good used motor (1/50 HP, 1800 RPM, 3-wire) for Roberts tape recorder Model 1055.*

M. R. Davis
2655 West Park Drive
Baltimore, Maryland 21207

Needed: *Set of probes for Model CRO-2 Jackson scope.*

James E. Boston
2505 Moorman
Cincinnati, Ohio 45206

Needed: *Instruction book and schematic for a Hickok OS10, AF/RF oscillator. Will buy, or copy and return.*

Harold Elwood
517 Melrose Avenue
South Plainfield, New Jersey 07080

Needed: *Schematic for Musicall intercom system, Model 999.*

Phillip D. Lund
220 Buena Vista
Claremont, California 91711

Needed: *Operators Service Manual for Pyramid Model CRA-2 capacitor-resistance-analyzer.*

B. W. Embree
27 Willow Avenue E.
Box 757
Souris, Manitoba ROK 2CO

Needed: *Manual for Paco Model G-30 RF signal generator and TV/FM marker generator.*

William F. Isokait
1318 Mimosa Lane
Silver Spring, Maryland 20904

(continued on next page)

(continued from previous page)

Needed: *Service data/schematics for Model A-100 signal generator manufactured by Approved Electronic Instrument; also need Moss Electronic Genometer TV-50 signal generator.*

David Huch
1915 "Y" Street
Omaha, Nebraska 68107

Needed: *Schematic for Audio Tex pocket meter Model 30-240.*

Louis Fabrizio
8750 57th Street North
Pinellas Park, Florida 33565

Needed: *Names and addresses of firms selling rebuilding equipment for picture tubes.*

Cristobal Ordonez
149 West 26th
Bayonne, New Jersey 07002

Magazines: *Copies of* **PF Reporter** *and* **Electronic Servicing** *from May 1957 to December 1970; yours for the freight.*

R. C. Spence
2407 Brooklyn Avenue
Parkersburg, West Virginia 26101

Needed: *Operating manual and schematic for Paco oscilloscope Model S-55. Will pay expenses.*

John M. Craddock
Box 151
Gibsonville, North Carolina 27249

For Sale: *Antique tubes, Rider's radio manuals, and metal-cased capacitors (10 for $5).*

Goodwin Radio Shop
Rankin, Illinois 60960

Needed: *UHF/VHF tuner for Delmonico-Nivico 9T-4 UHF TV set. Sams Photofact Folder 771-2. Tuner need not be in working condition or tubed; used one acceptable. Also, need UHF tuner (any condition) for 1950 model DuMont Teleset RA-109A (Sams Folder 7, set 110).*

William M. Moran
109 Mill Street NE
Vienna, Virginia 22180

Needed: *Power transformer number 2SB15086 for Model 61CA Motorola table radio. Also need schematic for a Zenith Transoceanic portable Model 151764.*

Earl T. Scott
P.O. Box 171
Walnut Grove, California 95690

Needed: *Schematic and service manual for Megatone Model CSR-800 combination auto 8-track AM/FM/MPX radio. Buy, or copy and return.*

Homer E. McLucas
1346 Norton Street
Flint, Michigan 48507

(Continued on page 52)

test equipment report

These features supplied by the manufacturers are listed at no-charge to them as a service to our readers. If you want factory bulletins, circle the corresponding number on the Reply Card and mail it to us.

Digital Wattmeter

Model 4371 THRULINE directional high-power wattmeter is a digital insertion instrument for measuring forward or reflected CW power in coaxial transmission lines. It measures power flow under any load condition from 25 to 520 MHz and from 1 to 1000 watts in six ranges. Insertion VSWR in 50-ohm systems is 1.1, and accuracy is ±5% OFS. Model 4371 can be calibrated in the field to known RF power standards, eliminating weeks of transit for periodic certifications.

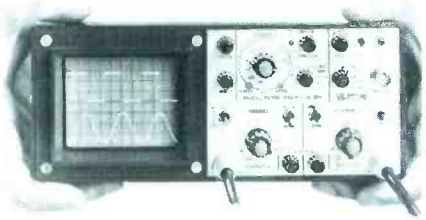
The wattmeter measures CW, AM, FM, and SSB signals. Its digital readout is useful for production testing and continuous service applications, since the information is displayed with the decimal point in place. The readout requires no mental transposition or attention to full-scale switch position. No plug-in elements are needed; all variable measurement parameters are push-button selectable on the front panel.

Model 4371 wattmeter from **Bird Electronic Corp.** sells for $950.00.

For More Details Circle (50) on Reply Card

Dual-Trace Mini-Scope

Model PS940A mini-portable oscilloscope from **Vu-Data,** features computerized triggering. A TTL logic circuit reportedly eliminates the need for front panel adjustment to achieve a stable trace display. It is stated the DC trigger mode allows the technician to make vertical position adjustments without losing sync. The mini-scope weighs less than 10 pounds and operates from self-contained batteries. The model includes the following standard features: 20 MHz bandwidth, 10 mV/div sensitivity, a built-in delay line for use in viewing pulse-leading edges, full dual-trace switching capability, algebraic waveform display,



low and high frequency-reject trigger modes. The price of the scope is $1,095.

For More Details Circle (51) on Reply Card

Portable, Triggered Scope

Offering all the features normally found in higher-priced oscilloscopes, **Systems Electronics** has introduced Systems 57, a portable, wide-bandwidth, 3-inch triggered scope for $275.00. The scope has a bandwidth of DC to 3 MHz at a high sensitivity of 20 millivolt-per-centimeter for the vertical deflection amplifier, plus horizontal sweep from 1 μ/Cm to 0.5 S/Cm in 11 calibrated steps.

Plus or minus internal and external trigger modes are provided. The control panel features a metallic-brush anodized face that includes red and blue coded legends to identify the vertical and horizontal deflection controls.

Encased in an insulated protective aluminum cabinet, the lightweight (15 pounds) scope is equipped with a "comfort-grip" handle that adjusts to serve as a ready tilt-stand for improved readability at many viewing angles.

