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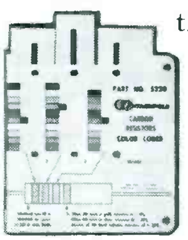

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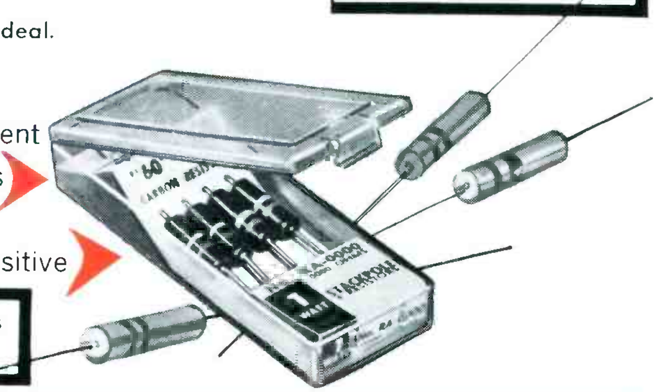

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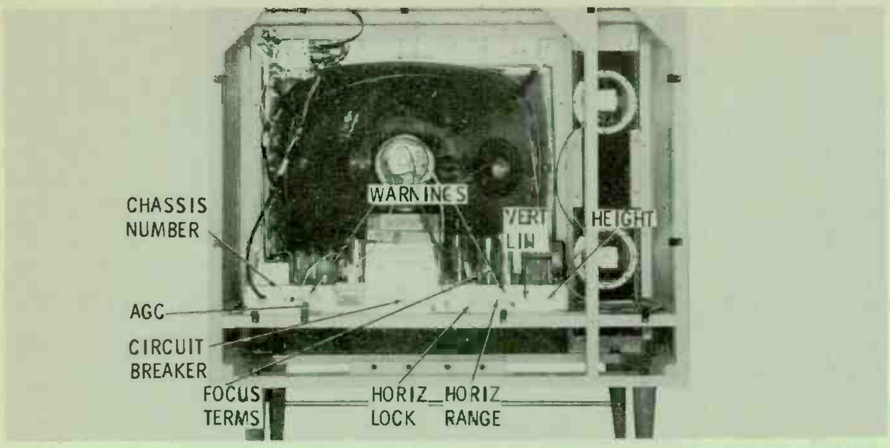
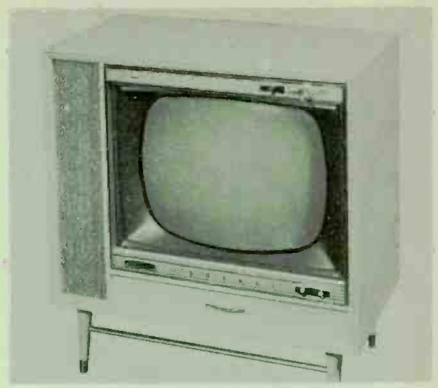
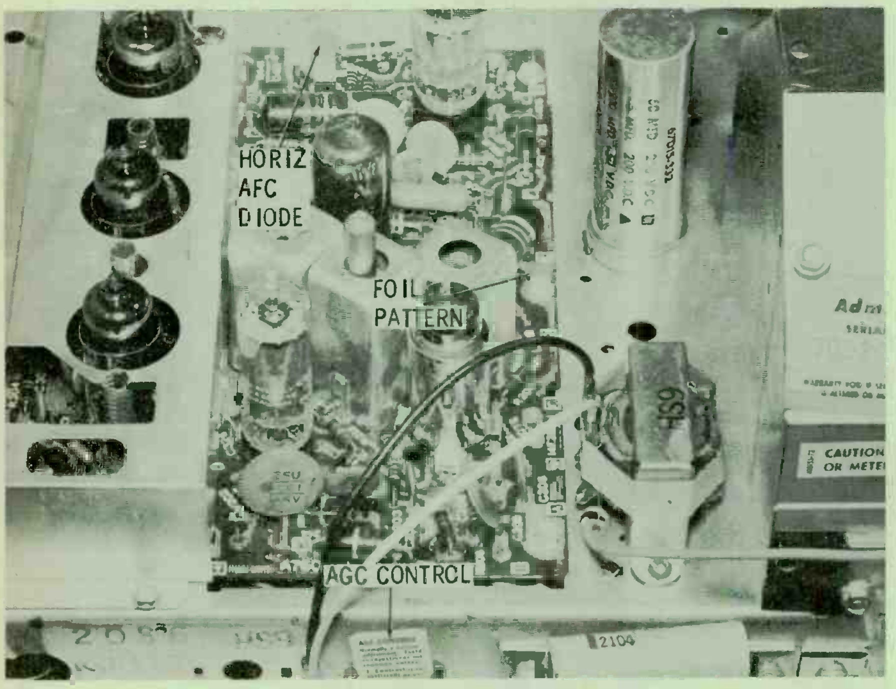
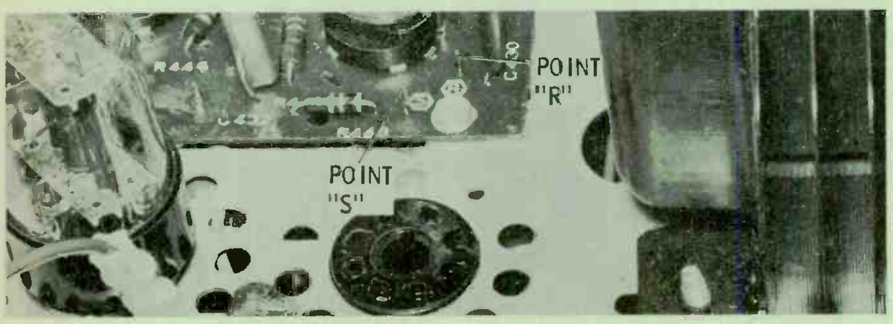
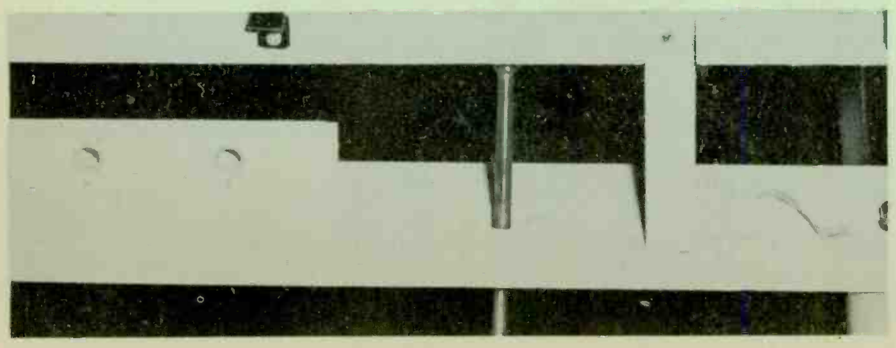










Admiral L22M23 Chassis 20S6

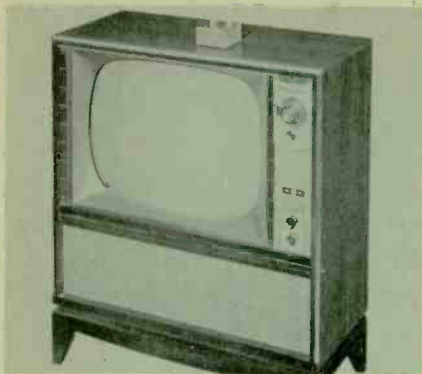
The *Super* ADMIRAL—that's what it says on the front of this cabinet—is a 16-tube VHF chassis with a 21", 90° picture tube. Front-operated controls are located above and below the right side of the screen—push-pull on/off switch, volume, channel selector, and fine tuning at the top; brightness, contrast, tone, and vertical-hold controls at the bottom. RF oscillator adjustments are accessible after the channel-selector and fine-tuning knobs are removed and the hole in the fine-tuning disc is lined up with the slug for the desired channel.

All setup controls are located on the rear apron of the chassis; two are covered with warning labels. The chassis is transformer-powered, and protected by a circuit breaker in series with the center lead of the transformer secondary. The filament circuit is protected by a 1½" length of #26 fuse wire. All except the low-voltage supply, damper, and high-voltage circuits are located on two printed boards.

The left-hand board contains the IF, AGC, and sync circuits, while the sweep stages are on the right. It's a little unusual to see the AFC circuit so far removed from the oscillator — so watch it. Foil patterns are shown on top of the board to make servicing easier. The proper adjustment of the AGC control (shown covered by notice) is as follows: Tune in the strongest station in the area. Set brightness at maximum and contrast for a normal picture. Make sure the hold controls are properly adjusted; then rotate the AGC control until either sound or picture begins to distort. Retard the setting 10° from this point and check operation on all channels.

We removed the 5U4 in the photo of the right-hand board so the two test points for horizontal circuit adjustment would be visible. To properly adjust the circuit, tune in a weak signal and set brightness and contrast for a normal picture. Make sure the AGC control is properly adjusted. Short point "R" to chassis, and connect a .22-mfd. 400-volt capacitor from point "S" to chassis (CAUTION, B+). Adjust the horizontal range control for a near in-sync condition. Remove the capacitor and adjust the horizontal lock to synchronize the picture. Remove the short from point "R" and readjust the horizontal lock if necessary.

In removing the chassis, a long-handled nut driver must be used because of the cross-brace across the rear of the cabinet.



Olympic TRW203M Chassis JRW

Here's Olympic's 1960 entry in the field of remotely tuned TV's. It's a 90°, 21" transformer-powered set containing a 15-tube VHF chassis and a 4-tube remote-control subchassis. Horizontal and vertical hold controls are actuated with thumbwheel knobs protruding from the bottom edge of the channel selector escutcheon. The remote transmitter (chassis JTR) uses a transistor (Olympic part no. TN-26912) as an RF oscillator; it produces one of two pretuned RF frequencies for remote control of off-on, volume, and channel selection.

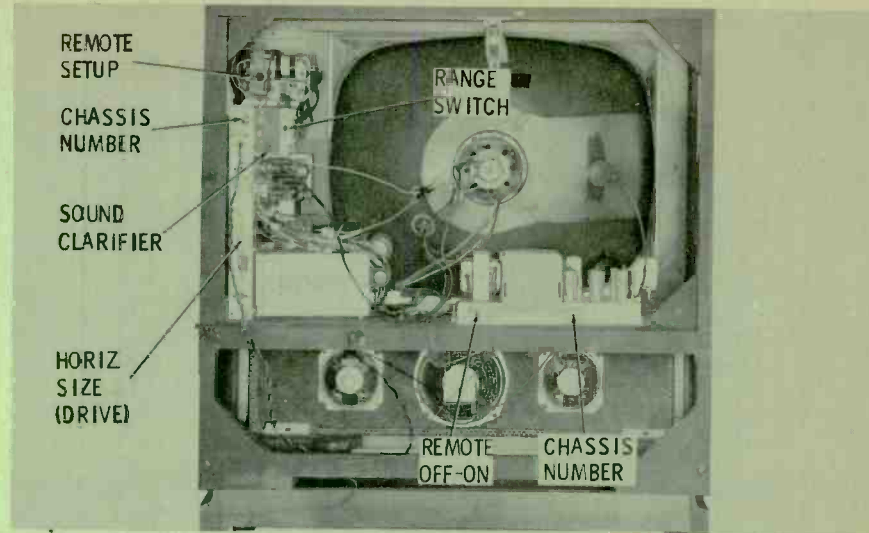
From the back, you can see that the conventionally-wired chassis mounts vertically on the left, while the remote receiver chassis mounts horizontally on the right. The triple speaker system is also shown. Programming adjustments on the power tuning unit are made by inserting a screwdriver into the cam slot for each channel. For unused channels, the cam is rotated one-half turn clockwise (until a stop is reached). A range switch, which controls attenuation in the antenna lead, provides for either local or distant reception. The adjustment labeled horizontal size is in reality a drive control in the grid circuit of the horizontal-output tube.

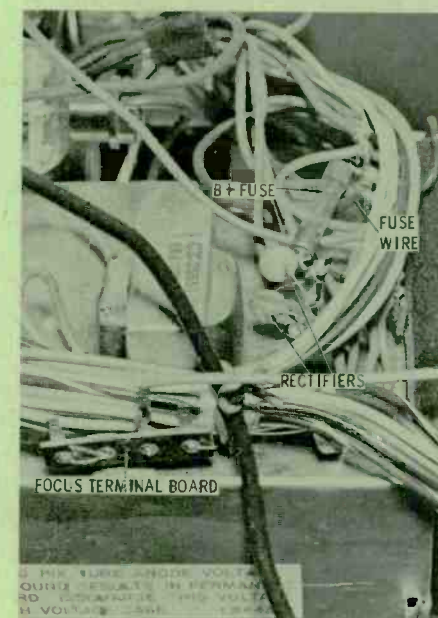
Located on the high voltage cage is a focus terminal strip (providing two different B+ voltages plus a ground connection); a 3-amp, pigtail-type fuse which protects the power supply; two silicon rectifiers; and a 3" length of #26 fuse wire which protects the filament circuit. The rectifiers, incidentally, are connected in a full-wave, voltage-doubler configuration.

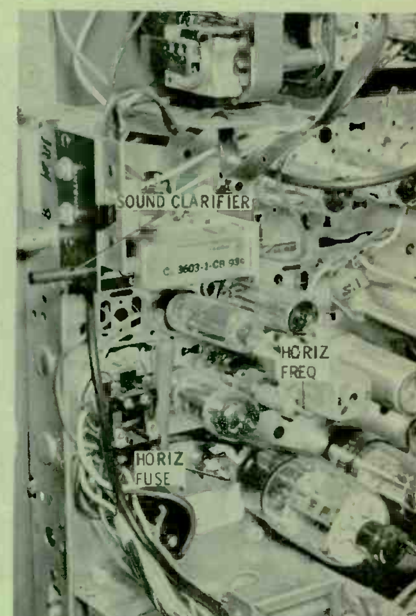
A ½-amp, type "C" fuse protects the horizontal circuit. Located just above this fuse is the horizontal frequency coil. The *sound clarifier* is an adjustment for the quadrature-grid coil of the audio detector.

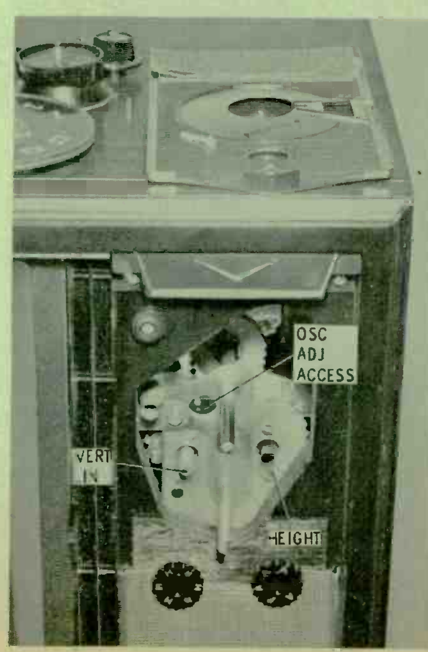
One Phillips-head screw is all that holds the channel-selector escutcheon in place after the tuner knobs have been removed. The channel indicator then slips off to provide access to the VHF oscillator, height, and vertical-linearity adjustments.

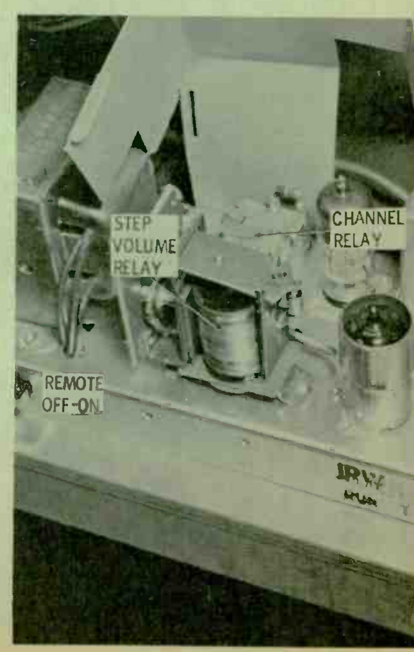
In the close-up of the remote receiver chassis, the raised "hood" lets you see the channel-selector relay, and the step relay which provides the control for off-on and three levels of volume. The filaments of the remote receiver are energized whenever the main and remote off-on switches are both in the "on" position.

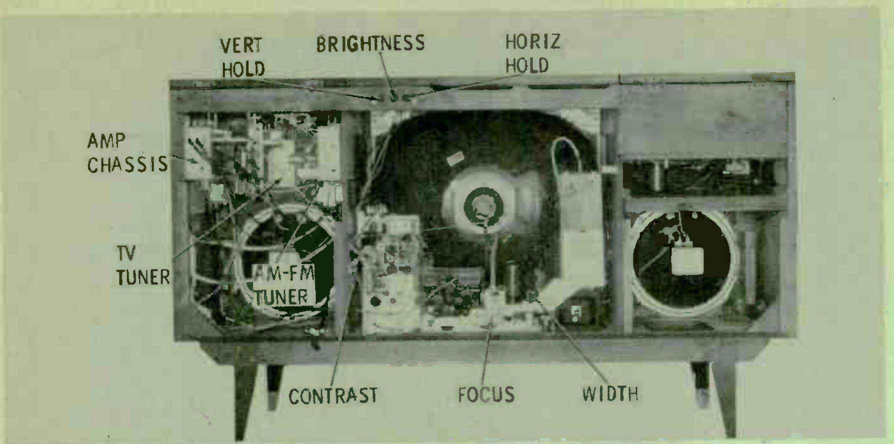


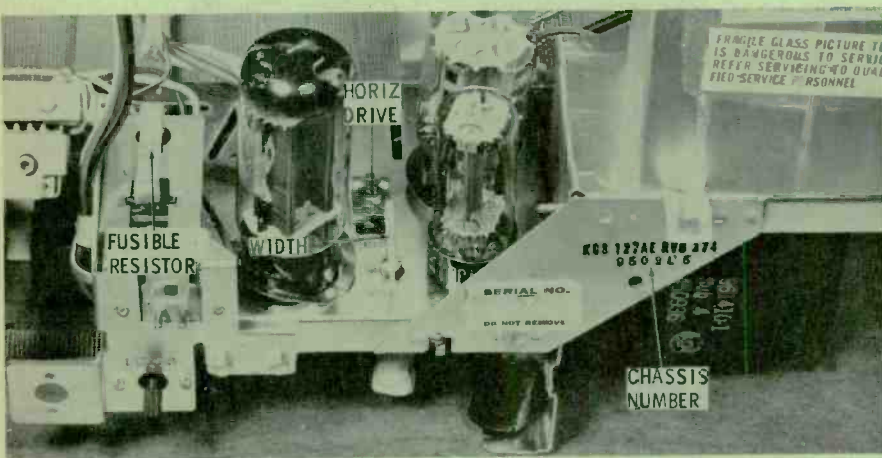


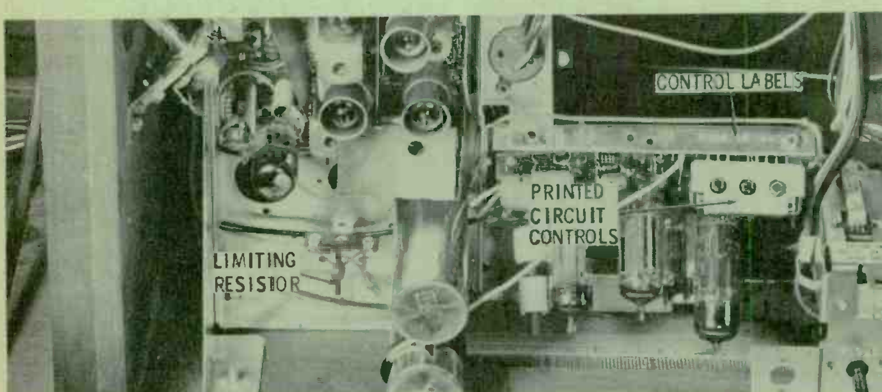


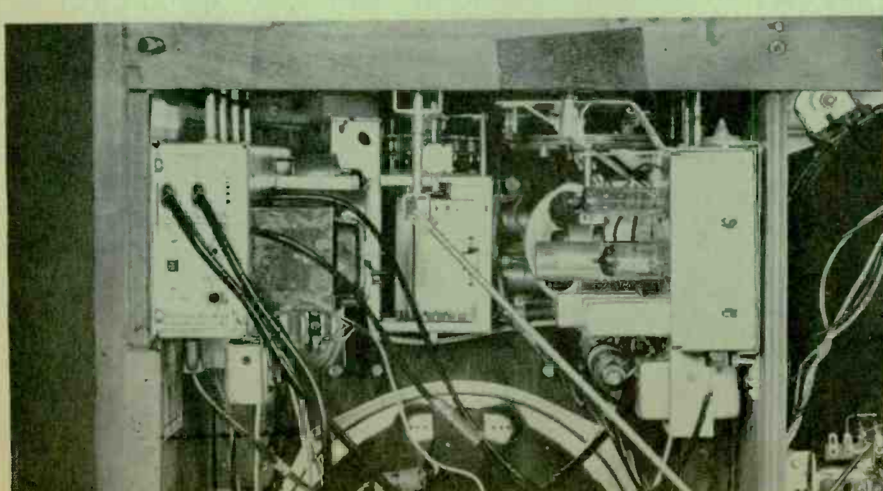












RCA Model 240-KV-775SU Chassis KCS127AE

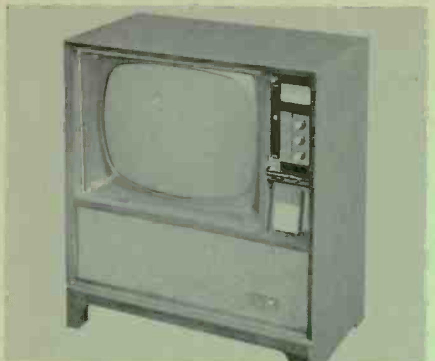
This wall of entertainment is one model in RCA's line of "has everything" receivers. The 24", 110° picture tube is centered between two speaker baffles which house the stereo speaker system and amplifier, AM-FM tuner, 4-speed stereo record changer, and TV tuner. Many modes of operation are available: AM, FM, AM-FM, TV, TV-FM, tape, and mono or stereo phono. Controls for these function, as well as some of the other operational controls, are under the right-hand lid. Exceptions are those for horizontal hold, brightness, and vertical hold, which are located on the back.

The rear-view photo shows the positions of the various units in the system. All chassis have their own transformer power supplies; however, the transformer for the AM-FM chassis (RC1192B) is for isolation only. Its tubes are connected in a series-string arrangement. IF, video and sound circuits are on the printed board at the left. The audio detector circuit is as far as the TV chassis goes in the sound section. The detected signal is fed to the two channels of the stereo amplifier, where it is amplified and used to drive all speakers. The printed board along the bottom of the TV chassis contains both deflection oscillators, as well as the AGC, sync, and vertical output stages. The conventionally-wired part of the chassis consists of the power supply, horizontal output, damper, and high voltage circuits.

The horizontal deflection circuits are protected by a fusible resistor (part #104295) rated at 300 ma; its DC resistance is about 9 ohms. Horizontal-drive and width adjustments are both located on the flat part of the chassis between the rectifier and output tubes; the focus control is just below the AC interlock.

A current-limiting resistor, connected in series with the AC line as a tube saving feature, has 120-ohms resistance when cold. As in other 1960 RCA sets, a multiple-control assembly is used; it contains three controls and six printed resistors for the vertical linearity, height, and AGC circuits.

There's more to the last picture than just the maze of wires required for such an elaborate system of electronic equipment. A closer look would disclose the use of the new *Guided Grid* TV tuner, quite an innovation for RCA.



Westinghouse Md. H-K4600 Chassis V-2378-6

This 21", 110° chassis, shown here in the *American Contemporary* model, features a *Remote Director* control system. The remote transmitter (chassis V-2387-1) uses a transistor oscillator (10027 or 2N402) to develop a modulated RF signal for controlling functions of on-off, volume, and channel selection in either direction. Power for the transmitter is supplied by a 6.5-volt mercury battery (Eveready E-165 or Mallory TR-165R).

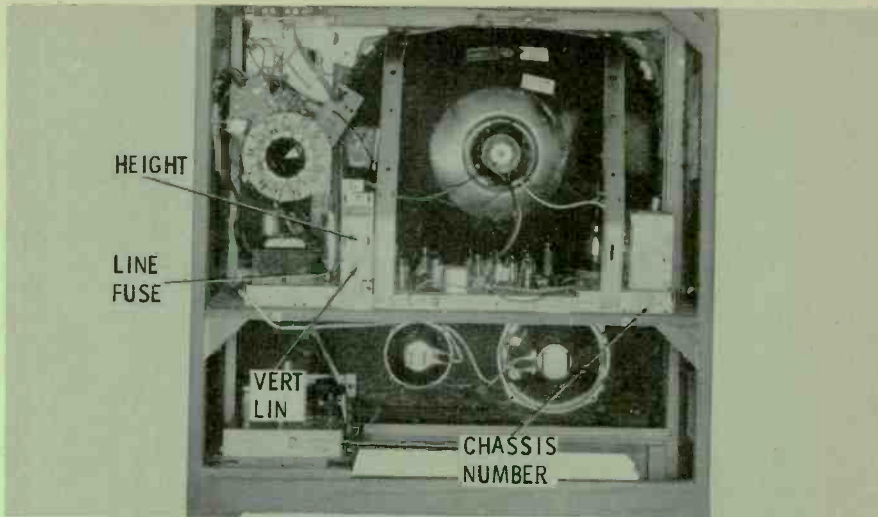
The TV chassis itself is an 18-tube, transformer-powered unit with a conveniently located 3.5-amp, slow-blow fuse connected in the AC line. The newest tube types you'll encounter are two 6FV8's, a 6EB8, and a 6ER5 or 6EA5 (depending on the tuner used). The major portion of the circuitry is contained on a single printed board nestled between a power-supply chassis on the left, and the horizontal-deflection chassis on the right. The remote receiver (Chassis V-2386-1) is housed in the speaker compartment.

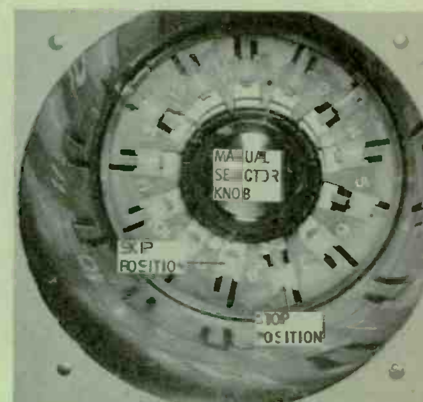
The control panel contains a push-pull switch for remote receiver power, two channel selector bars for power tuning, plus controls for off/on volume, brightness, contrast, vertical and horizontal hold, and the setup knob for *Memory Tuning* (fine tuning). The lower right side of the speaker compartment houses the remote-receiver microphone; also located in this area are indicator lamps which show when power is supplied to both the remote receiver and the main chassis.

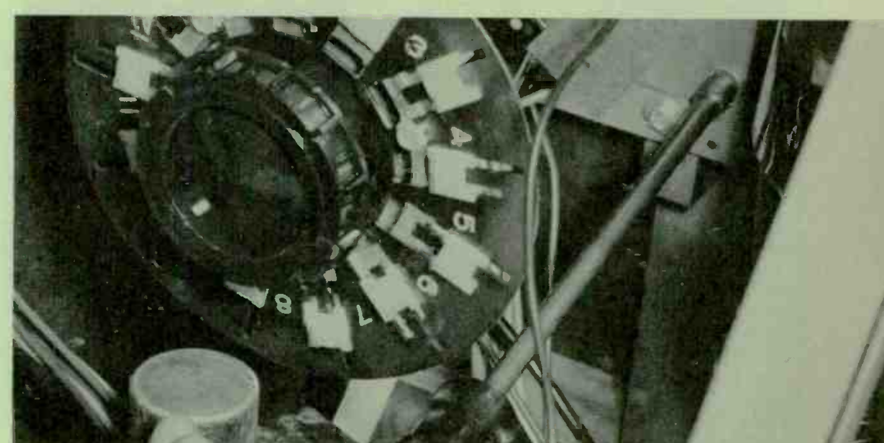
Power-tuning programming cams are accessible through a large tube in the rear cover. Each cam is located to the left of its respective channel number, and has two positions. The *in* position causes the channel to be skipped; the *out* position is used for active channels in the area.

The tuner, power-tuning mechanism, and control panel are held to the cabinet by five ¼" metal screws. A 5/16" nut driver is required to remove the two front chassis bolts and the two nuts holding the speaker leads, while a ⅜" driver is required for the two chassis bolts at the rear.

Upon removal of the chassis, you'll notice the approach this manufacturer has taken to make printed-board servicing easier. Termed the *See-Matic* board, it provides a schematic representation of the components, which simplifies circuit-tracing considerably. The protruding leads are also helpful in making test equipment connections.







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including Electronic Servicing

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ABOUT THE COVER

"Sailing, sailing . . ." or some such carefree theme will soon be in the minds of thousands of boat owners during the next few months. Mariners who venture beyond the sight of land depend on radio direction-finding equipment to help them determine exactly where they are. For a complete feature article on the subject, turn to page 44.

MALLORY NEWS

SPRING, 1960 | INDIANAPOLIS, INDIANA | FREE

HUBERT LINDSEY WINS 'GO PLACES' CONTEST

Special Report on Radio and TV Servicing in Mexico

C. A. Zinser

MEXICO, D. F.—Mexican radio and TV servicing is similar in most ways to that in the United States, but with some interesting variations. The first variation has to do with the method of new set distribution.

In the U. S., the three-step distribution system is the general rule (manufacturer to distributor to dealer to consumer). In Mexico, the two-step system is used (manufacturer to distributor to consumer). There is no intermediate dealer. But there is a further difference; the distributor is often a sort of manufacturer in his own right. He will often purchase "kits," assemble them, and sell them directly to the consumer. This type of activity is naturally confined to those distributors with rather substantial capital, but it is still a factor in the market.

As in the case of his American counterpart, the Mexican distributor is also a parts distributor. He sells electronic parts to service technicians. But, he almost always operates a service organization of his own. In general, this poses no particular problem, for the Mexican method of doing business is based on a definite personal relationship. Once the typical Mexican has established a business relationship, he maintains it on a lifetime basis.

The Mexican service technician faces most of the same technical

(Continued on page 2)

Lindseys Fly to Mexico City in January

STATESVILLE, N C.—Mr. and Mrs. Hubert Lindsey will fly to Mexico City Jan. 7. Mr. Lindsey's winning entry in the "Go Places With Mallory" contest resulted in the trip. The Lindseys will be joined by Mr. and Mrs. Joe Harris of Charlotte. Mr. Harris was responsible for Mr. Lindsey's entry in the contest and is thereby eligible for duplicate prize.

The two couples will fly to Dallas via Delta Airlines, and from there to Mexico City via American Airlines. They will stay at the Continental Hilton Hotel and plan to take several tours to historic sites in and around the Mexican capital. The couples will return on Jan. 11.

LATE FLASH

INDIANAPOLIS, IND.—J. E. Templeton, General Manager, P. R. Mallory & Co. Inc., Distributor Division, announced today that there would be a 1960 "Go Places with Mallory" contest. Mr. Templeton said, "The success of the 1959 contest proves that Service Technicians are interested in 'Going Places.' In fact, they go places three ways: by using quality Mallory products, getting a bargain on popular parts, and winning a free trip." Exact details of the 1960 contest will be announced at the NEDA Parts Show in Chicago, May 16-18, 1960.

TODAY'S DAFFYNITION

CUSTOMER—The guy who puts off going to the dentist for weeks but needs his television set fixed TODAY.

Winner Congratulated CHARLOTTE, N. C.—Hubert Lindsey is shown being presented with two tickets to Mexico City by J. E. Templeton, General Manager, Distributor Division of P. R. Mallory & Co. Inc. Joining the ceremony are: left to right, Grady Duckett, Mr. Templeton, Mr. Lindsey, Joe Harris and Wm. Fanning. (Photo by Haviland Smith.)

Hubert A. Lindsey, Service Manager, Curlee Tire & Appliance, Statesville, N. C., was named today as the winner of the 1959 "Go Places with Mallory" contest. The contest was sponsored by the Distributor Division, P. R. Mallory & Co. Inc., Indianapolis, Ind.

Mr. Lindsey won the contest by submitting the best statement on which line of Mallory replacement parts he liked the most. His purchase of a flight bag containing an assortment of parts from the complete Mallory line gave him his basis for comparison.

The grand prize of the contest is an all-expense week-end for two at the Continental Hilton Hotel in Mexico City. The trip will be via American Airlines and will feature tours to scenic and historic points in and around the Mexican capital.

Mr. Lindsey, 34, is a native of Statesville, attended high school there, is married, and has two children. He is a Marine Corps veteran of World War II.

Dixie Radio Salesman Named Co-Winner

CHARLOTTE, N. C.—Joe Harris, a salesman for Dixie Radio Supply, was named co-winner of the "Go Places With Mallory" Contest.

Mr. Harris sold Mr. Lindsey, the actual winner of the contest, his Mallory flight bag assortment of parts. Under the rules of the contest, Mr. Harris is to receive a duplicate grand prize, an all-expense week-end for two in Mexico City.

Mr. Harris, who now resides in Charlotte, was born in Mooresville, N. C. He is married and has two children. He is a Navy veteran of World War II.

(Continued from page 1)

problems as does his American counterpart, but has some to be found only in Mexico.

Mexico City power is 115 volts, 50 cycles, and because of serious fluctuations, voltage regulators are a "must" on TV sets. Power in the remainder of Mexico is 115 volts, 60 cycle, so his problems start with two power standards. But this is only the beginning, his most serious problem stems from parts availability.

Sources of parts in Mexico are literally world-wide. Some are made in Mexico (capacitors, coils, speakers, tubes, and transformers), but not in sufficient quantity to satisfy the demand. Other sources include the United States, Japan, and Europe. Exact replacement parts are often difficult to obtain or require long delays. Because of this, the Mexican service technician must be a "master substitutor." His customers are not going to wait 4 to 6 weeks for their TV sets to be repaired any more than would an American viewer.

The Mexican service technician operates his business mostly on a credit basis. His customers generally bring the sets to his shop and he usually delivers them when repairs are completed.

Mexican or American, service technicians face many of the same problems, but on one point there is no difference—all customers want the job done *today*—not "manana."

First Plane Trip for Mrs. Lindsey Mr. and Mrs. Joe Harris and Mr. and Mrs. Hubert Lindsey are shown with Delta Airline stewardess Norma Smith as they prepare to take off for a five day vacation in Mexico City. (Haviland Smith photo.)

Tours Feature of Trip

MEXICO CITY, D. F.—Interesting tours in and around Mexico City were arranged for the Lindseys and Harris' on their recent visit here.

The first day found our visitors touring the metropolitan area with a special stop at University City. Like thousands before them, they marvelled at the blend of ancient Aztec and ultra-modern architecture. The sight of the beautiful mosaic murals by Diego Rivera and Juan O'German on the buildings quickly brought cameras into action.

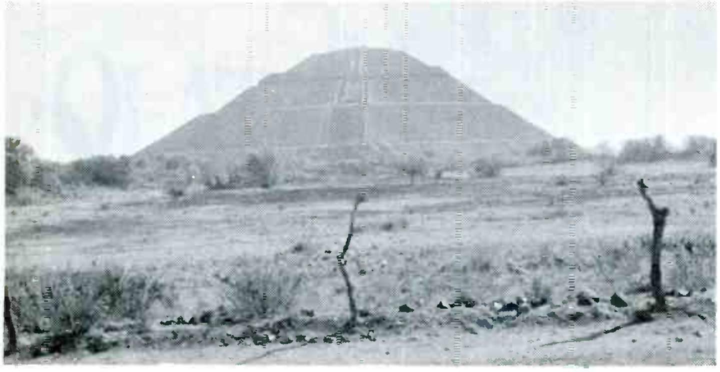
On the second day, the tour proceeded to the Pyramids of Teotihuacan and then on to the shrine of Guadalupe where, in 1531, the Virgin of Guadalupe appeared to the Indian Juan Diego.

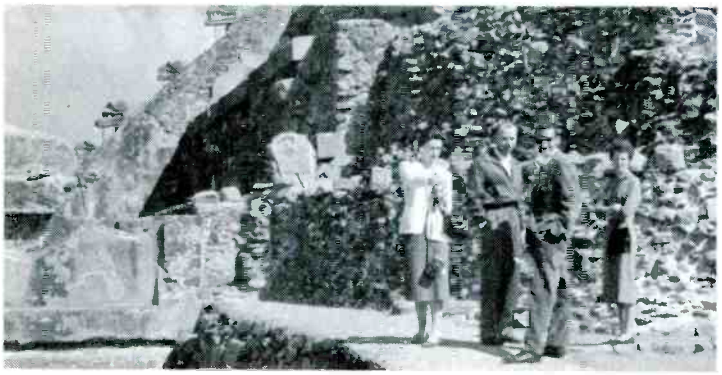
The gardens of Xochimilco were a feature of the third day's tour. Here, they were treated to the beautiful display of flowers at the floating gardens and visited the displays of pottery and flowers at the market. An afternoon at the bull fights came as a fitting climax to a whirlwind tour of the continent's oldest city.

Narciso Garcia, Mallory's Mexican representative, explains south-of-the-border TV servicing to Mssrs. Harris and Lindsey as Cecilio Martin, Manager, Electronica Geyen, S. A. looks on.

This photo was taken during a visit to one of Mexico City's largest distributors, El Centro Comercial, S. A. Left to right: Diego J. Garrido (General Manager), the Harris' and Lindseys, Narciso Garcia, and Romulo Garcia (President).

Picture Page



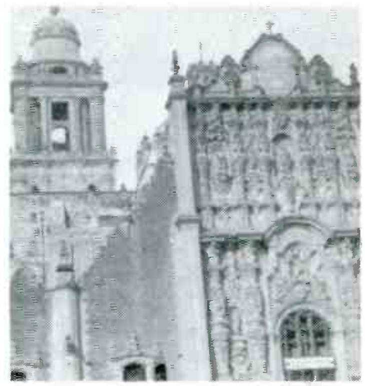


Teotihuacan

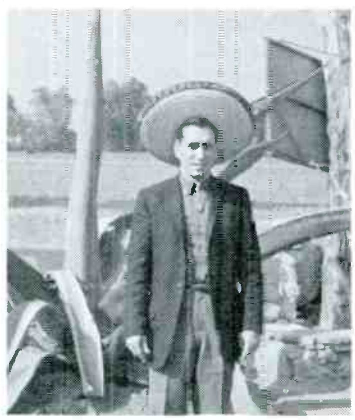
The Pyramids of Teotihuacan were constructed in 300 A.D. and are classic examples of ancient architecture. The pyramid of the Sun is larger at its base than any in Egypt. There is also a perfectly preserved temple and an archeological museum.

Xochimilco

The floating gardens had their origin in the tenth century when flowers and vegetables were planted on floating rafts to be used as tribute to the Aztecs. The rafts were later enlarged and poplar trees were planted with the roots growing through the bottom into the canal bed.



Study in Contrasts — Mexico City Architecture



Norte Americanos y los sombreros — Joe and Hubert in Mexican disguises — ¡Viva Villa!

Photos on this page by Joe Harris

. . . only flat on one side ▲

Oh! My achin' arches ▶

"Tired — But Happy!"

STATESVILLE, N. C.—A "tired — but happy" Mrs. Lindsey returned home after a five day vacation to Mexico City.

Mrs. Lindsey said, "I'm sure glad to be home so I can catch my breath and rest my feet. We had a wonderful time and especially enjoyed the pyramids and the floating gardens. There were so many things to see and do. At first, I was a little afraid to leave the children, but I'm glad we had a chance to make the trip. It was a wonderful experience."

"Ready to Go Again"

CHARLOTTE, N. C.—Mrs. Joe Harris is home again after an exciting five day stay in Mexico City. She and her husband took several tours in and around the Mexican capital.

Mrs. Harris described Mexico as a "never to be forgotten experience. We saw so many things and went so many places. The pyramids were tremendous and the floating gardens very beautiful. Another impressive sight was the Shrine of Guadalupe. We just had a wonderful time and I'm ready to go back again."

Electronic Brain Speeds Orders

INDIANAPOLIS, Indiana — A new wonder of the electronic age has been installed by the Distributor Division of P. R. Mallory & Co. Inc. It's a business machine called RAMAC. This machine is a whopper — 20 feet long, 18 feet wide, and 6 feet tall. Its lair is a specially air-conditioned room to keep it from developing heat exhaustion.

RAMAC is more than a mere machine, it's a whole accounting system. It performs, in seconds, functions which formerly took hours of tedious record searching. It magnetically records millions of tiny bits of stock control and order information and spits them out at an awesome rate in the form of printed invoices and shipping orders.

RAMAC makes it possible for Mallory to ship parts to its distributors quickly and accurately so that they may keep pace with the accelerating demands of modern electronic business.

Lindsey Opens New Service Shop

STATESVILLE, N. C. — Hubert Lindsey, winner of the 1959 "Go Places With Mallory" Contest, has announced the opening of the Forrest Heights T.V. Center at 825F North Center Street, Statesville. He will feature guaranteed service on all types of radio, TV, and hi-fi equipment.

Mr. Lindsey is a native of Statesville and has fifteen years experience in radio and TV repair. He received his technical education at the Southern Vocational Institute in Hickory, N. C., and was formerly Service Manager of Curlee Tire & Appliance.

The most modern electronic test equipment has been installed in the shop, and pick-up and delivery service is offered. (Photo by Tom Franklin.)

Mallory to Build New Plant

LEXINGTON, N. C.—P. R. Mallory & Co. Inc. has acquired a 17-acre tract here and will build a 60,000 sq. ft. plant.

The new plant is part of Mallory's program to expand its facilities in anticipation of 1960 and future sales gains. It will be occupied by the Mallory Battery Co., a division of P. R. Mallory & Co. Inc., which has headquarters in Cleveland and manufacturing facilities in Cleveland and North Tarrytown, N. Y.

The new plant will be used to manufacture advanced dry battery systems. These systems will be used to power hundreds of consumer, industrial, and military products.

Salesman at Work

Joe Harris, salesman for Dixie Radio, Charlotte, is explaining the contents of the Mallory flight bag to Bobby Jenkins, one of the many service technicians Joe calls on. Joe's territory includes southern North Carolina. (Photo by Tom Franklin.)

"Look Ma — No Wires"

The appliance cord may soon join the ranks of the dodo. A host of battery-powered personal appliances are on the market.

First it was the tiny transistor radio, then the cordless electric clock, and now the transistor TV. What next?

It would seem that the electric power utility's loss would be the battery dealer's gain.

Letters to the EDITOR

Dear Editor:

For only a few brief months, I have used Sams service literature, and I find it keynoted by quality. Please continue as you are, no matter what difficulties may arise. In quality lies the sound recovery of our economy, which is now sick from the lack of it.

With reference to the recent part- vs. full-timer debate in your columns, all of us "pots" should stop calling all of us "kettles" black so we can get down to the business of working on the basic problem—the cause rather than the effects. Do great numbers of Americans feel they must indulge in price-gouging, or work at two jobs (taking a chance on letting their children become delinquent), in order to eat? Or do they think they are deprived if they do not have everything possible?

Our economy needs to be refined gradually and rationally toward the conclusion that quality construction in all fields, honest selling, honest prices (even when high), and fair wages (ditto) are the hope of America. We need calm, considered, and considerate criticism, too!

A. McManus

Trenton, N. J.

Dear Editor:

In the debate between part-time and full-time servicemen, there are two points which, in my opinion, might well be discussed.

First, whose condition is it that needs to be improved—that of the pros, the part-timers, or the *public?* Are those who object to part-timers concerned with better service, reasonable prices, courtesy, etc., or are they thinking primarily of maintaining a select service group? This unfortunate attitude, more than anything else, antagonizes the set owner and heads him toward the part-timer. When he feels he's at the mercy of *one* serviceman, can you blame him for feeling trapped when they seem to gang up against him?

The second point I want to raise is this: Does the term "professional full-timer" include servicemen who spend most of their time and effort in selling new sets? Nearly every recognized full-timer in my area is a dealer. True, all advertise their service facilities and perform some service work; but, from what I am told by customers, they would rather sell a new receiver than try to repair an old one.

This was decisively illustrated to me just a few years ago on the very first job I did for a customer who was neither a close friend nor a member of my family. Three servicemen had previously looked at this set. One had installed a new tube; the other two had made no attempt whatsoever to repair it. All three had agreed that it should be traded in on a new one.

Still lacking in experience at that time, I tackled the job with misgivings. After all, if three real servicemen—! But what a boost that job gave my morale! I found the fabric belt that drives the fine-tuning control lying on the bottom of the cabinet. When this was repaired (a simple matter with rubber cement and shoemaker's thread), normal fine tuning was restored—and the picture was as clear as ever.

Similarly to Mr. C. H. Bond (January *Letters*), I have run into numerous sets that full-timers have diagnosed as needing new picture tubes or other extensive (and expensive) work; yet many of these were readily cured by minor parts replacements. By fixing these sets, I undoubtedly "do" someone out of numerous sales. On the other hand, the customer gets what he wants and is very willing to pay for the satisfaction he receives.

I have no personal grievance against any of these salesmen-servicemen. After all, they have aided me immeasurably in establishing my full-time business, and as long as they operate as they do, I will be a happy full-timer kept busy by their customers who prefer my methods. But they should stop and appraise their problems open-mindedly before blaming all of their ills on conscientious part-timers.

Robert W. McAloan

Lambertville, N. J.

Dear Editor:

This humorous sign, placed on the back of a service truck, is an excellent business-getter for Planet and Audio Television Co. of 569 Third Avenue, New York City.

David Deutsch

Brooklyn, N. Y.

Yes, and it probably saves a few dented fenders, too—especially on the truck!—Ed.

Dear Editor:

Please enter my subscription to PF Reporter for two years.

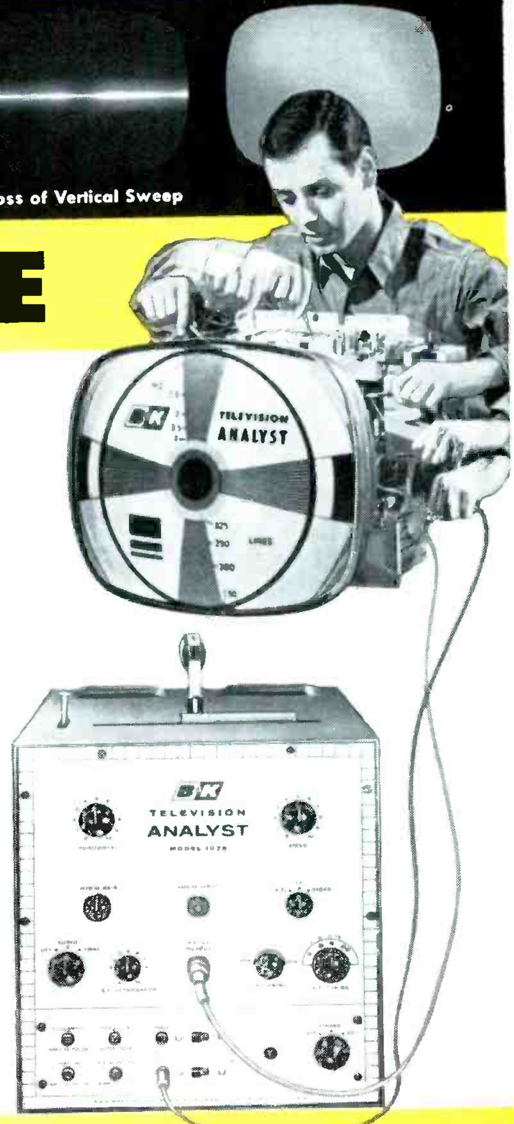
In the past 12 years I have subscribed to other magazines in the electronics field, and it wasn't until recently that I became thoroughly convinced of how you people really help the electronic service technician. Your articles are thorough, easy to read, and to the point; your various "tips" and aids such as *Video Speed Servicing* and *Previews of New Sets* are of incalculable help to the serviceman in the field. I certainly hope

Vertical Non-Linearity | Horizontal Non-Linearity | Smeared Picture | Loss of Vertical Sync | Heater-Cathode Leakage

PINPOINT TV TROUBLES

Video I.F. Overload | 60-Cycle Hum in Picture | Loss of Horizontal Sync | Loss of Vertical Sweep

IN ½ THE TIME



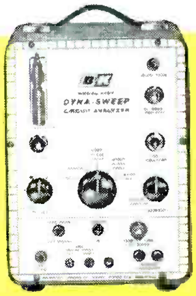
B&K TELEVISION ANALYST

By Easy Point-to-Point Signal Injection, You See the Trouble on the TV Screen and Correct it—Faster and More Profitably!

Most useful instrument in TV servicing today! Enables you to inject your own TV signal at any point and watch the resulting test pattern on the picture tube itself. Makes it quick and easy to isolate, pinpoint, and correct TV trouble in any stage throughout the video, audio, r.f., i.f., sync, and sweep sections of black & white and color television sets—including intermittents. Makes external scope or wave-form interpretation unnecessary. Enables any serviceman to cut servicing time in half, service more TV sets in less time, really satisfy more customers, and make more money. Color generator provides both rainbow pattern and color bars. Net $279.95

MODEL 1075 TELEVISION ANALYST

Makes Money for Thousands of Service Technicians



Solve Rough Sweep Output Problems with DYNA-SWEEP CIRCUIT ANALYZER

Saves many hours of service work. Provides vertical and horizontal sync and driving pulses that enable you more easily and quickly to check out every stage in the sync and sweep sections of a television receiver. Tracks down troubles in the horizontal and vertical output circuit including defective output transformer and yoke; checks for shorted turns, leakage, opens, short circuits, and continuity. Includes unique high-voltage indication. Eliminates trial and error replacements.

Model A107 Dyna-Sweep. Companion unit for use only with B&K Model 1075 Television Analyst for driving source. Net, **$54.95**

Model 1070 Dyna-Sweep. Same as Model A107 but has its own horizontal and vertical driving pulse, and is used independently of the Model 1075 Television Analyst, for separate testing. Net, **$74.95**

B&K

See Your B&K Distributor or Write for Bulletin ST25-R

B&K MANUFACTURING CO.
1801 W. BELLE PLAINE AVE • CHICAGO 13, ILL.

Canada: Atlas Radio Corp., 50 Wingold, Toronto 10, Ont.
Export: Empire Exporters, 277 Broadway, New York 7, U.S.A.

you continue as you are and improve as the years go on, since I expect to be a member of your family of subscribers for years to come.

ANTHONY C. ROMEO
West Hempstead, N. Y.

Dear Editor:

I am a faithful reader of your fine magazine and find it very helpful. Your article on printed-board servicing in the January issue just fixed a set for me—thanks!

DON DIXON
San Leandro, Calif.

Dear Editor:

I have been reading your magazine thoroughly for the past five years and think it is the best in the electronics field.

We have also signed up for the PEET program. I believe it is the best thing the Howard W. Sams Co. has done yet.

HERMAN A. ARROWOOD
Arrowood TV & Radio
Charlotte, N. C.

Dear Editor:

Kindly send two copies of your Annual Subject Reference Index for 1959, and two for 1958. One set is for the file we maintain in the shop, and I will use the other at home for reference during "bug and dog brushup."

Your periodical is, in my opinion, essential to the service industry, excellent in quality, and very current.

R. A. BACON
Dick's TV & Appliance Co.
Portageville, Mo.

Dear Editor:

We clip and file all your *Video Speed Servicing* items, and we have found so many other interesting and educational articles in the magazine that we have begun filing the contents page of each issue in the front of our VSS notebook. We want to pass this idea along to others who need help in locating valuable articles they remember seeing in PF REPORTER.

EDGAR L. LEES
Ed Lees Television
Youngstown, Ohio

Dear Editor:

Let me join the growing number of readers who have shown their appreciation for your fine technical publication by dropping a line to say, "Thank you." You and your competent staff are to be congratulated for the manner in which articles are presented and for your wide coverage of the electronics field.

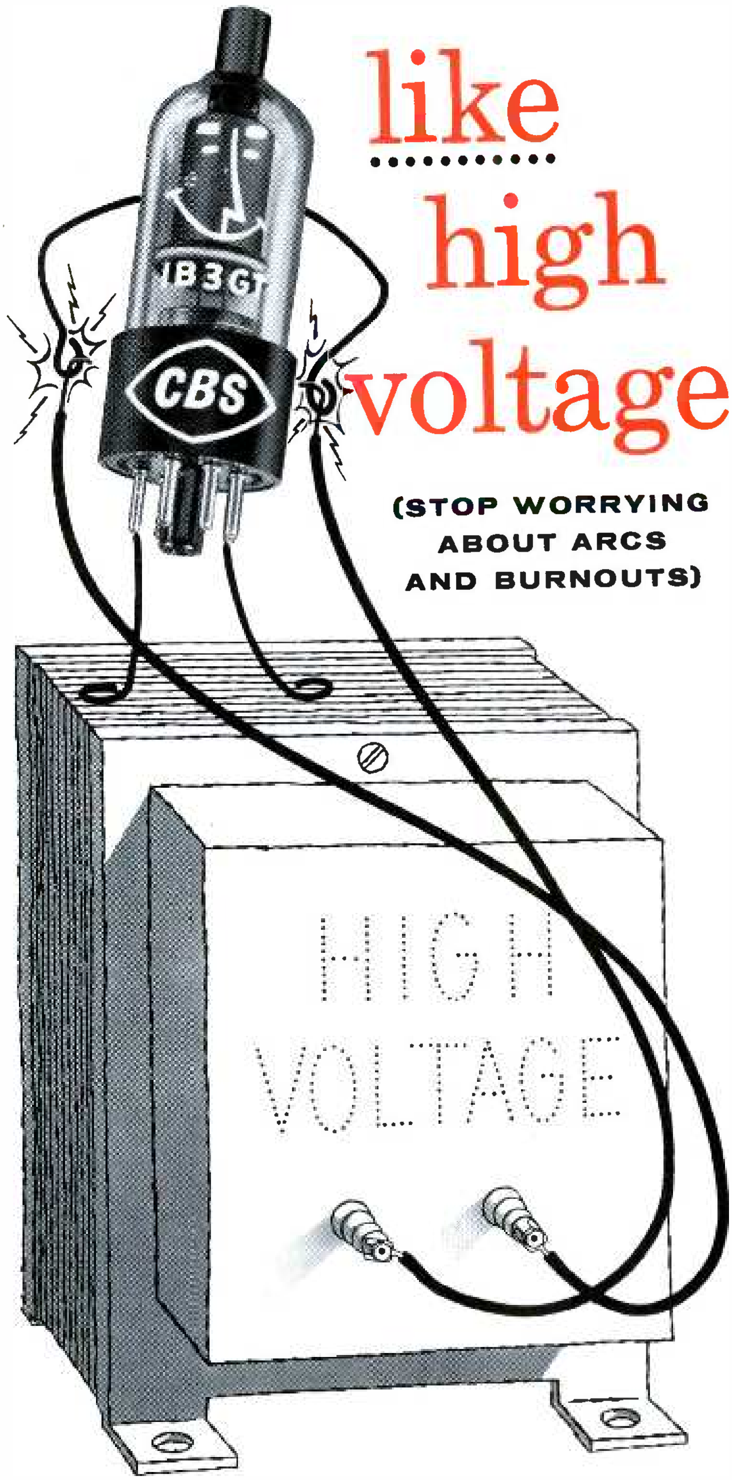
Sometime I would like to see an article on Zener diodes and their use as regulators, since these components seem to be used a great deal in commercial applications.

WILLIAM H. FOSTER
Tacoma, Wash.

Many thanks to you all for the bouquets, as well as your comments and suggestions. Specific subject ideas are always welcome; others are invited to let us know what they'd like to see in future issues.—Ed.

I like .... high voltage

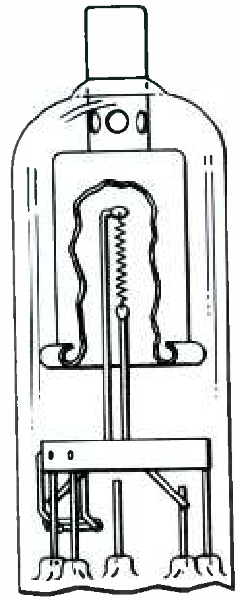
(STOP WORRYING ABOUT ARCS AND BURNOUTS)



"I'm clean as a whistle inside . . . no loose particles make me get grouchy and sputter. My filament coating stays put. My filament and anode keep a respectful and arcproof distance. You can depend upon me to take high voltage and like it."

Yes, the whole family of CBS high-voltage rectifiers offers you *total reliability* . . . proved in performance by leading TV and radio set manufacturers. Profit from the *total reliability* of CBS tubes. Use them yourself.

Ruggedness and dependability are built into every CBS high-voltage rectifier four ways: The Bantet stem gives solid four-point suspension. A simplified two-weld support cuts filament weld problems in half. A stretched filament coil (possible only with expensive cataphoretic coating) is sagproof and flakeproof. Positioning of anode with respect to filament is permanent.



TOTAL RELIABILITY
. . . proved in performance

CBS ELECTRONICS

Danvers, Massachusetts

A Division of Columbia Broadcasting System, Inc.

Receiving, industrial and picture tubes • transistors and diodes • audio components • and phonographs

If you're looking for a way to recapture tube sales lost to the corner drugstore, and have thought of offering your customers some form of tube-testing program, Seco's "Take - A - Tube-Tester - Home" plan may be just the answer. The program centers around their portable Model 78 *Grid Circuit and Tube Merit tester,* which is especially designed for loaning to your customers. When they return the unit, they also buy the tubes they need — but from you instead of the corner druggist!