For More Details Circle (52) on Reply Card

Solid-State RF Generator

B&K model 2050 RF signal generator from **Dynascan** is a solid-state, compact unit. The model provides three types of outputs: RF, 400-Hz modulated RF, and externally-modulated RF. Accuracy is 1.5 percent of dial setting. A combination high/low switch, plus continuously variable RF output control provides 20 dB of attenuation. Power supply is zener-regulated, and FET's are used in the RF and audio-oscillator stages for maximum linearity. The unit's applications include: AM receiver alignment, marker source for TV sweep alignment, RF amplifier gain test, signal tracing, and a signal source for production line and QC testing. The price of the generator is $107.00.

For More Details Circle (53) on Reply Card

Small Digital Multimeter

A handheld digital multimeter that measures capacitance, along with AC volts, DC volts and resistance, has been introduced by **Data Technology Corporation**. Model 21 has four DC and four AC voltage ranges with 1mV resolution; four resistance ranges with 1 ohm resolution, and four capacitance ranges with 1pFd resolution. Readout is by a 3½ digit LED display.

Several features contribute to the portable operation. Power is from four NiCad batteries, which can be recharged overnight. The case is high-impact polycarbonate, and the components inside are tightly fastened down to withstand impacts and vibrations.

Model 21 is priced at $269.00, complete with battery charger, test leads, and a belt-carrying case.

For More Details Circle (54) on Reply Card

Matcher/Reflected-Power Meters

Two matcher/reflected-power meters from **Gold Line Connector** eliminate the need for an SWR bridge. The GLC1087 is a 500-watt, 13-78 MHz unit, and the GLC1088 has a rating of 1000 watts and 144-220 MHz. By inserting the meter between the transmitter and antenna lead-in, and adjusting the tuning knobs to the lowest meter reading, reportedly an ideal match results and power loss is

minimized. The 1087 sells for $28.95, and the 1088 sells for $33.95.

For More Details Circle (55) on Reply Card

Portable Oscilloscopes

Systems Electronics 3-inch scope, Model 37, and 5-inch scope, Model 27, feature quick-removing vinyl-finish cabinets, and a printed circuit layout for easy servicing. Both models are equipped with a "comfort-grip" handle that adjusts to three positions to serve as a ready tilt-stand.

Model 37 provides all the functional controls of a full-sized scope, yet weighs only 11 pounds. It has a 3-inch CRT, operates over a bandwidth from 5 Hz to 2.5 MHz, and is priced at $165.00.

Model 27 features solid-state circuitry, a 5-inch CRT, bandwidth from DC to 2.5 MHz, weighs 15 pounds, and retails for $280.00.

For More Details Circle (56) on Reply Card

CORRECTION

Price of the Wayne transistor tester mentioned on page 40 of the November, 1974 issue of Electronic Servicing was in error, because it was based on an earlier model. Price of the Wayne WT2A transistor tester is approximately $150.00. □

News from the

SERVICE ASSOCIATIONS

NARDA Schools

National Appliance & Radio-TV Dealers Association (NARDA) has scheduled three 1975 Schools Of Service Management. The first will be held January 26-28 at the University of San Francisco, the second school is scheduled for Philadelphia February 9-11, and the third will operate February 23-25 at the University Of Notre Dame in Indiana. Registration fee is $125 to NARDA members for the 3-day school; non-members pay $185. NARDA is located at 318 West Randolph Street, Chicago, Illinois 60606.

ETA News

A newsletter from the North Carolina Electronic Technicians Association, Inc. tells of the formation of a new committee on Training And Education. Several of the local chapters have solid-state and CET training courses. There is a possibility of a one-day business-management school in cooperation with NARDA.

NATESA News

Two books are offered for sale by National Alliance of Television Electronic Service Associations (NATESA). "Television Service Contract Cookbook" gives answers about obtaining customers for prepaid service. "Practical Operations Manual For Independent Home-Electronics Service Business" was written by several successful servicers and gives suggestions for operating a profitable service business. Supplemental sheets for the loose-leaf book will be issued to keep it up to date. Either book can be purchased for $15 from NATESA. The COPE program continues to expand. This seems to be a cooperative program involving most of the NATESA members in obtaining answers to modern servicing problems. Also, NATESA members can obtain the Master Charge plan for 2%, which is said to be quite a saving. Other plans about insurance, eye glasses, and auto/truck purchases are designed to save members money. NATESA headquarters is at 5908 South Troy, Chicago, Illinois 60629.

NESDA News

NESDA (National Electronic Service Dealers Association) announced during the convention in Hawaii these goals for 1975: an increase of 30% in membership; and the installation of data-processing equipment at the headquarters in Indianapolis. Other actions taken at the convention appear to reflect the problems of inflation and rising costs. Dues were increased to $48 per year, the ISCET fee for the CET exams was raised to $20 from the previous $10, and a $5 fee was established for new ISCET initiations. NESDA delegates at Hawaii voted to push for complaint arbitration on a national basis to help resolve any customer-relations problems faced by the industry. NESDA continues to schedule Business Management Schools, and to search for solutions to the urgent problems of warranty. NESDA is located at 1715 Expo Lane, Indianapolis, Indiana 46224. □

productreport

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

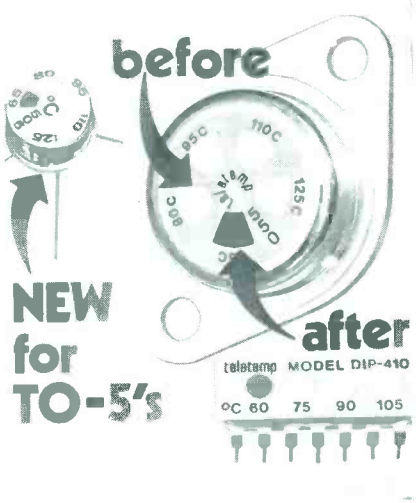
Electronic Projects Book

Thirteen easily-assembled electronic devices are featured in **Fascinating Electronic Projects**, No. FR-174, offered by **GC Electronics** for $1.25. Included in the book are schematics and instructions for building an emergency lamp flasher, metal locator, rechargeable lantern, psychedelic lights, hobby lie detector, and others. Most are battery-operated, feature solid-state design, and can be constructed for less than $10.00.

For More Details Circle (57) on Reply Card

Overheated Power Transistor Detector

An adhesive-backed temperature recorder capable of detecting overheated TO-5 power components has been introduced by **Telatemp**. Model 505 can be applied to the top of power transistors and other small component



packages. The unit contains five temperature increments, each calibrated at a specific value between +65°C and +125°C. These increments, or silver-colored windows, turn irreversibly black at their rated value with an accuracy of ±1 percent. Useful in analyzing circuit and component performance, the recorders detect overheating in prototype designs during troubleshooting and testing.

For More Details Circle (58) on Reply Card

Pocket Electronic Calculator

The EL-807 from **Sharp**, features the calculator-on-substrate (COS) system and liquid-crystal display with eight extra-large numerals. In the COS system, all circuitry is integrated on a single glass plate. According to the manufacturer, COS reduces power consumption and makes possible a reduction in weight, bulk, and size. The product weighs less than eight ounces with batteries included.

The liquid-crystal display features numerals that reportedly are three times larger than most mini calculators. The unit operates up to 50 hours on two penlight batteries, and costs $79.95.

For More Details Circle (59) on Reply Card

Tape-Player Parts Catalog

PTS Electronics offers a unique catalog, said to be the only one of its kind in the industry, that lists parts exclusively for tape players and recorders. An illustrated section helps identify the parts you need. Listings cover a full line of parts for almost all models and brands. Parts are stocked at PTS depots in Bloomington, Indiana; Springfield, Maine; and Longview, Texas.

The catalogs sell for $2.00 each.

For More Details Circle (60) on Reply Card

Marking, Engraving Instrument

Electro Stylus Model Mark IX includes seven interchangeable points for marking metals, plastic, glass, film, etc. Precision made for delicate engraving and strong enough for marking shop tools, the model is

reportedly quiet and lightweight. Electro Stylus with a set of five standard steel points is $19.95. Carbide point for metals is $2.95, and a diamond point for glass cutting, $7.95. An idea book and patterns are included.

For More Details Circle (61) on Reply Card

FM Digital Receiver

Four Nixie tubes read-out the frequency of the FM station tuned by the **Hervic Electronics** Model HR-150 digital stereo receiver. RMS power output before clipping is 100 watts per channel; both tuning and signal-strength meters are provided; and the variable controls are the sliding type. There are separate bass, mid-range, and treble tone controls. The dial has continuous tuning, and fast dialing is possible because the readout is corrected 60 times per second.

Price of the solid-state Hervic Model HR-150 is $849.95, and a walnut enclosure is available at $44.95.

For More Details Circle (62) on Reply Card

Motion-Sensor/Monitor

Motion in the picture from any video camera can be detected on the 9 inch screen of the SM-906 monitor introduced by **Javelin Electronics.** Six sensitized areas are furnished for detection, compared to one for many

other motion sensors. No suction cups, dangling wires, or "black boxes" are necessary, and the monitor is connected into a security system the same as a conventional monitor.

A beeping signal from a built-in speaker and a flashing panel lamp indicate an alarm. In addition, there's wiring for one normally-open and one normally-closed relay contact, and an AC voltage. These all operate when the sensor is triggered.

For More Details Circle (63) on Reply Card

Gator Grip Cord

Dyna-Mate II plugs and connectors with Gator Grip cord clamp from

General Electric are designed for greater safety and fast wiring. The Gator Grip cord clamp works like a drill chuck, tightening its hold on any size electric cord with a hand twist of the PVC/ABS housing. For safety, no metal parts are exposed.

The nylon grip automatically centers the cord and holds it; but reportedly does not damage the cord, which can be released quickly by hand.

For More Details Circle (64) on Reply Card

Noisy TV Tuner Cure

An inexpensive kit designed to help solve the problem of noisy VHF turret-type TV tuners is now offered by **General Electric.** The kit includes ten foam pads and a bottle of cleaning/lubricating jelly. To use, remove the tuner cover and affix the foam pad on the inside of the cover where the pad will lightly wipe all tuner contacts when they are revolved. Apply a light coating of jelly, and replace the tuner cover.

For More Details Circle (65) on Reply Card

Wirewound Resistor Kit

The BW-20 1-watt molded wirewound resistor kit from **TRW Electronics Supply** offers a broad range of resistance values for replacement parts.

The TRW resistor's 1-watt rating in ½-watt size means the technician can replace 1-watt units and save space; or insert the resistor in ½-watt space with the advantages of a double safety factor plus wirewound stability.

The kit includes 20 pieces, one each of 20 values from .27 ohm to 10 ohms, with 5% tolerance and in standard EIA 10% values.

For More Details Circle (66) on Reply Card

(Continued on page 50)

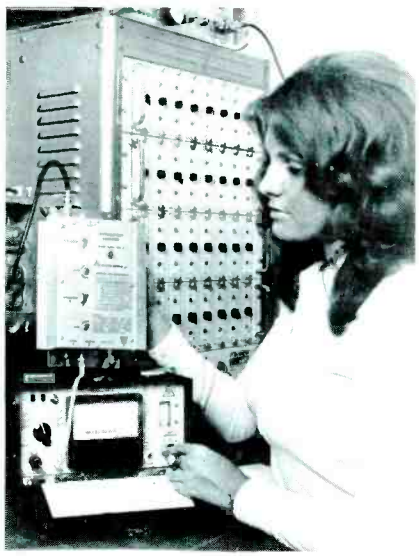
What would you like to read in ES? Send in your ideas.

antenna systems report

These features supplied by the manufacturers are listed at no-charge to them as a service to our readers. If you want factory bulletins, circle the corresponding number on the Reply Card and mail it to us.

MATV Distribution Amplifier

The **Delta-Benco-Cascade** Model DA-60 is a push-pull, high-output level, broadband (40-300 MHz) MATV amplifier. On a 12-channel system, the amplifier reportedly can be driven to an output of +60 dBmV without noticeable degradation of the picture quality.



Featuring a tilt control and a wide variation of gain, the DA-60 has a maximum gain of 45 dB, when the response is flat. Two switchable attenuators and a variable gain control can reduce the gain to 10 dB.

For More Details Circle (67) on Reply Card

UHF Mobile Antenna

Model ASP-830 from **The Antenna Specialists**, features more than 5 dB gain, and can handle 150 watts of RF power continuously, according to the manufacturer. The antenna maintains a VSWR of less than 1.5:1 over a wide bandwidth of at least 9 MHz, which is useful for repeater systems and broadband monitoring.