Perma-Power gave away so many cigarette lighters in their last "Vu-Brite" promotion that they're making another offer this spring. By buying "VuBrite" picture tube brighteners a dozen at a time, you also get an unbreakable polystyrene flashlight at no extra cost.

If you're looking for more premium deals, you can still earn your choice of a portable tube and tool case, ¼ H.P. electric tool set, pocket-size volt-ohmmeter, or any one of four other worthwhile items, with purchases of Motorola "Golden M" premium-rated tubes.

For shipping defective tuners to the factory, Standard Coil distributors will stock specially-designed cartons which can be instantly recognized and routed to a special service department. These repair jobs will be handled on a 48-hour in-plant cycle. To help their customers choose replacement units, the company will maintain an up-to-date Tuner Replacement Guide, as well as list recommended replacements in PHOTOFACT Folders.

The BIG Picture

According to EIA, over 5.7 million TV receivers were sold during 1959, an increase of 600,000 units over 1958. The public also bought nearly 8.9 million radios, as well as 1.6 million monophonic and 2.7 million stereophonic phonograph units (packaged units only) — almost a million more packaged phono units than were even produced in 1958! So if you're concerned about your future in the radio-TV-electronic business, you can cross one worry off your list — someone is using all this equipment, and *someone* has to repair it!

Starting April 20th, Dave Garroway encourages "Today" show viewers to ask for G-E's "BLACK-DAYLITE" picture tube when they need a replacement. Newspaper mats, recordings, and other promotional material will be made available for use by independent service dealers during the nation-wide campaign.

B & K's new 65,000 square foot plant at 1801 W. Belle Plaine, Chicago, has enlarged facilities for laboratory research, engineering, and manufacturing, fortifying the firm's planned program of expansion through development of new products and acquisition of other companies.

GET THAT SYLVANIA SIGN UP TODAY!

ARTHUR GODFREY IS SELLING YOU!

Now sponsored by Sylvania Silver Screen 85 picture tubes, Arthur Godfrey is selling America on you—the independent TV service dealer!

He's telling millions—on the CBS Radio network—coast-to-coast—that you are the man to see for the finest TV service. Millions more are reading about you in *The Saturday Evening Post*. When Arthur Godfrey tells folks to "look for the Sylvania decal in the window of your local independent TV service dealer's shop," make sure you're with it.

See your Sylvania distributor for Sylvania Silver Screen 85 picture tubes and Sylvania quality receiving tubes. Get your display kit of window streamers and posters. Get that sign up today!

Electronic Tubes Division, Sylvania Electric Products Inc., 1740 Broadway, N. Y. 19, N. Y.

SYLVANIA
SILVER SCREEN 85
4 WAYS BETTER

**Sharper focus*
**Clearer picture*
**Greater contrast*
**More light output*

See your local paper for time and station

"IT'S ARTHUR GODFREY TIME"—brought to you by

SYLVANIA

Subsidiary of **GENERAL TELEPHONE & ELECTRONICS**

Only Simpson's 260® VOM

Converts into 7 Different Testers

NEW Simpson "Add-A-Tester" Adapters

Add-A-Tester Adapters for 260 VOM

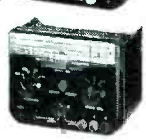
TRANSISTOR TESTER, Model 650... $25.95

Beta Ranges: 0-10, 0-50, 0-250, (F.S.)
Beta Accuracy: ±3%, with 260 ±5% nominal
Ico Range: 0-100 ua
Ico Accuracy: ±1%, with 260 ±3% (F.S.)

DC VTVM, Model 651............. $32.95

Voltage Ranges: 0-.5/1.0/2.5/5.0/10/25/50/100/250/500
Accuracy: ±1%, with 260 ±3% (F.S.)
Input Impedance: greater than 10 megs at all ranges

TEMPERATURE TESTER, Model 652.. $33.95



Temperature Range: −50°F to +250°F
Accuracy: with 260 ±2° (nominal)
Three lead positions provided
Sensing Element: thermistor

AC AMMETER, Model 653.......... $18.95

Ranges: 0-0.25/1/2.5/12.5/25 amps
Accuracy: ±2%, with 260 ±3% nominal
Frequency Range: 50 cycles to 3000 cycles

AUDIO WATTMETER, Model 654.... $18.95

Load Ranges: 4,8,16, 600 ohms
Wattage: Continuous 25 watts (8,600 ohms)
50 watts (4,16 ohms)
Intermittent 50 watts (8,600 ohms)
100 watts (4,16 ohms)
Accuracy: ±5%, with 260 ±10% nominal
Direct reading scale from 17 microwatts to 100 watts

MICROVOLT ATTENUATOR, Model 655........................ $18.95

Ranges: 2.5 microvolts to 250,000 microvolts continuously variable in decade steps
Frequency: DC to 20 KC
Accuracy: ± 1 db, with 260

BATTERY TESTER, Model 656....... $19.95

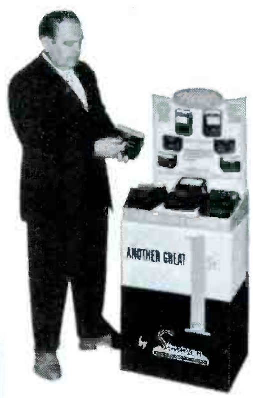
Checks all radio and hearing aid batteries up to 90 volts at the manufacturer's recommended load, or any external load.

Note: All Simpson 260® Adapters provide for normal usage without disconnecting the adapter.

World's Largest Manufacturer of Electronic Test Equipment

EXPANDS the Famous 260® As the Need Arises

Before you buy a VOM, consider your future needs in test equipment. Will you require a transistor tester . . . or a DC VTVM . . . possibly a temperature tester . . . or maybe an AC ammeter? If so, you can use Simpson's world-famous 260® VOM as the basis for these, as well as a whole "test bench" of high-quality instruments. All you do is plug in "Add-A-Tester" adapters. As each new test need arises, you buy only an adapter; you save the cost of duplicate meters and circuitry necessary for single-purpose testers. Currently available are the seven adapters shown at left. Additional Add-A-Tester adapters will be announced in future months.



See these adapters on display now showing at better distributors across the Nation.

Simpson

SIMPSON ELECTRIC COMPANY

5209 West Kinzie Street, Chicago 44, Illinois
Phone: EStebrook 9-1121

In Canada: Bach-Simpson Ltd., London, Ont.

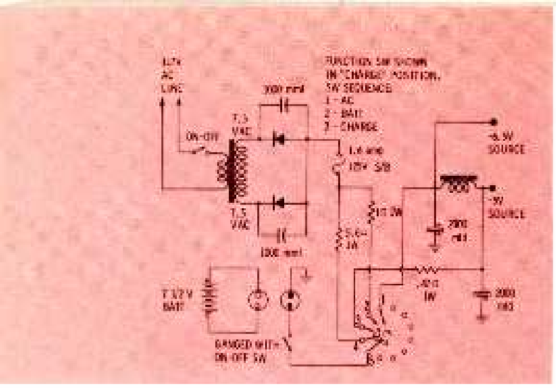


Fig. 1. In Philco 10AT10 TV set, battery is recharged from rectifier.

News about rechargeable batteries for portable TV sets, and helpful hints for testing and stocking radio batteries—Thomas A. Lesh

BATTERIES TODAY

With portable radios reaching new heights of popularity, and transistorized portable TV sets also beginning to appear on the market, the serviceman needs to know more about batteries than ever before. Testing and stocking conventional "dry cells" is an increasingly important part of his business, and he will also be expected to service equipment powered by other, less familiar types of batteries.

Rechargeable Battery Packs

Transistorized TV sets require considerably more power than radios because of the greater number of transistors and the added load imposed by the picture tube. If ordinary radio batteries of any reasonable size were used as a power source, they would be exhausted and ready for replacement after only about a half-dozen hours of operation. The most practical way of overcoming this obvious disadvantage is to use *rechargeable* batteries.

The Philco Chassis 10AT10 transistorized portable TV set, introduced last fall, uses a relatively low-cost Everready alkaline battery. This unit's individual cells, consisting of manganese dioxide and zinc electrodes with a potassium hydroxide electrolyte, are hermetically sealed; thus, the battery can be operated in any position without risk of leakage. Five cells are connected in series to obtain a total potential of 7.5 volts.

Since the battery has a rated capacity of 2 ampere-hours, and the current requirement of the TV receiver approaches 500 ma for battery operation, both the set and battery manufacturers recommend a maximum of four hours' playing time per charge cycle. This limitation is extremely important to remember, because an excessively heavy discharge results in a chemical reaction which permanently destroys the battery's rechargeability. Even moderately exceeding the unit's rated current capacity will materially shorten its life.

After a normal four-hour cycle of operation, the charge is replenished by flipping the function switch to the CHARGE position and plugging the receiver into the AC line. As Fig. 1 indicates, the battery is thereby connected across the output terminals of a full-wave silicon-rectifier circuit—the same one that supplies DC power to the receiver for "off-the-line" operation. A 5.6-ohm, 1-watt resistor limits the charging current to a safe level. Since the alkaline battery must be charged much more slowly than it is discharged, the circuit of Fig. 1 must be left in position for 20 hours in order to restore a full charge. Moderate overcharging will not damage the battery, as long as current is not applied at a higher-than-normal rate. One exception to this statement is a new battery, which must first be discharged to some extent before recharging is attempted. A brand-new unit in shelf storage will hold its initial charge as long as a conventional dry battery; therefore, it is neither necessary nor desirable to "trickle-charge" these alkaline units as you would a lead-acid battery.

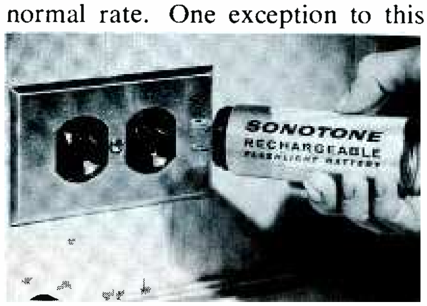
Nickel-Cadmium Type

Several experimental models of transistorized TV sets have included nickel-cadmium batteries; this type of power source is expected to appear in some future production models. The nickel-cadmium formula for batteries is not new—but its application to commercial units, suitably sized and priced for use in the radio-TV field, is a very recent development. Like the alkaline rechargeable battery, the latest-type nickel-cadmium units are hermetically sealed to prevent evaporation and leakage of the electrolyte.

Since small voltaic cells of any type have a limited current capacity, nickel-cadmium batteries do not provide significantly more playing time per charge cycle than alkaline units. Their chief advantage is in their ability to survive an almost unlimited number of recharging cycles. With proper care, they can conceivably last as long as the equipment in which they are used.

• *Please turn to page 81*

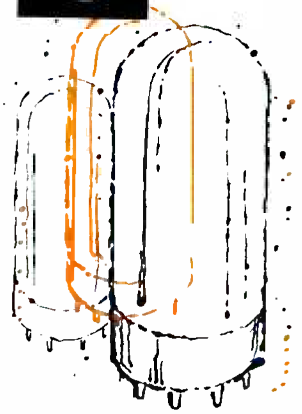
9-volt rechargeable battery marketed by B&K Mfg. for transistor portables.



Sonotone's nickel-cadmium rechargeable unit replaces two "D" size standard cells.

Burgess rechargeable batteries are made up of 1.25-volt nickel-cadmium cells.

QUICKER SERVICING



by Calvin C. Young, Jr.

What you should know about TUBE CHANGING

Professional-grade TV service work practically always involves something more than just tube changing. Few, if any, of the tubes in a television receiver can be replaced without producing some effect on the operation of one or more service controls; so, if you aim to restore the receiver to peak performance, you must give some thought to checking these adjustments. Sometimes, it's even advisable to make further operational checks beyond resetting service controls, as extra insurance against callbacks.

Fig. 1 sums up a number of basic facts about the service adjustments typically found in TV receivers. This information is a key to understanding how tube changing is likely to affect the various service controls.

Tube-by-Tube Analysis

Low-Voltage Rectifier

After a B+ circuit has been repaired, circuit adjustments are definitely necessary even if no service controls are located directly in the low-voltage power-supply section. Actually, there aren't many controls in the whole set that *won't* require readjustment after a feeble rectifier circuit has been brought back to normal.

The vertical and horizontal output amplifiers operate less efficiently at low supply voltages than at higher voltages, and if the various controls in these circuits were adjusted before the B+ circuit was restored to full output, the rise in supply voltage would make the picture oversized both horizontally and vertically. Therefore, the vertical size and linearity controls should be readjusted for an undistorted raster which "overscans" the screen by not more than 5%. This keeps most of the picture in sight, while still leaving a small margin of reserve sweep to compensate for tube aging.

Horizontal drive, width, and linearity, if adjustable, should also undergo a touch-up. For best results in checking linearity, use a pattern generator or a transmitted test pattern. It would also be wise to check the operating voltages of the horizontal output tube for any discrepancies; a tube-socket adapter comes in handy here.

Unless the set employs an automatically - focused picture tube, checking the focus adjustment wouldn't be a bad idea. In sets with permanent-magnet focusing assemblies, try changing the physical position of the focus unit. Also check the voltages at the various elements of the CRT, since these will affect focusing as well as brightness and contrast. As a final touch, the ion-trap magnet may need a slight readjustment for peak brightness and best focus.

Picture Tube

An old CRT with a remaining cathode-current capacity of under 100 microamps cannot place more than a 100-microamp load on the high-voltage supply. A weak high-voltage rectifier, even if nearly dead, may be able to hold up under this limited load; but when confronted with a new CRT's demand for 200 or more microamps, it will last for only a very short time. Whenever I replace a picture tube, I also install a new high-voltage rectifier—unless I am certain the existing tube is in like-new condition.

Naturally, such items as picture centering, focus, and ion-trap placement must be adjusted for optimum performance. In addition, it is a good policy to adjust vertical and horizontal size, and to reset AGC and sync controls for best operation.

Vertical Oscillator and Output

Since the vertical size and line-

• *Please turn to page 70*

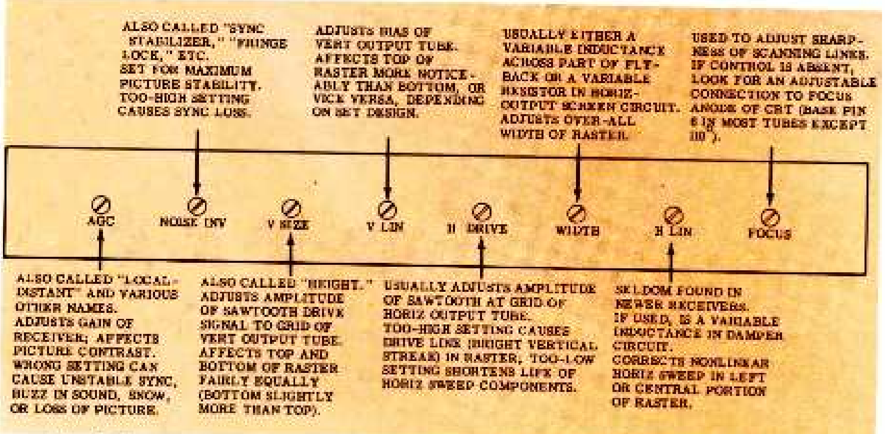


Fig. 1. Facts to keep in mind about the service adjustments of a TV set.

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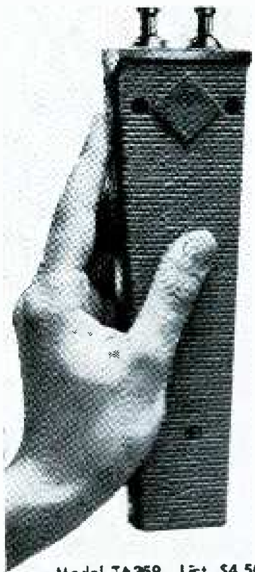

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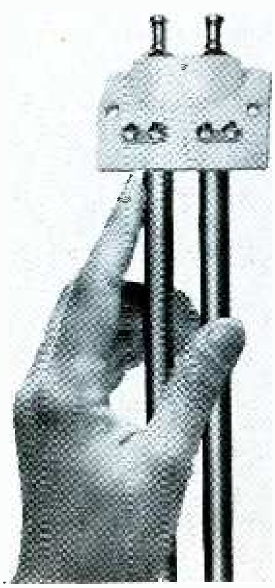

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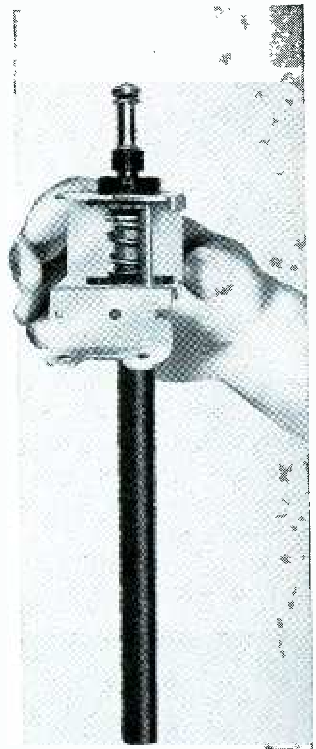

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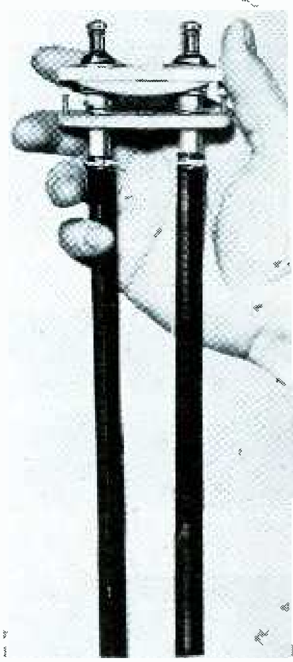

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Across the Bench

by Stan Prentiss

G.E.'S FRISKY

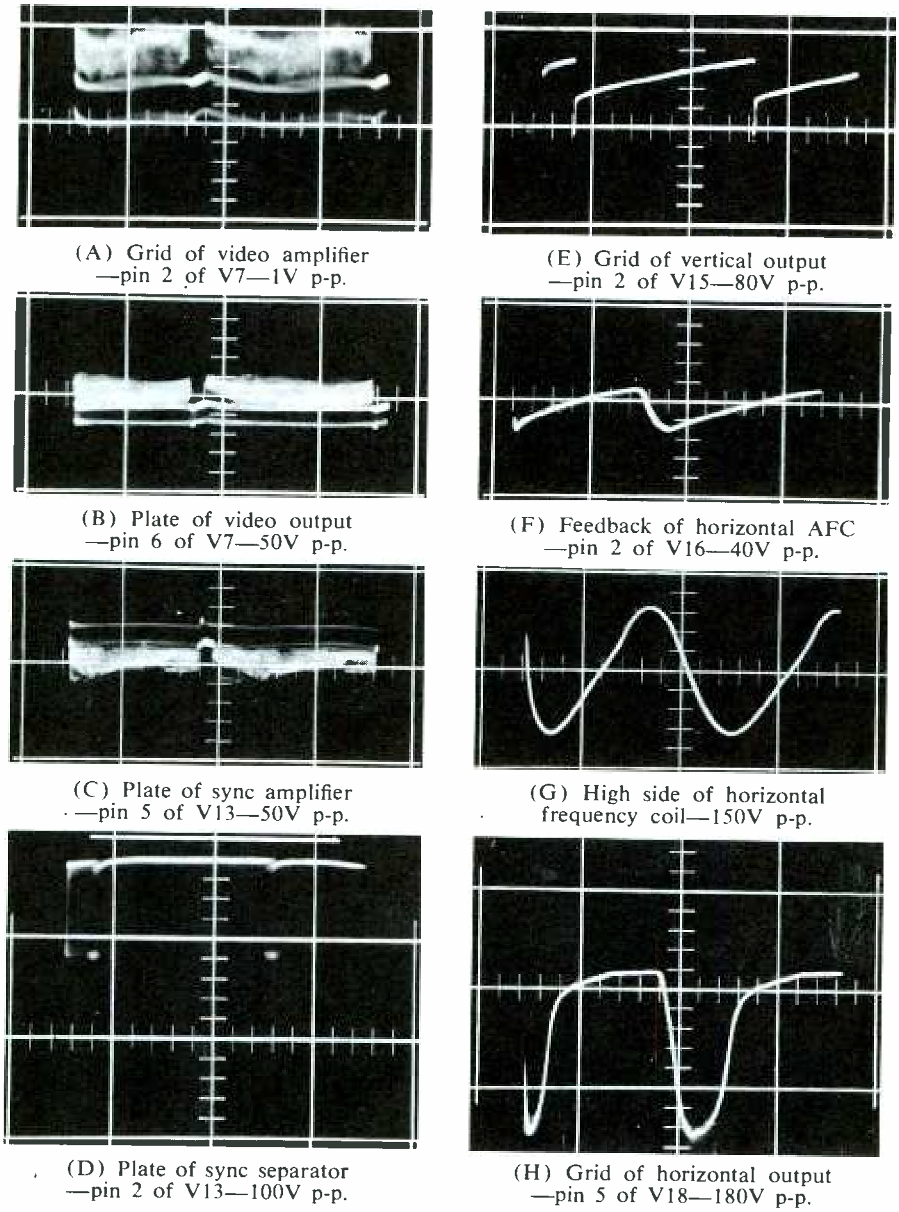
We've been hearing a chorus of distress signals lately from technicians who have been trying, with varying success, to service a batch of General Electric TV receivers made in the early 1950's. So, I have dug into this problem and have come up with some information to help you keep these unusually long-lived sets on their feet a while longer.

One particularly popular series of G-E models, all using the same basic chassis design, first appeared in mid-1950 and continued in production through 1951. Unlike today's TV chassis units, this old-timer did not carry a special chassis number to aid in identification. However, you will be able to recognize "it" if you remember that it appeared in all the models listed in Table I. Although the early- and late-production receivers in this series were covered in separate PHOTOFACT Folders, there are only minor differences between the two. Both have the same tube complement, virtually identical circuitry, and a very similar physical layout.

Up-to-date service information on this "Chassis X" wouldn't be complete without waveform data, so scope patterns at eight key test points in a normally-operating receiver are shown in Fig. 1. All waveforms were viewed with the contrast control adjusted to produce a composite-video signal amplitude of 1 volt peak to peak across the 3600-ohm video-detector load resistor.

Table II, a detailed troubleshooting chart, will help you to locate the causes of many common trouble symptoms in old General Electric receivers. Due to their age, these sets are likely to develop double troubles, triple troubles, or even more—but you can take care of such problems by attacking the symptoms *one at a time,* with the aid of the chart. In compiling these troubleshooting suggestions, I've tried to emphasize those failures which have actually been known to occur — neglecting the more improbable troubles.

Although references to certain electrolytic capacitors are included, I haven't run into trouble with them myself (except for the usual few failures of power-supply fil-



(A) Grid of video amplifier —pin 2 of V7—1V p-p.

(B) Plate of video output —pin 6 of V7—50V p-p.

(C) Plate of sync amplifier —pin 5 of V13—50V p-p.

(D) Plate of sync separator —pin 2 of V13—100V p-p.

(E) Grid of vertical output —pin 2 of V15—80V p-p.

(F) Feedback of horizontal AFC —pin 2 of V16—40V p-p.

(G) High side of horizontal frequency coil—150V p-p.

(H) Grid of horizontal output —pin 5 of V18—180V p-p.

Fig. 1. Key waveforms in normally-operating '50 General Electric receiver.

Table I—Models Discussed in This Article

1950 GROUP -- COVERED IN PHOTOFACT FOLDER 123-4	
Consoles	Table Models
14C102, 14C103	14T2, 14T3
*16C110, 16C111, 16C115	*16T1, 16T2
16C103, 16C104, 16C113, 16C116, 16C117; 17C101, 17C102	16T3, 16T4 16T5, 16T6
1951 GROUP -- COVERED IN PHOTOFACT FOLDER 141-6	
Consoles	Table Models
17C103, 17C104, 17C105, 17C107, 17C108, 17C109	17T1, 17T2 17T3
†17C112, 17C114	†17T4, 17T5, 17T6

* Have "stacked IF's" (second and third stages series-connected across B + source). This alternate circuit is shown in dotted lines on PHOTOFACT schematic.

† Include production changes covered in PHOTOFACT Folder 158-1

10 YEAR OLDS

ters). Neither have I had appreciable trouble with bad mica capacitors. But half-watt controls, half-watt resistors, and wax-impregnated tubular capacitors are a constant headache. Go after those wax-dribblers, and you will be well on your way to unraveling many a puzzle. If in doubt about their condition, throw 'em out.

Circuit Features and Troubleshooting Hints

These early G-E's were considered "hot" sets in several ways when they were introduced. For their day, they had a number of advanced features—some of which later became more-or-less standard practice in TV design.

RF-IF Section

One "different" feature of these sets, even by present-day standards, is the tuner circuitry. *Two* stages of RF amplification are used. The signal is coupled from the antenna into the cathode circuit of a grounded-grid 6AB4 triode, which in turn drives a partially AGC-controlled 6BC5 pentode. The mixer-oscillator is a 12AT7 — not too unusual in earlier tuners. However, its output is tuned to the 40-mc IF band, and this feature was "news" back in the days when the 20-mc IF strip was standard.

The IF strip includes three impedance - coupled, stagger-tuned stages employing 6BC5 pentodes. AGC bias voltage is fed equally to all three tubes (except in sets having "stacked IF's"), and the cathode resistor of the third IF stage is unbypassed to provide a small amount of degeneration for greater stability.

Contrast-Control Circuit

The contrast control in this chassis does not regulate the gain of the video amplifier, as in most other

• *Please turn to page 64*

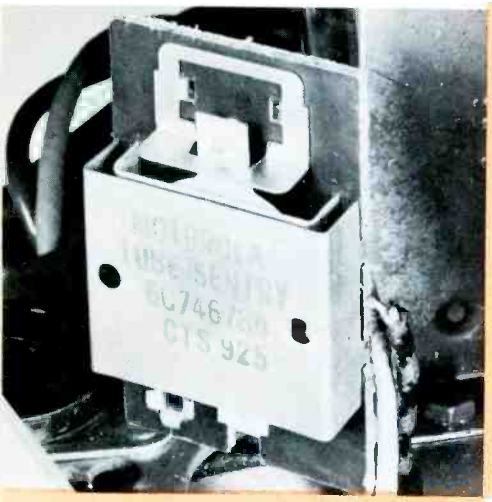
Table II—Troubleshooting Chart for G-E Models Listed in Table I

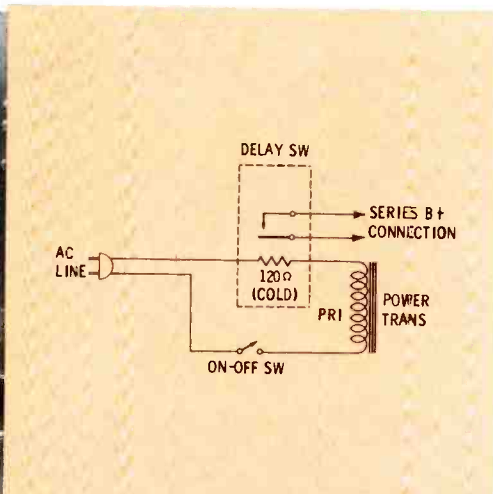
SYMPTOM	LIKELY CAUSE	REMEDY
No AC voltage to set	Bad AC plug, cord or on-off switch Open thermal cutout	Replace Attempt to reset. If it "blows" again, check for short in set—especially in filters C1, C2, C3, C4A. Cutout may also be defective.
No DC output voltage from B+ rectifier	Open selenium rectifier, filter choke, or input electrolytic	Replace M1 ('50) = M2 ('51)* Substitute or check L1, C1
Tubes do not light	Open negative-temperature-coefficient dropping resistor in series string Open picture-tube filament	Replace R120 ('50) = R121 ('51) Resolder filament pins or replace tube
Tubes V1 through V8, V12, V11, and V15 do not light (see Fig. 7).	Open tube filament or heater choke	Replace defective tube; replace L25, L27, L29, or L35 ('50) = L33 ('51)
Tubes V9, V10, V11, V13, and V16 through V19 do not light	Open tube filament or heater choke	Replace defective tube; replace L44
Abnormally long warm-up time (over 15 sec.)	Filament-dropping resistance too high Slow warm-up, interelectrode leakage, or short in some tube	Replace R120 ('50) = R121 ('51) Check tubes
Raster normal; no pix or sound	Defective RF, IF, video-amp, or pix tube Open video detector diode	Substitute or check V1 through V7; also V21 Substitute or check M5
Excessively bright pix containing black lines	Leaky or shorted coupling capacitor from video output stage to grid of CRT	Check for positive voltage on grid or CRT. If present, replace C53
No raster; all tube filaments lit	Defective tubes in horizontal sweep and high-voltage section Defective components in screen circuit of horizontal output Defective components in AFC, oscillator, or output stages	Substitute or check V16 through V20 Replace or check R113, R114, C106 Check for normal waveform at grid of horizontal output (see Fig. 1); if absent, troubleshoot oscillator and AFC
Hum (S-curve) in pix; may also be in raster	Heater-to-cathode leakage in video, sync, AFC or horizontal oscillator tube Defective boost filter capacitor	Substitute V7, V13, V16, V17 Substitute C5A, C5B ('50) = C6A, C6B, ('51). Replace entire capacitor if one section is bad
Above symptom, plus strong black bar across pix	Heater-to-cathode leakage in RF, IF or video tube Bad filter capacitors in B+ or video-amplifier circuit	Substitute V1 through V7 Substitute C2, C3, and C5C ('50) = C6C ('51)
Excessive contrast or bending in pix; may not be affected by changing contrast setting	Shorted or gassy IF or video tube Excessive RF input signal Defective contrast control Defective capacitors in AGC, sync or video circuits	Substitute V4 through V7 Insert attenuator pad in series with antenna Replace R1A Replace capacitors, especially paper tubular types, in circuits mentioned
Pix "pulls," but does not fall out of sync at max. contrast setting; fades abnormally at lower contrast	Defective electrolytic filter capacitor in boost circuit	Substitute C5A ('50) = C6A ('51). If defective, replace entire capacitor
Vertical lines at left side of pix	Open or missing bypass capacitor across 240-volt B+ source	Replace or add C108 ('50) = C75 ('51)
Insufficient horizontal deflection	Defective tubes Resistor increased in value Leaky capacitor	Substitute or check V17, V18, V19 Check R107, R108, R113, ('50) = R104, R105, R113 ('51) Substitute C98, C99, C100, C106, C109, C110 ('50)=C101, C99, C102, C106, C112, C113, ('51)
Dull pix, but normal high voltage	Weak picture tube Resistor increased in value Leaky capacitor	Check or replace V21 Check R48, R49, R3B ('50) = R51, R48, R3B ('51) Substitute C53, C54
Retrace lines visible	Vertical blanking amplifier tube not conducting (see Fig. 4) Defective resistor or capacitor	Substitute or check V14 Substitute or check R96, R83, C83 ('50) = R83, R90, C88 ('51)
Poor vertical hold	Defective video, sync or vertical tube Leaky or shorted bypass or coupling capacitor somewhere between video and vertical stage	Substitute or check V7, V13, V14, V15 Substitute capacitors, especially paper tubular units, in video, sync and vertical stages
No vertical deflection	Bad vertical oscillator or output tube Open vertical output transformer Open or shorted yoke winding Shorted capacitor in vertical multivibrator or output stage	Substitute or check V14, V15 Check T2 Substitute or check yoke Substitute capacitors, starting with C87, C86, C84, C82 ('50) = C88, C87, C85, C82 ('51)
Insufficient height	Low emission, leakage, or gas in vertical output tube Leaky capacitor Defective vertical output transformer Insufficient plate voltage on vertical sweep tubes Plate load resistance increased in value	Substitute or check V15 Substitute C87, C88, C4C ('50) = C86, C87, C5C ('51) Check T2 Check for adequate voltage from boost source Check height control R5; also R91, R95 ('50) = R86, R89 ('51)
Poor vertical linearity	Defective vertical output tube Capacitor leaky or changed value Resistor changed in value	Substitute or check V15 Substitute C4C, C81; also C87, C88 ('50) = C86, C87 ('51) Check linearity control R6; also R94, R93 ('50) = R88, R87 ('51)

*Since these receivers were covered in two separate Photofact Folders, two different item numbers have been applied to some components. In this chart, the designation ('50) is used for part numbers of receivers covered in Photofact Folder 123-4; ('51) indicates coverage in Folder 141-6.