Precise phasing is said to be possible with a phasing coil assembly that is molded to a pair of 5/8-wavelength radiators.

For More Details Circle (68) on Reply Card

High Input/Output MATV Amplifier

ACA has added a high-input/high-output distribution amplifier to its MATV line. Model MSV 70 has a 3.0

volt output with an input capability of 126,000 mV. The bandwidth covers 54 to 300 MHz, which includes CATV mid-bands and super-bands. Featured is a low noise figure of 4.1 dB, and variable gain control that allows considerably more input than the 126,000 rated input capability.

The price of the MSV 70 is less than $125.00.

For More Details Circle (69) on Reply Card

Antenna Pre-amp

Model AA 37 antenna pre-amp from **ACA** has 300-ohm antenna input and 75-ohm output for use with MATV systems, or in areas with high noise

level. The model boosts the signal at the antenna where it is strongest and free from interference. Gain averages 16 dB. □

For More Details Circle (70) on Reply Card

audio systems report

These features supplied by the manufacturers are listed at no-charge to them as a service to our readers If you want factory bulletins, circle the corresponding number on the Reply Card and mail it to us

Linear-Suspension Speaker

Model 25A from **Mitsubishi International** is a 3-way "linear"-suspension speaker system and reportedly offers well-balanced tonal quality in all frequency ranges. The speaker has a 14-inch woofer that is mold-shaped rather than pressed for added absorption and lower cone resonance. The woofer has a ported-cone cap that supposedly helps bass response and eliminates non-linear distortion. Duraluminum diaphragms are used in the 2-inch dome-radiator mid-range and 1-inch dome-radiator tweeter.

Specifications of the system include a frequency response from 30 Hz to 20,000 Hz, 60 watts maximum power, impedance of 8 ohms, and crossover frequencies from 700 Hz to 7,000 Hz.

For More Details Circle (71) on Reply Card

Condenser Stereo Headphones

TEL-111 stereo headphones from **Telephonics** have patented permanently-polarized electret diaphragms, which eliminate the bias supply normally required by electrostatic reproducers. Total harmonic distortion is less than 0.2% at 115 dB SPL, and the frequency response is said to be 18 to 24,000 Hz. An adapter is supplied for matching to amplifiers of 4- to 16-ohms impedance, enabling the phones to handle audio power up to 65 watts. Included is a plug-in phone jack and a phone/speaker selector switch. The TEL-111 weighs only 17 ounces, has foam-filled ear cups for comfort and better acoustic seal, and the headband is adjustable. The unit sells for $87.50.

For More Details Circle (72) on Reply Card

Noise Reduction System

The **Burwen** DNF 1201 Dynamic Noise Filter doesn't require pre-encoding of the sound source, and so can be used with sound produced by microphones, phono discs, or tapes. The bandwidth changes constantly, depending on the program material in use. The system can work with any two-channel stereo setup or matrix-encoded source. Because the filter is intended for home use, it is designed for simple operation and can be connected easily to any hi-fi system through record jacks on any receiver or preamp. Reportedly the component is capable of obtaining noise reduction in excess of 14 dB. Retail price for the filter is $299.95.

For More Details Circle (73) on Reply Card

Cassette Player/Recorder

Channel Master has engineered a cassette recorder for visual aid and educational uses. Model 6323 has a digital counter with reset button that permits the student to log specified points and locate them instantly for playback. A push-button pause control allows the student to proceed at his own pace. The unit has a built-in condenser microphone and a full complement of input and output jacks for remote control microphone, private earphone, and auxiliary input. An automatic shutoff protects the unit against excessive wear. Except for slide-operated volume and tone controls, the recorder is completely push-button operated and is priced at $74.95.

For More Details Circle (74) on Reply Card

Telephone Accessories

Telco Products has introduced a line of telephone accessories, including the ATR-100, a recording device which electronically tapes phone calls, automatically and legally. The ATR-100 begins operating when the phone is lifted and stops when it is hung up. The solid-state model may be used with most standard portable tape recorders, and does not interfere with normal telephone operation. ATR-100 attaches by plugging into a tape recorder and phone line, and retails for $29.95.

For More Details Circle (75) on Reply Card

Stacking Bins

Bay Products steel stacking bins and boxes are available in a variety of sizes, types, and shapes for efficient storage. Styles include boxes with hopper ends for easy removal of contents; boxes with continuous rims, drop handles, and reinforced corners; types with rigid handles, hook holes on each end, skid legs, and riveted label holders. The boxes are manufactured of 16-gauge industrial steel.

For More Details Circle (76) on Reply Card

Directional Microphone

Model 589S Unidyne from **Shure** features a unidirectional pickup pattern, wind/breath filter, and internal shock mount. The unit has a cardioid pickup pattern that is symmetrical about the axis and uniform at all frequencies. Other features include dual impedance, smooth frequency response tailored to compensate for proximity effect, and a built-in on/off switch with lockplate. The model sells for $51.00.

For More Details Circle (77) on Reply Card

Electronic Telephone Amplifier

Radio Shack has introduced the new DuoFone® Electronic Telephone Amplifier/mike and speaker enclosures.

The DuoFone amplifies calls to room-filling volume so that everyone present can join the conversation. An ultra-sensitive mike picks up your voice from anywhere in the room, and the solid-state amplifier lets you hear callers the same way you listen to a radio.

Outgoing calls are made normally, using your telephone. When the called party answers, press the Talk-Bar and hang up your phone. Volume may be adjusted as desired.

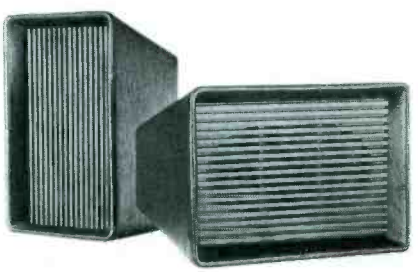
A "jack in a plug" makes installation easy with most phones. Insert this jack in your telephone wall outlet, then plug your phone into the piggyback jack. The DuoFone operates on three "D" cells.

The DuoFone is priced at $29.95. (Might be subject to local telephone company. tariffs.)

For More Details Circle (78) on Reply Card

"Mount Anywhere" Mini Stereo Speakers

Utah Electronics announces the SA53 stereo speaker kit that can be securely mounted at any angle without drilling holes, by using special hook-and-pile fasteners included with each kit. Two high-fidelity speakers use heavy ceramic magnets for smooth, wide-range response, and are pre-connected to color-coded wire for



fast hook-up. Each kit includes complete instructions.

For More Details Circle (79) on Reply Card

Trumpet Speakers

GC Electronics introduces two all-weather trumpet speakers for clear sound reproduction indoors or out-

doors. Available is a 5-inch horn type, No. S2-245, for paging or public address, and a 6-inch speaker, No. S2-246, for use as an extension speaker for radio or Hi-Fi. Both are 5-watt, 8-ohm speakers and come complete with adjustable mounting brackets.

For More Details Circle (80) on Reply Card

Bass Reflex Speaker System

A bass-reflex enclosure with a tuned port to increase the low-frequency response is featured in the Model 8 offered by the **Onkyo Sales Division** of Mitsubishi. The system has a woofer with an eight-inch "non-press" molded cone with ported cap, a heavy ferrite magnet, and a long-throw voice coil, which is matched to a two-inch cone tweeter speaker.

The two-way internal crossover network is constructed on a PC board, and is said to divide the

frequencies smoothly and without distortion.

Model 8 speaker system sells for $89.95.

For More Details Circle (82) on Reply Card

"Voice-Control" Safety System Speakers

Providing sound distribution for large areas, Models AP-15TU and APF-15TU from **Atlas Sound**, reportedly comply with the latest safety standards governing water and corrosion resistance and electrical connections. Within temperature limits ranging from 150°F to -30°F, the speakers are said to operate without loss of signal.

For More Details Circle (83) on Reply Card

Music-On-Hold Telephone System

Neotec Speak-Eze 600 is an automatic telephone answering and music-on-hold system for multiple line usage. Model 600 can answer your phone, take calls from multiple lines and deliver music to any caller placed on hold.

For More Details Circle (84) on Reply Card ☐

"Big Mag" Speakers

RCA has introduced its new "Big Mag" stereo speakers set with powerful sound reproduction from a large 10-ounce ceramic magnet.

"Big Mag" speakers, with foam-padded grills for safety, are especially suitable for use in cars, boats, recreational vehicles and trucks, or ceiling and wall installations around the home. Its frame measures just 6-1¼", making it suitable even in confined areas.

Technical specifications are as follows: 5-3/4" speaker, 6-1/4" frame, 6-1/2" grill; 8-ohms voice coil impedance at 80-11,000 Hz frequency response; 16 watts music maximum input.

Manufacturer's suggested list price is $19.95 per pair.

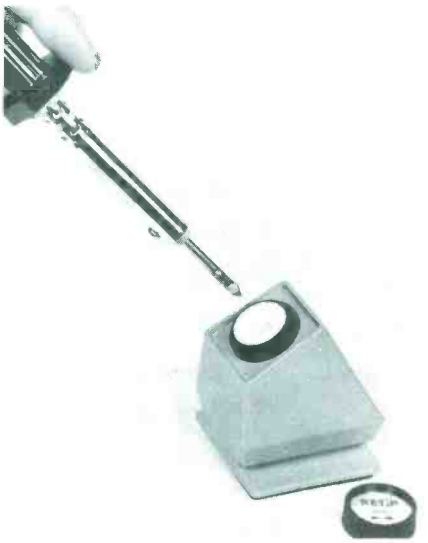
For More Details Circle (81) on Reply Card

productreport

(Continued from page 45)

Soldering Iron Tip-Cleaner

Instant cleaning of soldering iron tips is now possible with RE-TIP from **GC Electronics**. Reportedly, the product (#9482) instantly and uniformly cleans tips up to ¼-inch in diameter, prevents contaminated solder joints, and prolongs tip life.



For More Details Circle (85) on Reply Card

TV Service Table

RCA's service table is handy for moving TV chassis around the shop. The easy-to-assemble roll-around utility table offers nearly four square feet of work surface. The top shelf is constructed of 20-gauge sheet metal. The convertible bottom shelf can be installed with a flat surface; or inverted, making a lip to prevent small parts and tools from falling.

For More Details Circle (86) on Reply Card

For More Details Circle (23) on Reply Card

For More Details Circle (24) on Reply Card

Multi-Purpose Cutting Tool

Three interchangeable blades are featured in the multi-purpose cutting tool from **General Electric**. The tool can cut light plywood, laminates, wire screening, aluminum, asbestos, galvanized metals, plastics and others.

For More Details Circle (87) on Reply Card

Tuner Foam Cleaner

PTS Electronics has developed PTS #108 Green Giant Tuner Foam for continuous cleaning, polishing and lubricating of tuner contacts. Safe for all plastics, the cleaner reportedly will not cause drift or detuning when sprayed on contacts only. ☐

For More Details Circle (88) on Reply Card

(Continued from page 38)

Solution to:

OUR CURRENT PUZZLER:

1. corrosion	13. schematic
2. earphones	14. turntable
3. alignment	15. prototype
4. alligator	16. converter
5. generator	17. induction
6. frequency	18. modulator
7. kilocycle	19. diaphragm
8. amplifier	20. polyphase
9. decibel	21. Dellinger
10. welding	22. cabinet
11. cartridge	23. transonic
12. electronics	24. sending
	25. width

Start with 100 points and deduct 4 points for any part you may not have answered correctly.

Your rating:

60 - 64 Circuit incomplete.
68 - 72 Encountered high resistance.
76 - 84 Current flowing.
88 - 96 Excellent.
100 **PERFECT!** You're a real live wire! ☐

letters to the editor

Dear Editor:

For years, many television manufacturers have envied RCA and Zenith because they outsold all others. Perhaps one of the main reasons for the large sales is that other companies didn't provide the same speed and convenience of obtaining repair parts. Any serviceman can go to the local Zenith or RCA distributor, obtain replacement parts, and repair the receiver the same day. With other makes, the delays for paperwork and shipping run from one to three weeks.