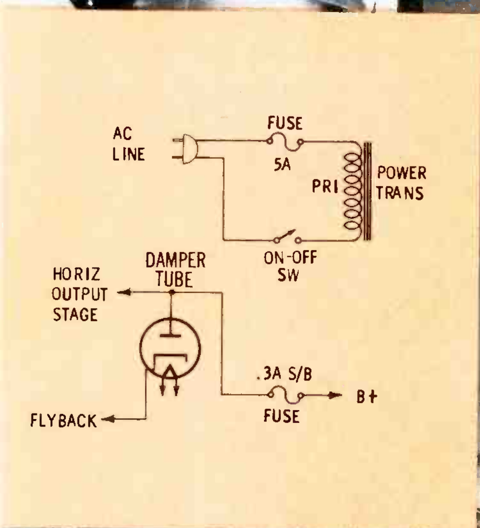
CIRCUIT SAFETY DEVICES

Modern television receivers are sprouting several new signs of safety. In addition to one or two special fuse types, you're also apt to run across small thermal switches and odd-looking resistors. If you're not fully acquainted with these circuit-protecting components, you may find them a real troubleshooting bottleneck. Here are some you'll be seeing.

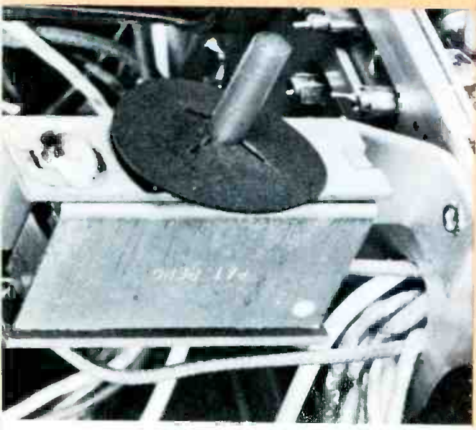


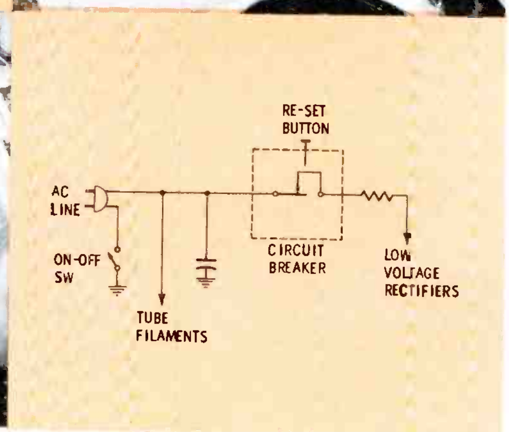


If all tubes light, yet the set doesn't operate, see if a thermal delay switch is used. This unit consists of a resistive element and bimetallic switch usually housed in a small shielded assembly as pictured. The resistor may be located in the primary circuit of the power transformer, while the bimetallic switch acts as a series connection in the B+ line. Thus, tube filaments are permitted to warm up prior to the application of B+. If the unit is working, you should be able to hear it click several seconds after the set is turned on. Some of these assemblies may have a small adjustment screw; however, these are preset at the factory and, barring physical damage, should not require adjustment in the field.



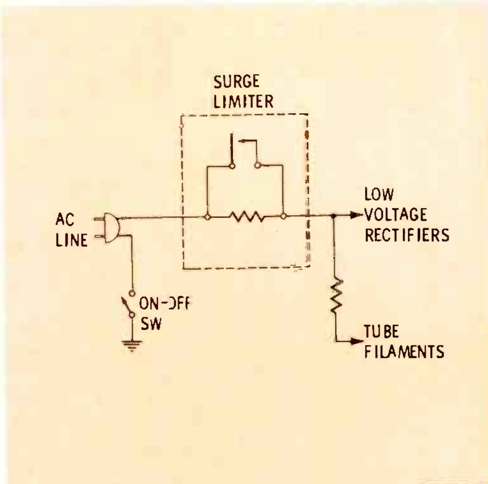
In our investigation of protection devices, we mustn't overlook fuses. You will still find cartridge and pigtail fuses used in both instant and slow-blow varieties. Shown here are a cartridge-type fuse, connected in series with the primary of a set's power transformer, and an "N" type unit protecting the horizontal sweep-circuit components. The newer "N" style fits into a special holder that prevents installing a fuse of the wrong type or rating. Straight wire fuses are being used to a greater extent these days, in both series and parallel filament circuits. These are generally pieces of #24 to #28 copper wire, ranging in length from 1" to 3". Remember, never replace fuses indiscriminately, without regard for ratings and characteristics.



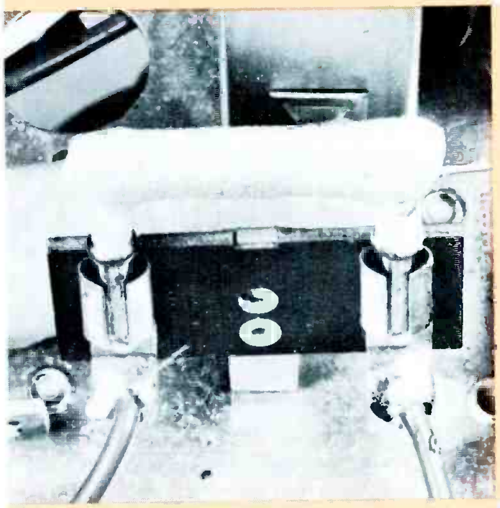


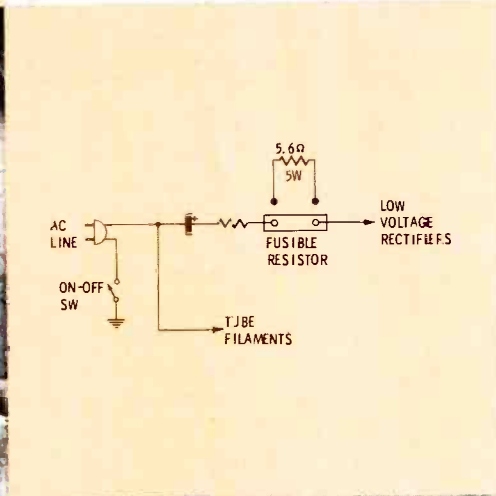
Here's another safety device you see a lot of these days. It's a thermal cutout or circuit breaker equipped with a manual reset button which is accessible from the rear of the chassis as pictured. A typical application is shown in the partial schematic; heat due to excessive current drawn by the B+ supply will cause the breaker to open, thus safeguarding rectifiers and other series components. If this unit opens, tube filaments will remain lighted, but B+ will not be applied and the receiver will not operate.

The power-consuming fixed resistor, used for years to protect components against initial surge current, is now being replaced by something a little different—a combination resistor and thermal switch. A wirewound resistor (having a value of about 100 ohms cold) is placed in close proximity to a bimetallic strip which, in turn, acts as a shorting switch across the resistor. The resistor limits the initial current and, after a few seconds' delay, closes the switch with the heat it generates. Even many sets with power transformers are now using this form of surge protection to control warm-up.

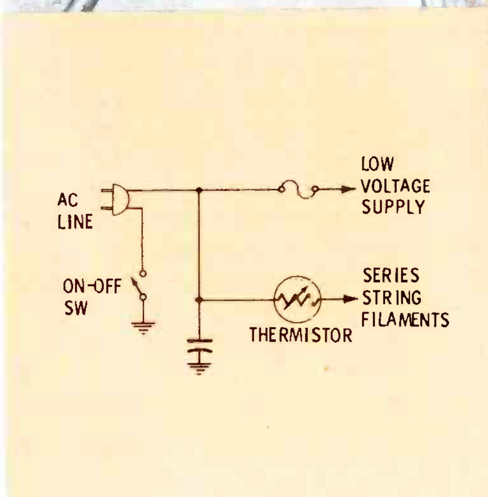


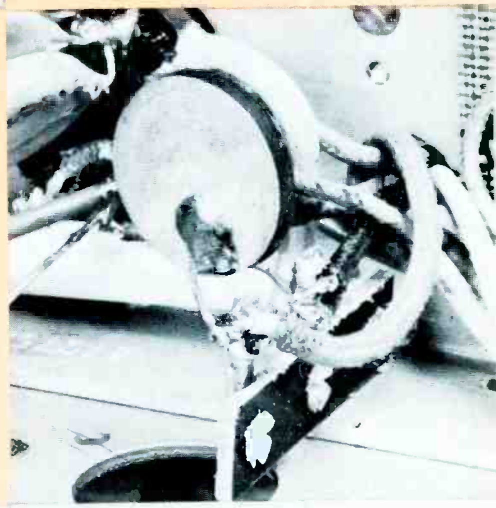
Fusible resistors fall into the category of protective devices, and are especially popular in today's TV portables. Illustrated here is a typical plug-in unit rated at 5.6 ohms, 5 watts. The "sugar-coated" component plugs into a pair of banana-type connectors on a terminal board. Actually, the *fusistor* serves two purposes: It limits surge current when power is first applied, and it protects the B+ rectifier circuit against overloads. Both resistance value and wattage rating are important. If you install one of equal wattage, but of lower resistance, the fuse feature may be impaired ($P=I^2R$). If, on the other hand, you install one with a higher resistance, it will overheat and open more readily.





Thermistors, or temperature-compensating resistors, are employed to prolong the lives of tubes and other components. As shown, they are shaped like a large disc capacitor. By decreasing in value as they heat up, they provide automatic control of surge current. You'll often find thermistors employed in series filament circuits as shown in the schematic. When measuring the resistance of a thermistor, remember that its value depends on temperature. The rated resistance of the unit shown here is 200 ohms cold and 6 ohms hot. In many 110° receivers, you'll find thermistors used in the vertical deflection circuit. Here, however, they compensate for changing resistances in the yoke winding as the set warms up.





If you have a customer complaining about too many tubes going out, or other repeated failures which are apparently due to high line voltage at certain times of the day, you'll want to consider installing one of the universal-type regulators now available. Here are just a couple of the surge-limiting devices which can be used on about any receiver. The smaller unit is a surge resistor paralleled by a bimetallic shorting switch; it's designed for chassis mounting and should be connected in series with either side of the input power line. The other unit is similar electrically, but is housed in a plastic case for external use.

AUDIO FACTS BY ALAN ANDREWS

testing HI-FI

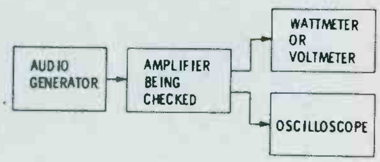


Fig. 1. Basic test setup for checking frequency response of an amplifier.

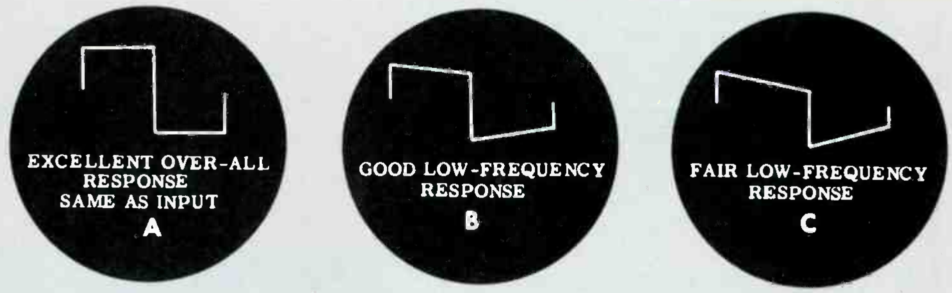


Fig. 2. Square-wave patterns due to

Hi-fi circuitry is less complex than that of TV—but, to offset this advantage, operational standards for hi-fi equipment are more stringent. Circuit performance which would be considered normal in radio or TV might easily be below par by hi-fi standards. It is nearly impossible to pinpoint minor faults in an audio system simply by listening to it, so hi-fi servicing requires more objective tests and measurements than TV servicing.

Much specialized audio test equipment is available for the technician's use in determining whether or not the operation of a circuit is up to true hi-fi standards. The most important instruments for this work are the audio signal generator, audio VTVM, harmonic distortion analyzer, and intermodulation distortion analyzer. Somewhat less essential—but still very helpful—are the audio wattmeter, wow and flutter meter, decade attenuator, stroboscope disc, and various types of test records and tapes.

This special equipment is not absolutely essential for performing a high percentage of hi-fi repairs, since most troubles such as bad tubes, loose connections, and outright component failures can be detected with the same equipment available in the average TV shop. However, there are a significant number of occasions when test equipment designed specifically for audio work must be used to achieve proper results. Even when it does not enter into the actual repair procedure, it can be utilized to advantage for checking the final results of service work. Your public relations are immeasurably improved if you can demonstrate to customers precisely how well their equipment is working. Just after a hi-fi rig has been serviced, the owner is likely to worry about every little flaw (real or imagined) in its performance—unless he can be convinced that his unit is performing strictly according to specifications. The necessary reassurance can be provided by routinely making a series of precise distortion and frequency-response measurements on instruments brought to the shop, and reporting results in writing.

The most-often-heard complaint about hi-fi performance, other than actual failure of the equipment, involves some type of distortion. If a trouble cannot be localized and repaired in the home, and the unit is brought to the shop for further examination, time is often saved by making routine distortion checks before attempting to isolate the exact source of the trouble.

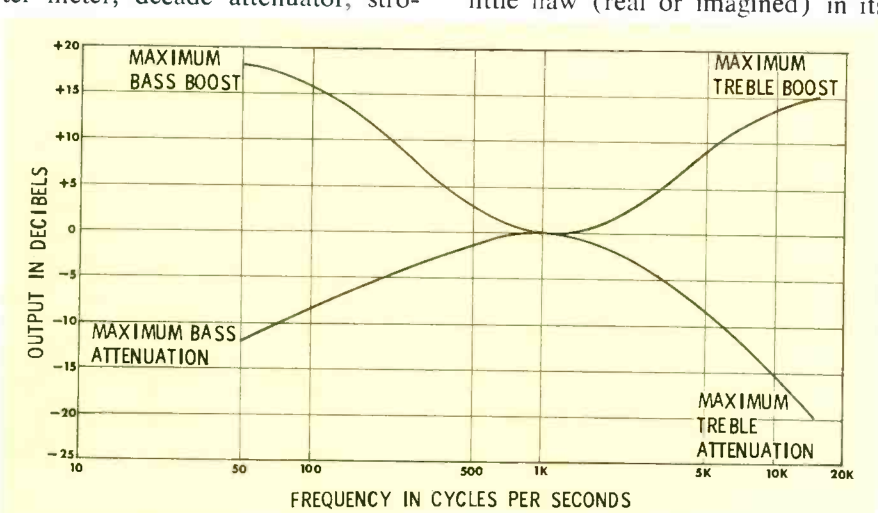


Fig. 3. Tone controls can vary amplifier response within these limits.

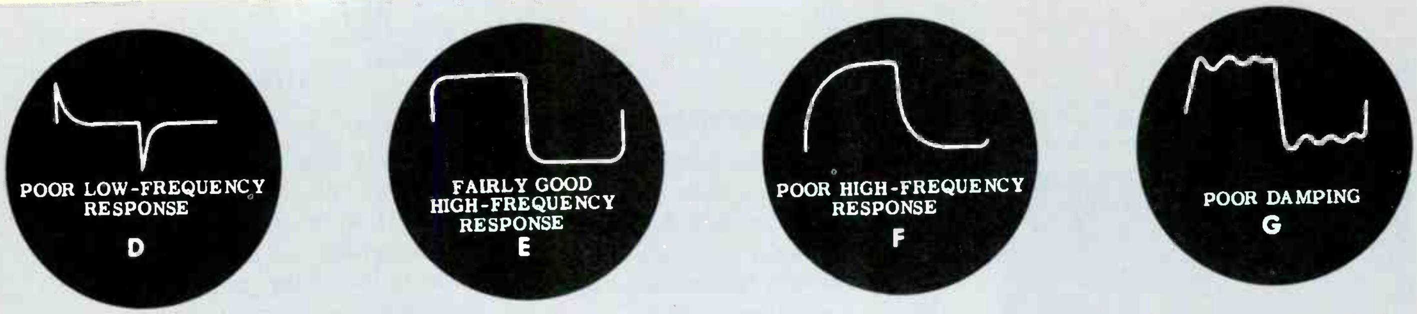
Analyzing Frequency Distortion

Frequency distortion, defined as the inability of a hi-fi system to handle all audio frequencies equally well, is often the underlying cause of a customer complaint. Hence, one of the following checks of frequency response is helpful in pinning down the nature of the defect.

Sine-Wave Response

The basic test setup of Fig. 1 provides one means of measuring the extent of frequency distortion. An audio generator supplies a clean sine-wave signal to the amplifier being checked. The output level of the amplifier is read by a wattmeter or a voltmeter, connected across a dummy load resistor with value equal in ohms to the impedance of the speaker system. A scope is used

amplifiers for distortion



different types of frequency distortion.

to indicate whether or not the output signal is still a pure sine wave or is distorted. If the scope is calibrated so that the AC voltage amplitude of the signal can be determined from the pattern height, no separate meter is required for measuring the output level.

The generator is first tuned to about 1000 cps, and the amplifier controls are adjusted to their normal operating positions. If a pure sine-wave output can be obtained, similar tests are repeated at a number of other frequencies across the audio band. The generator output level should be kept constant at all times. If the frequency response of the amplifier is normal, the amplitude of the sine wave should remain constant, and no clipping of peaks or similar distortion should be noticed at any audio frequency.

With the gain control of the amplifier turned to maximum, clipping of the sine wave may be noted. If so, the gain setting should be reduced until the waveform assumes a normal shape. The audio power output at this gain setting represents the *maximum undistorted* power available from the unit, sometimes a key to the condition of the amplifier. If rated power output cannot be obtained, trouble in the unit is indicated.

The tone controls should be set to the "flat" position to insure uniform frequency response. If a satisfactory response canot be obtained under these conditions, nothing more serious than a slight miscalibration of the tone-control dial markings may be indicated. Of course, any more than a slight discrepancy in frequency response suggests trouble in the amplifier.

When looking for reasons why a frequency-response check gives unsatisfactory results, don't forget the test setup itself! Just as in TV alignment, testing can be affected by uneven or distorted output from the generator, or by improper connections between the generator and the amplifier. The operating manual of the generator should be checked for suggestions regarding hook-up to various types of amplifier input circuits.

Square-Wave Response

A square-wave input signal can also be used to advantage in checking amplifiers. In addition to giving information on frequency response, this method indicates phase distortion and shows the response of the amplifier to transients (sudden changes in signal voltage). The equipment setup is the same as in Fig. 1, except that a square-wave generator is used instead of a sine-wave unit. A few commercially-available audio generators provide both sine- and square-wave signals.

A square wave of signal voltage (Fig. 2A) is composed of a fundamental frequency plus odd-numbered harmonics. For example, a 400-cps square wave contains components of 400, 1200, 2000, and 2800 cps. Even-numbered harmonics (80, 1600, and 2400 cps, etc.) are missing. So, when we apply a square-wave signal to an audio system, we are applying a number of different frequencies at the same time. The output waveform then shows the response of the amplifier to the whole combination of frequencies — a much better indication of amplifier performance than a response to a single-frequency sine wave.

• *Please turn to page 77*

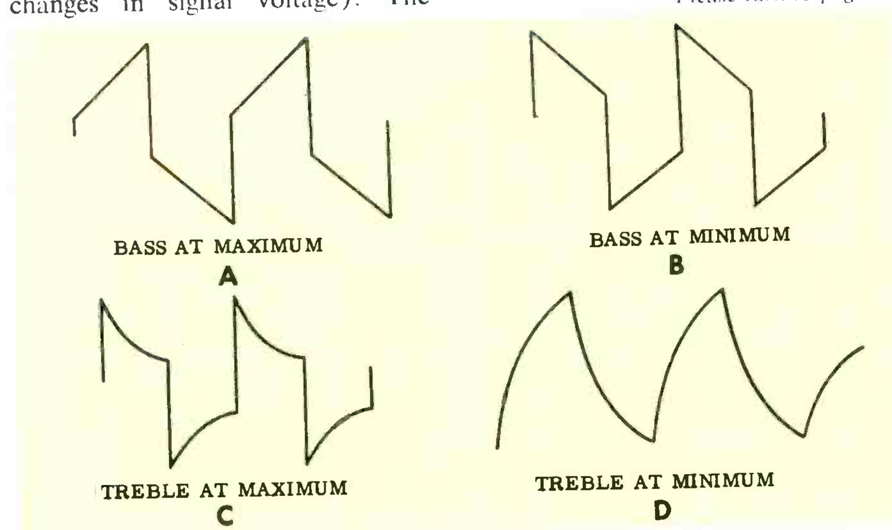
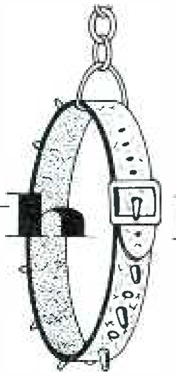
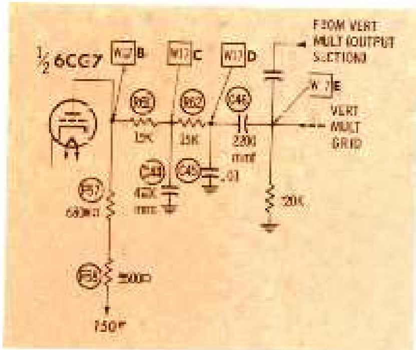


Fig. 4. Rotating bass and treble controls affects square wave response.

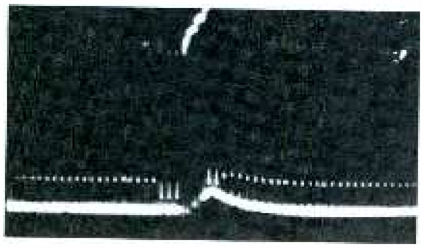
Tough Dog



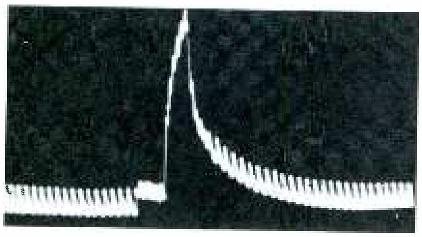
JOE A. GROVES



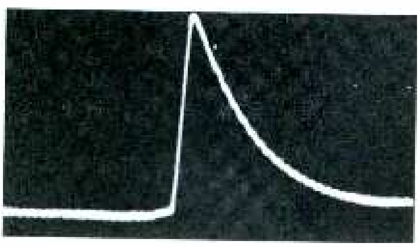
(A) Schematic of integrator circuit.



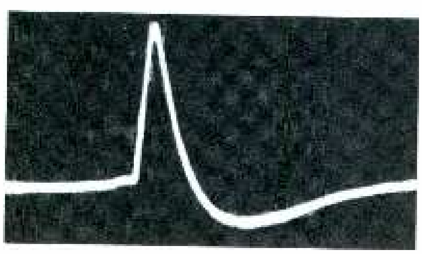
(B) Phase-inverter plate waveform.



(C) Waveform at junction R61-C44.



(D) Pulse at junction R62-C45.



(E) Input to multivibrator grid.

Fig. 17. Vertical sync pulse is gradually reshaped by integrator network.

Integration

In the last installment of this series, we saw how sync pulses were applied to the horizontal AFC stage. Now let's take a look into the integrating network which interconnects the sync amplifier and the vertical sweep circuits. Remember that the longer time interval and duration of the vertical pulse is what makes it easy to direct the horizontal and equalizing pulses into the horizontal circuit, and the vertical pulses to the vertical network.

Fig. 17A shows the vertical sync path through a typical integrator. Only identification numbers have been shown for the waveforms, providing a key to an analysis using expanded waveform presentations.

Fig. 17B is an expanded view of the vertical sync pulse at the plate of the sync phase inverter. Notice that the vertical pulses are already beginning to build up to a higher amplitude (to form the one pulse which will be present at the integrator output), while the horizontal pulses in the signal maintain a constant amplitude.

Going into the first stage of integration, the vertical pulses (Fig. 17C) continue to be accentuated as the charge on C44 builds up. While the horizontal pulses are still present, their amplitude has been greatly reduced due to the time constant of R61 and C44.

Fig. 17D shows the charge built up across C45, filtering the individual vertical-pulse segments into one pulse. R62 and C45 have completely eliminated whatever remained of the horizontal pulses.

Fig. 17E is the final output of the integrator as the vertical sync pulse is fed to the grid of the vertical multivibrator (which has been disabled to view this series of waveforms). Fig. 18 shows two of the pulses as they would normally be viewed with the multivibrator disabled (no horizontal expansion). The original amplitude of the vertical sync pulses at the plate of the phase inverter was about 40 volts (the same as the horizontal pulses). Now the horizontal pulses have been completely eliminated from the integrator output, and the remaining vertical sync-pulse spike has an amplitude of only 5 volts.

Fig. 19 shows the normal waveform viewed at the multivibrator grid with the multivibrator running and locked in by the applied sync pulse; the amplitude of the entire signal is 140 volts. To show the relative amplitudes of the small vertical sync pulse and the large multivibrator feedback pulse, the vertical oscillator was thrown out of sync and the waveform in Fig. 20 photographed. As you can see, it is imperative that you disable the multivibrator when checking the vertical integrator circuit.

More Dog Food

In Part 1 of this series, we demonstrated the effect of heater-cathode leakage on the sync separator

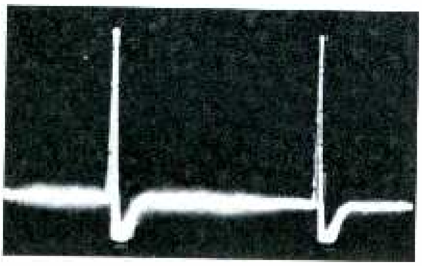


Fig. 18. Integrator output (horizontal gain of scope returned to normal).