Now we have a new problem: modules. How many independent technicians can tie up so much money in inventory, not knowing how much he will be stuck for? Again, it's easy for technicians to drop by a local RCA or Zenith distributor and obtain the modules needed, without stocking dozens of them.

The theory that technicians should specialize on certain brands is a lot of bunk. With business the way it is, how many can do that?

I predict that any TV manufacturers of modular sets that do not provide local distributors are doomed to failure. The public already is annoyed at the higher repair prices of the new sets. But to wait weeks for a module to be shipped will cause further irritation. Also, having a kit of modules is no cure-all. I can sell one module in the morning and again need another of the same kind in the afternoon.

I hope this letter will be printed, because the problem is serious and concerns both technicians and manufacturers.

Sincerely,
Max Goodstein
Flushing, New York

"We've decided we want it in the den after all."

bookreview

Tape Recorders—How They Work (Third Edition, Number 20989)
Author: Charles G. Westcott, Richard F. Dubbe
Publisher: Howard W. Sams & Co., Inc. 4300 West 62nd Street, Indianapolis, Indiana 46268

Size: 240 pages
Price: $5.50 paperback
Beginning with a short history of magnetic recording, this book gives information concerning the motorboard-tape-transport mechanism, drive motors, volume indicators, bias oscillators, amplifiers, magnetic heads, recording tape, and the theory of magnetic recording. A chapter is also included on test equipment and testing procedures. Written in an easy-to-understand style, the text explains and illustrates the mechanical and electronic principles of modern tape recorders. Updated to include the latest in cassette and cartridge recorders as well as stereo and quadriphonic recording equipment, the text also includes photographs, charts and schematics.

Logical Color TV Troubleshooting—Including Quick-Reference Symptom Guide
(TAB book 690)
Author: Ben Gaddis
Publisher: TAB Books, Blue Ridge Summit, Pennsylvania 17214
Size: 240 pages, 151 illustrations
Price: $8.95 hardbound, $5.95 paperback
Repair know-how, TV theory and circuit troubleshooting are explained from a practical, common-sense point of view in this book. Beginning with a systems approach to color TV, Gaddis explains how information is conveyed between the receiving and transmitting subsystems, and gives a functional description of the color TV receiver and how to use it as a test instrument for troubleshooting. The need for such test instruments as dot-bar and sweep-marker generators, vectorscopes and oscilloscopes, CRT testers, color TV analyzers, flyback and capacitor checkers is discussed.
Once trouble has been isolated, the next step is finding the defective parts, which often requires a thorough knowledge of circuit theory. Coverage of circuit theory includes chapters on tuners and amplifiers, as well as resistance and voltage checks. □

readersexchange

(Continued from page 40)

Needed: *Schematic or operating manual for Melco Supreme battery-operated 6-volt radio manufactured by Amsco Products.*
Lowell E. Bateman
1958 Parrish Road
Kawkawlin, Michigan 48631

Needed: *Service data for Estey Organ Model 1307.*
J. M. Sullivan
1313 George Washington Way
Richland, Washington 99352

Needed: *Junk Symphonic Mini-TV Model TPS-5050 for parts.*
Michael J. Kittl
17084 Canterbury Circle
Holly, Michigan 48442

Needed: *Schematic for Philco radio Model 42-380, code 121.*
C. L. Orbegoso
730 Duke Street
Northumberland, Pennsylvania 17857

For Sale: *Rider's Radio Manuals Volumes 1 through 13, cloth bound. Best offer. Also, have some Philco tubes for older radios and early TV's.*
Harold E. Jones
P.O. Box 112
Ithaca, New York 14850

Needed: *Schematic for an Imperial Model Capri (Export chassis 664) AM/FM/Phono console. Looks like a Telefunken or Grundig, but can't match it.*
C.A. Joseph
Pax-Tronics
Route 5
Great Mills, Maryland 20634

Needed: *Manual and schematic for radio receiver, Model RCH, 1-CZC-46209, Navy Department, Bureau of Ships.*
D.J. Ferguson
Clintondale Community Schools
35100 Little Mack
Mount Clemens, Michigan 48043

Needed: *Power transformer for Eico Scope Model 470K.*
Sam Lasky
33-06 106 Street
Corona, New York 11368 □

catalogs literature

Circle appropriate number on Reader Service Card.

100. Littlefuse—the line of "Littelites" miniature lampholders is featured in a color catalog including detailed drawings complete with mounting dimensions, information tables, and a cross reference to military part numbers. An easy-to-use ordering table lists available options, special features, housing finishes, resistors, lens-cap styles, and colors.

101. Altec—a 24-page color-illustrated brochure features the Altec line of hi-fi loudspeaker systems, including raw-frame speakers and utility systems.

102. Pageant/M. A. Miller Industries—offers a 1974 catalog on Pageant-brand replacement needles. Illustrations and descriptions of more than 800 styles of needles in both sapphire and diamond types are included. The catalog makes it possible to locate a particular needle style by knowing either the cartridge number, phonograph model number, or the needle number of another manufacturer.

103. Triplett—a 16-page catalog features Triplett's line of test equipment from multi-purpose VOM's, through laboratory and special features-testers, to G/P portables, temperature testers and accessories. The catalog, 60-T, contains a selection guide chart designed to help select a tester for specific requirements.

104. Mountain West Alarm Supply Company—has announced an alarm equipment catalog, A-75. The 96-page catalog describes over 450 intrusion-and fire-alarm products. Equipment offered ranges from simple kits with instructions, to the latest ultrasonic, radar, and infrared intrusion detectors.

105. RCA Electronic Components—has released a revised product guide describing picture tubes for the renewal market. The guide, PIX-300H, includes a directory which lists replacements for 975 industry types, plus over 85 foreign types. Basing diagrams, pictorial views illustrating safety feature constructions, and keys to tube sizes in the old, new, and foreign type designation systems are covered.

106. International Rectifier Corporation—makes available the 1974 edition of the semiconductor cross-reference and transistor data book. The 70-page brochure lists over 44,500 parts and corresponding replacements. The parts are indexed in straight alpha-numeric sequence for easy location. Also included are transistor specifications, showing polarity, case style, maximum current, typical bandwidth and gain, and price information.