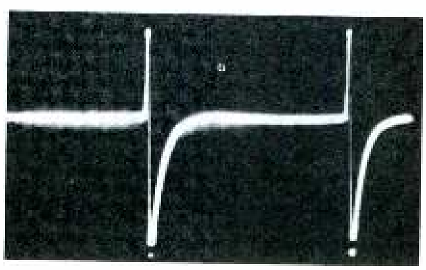


Fig. 19. Multivibrator grid waveform with circuit oscillating and in sync.

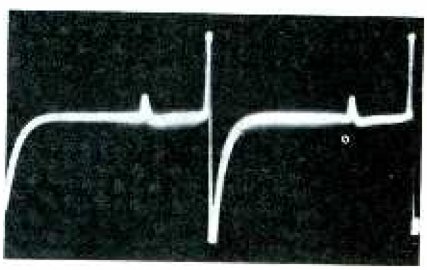


Fig. 20. Same as Fig. 19, but with multivibrator detuned to show pulses.

Sync Troubles

Part 3—A step-by-step analysis of vertical integrator action, followed by waveform clues to faulty sync separation.

output—but we didn't pursue the subject to show how vertical oscillator stability was affected. Fig. 21 shows the distorted output of the integrator when hum modulation is introduced by heater-cathode leakage in the video output stage. Although the problem is one of stability, and sync-circuit operation has been affected, we again must realize that the real trouble was in a stage preceding the sync circuits.

Fig. 10 showed the effect of a leaky coupling capacitor in a 3BU8-type separator circuit. This waveform is presented again for comparison with Fig. 22, to show how much more sensitive the triode-type circuit is to this defect. The small amount of composite video in Fig. 10, due to 100K-ohm leakage in C41 of Fig. 12 (see "repeat" of this schematic), contrasts sharply with the large amount of video present in Fig. 22 due to 1.5-megohm leakage in C22 of the triode circuit in Fig. 4 (also repeated).

This same triode circuit contains another component connected in series with the regular coupling capacitor C22. Printed-circuit network K2, consisting of a 1500-mmf capacitor paralleled by a 270K-ohm resistor, increases the sync pulse amplitude in relation to video information. Fig. 23 shows the normal output of the sync amplifier, while Fig. 24 shows the effect of a leaky capacitor or reduced series resistance in K2. Notice the presence of video information in the sync-output signal, and the vertical sync pulse compression.

Still another cause of what appears to be sync-circuit trouble is poor low-frequency response somewhere in the video circuit. Normally, this causes picture smear; it's possible, however, for a set to produce an acceptable picture and still have poor vertical stability. The reason is that the video frequencies for most picture elements are well above the 60-cps repetition rate of the vertical sync pulses. If the brightness is turned up until details of vertical-blanking bar reproduction are visible, the pulse will appear smeared. Another indication is readily noted in the waveform at the plate of the sync separator. Fig. 25 shows fairly normal horizontal pulses in the separated output signal, while a gap in the waveform indicates almost complete compression of the vertical pulses. The trouble producing this particular symptom was a decrease in value of the coupling capacitor between the video detector and amplifier stages.

Although there are many other troubles which can appear to be sync defects, the foregoing problems should provide a sufficient sampling to prove that a sync circuit's operation can be accurately analyzed through proper use of a scope. Voltage readings simply do not provide a positive indication of what is going on in pulse-operated circuits; therefore, checking sync-stage volt-

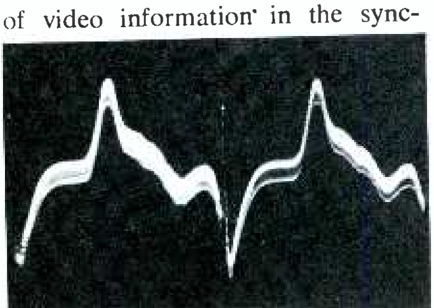


Fig. 21. Output of integrator when sync-input signal contains 60-cps hum.

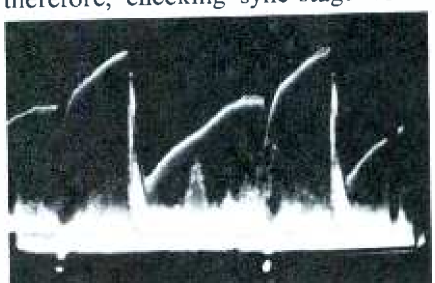


Fig. 22. Leaky grid capacitor in triode separator greatly distorts output.

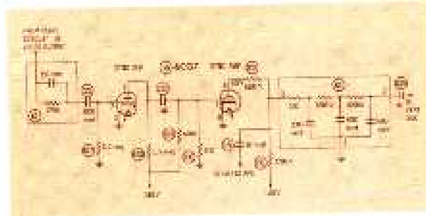


Fig. 4. This widely-used sync circuit is composed of two triode stages.

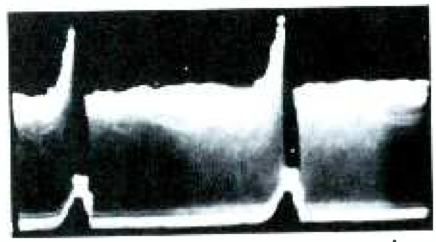


Fig. 10. With leaky input capacitor, video reaches separator plate (30 cps).

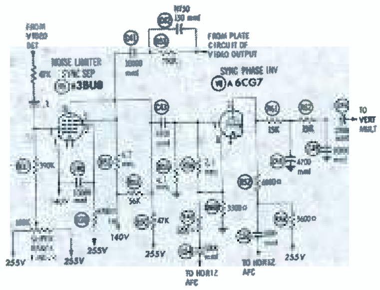


Fig. 12. The 3BU8 sync separator contains a built-in noise-limiting feature.

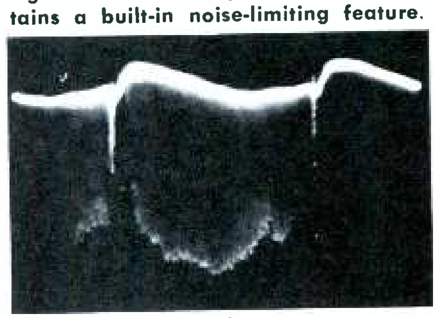


Fig. 25. Poor low-frequency response totally destroys vertical sync pulses.

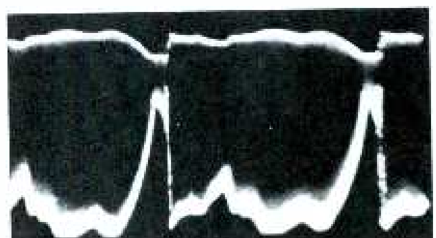


Fig. 24. Output is distorted due to decreased series resistance in K2.

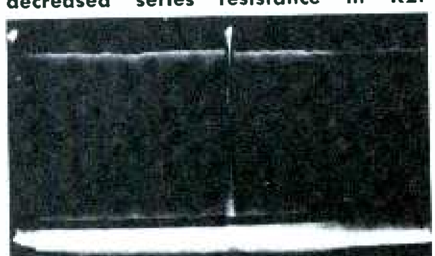
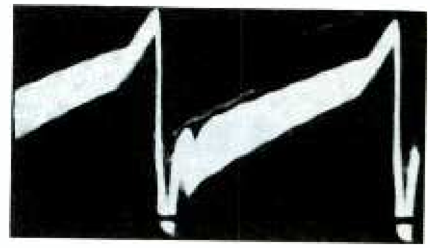
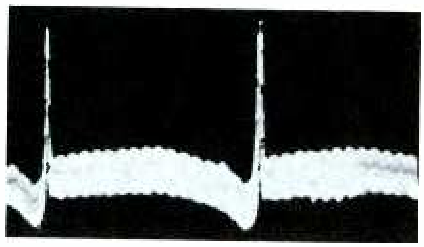


Fig. 23. Normal output of sync amplifier in dual-triode circuit of Fig. 4.

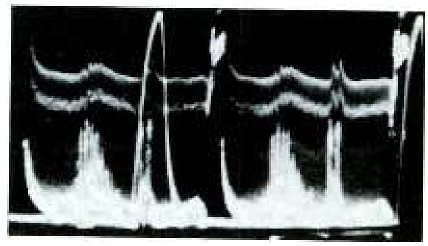
(A) Sweep energy in composite video.



(B) Hum in sawtooth wave.



(C) Hum in separated pulse signal.



(D) Leaky capacitor across input.

Fig. 26. Waveforms misrepresented because of hook-up or probe deficiences.

ages is a very limited means of troubleshooting.

Lies! Lies! Lies!

While scope-waveform analysis is the best way to troubleshoot sync problems, you may be confronted with a lie at times. The scope itself isn't lying; it shows exactly what goes on in the circuit. It is possible, however, for the scope connection to upset the operation of the circuit and lead to a wild-goose chase. If one isn't aware of this danger, and fails to guard against it, a dog will be born.

Fig. 26 shows four different waveforms depicting erroneous indications caused by overloading of circuits, introduction of hum modulation, or deficiencies in the scope probe. With the high-voltage cage left off the receiver of Fig. 12, sufficient horizontal-sweep radiation is picked up at pin 9 of the 3BU8 to produce the distortion evident in Fig. 26A. Different types of hum resulting from poor ground connections to the scope are illustrated in Figs. 26B and 26C. Lastly, Fig. 26D shows how a technician booby-trapped himself by temporarily connecting a small-value capacitor across the scope terminals to "clean up" a noisy waveform at the grid of a sync-separator stage. The capacitor turned out to be leaky, and the composite video signal became badly distorted because of the low-resistance shunt placed across the grid-leak resistor of the sync separator.

Know what to expect from your particular scope from first-hand knowledge gained through regular use. Most of the waveforms used in this analysis were viewed using a low-capacitance probe. *All* were taken from a standard service scope, similar to those used by many of you in your daily work on TV sets. Happy dog catching! ▲

Review Questions For Complete "Tough-Dog" Series

1. What does "sync separation" mean?

2. The height of a vertical blanking pedestal equals what percentage of the total amplitude of the composite video signal?

3. What determines the amount of grid bias on a sync separator?

4. How does 60-cps hum distort a sync-separator plate waveform viewed at a scope sweep rate of 30 cps? At a rate of 7875 cps?

5. How is the separated vertical sync pulse usually affected by a leaky capacitor in the separator's grid circuit?

6. Does a pentagrid or –BU8 type sync separator require an amplifier stage following it? Why?

7. What is an average amount of plate current for a triode-type sync separator with no input signal applied?

8. What action must you usually take before you can view a correct vertical-pulse waveform at the output of the integrator?

9. Describe the two sync pulses fed to a phase-detector horizontal AFC stage.

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STOCK GUIDE for tv tubes

The tube types listed on this page should account for well over 90% of your tube stock requirements. To keep the chart down to a manageable size, about 100 of the rarest type numbers have been omitted; however, we will keep you informed on these rare types and where they are found. Look for this information in *Previews of New Sets,* and also in special coverages like the article "The 1960 Crop of TV Tubes" in the March, 1960 issue.

Two columns of figures are listed along with the type numbers in the chart. The first column is purely a matter of statistics. Here's the meaning of the figures: If you took a cross-section sampling of 1,000 tubes from all TV sets now in service, you could expect to find the stated number of tubes of each type in this sample. (To avoid omitting many types which are only moderately popular, we have listed a figure "1" for each type with a usage frequency of at least once per 2,000 sockets.)

This column of figures, as it stands, is naturally not a suggestion to stock the exact number of tubes listed. The statistics should be combined with your own experience to produce information tailor-made to your own needs. Here are three factors to be considered:

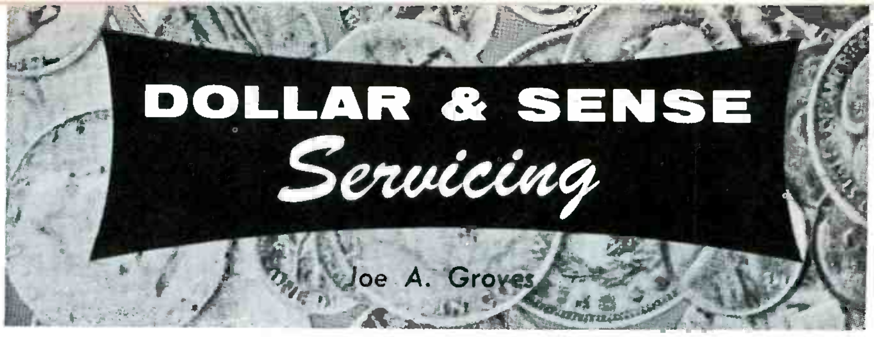
1. Relatively high failure rate of certain types such as cascode RF amplifiers and power output tubes.
2. Specialization in certain makes of sets, such as regional brands. (As a national publication, PF REPORTER necessarily gives nationwide averages based on all brands of receivers.)
3. Average age of those sets which contain a particular tube type.

The second column of figures marked "Caddy Stock" is a suggested stock of 350 tubes to be carried on home calls—either in two medium-size caddies or one "king-size" caddy. This list attempts to strike a balance between having enough different types and having a sufficient stock of widely-used types to meet most contingencies.

Keep yourself informed of trends toward increased or decreased use of various tube types. This is easy to do by comparing the current *Stock Guide* with previous editions, which appear in the April and October issues.

*Note: *indicates a 450-ma series-string tube.*

TUBE TYPE	USE PER 1,000	CADDY STOCK	TUBE TYPE	USE PER 1,000	CADDY STOCK	TUBE TYPE	USE PER 1,000	CADDY STOCK	TUBE TYPE	USE PER 1,000	CADDY STOCK	TUBE TYPE	USE PER 1,000	CADDY STOCK
1AX2	1	1	5CQ8	1	1	6BH8	2	1	6CY7	1	1	8BQ5	1	1
1B3GT	35	5	5CZ5	1	1	6BK5	2	1	6CZ5	1	1	*8CG7	1	1
1G3GT	5	2	5EA8	1	1	6BK7A/-B*	6	2	6DA4	1	1	8CX8	1	1
1J3	3	1	5J6	1	1	6BL7GT	4	2	6DB5	1	1	8EB8	1	1
1K3	1	1	5T8	2	1	6BN4	2	1	6DE4	1	1	*9AU7	1	1
1S2A/DY87	1	1	5U4GB	38	6	6BN6	7	2	6DE6	4	1	9BR7	1	1
1V2	1	1	5U8	6	3	6BN8	1	1	6DE7	1	1	10DE7	2	1
1X2A/-B	8	3	5V3	2	1	6BQ5	2	2	6DG6GT	1	1	12AF3	1	1
2BN4	2	1	5X8	1	1	6BQ6GTB	13	4	6DK6	2	1	12AT7	6	4
2CY5	3	1	5Y3GT	2	2	6BQ7A	12	4	6DN7	1	1	12AU7/-A	22	6
2ER5	1	1	6AB4	1	1	6BR8A	1	1	6DQ6B	11	4	12AV5GA	1	1
3A3	1	1	6AC7	3	1	6BS8	1	1	6DR7	1	1	12AV7	1	1
3AL5	1	1	6AF3	1	1	6BU8	4	2	6DS5	1	1	12AX4GTA	8	3
3AU6	4	1	6AG5	3	2	6BW8	1	1	6DT5	1	1	12AX7	4	2
3BC5	1	1	6AG7	1	1	6BX7GT	1	1	6DT6	5	2	12AZ7A	1	1
3BN6	4	2	6AH4GT	2	1	6BY6	3	2	6EA7	1	1	12B4A	1	1
3BU8	3	2	6AH6	4	2	6BY8	1	1	6EA8	5	1	12BH7A	9	3
3BZ6	17	4	6AK5	2	2	6BZ6	17	5	6EB8	2	1	12BQ6GTB	1	1
3CB6	10	3	6AL5	41	4	6BZ7	3	2	6EM5	1	1	12BR7	1	1
3CS6	2	2	6AM8/-A*	4	1	6C4	5	2	6ER5	1	1	12BY7A	11	4
*3CY5	1	1	6AN8/-A*	5	2	6CB6	88	8	6ES5	1	1	12C5/-CU5	3	1
3DK6	2	1	6AQ5/-A*	18	4	6CD6GA	2	2	6EW6	1	1	12CA5	1	1
3DT6	5	2	6AS5	3	1	6CF6	2	1	6FV6	1	1	12CU6	1	1
4BC8	2	2	6AS8	1	1	6CG7	28	6	6GH8	1	1	12D4	2	1
4BQ7A	2	2	6AT6	2	1	6CG8/-A*	3	2	6J5	2	1	12DB5	1	1
*4BU8	1	1	6AT8/-A*	2	2	6CH8	1	1	6J6	14	4	12DQ6A	8	4
*4BZ6	1	1	6AU4GTA	6	2	6CK4	1	1	6K6GT	5	2	12DT5	1	1
*4CB6	1	1	6AU6	70	6	6CL6	2	1	6S4A	1	1	12L6GT	3	2
*4CS6	1	1	6AU8A	3	2	6CL8/-A*	1	1	6SL7GT	1	1	12SN7GTA	2	2
*4DT6	1	1	6AV5GA	2	2	6CM6	1	1	6SN7GTB	45	8	12W6GT	1	1
5AM8	2	1	6AV6	10	3	6CM7	4	2	6SQ7	2	1	*13DE7	1	1
5AN8	1	1	6AW8A	12	4	6CN7	3	1	6T8	10	3	*17AX4GT	1	1
5AQ5	6	2	6AX4GTB	15	6	*6CQ8	2	1	6U8/-A*	15	6	*17D4A	1	1
5AS4	1	1	6AX5GT	1	1	6CS6	3	2	6V3A	1	1	*17DQ6A	1	1
5AT8	2	1	6BA6	5	2	6CS7	1	1	6V6GT/-A*	11	3	19AU4GTA	2	2
5B8	1	1	6BA8A	2	2	6CU5	1	1	6W4GT	12	1	25AX4GT	1	1
5BK7A	1	1	6BC5	4	2	6CU6	2	2	6W6GT	7	3	25BQ6GTB	2	2
5BR8	1	1	6BC8	2	2	*6CU8	1	1	6X8	6	2	25CD6GB	1	1
5CG8	3	2	6BE6	4	2	6CX8	1	1	7AU7	3	1	25DN6	1	1
5CL8A	2	1	6BG6GA	2	2	6CY5	1	1	*8AW8A	1	1	25L6GT	3	2



DOLLAR & SENSE Servicing

Joe A. Groves

Work Standards. You can profit by taking advantage of some of the thinking of big business, especially along the line of improving efficiency to increase profits. Large companies increase their operating efficiency by employing trained time-study personnel to set "work standards"—that is, to determine the most efficient manner of doing every job. This, of course, is out of the question for small business—but the concept isn't.

Take a few minutes to think about improving efficiency in your own servicing operation. Time is money; minutes saved produce profits, while those wasted represent a loss. How many dollars does it cost you each week to look for misplaced hand tools, walk several steps for a replacement part not at your fingertips, unsolder connections that could be clipped, use an improper wrench or tool because the correct one isn't available, and on and on? Taken one at a time, the individual improvements seem negligible; but when added together, a considerable saving in time will result from closely studying work standards and making suitable improvements.

$ & ¢

Where's the Break? Like a giant snowball plummeting down a mountainside, an entirely new type of business has been expanding at a phenomenal rate during the past 18 months. A large segment of the American public is now able to obtain service on anything and everything through central service-brokerage offices.

The amazing success of these "Service Clubs" proves that a fair percentage of the public is dissatisfied enough with present servicing arrangements to pay $5-$12 yearly for an assurance of satisfactory service, at a reasonable price, whenever needed.

It is of particular concern to the electronic service industry that a national poll showed calls for radio and television service ranking first in one out of five service clubs. To this industry's credit, however, it should be noted that it ranked "least-in-demand" in two-thirds of the reports.

The particular effect of such clubs on *you* depends strictly upon the relationship now existing between you and your customers. If this relationship is good, you have no need to fear the growth of service clubs; in fact, you yourself may become a contractor for one of them. On the other hand, if all isn't rosy in the customer-loyalty department, the appearance of one of these clubs in your area may well be cause for consternation.

What has led to the quick acceptance of the service-club idea? Could it be a misunderstanding within the industry as to what the customer expects when he asks for service? The dictionary definition of *service* — "work performed for another"—is too simple to be of much help in answering this question, although the key words "for another" do provide some clue.

Since you're in a service *business,* you're bound to think of service mainly in terms of profit and loss. Thus, when the word "service" is mentioned, the phrase "service charge" quickly comes to mind. However, the customer places a different emphasis on this phrase, transposing the words to make it read, "charge for service." To him, "service" means not only the repair, but also the personal contact involved in the service job.

As soon as this contact has been established, you become the customer's servant! Then your courtesy, thoughtfulness, and appearance, as well as your professional skill, are subjected to his closest scrutiny. Satisfying all of the psychological whims of each customer's family (including treatment of children and pets!) makes your service satisfactory; anything less makes the customer reluctant to call you again or recommend you to his friends.

Evidently, the new service clubs are doing an effective job of catering to people's personal needs. So can you, if you constantly try to please.

More Applied Psych. A customer service-record file placed near the phone can come in handy when a call is received. If you learn the customer's name first thing, you can pull out his record while listening to the complaint—then you can reply with, "Is that the same Brand X we serviced last June? Do you still live at 233 Elm?" This cements your relations with the customer by showing that you have taken a personal interest in him.

If the call concerns a recent job, it's especially important to let the customer know you remember the details of the service you performed on his equipment. Nothing is more irritating than calling about a just-completed job and getting only pat answers of a completely impersonal nature—or, worse still, an attitude of "I don't know anything about that."

In addition to helping you create good will, a record file reminds you of special tube and tool requirements, correct service data to use, and other information you need for planning the call.

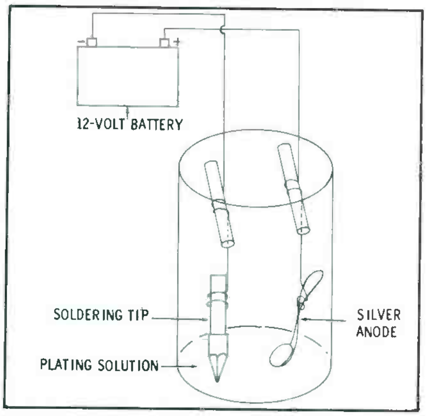
$ & C

Phony Business. If you operate a small shop, who answers the phone when you're out to lunch or gone for the day? No one? Then you're losing business! Most people, when they want service, will keep trying to get in touch with someone. If your phone isn't answered during certain hours, chances are potential customers will try to reach one of your competitors.

The funny thing is, once they get to talk to someone, they're often willing to place an order for service — even if they're told it won't be handled until the next day!

What's the solution? A telephone answering service costs only around $20.00 a month — or, for about $12.50 a month, you can have the telephone company install a device to answer and record incoming calls. By pre-recording your voice, you can greet callers electronically, and ask them leave their name, address, and phone number so you can call them back at a specified time. While you can't be assured of 100% effectiveness, it's better than nothing at all — and the profit from three or four extra calls a month may easily cover the added expense.

TIPS for TECHS



Save Soldering Iron Tip

Do your soldering-iron tips corrode and pit when the iron is left on for a long period of time? Here's how you can permanently tin them and thus prolong their usefulness indefinitely.

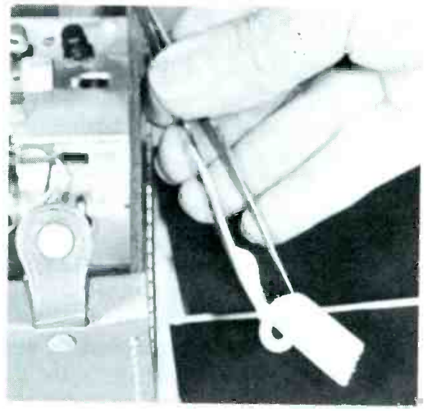
Dissolve one ounce of potassium silver cyanide in a pint of water contained in a small plating tank or jar. Connect the copper tip and any silver object (such as a spoon or fork) to a 12-volt battery as shown in the drawing. Allow the current to flow overnight. This will not discharge the average battery, because current drain quickly tapers from about 300 ma to approximately 5 ma.

By electrolysis, silver will be transferred through the solution to form a smooth, heavy coating on the soldering tip. In use, a quick wipe with a clean cloth will remove any residue which may form—and you'll never again have to re-tin the tip.

CAUTION: Cyanides are deadly poisons and must be handled carefully. The above operation should be carried out in a well-ventilated room or outdoors. Use rubber gloves in handling the solution and plating equipment. Wash the tank, soldering tip, etc. in running water.

Hex Driver Removes Tube From Shield

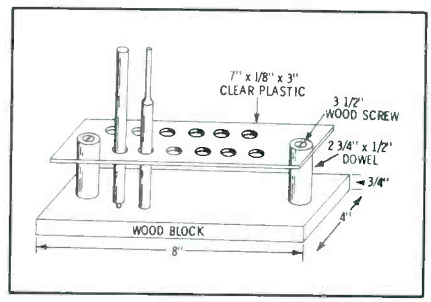
To remove miniature tubes from tight tube shields, use a 1/4" or 3/16" hex-head driver to gently push the tube while holding the shield. The end of the driver fits nicely over the nipple of miniature tubes, and distributes the pressure evenly, thereby minimizing the chances of breaking the tube.



Tape Retrieves Washer

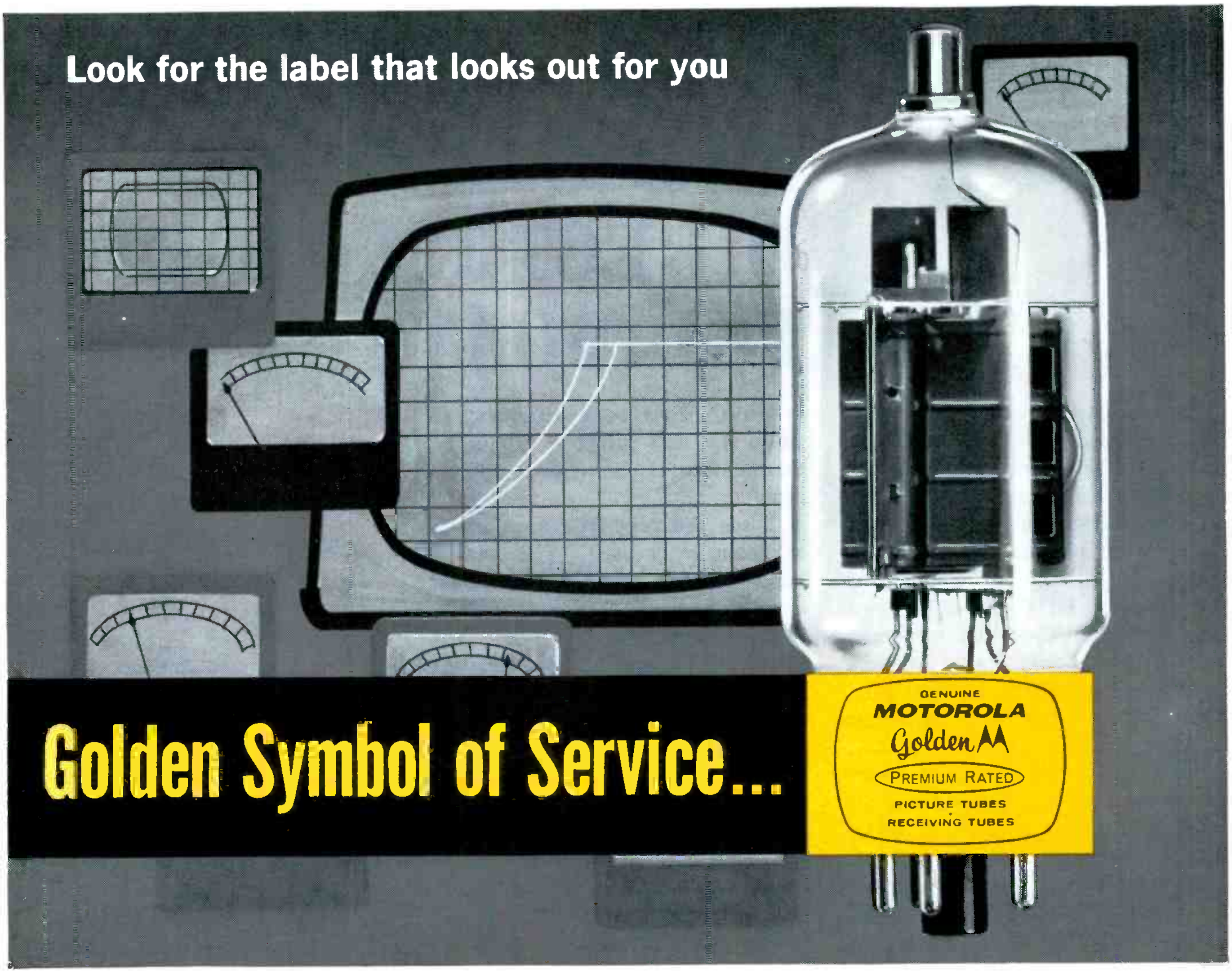
Space is at a premium inside transistor-type and other small radios, and there is not enough room to manipulate parts with regular tools.

To remove small items like washers from such receivers, attach a piece of adhesive tape to one prong of a pair of tweezers, and press the sticky side onto the part.



Alignment Tool Stand

It's much easier to select an alignment tool of a particular type if all of them are stored in a handy stand on the bench. You can easily make yourself such a stand from a piece of clear plastic about 1/8" x 3" x 7", a piece of wood 3/4" x 4" x 8", a couple of lengths of 1/2" x 2 3/4" dowel or broom handle, and two wood screws. First, drill holes in the plastic sheet to accept the shanks of your alignment tools. Add an extra hole near each end to accept the two wood screws, as shown in the drawing. Drill a hole down through each upright dowel for these screws. Finally, fasten the plastic top deck to the wood base, using the two dowels as vertical separators. The clear plastic top of the stand lets you view both ends of your alignment tools for effortless selection.



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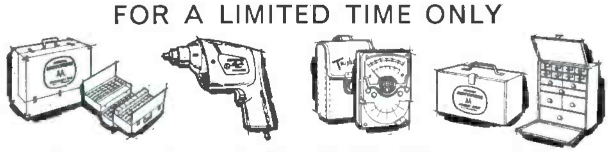

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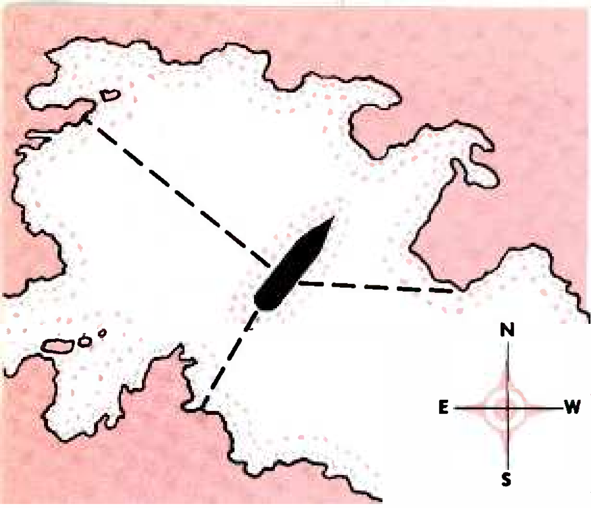

Uses, special circuit features, and general servicing hints for these handy navigation aids—by Allen Lytel

RADIO DIRECTION FINDERS FOR BOATS

Thousands of small boats are now equipped with radio direction finders (RDF), since many simple and inexpensive versions of these valuable navigation aids have been made available to the weekend sailor.

In essence, RDF's are little more than ordinary AM radio receivers, with a few modifications for improving their ability to determine the direction from which a signal is being received. A loop antenna is used because of its highly directional characteristics. Operating an RDF is a simple process of rotating the antenna and using a *null indicator* (such as a meter, headset, or speaker) to find the point of minimum signal pickup. As shown in Fig. 1, this null point occurs when the loop is turned with its broad side toward the oncoming signal. RDF's are tuned to nulls rather than to peak readings because the null provides a sharper, more accurate directional indication.

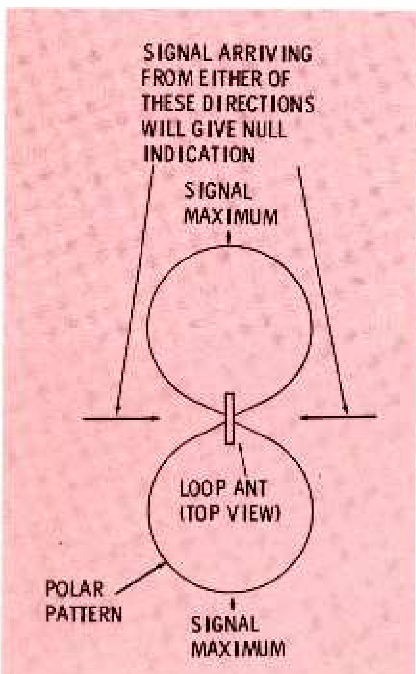

Fig. 1. Loop antenna has suitable polar pattern for direction finding.

Three different frequency bands are commonly used. The beacon band (150 to 500 kc) includes weather navigation stations, marine beacons, and aircraft ranges. The broadcast band (550 to 1600 kc) allows utilizing local AM radio stations when their locations, frequencies, and call letters are known. The marine band (1.6 to 5.0 mc) includes Coast Guard stations and other boat transmissions. Generally speaking, it is advisable to use the lowest available frequencies for direction-finding purposes.

Not all RDF receivers tune to all the above-mentioned bands, nor are the individual bands covered to exactly the same extent by all receivers. Some units which include the broadcast band also double as regular portable radios.

Plotting a "Fix"

From the RDF user's point of view, this term implies nothing shady; it's just a means of finding out where he is. A "fix" is obtained by taking RDF bearings of at least two (preferably more) transmitting stations whose locations are known, and plotting these on a chart. The *magnetic bearing* of each received station is found by determining the angle between the signal source and magnetic north, as indicated by checking the RDF reading against the boat's compass. Lines are then drawn at the correct angles through the transmitter sites on the chart, and their intersection represents the boat's position. Fig. 2 illustrates a typical fix using three AM broadcast stations as signal sources.

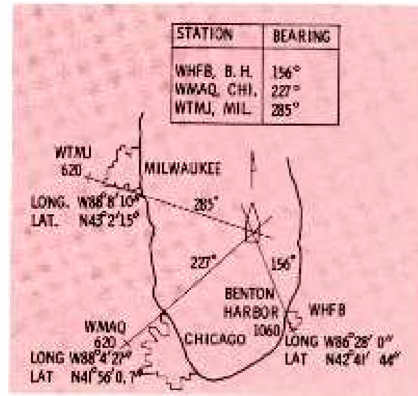

Fig. 2. Bearings from three stations fix boat's position on Lake Michigan.

Bearings must be taken from stations separated by more than 30° in order to establish an accurate fix. Fig. 3 demonstrates how a slight error in detecting null points can lead to a misjudgment of the boat's position when the signal sources are clustered too close together.

In addition to magnetic bearings, *relative* bearings (the angle between RDF indications and the prow of the boat) are of some advantage in helping the RDF user to set his

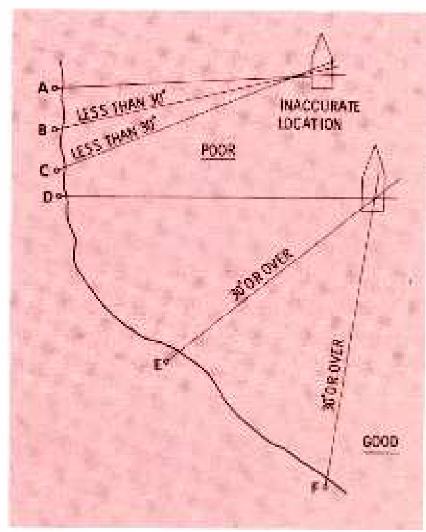

Fig. 3. Stations must be at least 30° apart to plot position accurately.

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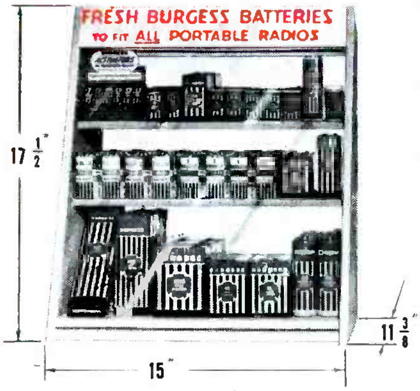

No. 604 Counter Merchandiser

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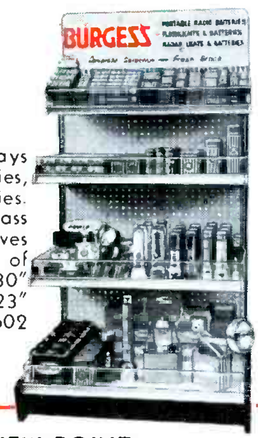
No. 601 Glass Front Counter Fixture Display

Attractive display fits needs of all types of dealers. Glass front, wood sides, open in back. Three sturdy shelves display large selection of batteries. Encourages fast buying action in heavy traffic spots in your store. Height 17½"; Width 15"; Depth 11⅜". Counter fixture included with No. 601 Portable Radio Battery Assortment.

No. 602 Store Fixture Floor Display

Standard half-gondola store fixture displays complete line of portable radio batteries, flashlights, lanterns and their batteries. Beautiful merchandiser sets up easily; glass binned shelving is pre-assembled. Shelves are adjustable. It takes full advantage of your store traffic to build impulse sales. 30" wide; 50" high (60" with sign); and 23" deep. Floor display included with No. 602 Store Fixture Assortment.



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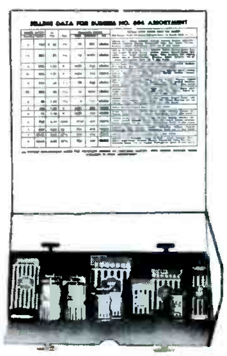

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course. It is also possible to navigate a boat by "homing" on a signal, if a usable signal source happens to be directly in line with the desired heading.

Special Receiver Features

The main difference between an RDF and an ordinary radio receiver is that the former must be very sensitive to fluctuations in received-signal strength, while the latter is designed to *override* such variations as much as possible. Therefore, if the audio output of the RDF receiver is to be used as

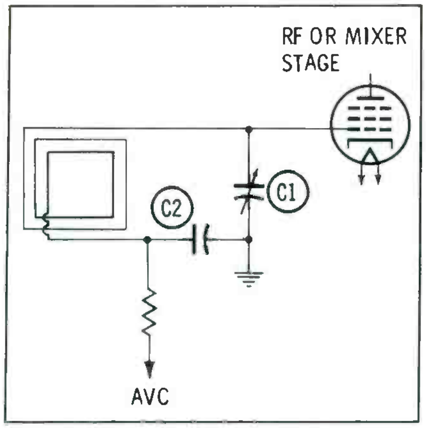


Fig. 4. Ordinary radio's loop antenna is unbalanced with respect to ground.

a null indicator, AVC is a drawback rather than a desirable feature. Many RDF units are equipped with a switch that grounds the AVC line while taking bearings; this insures constant operation of the receiver at full RF-IF sensitivity, and thus provides sharp null indications. Of course, it is also possible to leave the AVC system in operation and use the level of the AVC voltage as a null indicator.

Some sets have a BEARING WIDTH potentiometer which allows the user to vary sharpness of the null indication by regulating RF-IF gain. In units without AVC, this control often adjusts the cathode bias on the RF and IF amplifiers; in other sets, it provides for a greater or lesser extent of AVC action.

Random noise interference may make it impossible to determine the exact point of minimum-signal reception, especially when a bearing is being taken on a weak station. Some of the more elaborate RDF receivers employ a beat-frequency oscillator to overcome this problem. As long as the carrier of the desired station can be picked up at all, the beat frequency between it and the BFO signal provides a steady tone. This tone is much more reliable than ordinary program material for accurately detecting null points.

Several forms of null indicators — meters, loudspeakers, headsets, etc.—were mentioned in the introduction. Meters or tuning eyes give more accurate results than the simple aural indication provided by speakers or headsets. A voltmeter may be used to indicate the amplitude of the rectified RF signal at the output of the detector; this is

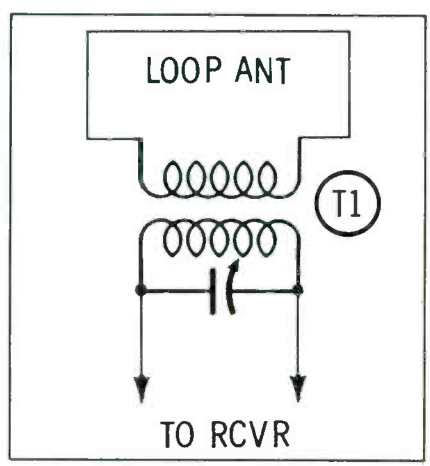


Fig. 5. Transformer-coupled antenna is balanced, thus better for RDF use.

almost the same thing as monitoring the AVC voltage. Another method of measurement is to insert a milliammeter in the plate circuit of some amplifier whose level of conduction is proportional to signal amplitude.

Loop Antennas

An ordinary radio receiver seldom operates as an accurate direction finder, since its loop antenna is not balanced to ground, and its loop is not as critically bidirectional as one designed especially for direction finding. In fact, its two null points are likely to be less than 180° apart.

In a typical home radio (Fig. 4), one leg of the loop is grounded

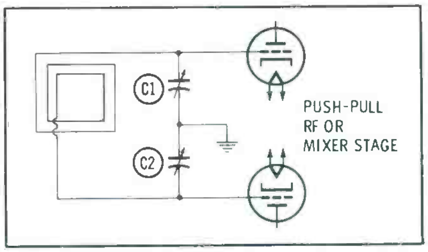


Fig. 6. This loop can be balanced by proper adjustment of both C1 and C2.

through capacitor C2 and the other through variable capacitor C1. These units are so unequal in value that an unbalanced condition is produced. On the other hand, the loop in Fig. 5 *is* balanced because T1 isolates it from ground. Another type of balanced loop is shown in Fig. 6. Capacitors C1 and C2 tune the loop to resonance, and the capacitance ratio between them can be varied to compensate for any dissymmetry in the loop.

As an RDF loop is turned, the capacitance between its various parts and ground may also vary. This effect can be offset by an electrostatic shield placed around the loop (Fig. 7). The device clamped onto the shield at the top of the loop is simply an insulated section which breaks the continuity of the shield and prevents it from behaving like a shorted turn.

Some loops are wound on a ferrite core and are very small. Fig. 8 shows such a loop installed in a pointer-type knob. Notice that the loops in both Figs. 7 and 8 are equipped with an azimuth card, or

Fig. 7. Electrostatic shield on loop is broken by insulated collar at top.

compass rose, to indicate orientation.

Sense Antennas

It was pointed out in Fig. 1 that a null indication can be obtained with the loop in either of two positions which differ by 180°. Unless the RDF user knows his approximate heading and the general location of stations being received, there is always the danger of tuning the receiver to the wrong null point. To overcome this problem, some direction finders employ a vertical *sense antenna* that enables the user to determine which null indication is the correct one. In Fig. 9, the sense antenna is connected to one side of the main loop by closing S1. R1 eliminates certain resonant effects of the sense antenna.

With the extra antenna connected, one edge of the loop will pick up a stronger signal than the other edge; thus, the signal from the sense antenna will increase the output voltage of the loop for signals coming from one direction only. To take a bearing, the user leaves S1 open while he finds two null points 180° apart. Next, he closes S1 and adjusts the loop to the position which gives maximum signal. This maximum indication tells him the general direction of the incoming signal, and the null reading indicates the exact bearing of the signal source (within the accuracy limitations of the instrument).

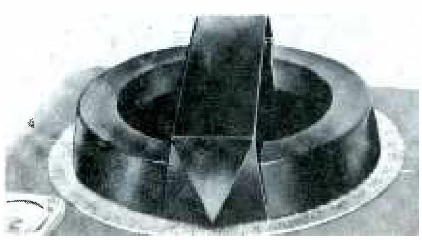


Fig. 8. Compact ferrite-core loop is often used in portable RDF equipment.

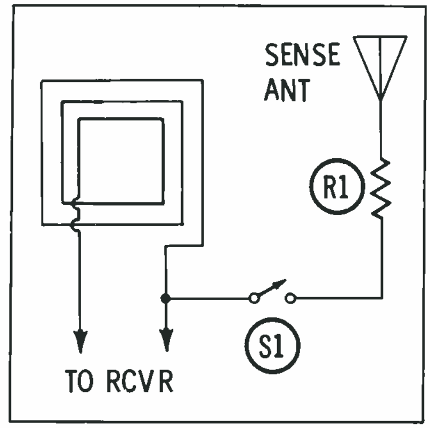


Fig. 9. Sense antenna determines which of two nulls is the correct one.

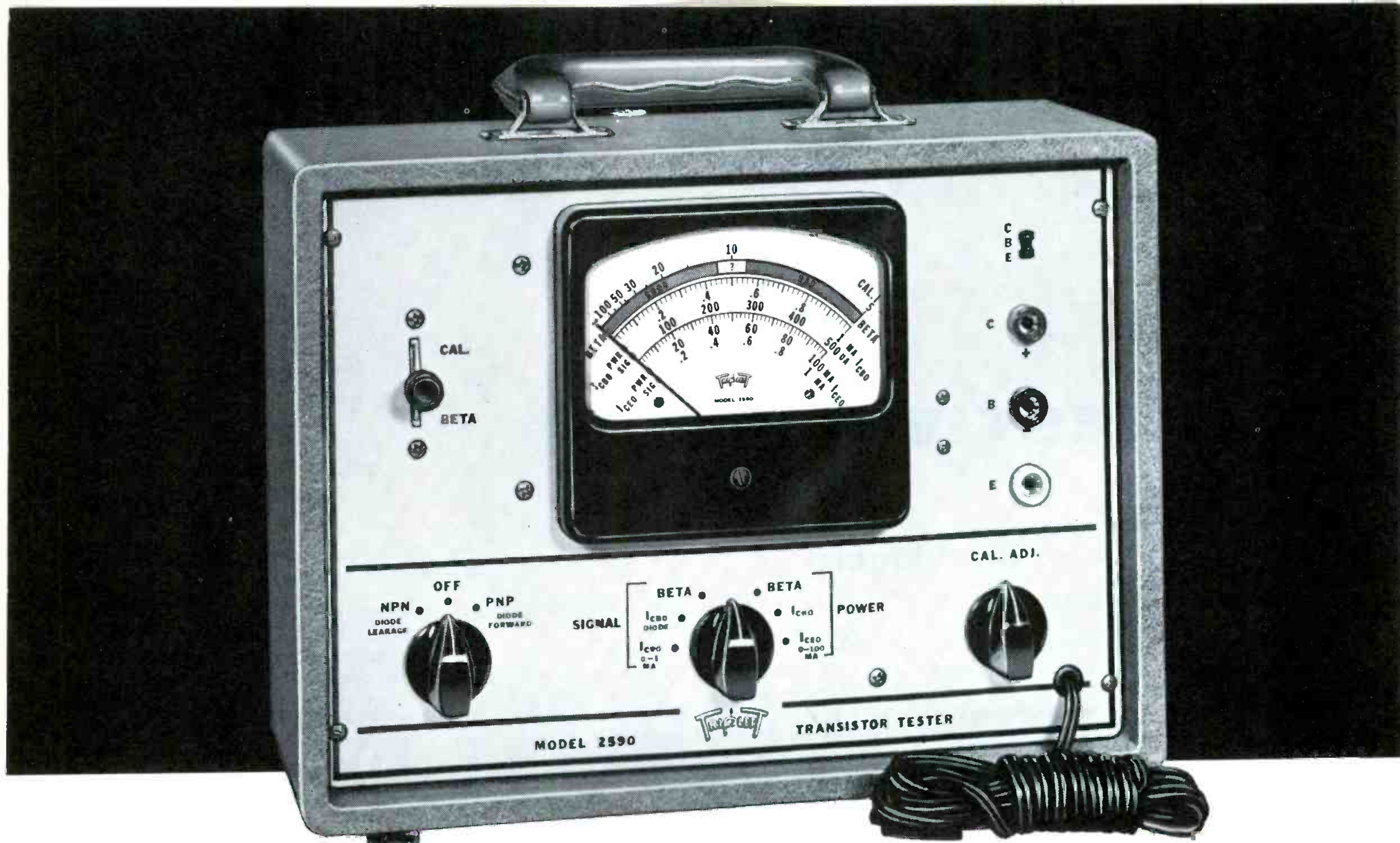
Servicing

Since RDF's differ from typical AM receivers in only minor circuit variations, they will present very few unfamiliar service problems. The most common types of RDF's brought into regular radio-TV shops for servicing will be portable, and these can be shop-serviced using standard test equipment.

Special emphasis should be placed on alignment, however, since good reception under adverse conditions may be required. If the unit is used in one of the larger classes of boats, it may be advisable to wait and put the finishing touches on antenna, RF and mixer alignment with the unit installed in the location where it will be used. Error introduced through nearby metal objects can affect the loop antenna enough to provide inaccurate bearings, with resulting complaints of malfunction in the receiver.

Tubes should be checked very carefully. Remember — the user may be staking his life (maybe unconsciously) on the reliability of a direction finder. Therefore, it demands a rigidly high standard of servicing. Dirt, moisture, and corrosion are some of the greatest enemies of this equipment—so be on guard against them. ▲

Editor's Note: For readers desiring a more comprehensive treatment on Radio Direction Finders, as well as other marine electronic equipment, we suggest Howard W. Sams "Marine Electronics Handbook," available through electronics parts distributors.



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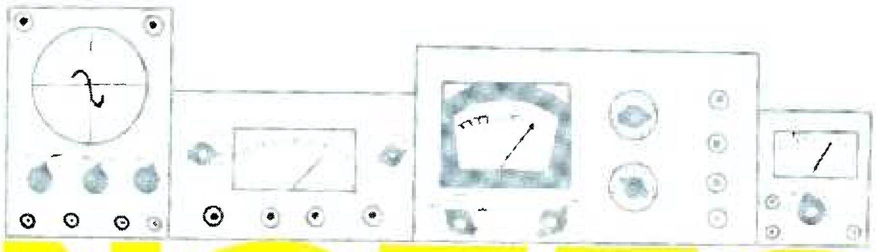


NOTES ON TEST EQUIPMENT

by Les Deane

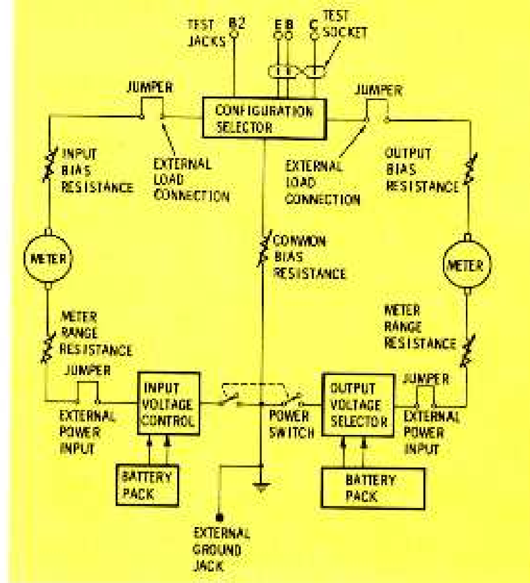


Fig. 2. Diagram showing the basic circuitry of the Model 850 Analyzer.

Breadboard

The instrument pictured in Fig. 1 is the Model 850 Transistor Analyzer manufactured by Hickok Electrical Instrument Co. of Cleveland. This unit is designed primarily to enable radio and TV servicemen to check transistors simply and accurately; however, its usefulness also extends to the laboratory for applications in the design and study of transistor circuits. Since dynamic transistor tests can be performed in simple breadboard fashion, the instrument is useful to the engineer, experimenter, student, and serviceman alike.

Specifications are:

1. *Power Requirements — ten self-contained 1.5-volt batteries, replaceable with standard size "D" cells; spring-return power switch provided; input supply variable from 0 to 2.75 volts with source resistance of .5 ohms; regulated output supply variable from 0 to 12 volts in 1.5-volt steps, source resistance .5 ohms; input and output circuits provided with panel binding posts for externally-applied power.*
2. *Transistor Tests—checks* NPN *and* PNP *transistors of either low-signal or power types for: collector leakage in common base or common emitter circuits, current gain* (beta), *alpha, input resistance, output resistance, power gain, and linearity.*
3. *Design Applications — breadboard configurations of common-emitter, common-base, or common-collector circuits for both* NPN *and* PNP *types; 6-position selector automatically provides diagram of configuration; input-circuit resistance variable from 0 to 1 megohm; output circuit variable from 0 to 100K ohms; input and output circuits provided with built-in meters and panel binding posts for external signal use.*
4. *Panel Meters — 3½" direct-current instruments connected in both input and output circuits; 5 ranges of 100 ua, 1 ma, 10 ma, 100 ma, and 1 amp full scale, with meter resistance given for each range; over-all accuracy ±2%; silicon diodes provide overload protection.*
5. *Other Features—standard transistor socket plus 4 individual test jacks (with clip leads) provided on front panel; transistor reference charts supplied in manual.*
6. *Size and Weight—metal case 13" x 16⅜" x 7"; 13 lbs. (less batteries).*

Taking notes on the Model 850 in the lab, I discovered that the instrument is something more than an ordinary transistor checker. As its name implies, it is a complete dynamic analyzer. Not only is it capable of performing all tests necessary for accurately evaluating transistor characteristics, but its flexible circuitry also permits the operator to study or construct various transistor-circuit configurations. This feature has a sort of hidden value in that, by working with the instrument, the user continually increases his understanding of transistor theory and circuit operation.

The most impressive physical feature of the instrument is its breadboard-like panel and configuration selector, providing a schematic presentation of the way the transistor is actually connected in the system. The selector switch, located just above the center of the panel, has six individual positions; these correspond to common-emitter, -collector, and -base configurations for either PNP or NPN transistors. Through a small panel cutout directly above this selector, the transistor connections are shown for each switch position.

A diagram of the Hickok Analyzer is shown in Fig. 2, which is a slight elaboration of the breadboard circuitry imprinted on the front panel. Basically, it consists of input, output, and common-return circuits. The battery packs (batteries not supplied with the unit) consist of two regular 1.5-volt flashlight cells for the input section and eight for the output section. Individual battery holders are mounted on a panel which, in turn, is held to the back of the case by six ¼" metal screws. To install or remove the batteries, the panel is merely tilted back as shown in Fig. 3.

Both input and output voltages are variable; also, by removal of a single jumper (Fig. 2), an external voltage source can be used for either circuit. Internal meter resistance will change for the current range selected; therefore, the range-selector switches are calibrated not only in full-scale current, but also in ohms of series resistance. Both ends of the panel knobs are used to indicate these values.

Variable bias resistance is accomplished by use of 11-position switches in both input and output branches. Open and short positions are also included for certain configurations. Resistance values other than those provided by the bias switches may be inserted in place of the jumpers connected between the battery supplies and the switches.

The Model 850 is usable up to 5 mc for breadboard design applications, which is more than adequate for general transistor circuit work. In the manual, I noticed that circulating collector current should not exceed 5 ma for low or medium power transistors, and 500 ma for power types. This caution also applies to measurements of *beta* (the current amplification factor of a transistor). When experimenting with the test functions, I found that the instrument could immediately detect shorted or open transistors as well as indicate the two most important evaluation characteristics —

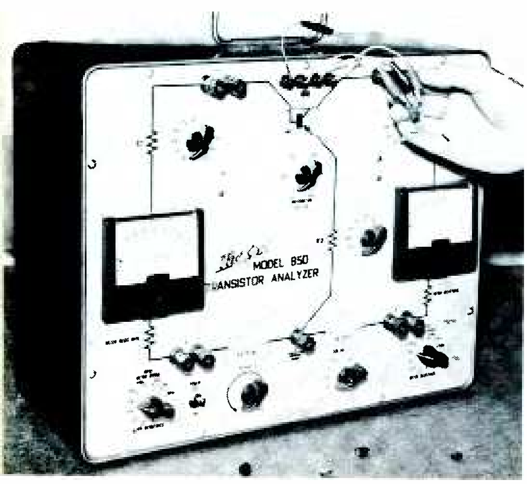


Fig. 1. Front panel of Hickok's Transistor Analyzer shows circuit hook-up.

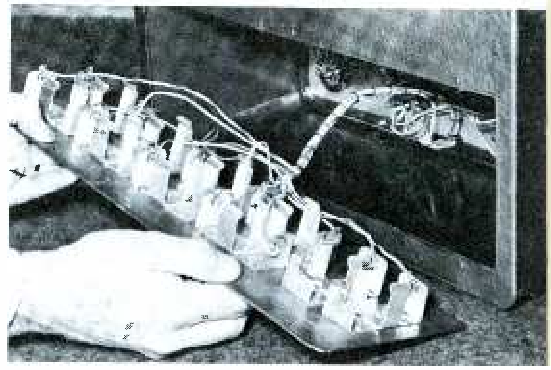


Fig. 3. Ten-cell battery panel removed from the Hickok Transistor Analyzer.

leakage and gain. These exacting tests are particularly suitable for checking transistor interchangeability and for matching pairs in push-pull applications.