107. Eico Electronic Instrument Company—has released a 6-page condensed catalog featuring its line of electronic test and measuring instruments. Over 100 electronic kits and factory-assembled instruments, including oscilloscopes, VTVM's, VOM's, generators, tube/transistor testers, and power supplies, are listed.

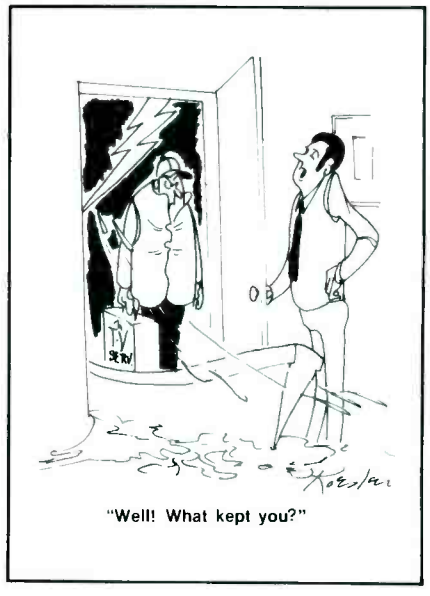
108. Fordham Radio Supply Company—has made available a 48-page illustrated, discount mail-order catalog, designed as a quick-reference ordering guide. Included are tools, service and repair kits, tubes, test equipment, phono cartridges and needles, speakers and microphones, antennas, components and other servicing aids. All products are shown with their discounted prices.

109. Jensen Tools and Alloys—offers a tool catalog with descriptions of over 2,500 items. The 112-page handbook includes sections covering tool kits, solder, technical data on tool selection, and tool "terms".

110. Bernard Franklin Company—announces a rack catalog which includes technical information for the bulk storage rack. The rack is intended for large items too big or bulky for standard shelving. Models include heights to 12 feet, depths to 4 feet, and beams to 10 feet.

111. Radio Shack—introduces a 1975 Electronics Catalog 250, which lists hundreds of specialized electronics items, parts and accessories, tools, tubes and transistors, wire and cable, home security products, intercoms, microphones, timers, batteries, and a library of books on electronics and related subjects. The 164-page catalog has 100 full-color pages and introduces many products.

112. Vaco—the Answer Book provides technical information and reproducible copy for distributors to prepare their own catalogs, or for conversion to micro-fiche for cost-and space-saving reference. All type is large and easy-to-read. □



"Well! What kept you?"

The MARKETPLACE

This classified section is available to electronic technicians and owners or managers of service shops who have for sale surplus supplies and equipment or who are seeking employment or recruiting employees.

Advertising Rates in the Classified Section are:

- 25 cents per word (minimum $3.00)
- "Blind" ads $2.00 additional
- All letters capitalized 35 cents per word

Each ad insertion must be accompanied by a check for the full cost of the ad.

Deadline for acceptance is 30 days prior to the date of the issue in which the ad is to be published.

This classified section is not open to the regular paid product advertising of manufacturers.

FOR SALE

INCREASE EARNINGS—YOU deserve more for your expert electronics know-how. Service Contract Cookbook, and, Practical Home Electronics Business Manual tell how. Either book, $15.00. Both ordered at same time, $25.00. Prepaid. NATESA SCOPE, 5908 S. Troy St., Chicago, Ill. 60629. 12-74-3t

TV & RADIO TUBES 36c EA!! Free color catalog. Cornell, 4221 University, San Diego, California 92105. 10-74-6t

NEW Canadian Magazine "Electronics Workshop". $5.00 yearly. Sample $1.00. Ethko, Box 741, Montreal "A" Canada. 10-74-12t

UNUSUAL SURPLUS AND PARTS Catalog. $1. ETCO Electronics Dept. E.S., Box 741, Montreal "A" H3C 2V2. 12-74-12t

PRECISION E200 and E400 signal and sweep generators, includes cables. Best offer. Also many OBSOLETE TUBES. $4.00 each shipped. List your needs. Elmwood TV, 136 Market Square, Newington, Conn. 06111. 1-75-2t

DYNCO-A-R-TRANSISTORS, REPAIR BOARDS & UNITS, SPEAKER SERVICE. SEND FOR PRICES AND DETAILS: BEAR ELECTRONICS, 177-E-HILLCREST ROAD, MT. VERNON, N.Y.10552. 1-75-3t

T.V. SERVICEMEN: 2.5A-1000V diodes; Hep-170, IR-170 4/$1.00. Fantastic prices; test equipment, parts. 10 cents for list. F. & M. Electronic Dist. Box 236, DEPT. K Maspeth, N.Y. 11378. 1-75-4t

LAKESIDE PICTURE TUBE REBUILDER - complete with many extras, e.g. neck glass, basis, pump oil, practice stems, spark coil. $1,500. FOB Oxon Hill, Md. 13207 Park Lane, Oxon Hill, Md. 20022. (301)292-2070 1-75-1t

FOR SALE (CONT'D)

BUILD - Color CRT and Circuit Quick check analizer. Pinpoint Color and CRT problems fast with easy and inexpensive to build tester. Instructions $1.00. Bills, 1063 N.E. 19th St., Ocala, Fla. 32670. 1-75-1t

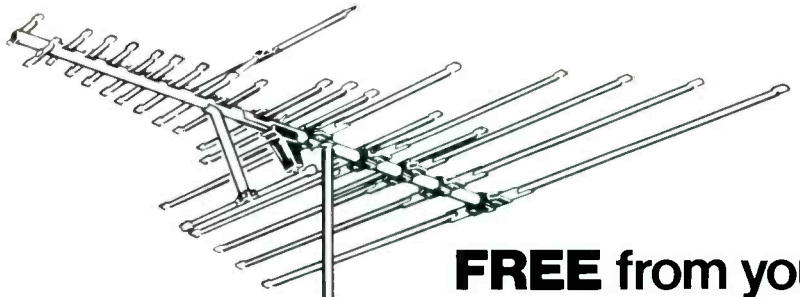
EDUCATION-INSTRUCTION

REPAIR TV TUNERS—High Earnings; Complete Course Details, 12 Repair Tricks, Many Plans, Two Lessons, all for $2. Refundable. Frank Bocek, Box 3236 Enterprise, Redding, Calif. 96001. 12-74-6t

HELP WANTED

ELECTRONIC TECHNICIAN WANTED Benefits are, retirement, loss of income, health and accident insurance, 5 day week, paid vacation. Send experience resume to Senatra TV, 113 4th Street West, Milan, Illinois 61264. 1-75-1t

advertisers' index



FREE from your Winegard distributor:

New "BIZ BOOMER UPPER KIT" gives you 15 ways to put more ring in your register... more profit in your picture in '75.