Check DC from 5 mv to 5 kv

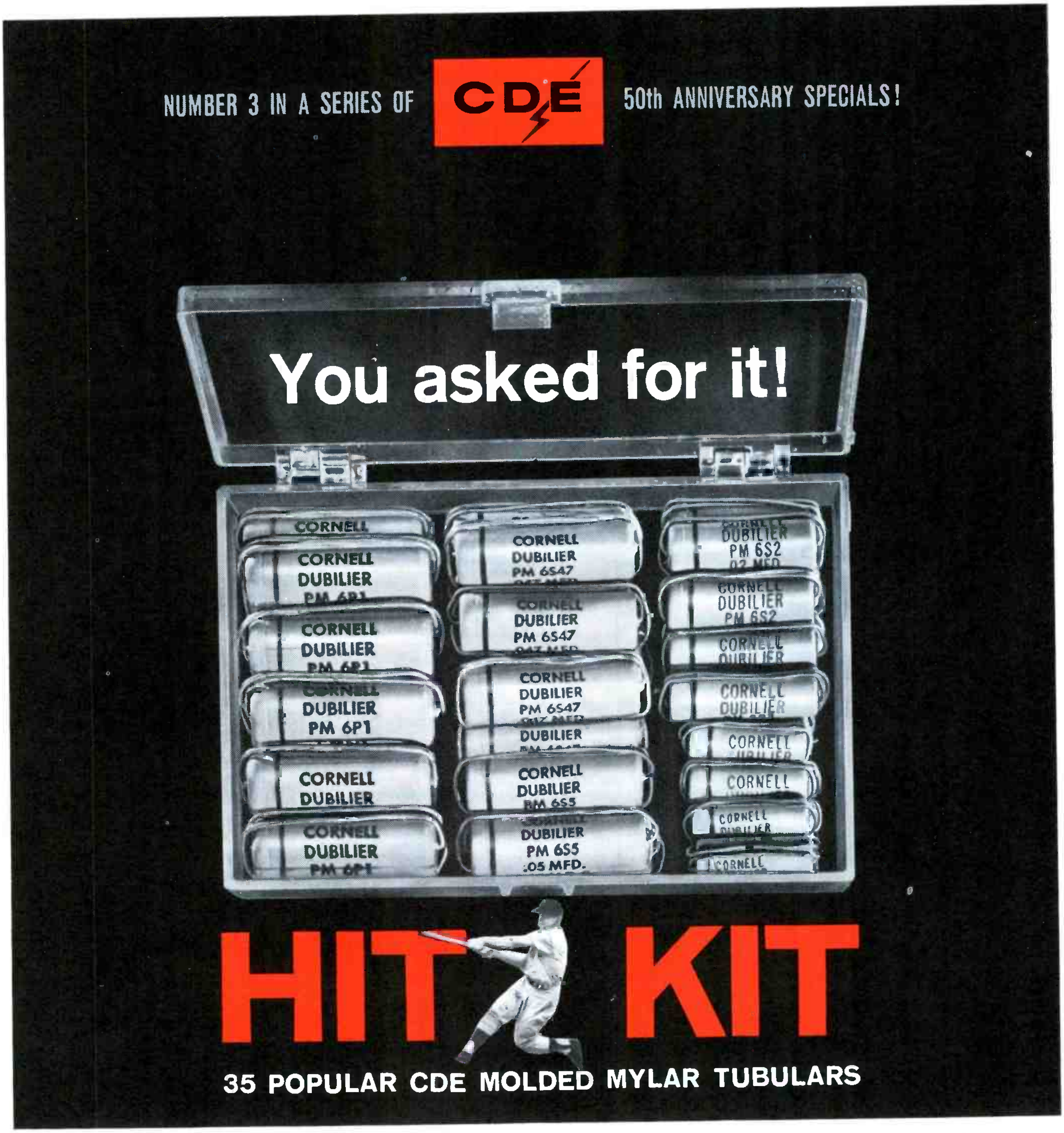
The volt-ohm-milliammeter pictured in Fig. 4 is the second test instrument to be marketed by RCA Electron Tube Division of Harrison, N. J. in both kit and factory-wired form. (The first, a *Volt-ohmyst* Model WV-77E, was covered in this column for August, 1959.)

This new VOM, Model WV-38A, features two extra-low DC ranges for voltage measurements in transistor circuits, and comes complete with test leads, batteries and manual. Kit versions also include simple step-by-step assembly instructions and large, easy-to-follow drawings.

Specifications are:

1. *Power Requirements—five self-contained 1.5-volt batteries, one size "D" and four* penlite *cells.*
2. *DC Voltmeter—eight ranges of 0 to .25, 1, 2.5, 10, 50, 250, 1000, and 5000 volts; sensitivity 20,000 ohms/volt; accuracy ±3%; polarity switch provided.*
3. *AC Voltmeter—six rms ranges of 0 to 2.5, 10, 50, 250, 1000, and 5000 volts; sensitivity 5000 ohms/volt; accuracy ± 5%; frequency response within .5 db from 10 cps to 50 kc for all ranges up to 50 volts full-scale.*
4. *Ohmmeter—0 to 20 megohms in three ranges of R x 1 (center scale 12), R x*

Fig. 4. RCA's new VOM features .25- and 1-volt full-scale DC ranges.



NOW – just in time for baseball TV-viewing (and TV-servicing) CDE has the Hit Capacitor Kit *you* asked for: 35 *popular molded* Mylar* tubulars that "shortstop" call-backs! Quality-proven by two years of consistently dependable replacement service, these high temperature, moisture-resistant "PMs" are the values you need and use every day. And now you can have this convenient assortment–plus a sturdy, plastic parts-or-jewel box–all for the price of the capacitors alone! A real "double-header." Get *two* "PM Kits" today–one for your shop, another for your service bag–from your CDE Distributor. Cornell-Dubilier Electric Corp., South Plainfield, N. J.

HERE'S THE BOX SCORE

No.	*Item*	*Mfd.*
3	PM 6D2	.002
5	PM 6D5	.005
6	PM 6S1	.01
5	PM 6S2	.02
5	PM 6S47	.047
6	PM 6S5	.05
5	PM 6P1	.10
Voltage: 600 VDCW		

ALL FOR ONLY $6.87

Pick the four teams in each major league that you think will be standing in 1, 2, 3, 4-order as of midnight, May 31, 1960 and win $100 worth of *any* CDE merchandise if the sequence you pick is closest to the actual order. See full contest details in kit.

*DuPont T.M.

CDE

CORNELL-DUBILIER ELECTRIC CORPORATION

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100, and R x 10,000; accuracy ±3° of pointer position on scale arc: zero-ohms adjust provided on panel; 1.5-volt potential applied on R x 1 and R x 100 ranges, 7.5 volts on R x 10,000 range.

5. *AF/db Meter—output ranges 0 to 2.5, 10, 50, and 250 volts; power levels from -20 to +50 db; zero db =1 milliwatt of AC power across a 600-ohm load; output jack with DC blocking capacitor provided.*
6. *DC Ammeter—six ranges of 0 to 50 ua, 1 ma, 10 ma, 100 ma, 500 ma, and 10 amps; accuracy ±3%; insertion loss .25 volts; separate jacks provided for 50-ua and 10-amp ranges.*
7. *Panel Meter — 5¼" extended-view unit with clear plastic front; 50 ua sealed movement; five individual scales plus db chart provided on face.*
8. *Accessories—two high-voltage probes available, one for measurements up to 25 kv and one for 50 kv.*
9. *Size and Weight—6⅞" x 5¼" x 3⅛" (excluding handle), 3½ lbs.*

When I removed the instrument chassis from its plastic case, I could see that almost all of its chassis wiring was confined to a single printed board. (See Fig. 5.) Components and certain connection points are located and identified by numbers on the top side of the board, while the etched wiring itself is confined to the back. The range-selector switch, mounted near the center of the board, can be rotated in either direction through all of its 12 positions.

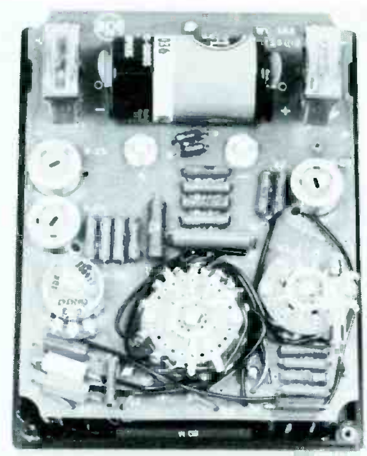


Fig. 5. Kit or factory-wired, the WV-38A utilizes a one-piece printed board.

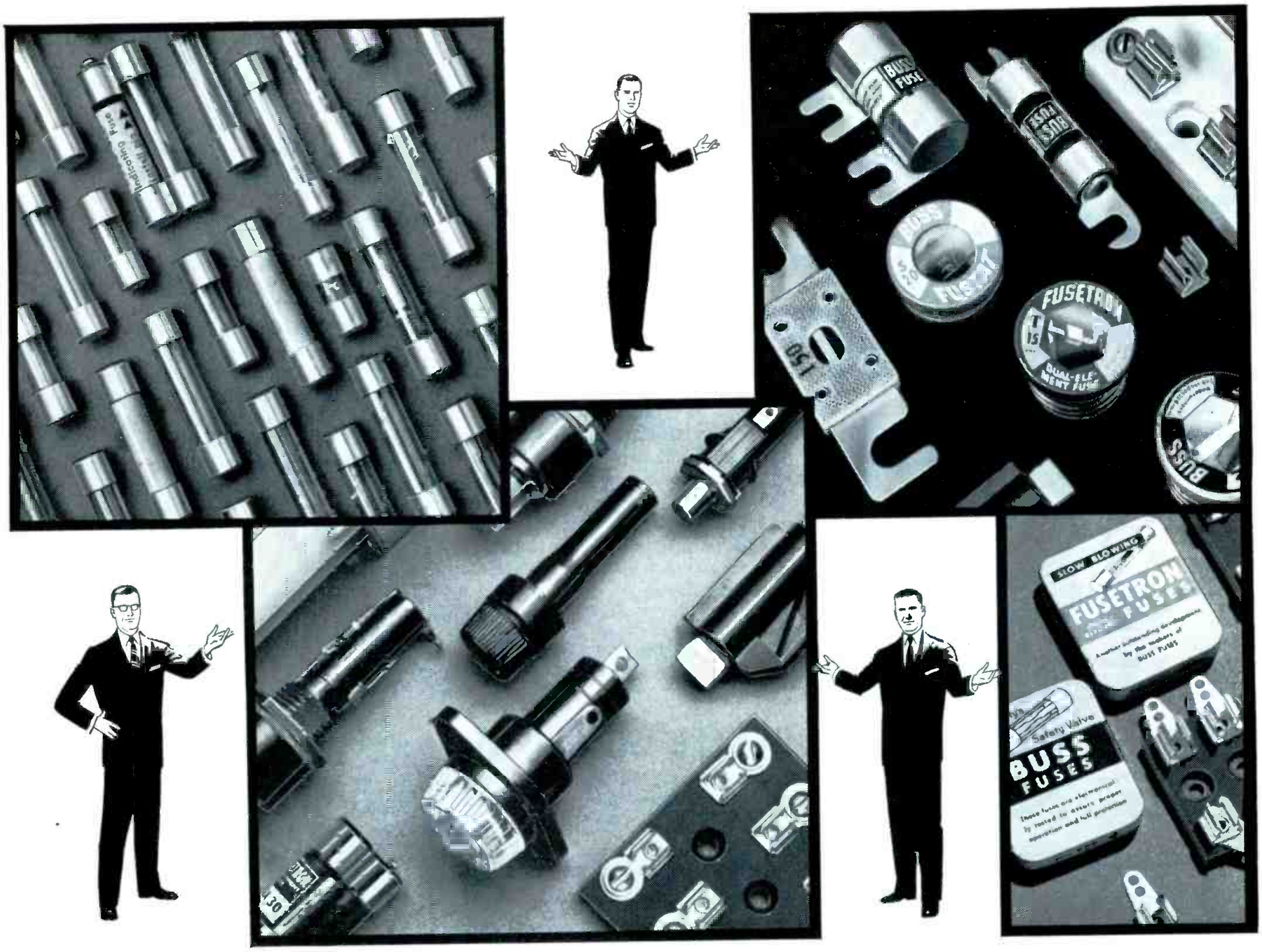
The battery pack is made up of a single size "D" cell, mounted between two spring clips near the top center of the board, plus four smaller *penlite* cells vertically positioned in pairs to the right and left of the larger battery. Each pair of *penlite* cells is held in by a U-shaped spring clip; to replace, the sides of the holder are merely pressed in and the clip is removed as shown in Fig. 6.

The pigtail fuse lying across the AC-DC function switch (lower right of Fig. 5) is a 1-amp, 250-volt unit connected in series with the common test jack; it protects the multiplier resistors against overloads during ohmmeter and milliammeter applications. If this fuse blows, the meter will be inoperative on all functions in which the common jack is employed.

Uses for this VOM are, of course, evident from its list of specifications. I found it particularly useful for checking bias potentials in transistor radios, especially on the two lowest full-scale ranges of .25 and 1 volt. These low ranges are also handy for measuring critical AGC voltages and checking for slight bias changes on an amplifier or oscillator grid.

As with most VOM's, placing the test leads across a high-impedance circuit may cause loading problems. To overcome this condition, additional resistance can be placed in series with the "hot"

Fig. 6. Spring clips hold small batteries and serve as electrical contacts.



Here are the plain facts!

. . . *why it pays to standardize on* BUSS FUSES

IT'S A FACT! BUSS fuses have provided dependable electrical protection under all service conditions for over 45 years in the home, in industry and on the farm.

IT'S A FACT! You never have to stop and explain why you carry BUSS fuses because your customers accept them as the finest available.

IT'S A FACT! Every BUSS fuse you sell or install is tested in a sensitive electronic device that automatically rejects any fuse not correctly calibrated, properly constructed and right in all physical dimensions.

IT'S A FACT! When you sell or install BUSS fuses, you avoid complaints that your fuses failed to protect or that they opened needlessly.

IT'S A FACT! Selling and installing BUSS fuses saves you time and trouble by avoiding call-backs . . . you keep your full profit and create satisfied customers.

IN SHORT . . . why take a chance with your good name by carrying fuses that might be faulty? Standardize NOW on genuine BUSS fuses. They help you protect your profits and your reputation for service and reliability.

For more information on BUSS and FUSETRON Small Dimension fuses and fuseholders, write TODAY for Bulletin SFB.

BUSSMANN MFG. DIVISION, *McGraw-Edison Co.* University at Jefferson, St. Louis 7, Mo. 460

BUSS fuses are made to protect - not to blow, needlessly.

BUSS makes a complete line of fuses for home, farm, commercial, electronic, electrical, automotive and industrial use.

FUSETRON · TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION · BUSS · McGRAW-EDISON lead, using a value higher than the impedance of the circuit under test. If you use just any value for the isolating resistor, however, the readings obtained will be only relative and not at all accurate. To help you make exact measurements under these conditions, the RCA manual goes a step farther, listing specific resistor values to be used with various scales.

For example, suppose you wanted to take a low-voltage grid measurement using the 2.5 volt range, but found that the instrument loaded the circuit so that an accurate reading was virtually impossible. In this case, you could either add a series resistor of 50K ohms, refer to the 5-volt scale and multiply by 2, or use 150K ohms and multiply the reading obtained on the 10-volt scale by 4. Multiplication factors and resistance values are also listed for use on the meter's 50- and 250-volt ranges.

Lab Tester for Shop

If you're in the market for a tube checker and want one that will test all types with a high degree of accuracy, you'll be interested in Triplett's new Model 3444 *Laboratory Tube Analyzer*. This unit is designed to measure vacuum-tube characteristics using applied potentials and signal amplitudes resembling those found in standard laboratory equipment. Although the instrument is fairly large in size, it is portable and comes complete with up-to-date tube listings, grid- and plate-cap leads, detachable lid, and instruction manual.

Specifications are:

1. *Power Requirements—105/127 volts, 50/60 cps; power consumption less than 20 watts in standby; line adjustment, overload indicator, and line fuse provided.*
2. *Short Test—shorts and leakage between tube elements checked with application of 85 volts DC in accordance with EIA standards; leakage sensitivity 10 megohms; measurements indicated directly on panel meter.*
3. *Dynamic Tests—mutual conductance indicated in 4 micromho ranges on panel meter; regulated plate, screen, and bias potentials plus 5-kc test signal employed; VTVM circuit detects only AC component of plate voltage; special gas/grid-current test and cutoff/plate-current measurements provided.*
4. *Emission Test—cathode emission for diodes and rectifiers measured under load and indicated on DC milliammeter.*
5. *Other Tests—measurement of firing voltage and control range for regular and reference tubes; tuning-eye tubes checked for shadow reaction; thyratrons tested for cutoff characteristics; special panel jacks provided for noise test; picture tubes tested through use of accessory adapters.*

Fig. 7. *Dim, Dim the Lights*—Triplett's new tester has its own "glow" power.

6. *Panel Features—200-ua meter with 4" scale and knife-edge pointer; storage compartment beneath removable triple-window roll chart; special socket adapter for acorn-type tubes; filament-voltage selector providing 23 different potentials from .6 to 117 volts; 8 test sockets, including one combination unit that accommodates 4, 5, and 6 prong tubes; 7- and 9-pin straighteners on panel.*
7. *Size and Weight—leatherette-covered case 15 3/16" x 18 13/16" x 7¾", 24 lbs.*

Fig. 7 pictures the instrument in operation on the bench; lab lighting was purposely dimmed to better illustrate those portions of the panel illuminated by concealed pilot lamps. Two bulbs light the face of the meter, while the roll chart is lighted by three individual bulbs—one for each window.

Basically, testing with the Model 3444 is accomplished through manipulation of various rotary switches. Don't let the number of controls shown in Fig. 8 give you the impression that this piece of equipment is too complex for speedy testing; actually, the operating procedures are fairly simple and straightforward. The instrument panel slopes toward the front of the case so that you will have little difficulty viewing the meter face at the top, even though it is positioned about ½" below its protective guard.

Of the test sockets lined across the top of the panel, the three on the right (Fig. 8) feature special "socket savers." Since the octal and both 7- and 9-pin miniatures are the most frequently used,

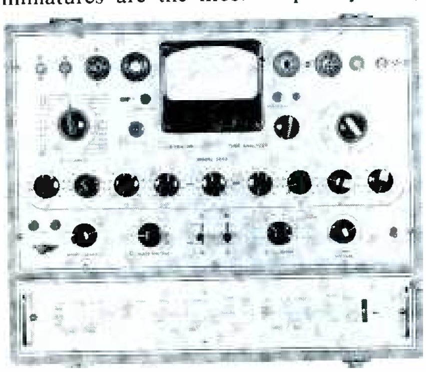


Fig. 8. View of the Model 3444 panel showing array of sockets and controls.

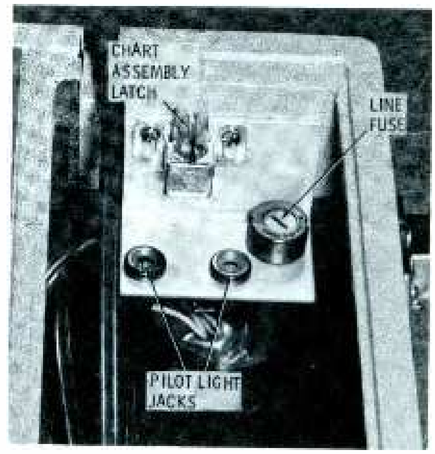
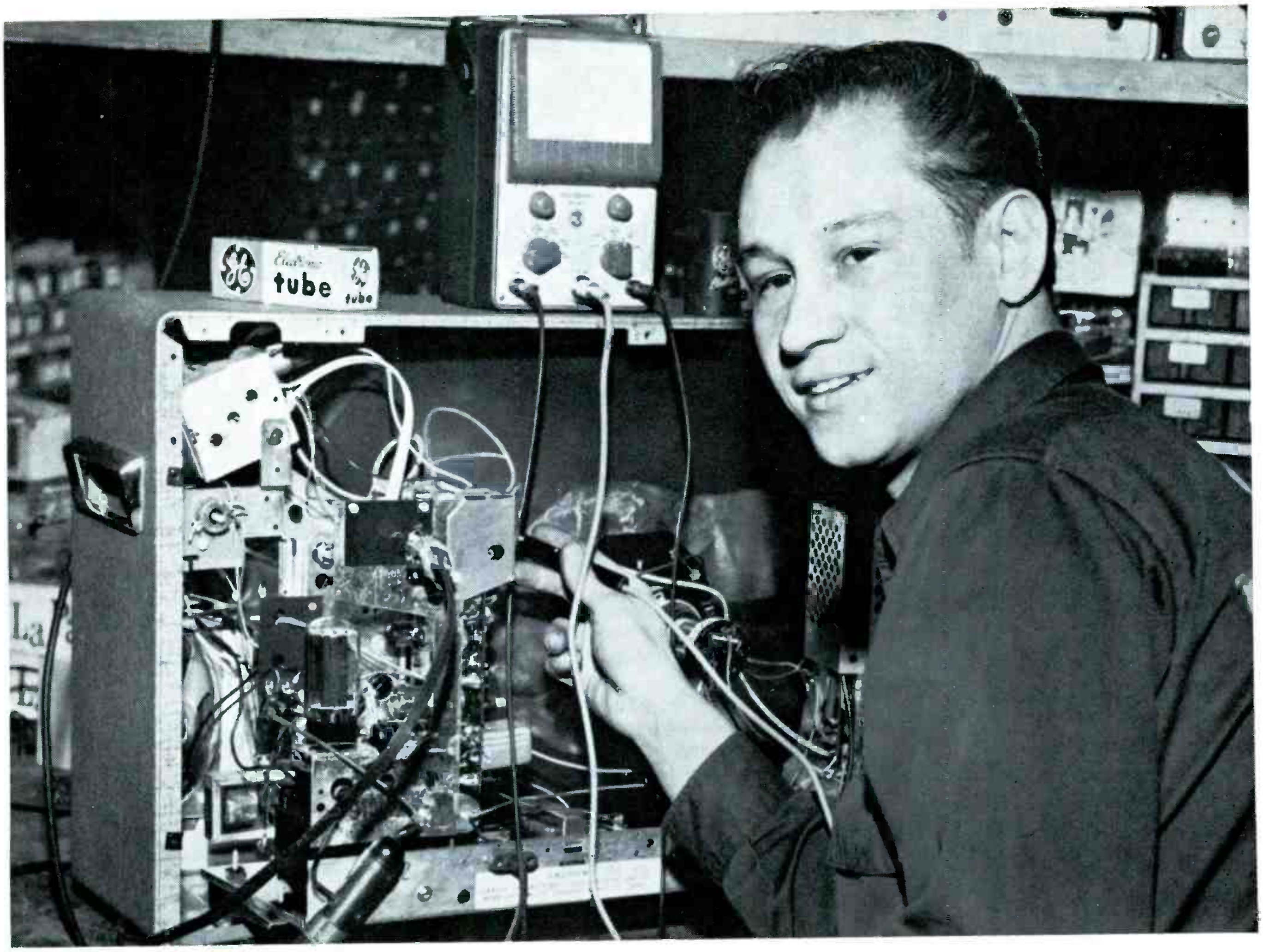


Fig. 9. Corner view of compartment in Triplett's Laboratory Tube Analyzer.

they are not permanently wired, but make use of throw-away adapters which are easily replaced when they become worn. After removal of the two screws holding the top metal plate, the socket or sockets can be unplugged and new ones inserted. Replacements are available from the manufacturer.

Another interesting feature of this tester is the provision made for checking and calibrating the 5-kc test signal and micromho indications. This is accomplished through the use of the adjustment labeled Gm CHECK. The knob, located to the right of the meter and directly below the PLATE CAP jack, controls a combination push-button switch and potentiometer. In its normal position, the knob is free to turn, but has absolutely no effect. Adjustment is made by turning the knob until it engages a small slot in the control shaft; then, as the knob is pressed down, a switch is actuated, connecting the potentiometer into the circuit. With the *Tube Analyzer* on, the "D" selector in one of its four Gm positions, and the SHORT-LEAKAGE switch set to VALUE, a balance between test signal and micromho reading can be obtained by holding the VALUE lever down and adjusting the Gm CHECK control for a full-scale indication on the meter. This calibration is necessary only periodically, but it must always be performed under exact line-voltage conditions.

As with many Triplett testers, the Model 3444 has a storage compartment under the roll-chart panel. This space is essentially reserved for the AC line cord, plate- and grid-cap leads, plus accessories such as the acorn tube-socket adapter furnished with the unit. The entire roll-chart assembly snaps into the top section of the compartment and is held stationary by a latch at each end. Items pointed out in Fig. 9 are found in the lower left-hand corner, mounted to one of the latch brackets. The fuse is a 3-amp unit connected in series with the primary winding of the power transformer, thus offering over-all protection to the instrument. Since the removable chart assembly is equipped with three pilot lights, two banana jacks are used for making electrical connections to the bulbs mounted under the roll chart. ▲



"The 'Designer' is the

LEAST TROUBLESOME SET

we have ever serviced,"

says Bob Wauganman of Bob's Television, 9518 Madison Street, Cleveland, Ohio.

"Speaking of the General Electric 'Designer'," says Bob Wauganman of Bob's Television in Cleveland, Ohio, "there probably isn't an easier set on the market today to service.

"We can do 90% of shop work without removing the set from the cabinet, and we find that, because General Electric licked the heat dissipation problem, 'Designers' last longer and suffer less breakdown.

"We have very few service calls on 'Designers'. Those that we do have are easily corrected. This gives us lots of time to get in more calls per day and, of course, it helps us to make more money, too."

"Designer" Tubes are directly replaceable, fuses accessible, and you easily get at the key check points. Another thing: the painted schematic on the boards helps you find your way around quickly. Again, more calls per day—and more money.

Precision Etched Circuitry is used in all "Designer" sets and is reliable and uniform so that when you have serviced one you will never have to puzzle over the next one.

"Designer" TV—called the easiest-to-service set in television! General Electric Company, Television Receiver Department, Syracuse 8, New York.

Progress Is Our Most Important Product

GENERAL ELECTRIC

THE TROUBLESHOOTER

ANSWERS YOUR SERVICE PROBLEMS

Surg-ury

In a Canadian TV with a voltage-doubler power supply, the 7.5-ohm fusible resistor burns out every two or three months. Surge current is around 500 ma, but normal drain is 300 ma. Can you help me find the reason why the resistor keeps blowing out?

GERARD LEBOEUF

Rimouski, P. Q., Canada

Your measured currents seem normal; a 500-ma surge is not uncommon. Try changing both rectifiers (especially if they are selenium units). Line-voltage fluctuations are a highly probable cause of this trouble. Another possibility is an intermittent short in the set—most likely in the damper tube.

Video Response

How can I use regular shop equipment to check the frequency response of video circuits?

J. R. SIMONIN

Detroit, Mich.

A marker generator, sweep generator, and scope can be used to check the frequency response of these circuits. Connect the outputs of both generators to the input of the video detector (across the secondary of the last video IF transformer). The cables should be properly terminated with resistance values equal to generator-output impedance—usually 75 ohms. Set the marker at 100 mc and the sweep to 106 mc with a 6-mc sweep width. The two signals will heterodyne in the detector, providing a "video sweep" difference signal which ranges from about 40 kc to 6 mc. A demodulator probe can be used with the scope to observe the familiar response-curve pattern; or, if you prefer, a low-capacitance probe and wide-band scope can be used to view the actual video-frequency waveform (see schematic and waveform drawings).

To determine what frequencies are being either attenuated or accentuated, increase the marker frequency so that part of the response runs off the base line. The reading on the generator dial can then be used to determine which portion of the response is being affected.

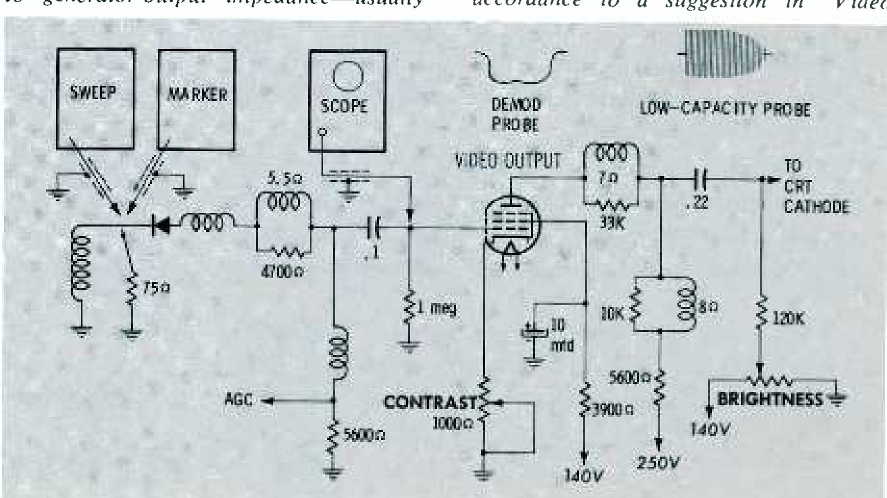
Shrinkin' Philco

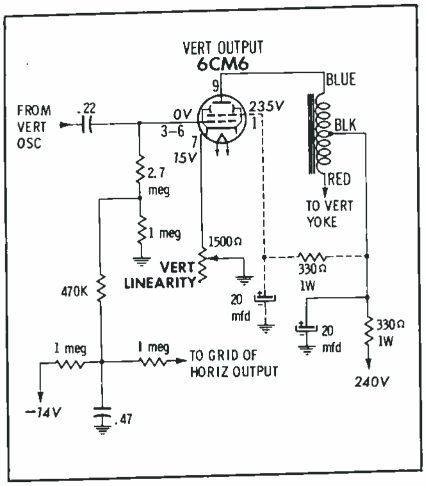
A Philco Chassis TV-354 has a raster that shrinks about 4" over-all whenever channels are changed. I've checked all resistors and capacitors in the vertical circuit and substituted different makes of new tubes. The output waveform decreases in amplitude, too. I've changed the output transformer and tried the circuit alteration shown on the enclosed schematic.