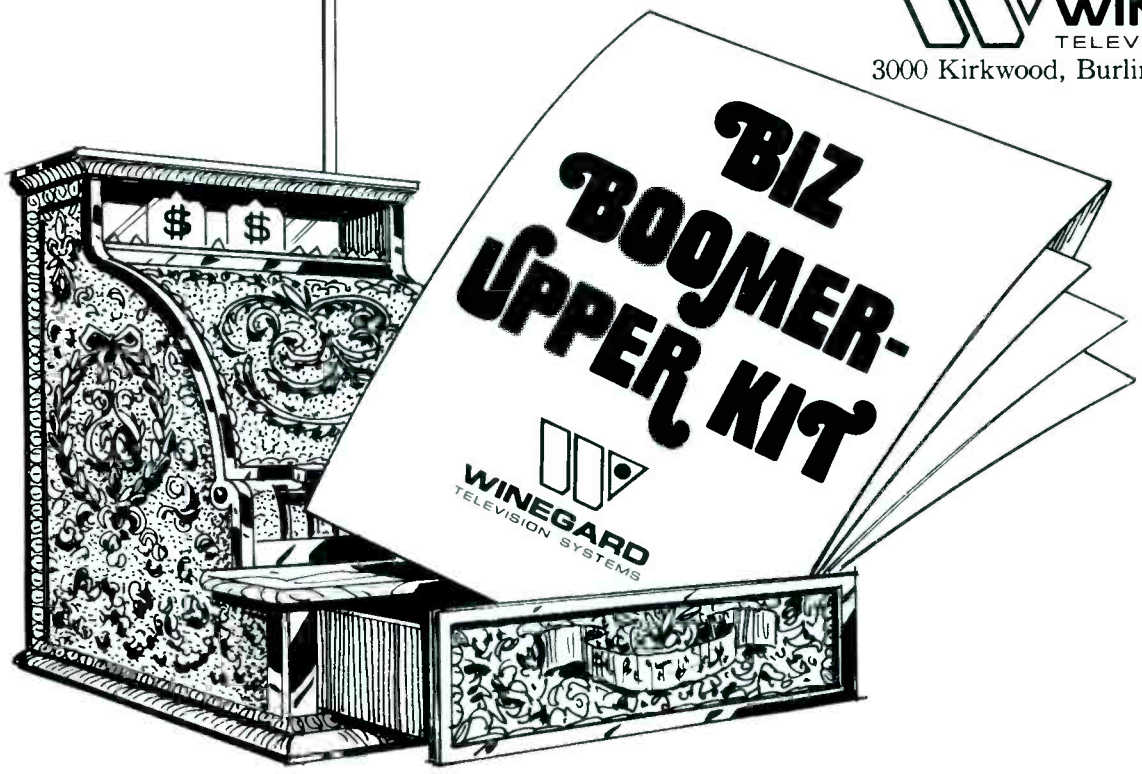
Antenna sales slipping? Profits sliding? We can give you some timely, tested, proved effective help. A special Biz Boomer-Upper Kit with 15 sales-getter ideas and the materials you need to put 'em in action.

The kit's yours at no cost from your Winegard distributor. Designed so that *together* you can launch a planned program to sell replacements for all those tired old weather-beaten or damaged antennas on homes in your area.

In today's competitive climate, this could be the extra promotion power you need to push profits up to—or ahead of last year's. Definitely, an offer you shouldn't refuse.

Not yet in the antenna business? There's plenty of potential going unsold right now. And your Winegard distributor can help you cash in. Why not contact him—today.

WINEGARD
TELEVISION SYSTEMS
3000 Kirkwood, Burlington, Iowa 52601



SUBBER™

TV Service Instruments for signal circuit analyzing.

When Castle introduced the TV Tuner SUBBER* analyzing instrument a couple of years ago it became the first practical way to easily test the VHF tuner, UHF tuner and i.f. amplifier system of any TV receiver. Being lightweight, self contained and battery powered the TV Tuner SUBBER* Mk. IV is the first such instrument which may be carried on service calls and used with ANY color or black and white TV receiver . . . at $45.95 for the battery powered Mk. IV, or $52.95 for the a.c. plus battery powered Mk. IV-B the instruments have been known to pay for themselves in TIMESAVING in the first two weeks of use!

Now we have introduced the Mk. V Master SUBBER*, an instrument which is absolutely unique . . . there is nothing else like it anywhere! It is completely portable and battery powered, practically foolproof in it's simplicity of operation when testing ALL the signal stages of any color or black and white TV receiver. The substitution signals available allow tests of the following stages: VHF tuner, UHF tuner, each video i.f. amplifier, video detectors, video amplifiers, 4.5 MHz sound i.f. amplifiers, sound limiter, sound detector and audio amplifier. It includes a signal level meter for testing the antenna signal. Inbuilt telescopic antenna makes the meter adaptable for true field strength measurements. Inbuilt monitor loudspeaker ensures foolproof substitution tests . . . every time!

At $169.95 the Master SUBBER* instrument is the best bargain in an analyzer that has ever been available. It will save oodles of time in the hands of a professional troubleshooter . . . and help advance the novice to professional status.

All SUBBER* instruments come complete with batteries, connecting cables and comprehensive instruction manual. The Master SUBBER* comes complete with wall plug-in transformer for 120vac 60Hz operation.

As an added bonus, all SUBBER* instruments enable use of the high speed agc system analyzing procedure invented by Castle . . . the first practical method for analyzing agc system defects without confusion.

*A registered trademark of Castle TV Tuner Service, Inc.

These instruments boast the extra features of all Castle products — advanced technology — modern styling — and they work!

If you need to save some analyzing time . . . you need a SUBBER* instrument!

See your stocking distributor . . . or write for more details and complete specifications.

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