PETER GUTIERREZ

Topeka, Kan.

I see you've modified the circuit in accordance to a suggestion in "Video





Speed Servicing," Vol. 2. The dotted portion is also suggested. Try it. Another tip: Check the waveform at the grid to see if it changes appreciably when the raster shrinks.

The set may have a poorly-regulated power supply. Monitor the fixed negative-voltage source and boost line, as well as B+; fluctations of any of these supply voltages could cause your trouble. If poor voltage regulation isn't corrected by two new 5U4's, increased power-supply filter capacitance may be called for. Actually, a partially open capacitor would probably be at the root of such a trouble.

Real Gone

The picture and sound intermittently cut off in a Stromberg-Carlson Chassis 622 Series, and the AGC line develops −150 volts. Switching to VHF and back to UHF restores normal operation, and touching the grid of the third video IF slowly returns the set to normal. The condition pops up at any time and without warning.

J. M. Thurston
Ft. Wayne, Ind.

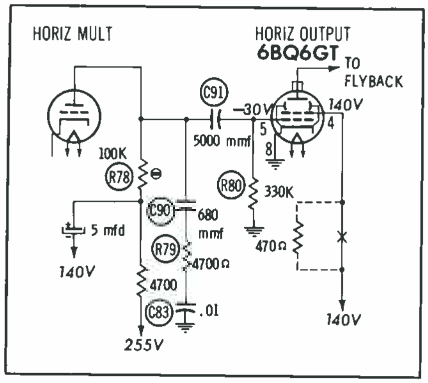
The highly negative AGC holds the clue to this one. Evidently the third video IF is going into oscillation because of improper alignment, an open bypass capacitor, or some other reason. Placing a probe or finger on the grid of this stage introduces enough capacitance to stop the oscillation, and the picture and sound reappear as soon as the charge on the AGC filter capacitor bleeds off to a nearly normal level.

Runnin' Wild

I'm having sync troubles in an RCA Chassis KCS117A. The picture runs wild, but can be stopped momentarily with the hold controls. All components in the sync circuits have been checked and tubes substituted. Voltages in these stages are all normal.

August P. Rondinelli
Trenton, N. J.

"Video Speed Servicing," Vol. 3, shows two common causes for sync loss in this chassis—a defective cathode resistor in the video output stage, or a bad coupling capacitor between sync stages.



If substituting for these parts doesn't solve the problem, forget your VTVM and grab your scope to trace the defect to its source. Review the series, "Tough-Dog Sync Troubles," in the February through April issues for advice in analyzing this type of symptom.

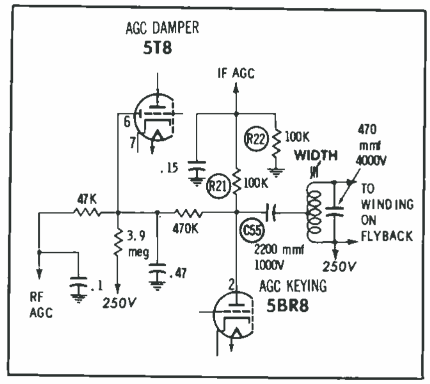
Overdrive

I have a Motorola Model 21T4AC with a bright line from top to bottom through the center of the screen. Waveforms, voltages, and components have been checked, and I give up. The line disappears if a substitute input signal is applied to the flyback, but not if a signal is injected at the output-tube grid.

F. B. GUTHRIE
Drexel Hill, Pa.

Sounds like a drive line. Its normal cause is an overdriven horizontal output-tube grid, providing excessive DC bias. The result is a rough transition between damper and horizontal output-tube conduction near the middle of each horizontal sweep cycle. This momentarily slows the scan and produces the bright line.

Be very critical of all components and voltages in the accompanying schematic. Substitute any component in question, rather than depending on a checker. Note that some versions use 120K ohms for R78; also, a revision in later production changed R79 to 6800 ohms to reduce foldover. Make certain the output-tube cathode is properly grounded, and scope the screen grid to be sure the supply voltage is properly filtered. Try connecting the 470-ohm resistor in the screen circuit if not already installed.



Why Plus?

I've got an RCA TV Chassis 5377 with 250 volts on the grid of the first IF. The set is drawing excessive current, but I can't pin down the cause.

RUSSELL FREESTONE
Glasgow, Mont.

I'd bet on C55, which couples the keying pulses from the horizontal output circuit to the plate of the AGC tube. If this capacitor became shorted, at least 250 volts would appear on the AGC line. Since you say the first-IF grid voltage is a full 250 volts, and not some lower value, I have an idea that R22 has become open or greatly increased in resistance. Other AGC-circuit components may also have been damaged—so I'd recommend a thorough analysis of voltages and resistances on and around the AGC network.

Partial Cure Kills

An Admiral Chassis 24D1 has a severe case of horizontal jitters. I've found a bad output filter in the power supply, but when I replace it I lose all brightness. Can you give me a lead to the trouble?

CHELCIE HOSKINSON
West Hamlin, W. Va.

Here's a good case of multiple problems. Since you've discovered the bad filter, replace it with one of correct rating. Apparently, the restored B+ is killing the horizontal oscillator. This sounds like AFC trouble—so remove the AFC tube to see if the raster is restored. You'll probably find that the increased B+ voltage is causing the AFC to disable the oscillator as a result of a leaky capacitor. Checking the AFC and oscillator circuits with a VTVM and scope should lead to the solution of the remaining problem.

Organ to Juke

I want to connect a Lowrey Model LS organ to a Wurlitzer Model 50 juke-box amplifier. Making the connection from the output jack of the organ won't work. Can you give me advice about the hookup, and can I use the juke-box speaker?

JOHN J. ZEDER
Williamsville, N. Y.

The signal at the organ's output jack is strong enough to drive an external speaker, so you're overdriving the amplifier. An output taken from pin 1 of the socket going to the "swell" pedal will give you better results, but the amplifier still may distort the signal because of its uneven response. The juke-box speaker should work all right with the amplifier; however, you might do better to disconnect it and attach it directly to the output jack of the organ.

Converts With Ease

I have an RCA Chassis KCS47C I want to convert into a 21" set. A composite video signal of 100 volts peak to peak is available to drive the new tube. I'm figuring on using a 21FP4C to replace the 17CP4. Mechanics of the conversion offer no problem. Do you have any suggestions in regard to circuit changes?

TALMAGE ALLEN
Los Angeles, Calif.

Deflection angle is the same; you have plenty of signal (72 volts of bias will produce visual cutoff on the 21FP4C); you'll increase the high voltage when you ground the outer coating of the new tube; so you have a clear track for this conversion.

The only unsolved problem is to pick up a focusing voltage somewhere to connect to pin 6 of the new tube. Experiment with applying various voltages from either ground or B+ to find which gives best results. Caution! DON'T use boost voltage to focus this tube.

"You're a very lucky parent, Mrs. Filstrup. I've located your JENSEN CARTRIDGE!"

G.E.'s 10 Year Olds

(Continued from page 29)

sets; instead, it adjusts the RF-IF gain by varying the AGC bias voltage. The control range is relatively small, and AGC is never completely removed from the controlled stages.

Fig. 2, a schematic of the contrast-control circuit, shows that the lower end of this control is connected to the grid of the sync separator. At first, it might appear that the separator is receiving bias voltage from the AGC circuit, but just the opposite is true; the AGC voltage is being partially derived from the separator grid voltage. The contrast-control circuit forms part of the grid-leak resistance in the sync-separator stage; therefore, a negative DC voltage—which increases in direct proportion to the strength of the sync-input signal—appears at the "lower" end of the contrast control. At the same time, operation of the video detector generates a negative DC voltage across the detector-load resistor, also in direct proportion to input-signal strength. This detector voltage adds to the voltage generated by the sync separator; however, the signals which produce these two aiding DC voltages are opposite in polarity. (The sync pulses are negative-going in the video-detector output signal, but positive-going in the separator-input signal.) Consequently, the signals' AC components tend to cancel each other, while the DC components reinforce each other—and a minimum of filtering is required to obtain a pure DC voltage for the AGC line.

A number of other receivers, including G-E's later models, also feature an interconnection between the AGC and sync-separator circuits. However, this network seldom contains a potentiometer.

Is it any wonder that anything which interferes with the satisfactory operation of any video IF, detector, video amplifier or sync stage will produce a chain reaction leading to a pitiful picture? Shorted and gassy tubes are prime suspects when you have this type of trouble. Next in line are leaky bypass and coupling capacitors, resistors that have changed value, and faulty electrolytics, in that order. When resistors in the contrast-control circuit

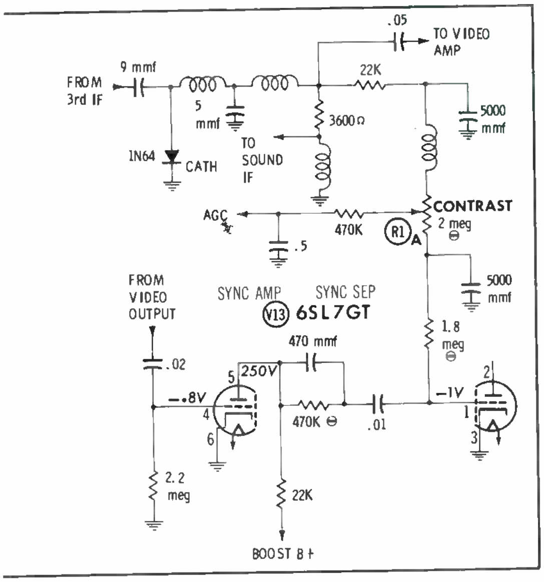


Fig. 2. Contrast control regulates AGC voltage; ties into sync separator.

change value, or leakage develops in one of the AGC filter capacitors, these receivers will overload at normal to high contrast settings and will produce very dark pictures. In addition, sync pulses in the video-output signal may be compressed, as in Fig. 3; if so, the receiver will probably lose either vertical or horizontal sync, or both. Most certainly, the picture will at least be distorted to some extent by horizontal pulling. In this series of receivers, advancing the contrast control should not cause sync compression, except perhaps at the very highest settings.

The best way to check for squashed pulses is to connect your scope through a low-capacitance probe to the grid of the sync amplifier, and then vary the contrast control over its range. If overloading occurs at normal signal levels with R1 at a low or medium setting, you definitely have trouble in the stages ahead of the sync amplifier. Otherwise, look to the sync section for the reason behind any synchronization problems you may have.

Sweep-Circuit Features

Looking at the sweep section

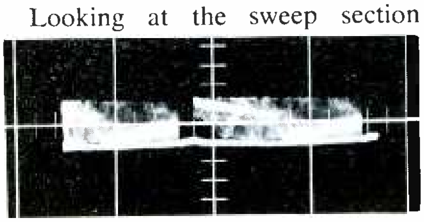


Fig. 3. Sync-pulse compression in video signal (compare with Fig. 1B).

(Fig. 4), we find that the vertical output tube also acts as one section of the vertical multivibrator. Some of us will remember the perplexity we felt a number of years ago when we first encountered this type of circuit, but it has become too commonplace by now to excite much comment. The most surprising feature of this old G-E circuit, to the eyes of today's technicians, is the use of a 12AU7 as a vertical output tube. Hardly considered a power amplifier by ordinary standards, this dual triode has both its sections connected in parallel to supply sufficient current for producing vertical sweep.

The vertical retrace-blanking circuit of G-E's '50 and '51 sets is unusual, to say the least. The positive "kickback" pulses present at the top of the vertical output transformer are applied to a vertical blanking amplifier (half of a 12SN7GT in Fig. 4) which inverts them. The resulting negative-pulse signal is fed to the accelerating anode of the picture tube in order to cut off beam current during vertical retrace time.

In the horizontal sweep section (not shown), you'll find a sine-wave oscillator circuit controlled by a dual-diode phase detector through a reactance tube. This layout appears strange after years of seeing little else but *Synchroguide* and multivibrator-type horizontal oscillators; however, it is almost a direct ancestor of the up-to-date Zenith circuit described in the July, 1959 *Servicing New Designs* column.

The sound circuits give a telltale clue to the age of this G-E chassis series. Did it ever occur to you

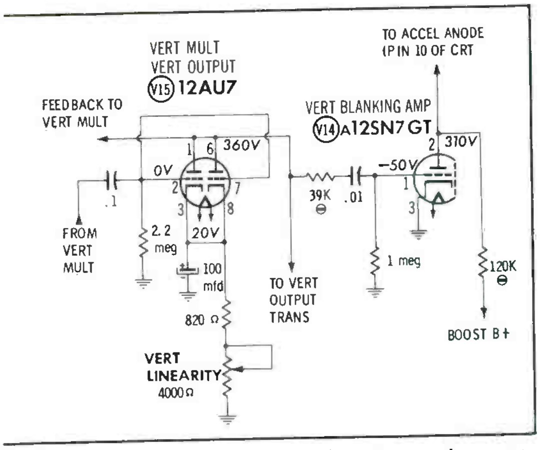


Fig. 4. Vertical blanking pulses are amplified and fed to pin 10 of CRT.

that proper focusing of the picture might be dependent upon audio-output tube conduction? Take a good look at Fig. 5, and note that the magnetic focus coil and its control are connected in the cathode circuit of the audio output stage. Therefore, a decrease in cathode current will cause not only blurred sound, but also a blurred picture.

Early Series String

TV sets with series-connected tube filaments and no power transformer are commonplace today, but they were the exception to the rule a decade ago. At that time, tubes especially designed for TV series-string applications (with 600-ma filaments having controlled warm-up time) were not yet available; so G-E used *two* paralleled strings of 300-ma tubes (Fig. 6) in their early receivers. This explains why about half of the tubes in the set will go dark whenever one tube burns out. The picture tube, which requires 600 ma of filament current, is the only tube common to both strings.

Although not equipped with an isolation transformer of any kind, this G-E chassis does not fall strict-

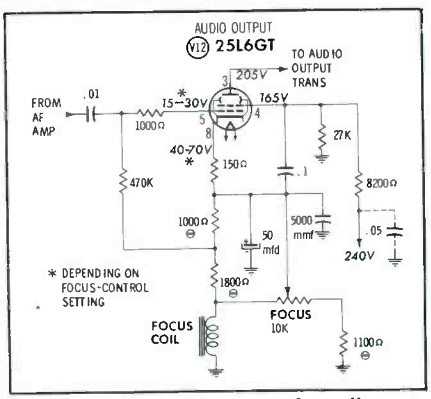


Fig. 5. Cathode current of audio output tube passes through focus coil.

ly into the "hot" category. The low side of the AC line is connected to a common or B-minus network, which is isolated from the metal chassis by resistors and capacitors. Nevertheless, since B-minus must serve as a ground point for test equipment, you need to classify the old G-E as a "hot" set for servicing purposes. I strongly recommend an isolation transformer between you and oblivion.

The location of the on-off switch in the low side of the AC input circuit presents an added hazard. If the AC power cord is plugged in so that the ungrounded side of the power line is connected to the thermal cutout, there will be no difference in potential between B-minus and earth ground—as long as the on-off switch is closed! But if you cut the power off and *then* measure between B-minus and an external ground with an AC voltmeter, you will find 117 deadly volts on the B-minus network. Reversing the line plug in the wall socket doesn't solve the problem; this protects you while the set is turned off, but places 117 volts AC on the B-minus wiring when the set is on.

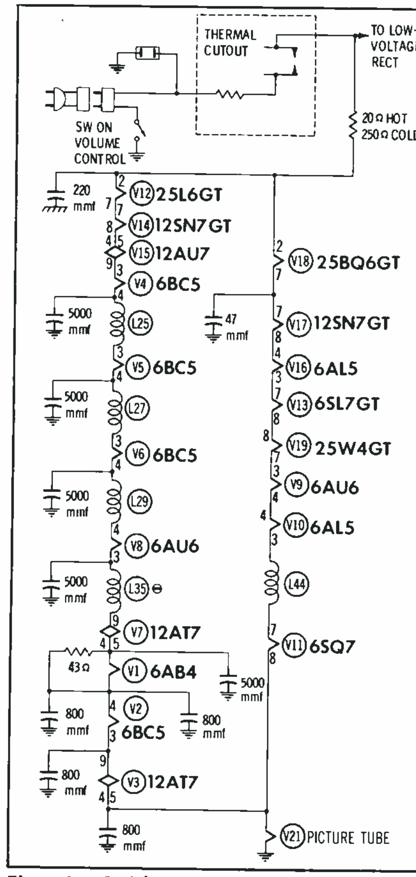


Fig. 6. Guide to series-parallel filament circuit of early G-E TV receivers.

Another reminder: Don't absent-mindedly clip the ground leads of your test instruments to chassis, or you will pick up enough hum to make measurements meaningless. Fig. 7 shows the sad results of attempting to view a waveform with the ground lead isolated from B-minus.

The low-voltage power supply of these receivers uses two selenium rectifiers in an entirely conventional half-wave voltage-doubler circuit. The bimetallic thermal cutout in series with the input lead is a type of circuit breaker which serves the same protective function as a fusible resistor, and also protects the filament circuit. If it opens, you can reset it by pressing a red button on the rear of the chassis. Resetting should be delayed at least several seconds, to allow the metal elements to cool.

As insurance against future complaints of hum or picture bending, check the low-voltage power supply for adequate filtering as well as normal DC output voltage. The scope waveform across the input filter capacitor should measure no more than approximately 25 volts peak to peak, as shown in Fig. 8A. Only

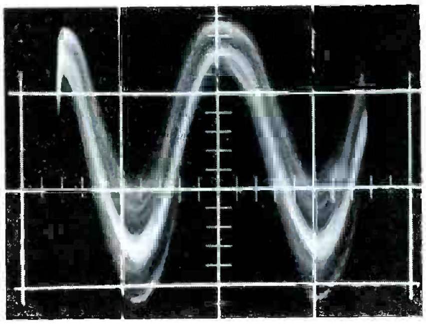


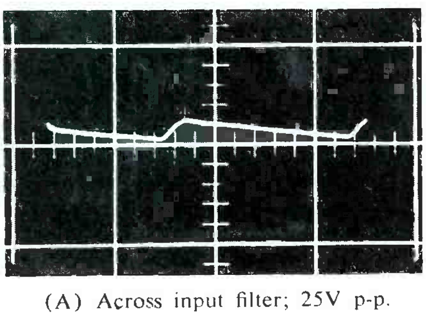
Fig. 7. Severe hum distorts waveform when scope is grounded to chassis.

about 1.5 volts of ripple should be seen at the positive terminal of the output capacitor (Fig. 8B).

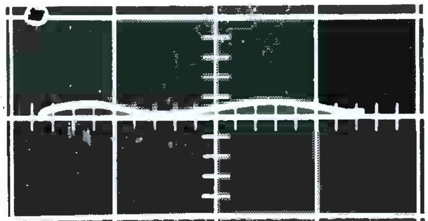
Service Calls

A frequent complaint from owners of old G-E receivers is, "The set's dead," since a burned-out tube in the right-hand series string (Fig. 6) will disable both high voltage and sound. An open condition in the other series string will also result in loss of sound, and the raster will collapse to a bright line because vertical sweep will be disabled.

If all tubes are lit, and you don't have a tube checker, voltmeter, filament-dropping resistor, and a pair of selenium rectifiers with you on the home call, you can figure on a shop job. Once you have the set on the bench, go to work with the aid of the troubleshooting chart, your scope, and your voltmeter. Take a little extra time to do the job right; the results will be delightful. These receivers can still give darned good pictures. ▲



(A) Across input filter; 25V p-p.



(B) Across output filter; 1.5V p-p.

Fig. 8. Normal power-supply ripple.

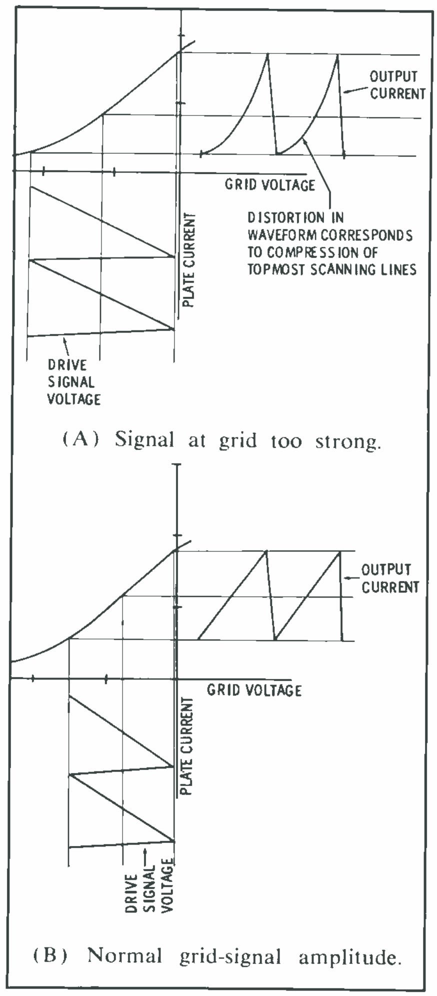
Tube Changing

(Continued from page 26)

arity controls are likely to have been adjusted to compensate for a weak oscillator or output tube, replacement of either of these tubes may call for resetting both controls. Before proceeding with final adjustment, it is my usual practice to turn both these controls to minimum as a check on vertical centering. The black areas above and below the resulting vertical scan line should be equal if centering is correct. Recenter the line vertically, if necessary, before adjusting the size and linearity controls to fill the screen.

The size (height) control is most often located in the plate circuit of the vertical oscillator, where it can most effectively regulate the amplitude of the drive signal fed to the grid of the vertical output tube. Replacing the oscillator tube may increase the peak-to-peak value of the sawtooth signal, and installing a new output tube will generally result in more deflection for a given drive-signal amplitude. As a rule, then, the height setting must be slightly reduced after replacement of either tube.

Don't worry about faulty linearity until after the height control has been reset, since reducing the height to a near-normal level may automatically restore good linearity. The simplified diagrams in Fig. 2 show why this is so. For the purpose of this illustration, we will assume that linear plate current in the output tube will result in linear yoke current. With excessive drive-signal strength (Fig. 2A), negative swings of the signal bring the output-tube grid voltage to (or beyond) cutoff. The negative peaks of the plate-current signal waveform are then flattened, and the top portion of the raster is compressed. In Fig. 2B, the lower peak-to-peak amplitude of the input signal allows it to appear entirely on the linear portion of the tube's characteristic curve. (In a large percentage of sets, an automatic reduction in grid-leak bias helps this action along.) Consequently, the output-current signal becomes linear. In case the



(A) Signal at grid too strong.

(B) Normal grid-signal amplitude.

Fig. 2. Excessive drive-signal amplitude tends to compress top of raster.

scanning lines are still unevenly spaced after height has been adjusted, the linearity control must be reset in order to restore the correct operating bias on the output tube. As a final check for proper linearity, set the vertical hold control to produce a "slow roll" condition, and see if the thickness of the vertical blanking bar remains fairly constant as it travels down the screen.

Be sure to check the range of the hold control if the oscillator tube has been replaced. The picture should roll both ways. If it won't, look out for further trouble in the oscillator circuit.

Horizontal Oscillator and Output

The horizontal oscillator tube is generally a dual triode (usually a 6CG7, 6SN7 or 12AU7). Since interelectrode capacitance (including that between tube sections) may vary quite a bit among individual tubes, it is advisable to readjust the oscillator circuit each time the tube is replaced.

This alignment is usually nothing more than a simple touch-up of the horizontal frequency slug, except in some sets that employ a standard type of *Synchroguide* circuit containing two slugs. In the latter case, knowing which slug to turn can be a problem. To avoid an unnecessary trip to the shop, just remember this: Reset *only* the frequency slug, never the waveform slug, unless you have a scope hooked up to the circuit. If you don't know which is which, give each slug one turn and then bring it back to its exact original setting. The one that most noticeably shifts the picture is the frequency slug. Adjust it for proper lock-in at the center of the hold-adjustment range.

The horizontal output tube, in spite of its special operating conditions, is still basically a power amplifier. Its primary purpose is to raise the grid signal to a high enough power level for driving the horizontal yoke coils. In any amplifier stage, gain depends on tube Gm, circuit operating voltages, and load impedance. The least constant of all these factors is Gm, which can vary over a great latitude according to the condition of the tube. If you install a "hot" new horizontal output tube in a set to correct for a slight lack of width, you can expect the width trouble to return long before your guarantee period runs out. The Gm decreases slightly during the first 100 hours or so of tube operation, and the tube then settles down to delivering its normal work load for the rest of its useful life. For this reason, you should allow a brand-new horizontal output tube to overscan the CRT screen to a slight degree.

If width, drive, or horizontal linearity controls were previously advanced to make up for a weak horizontal output tube, it will be necessary to change their settings back to the original level when a new tube is installed. In case a receiver lacks these controls, and a known good horizontal output tube does not provide satisfactory sweep, you have no recourse except to troubleshoot the circuit. Due to the use of grid-leak bias on the output stage, insufficient drive-signal strength results in excessive tube current. This shortens output-tube life and may also contribute to the early demise of the damper tube and output transformer. Therefore, it is a general practice to adjust a drive control for maximum signal voltage, and then reduce the signal amplitude just enough to remove any folds or wrinkles from the picture. This results in a condition of minimum circuit current, usually accompanied by acceptable width and linearity.

The drive control is often a small trimmer capacitor conected as shown in Fig. 3. Signalwise, the trimmer is in series with fixed capacitor C2, and the two components form an AC voltage divider. As the trimmer is tightened, its capacitance increases, and a smaller proportion of the total available signal is applied to the output-tube grid. Caution: Some sets have a *series* trimmer (in place of C2), and tightening this adjustment will cause an *increase* in drive-signal strength. Observe the effect on the raster, or consult service data, to determine which way the trimmer adjustment of a particular set should be turned to obtain greater drive.

A number of receivers have potentiometer-type drive controls. These are usually located in the oscillator plate circuit, and their effect on the sawtooth signal is comparable to that of the height control in the vertical section. You may also find the term "drive control" applied to a potentiometer that varies the output-tube screen voltage, but this adjustment is more often called a width control.

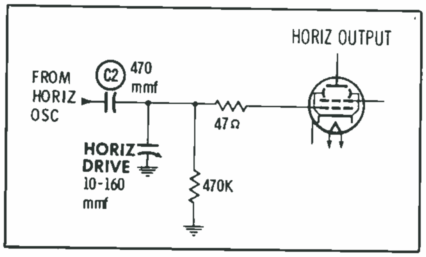


Fig. 3. Drive trimmer forms AC voltage divider with fixed capacitor C2.

A more widely-used type of width control is a variable inductor connected across a portion of the flyback transformer to reduce yoke current. When you don't find any width adjustment on the back panel of the receiver, check to see if the flyback has an adjustable core gap, or if a metallic *width sleeve* is inserted into the center hole of the yoke to reduce the strength of the magnetic field surrounding the electron beam.

Many older sets have a horizontal linearity coil connected in series with the damper plate (or cathode) lead. The main function of this variable inductor is to assure a smooth changeover from damper conduction to output-tube conduction during the early part of each horizontal sweep cycle. Replacement of either the damper or output tube may necessitate a touch-up of the linearity adjustment; if in doubt about the correct setting, tune the slug for a compromise between minimum output-tube cathode current and acceptable horizontal linearity.

Since there is considerable current through the linearity coil, it often changes value to such an extent that a linear picture cannot be obtained. The only cure is to replace the defective coil.

Sync Separator and Amplifier

For our present purposes, "amplifier" means any sync tube other than the separator—including clippers, phase inverters, and noise cancellers. Replacement of tubes in the sync section should naturally be followed by adjustment of any noise-inverter or similar controls.

The major consideration in adjusting *any* sync control, regardless of its name, is to set the operating point of some stage for maximum sync stability on all received channels. Noise-inverting features come into play only when the noise level approaches the level of the sync signal. For this reason, a noise-inverter control should always be adjusted on the weakest or most noise-influenced station received in your area. The general practice is to preset the control to its farthest counterclockwise position, and then to turn it clockwise until the picture just begins to be unstable. The control is then backed off until a steady picture is restored. Following this, the picture from the strongest station should be checked for stability, and the sync control turned farther counterclockwise if necessary to insure good lock-in on all received channels.

New sync tubes often mean a boost in sync amplitude. This could cause the horizontal oscillator to shift frequency enough to affect the range of the horizontal hold control; therefore, be sure to check this control's action, and readjust the horizontal-frequency slug if required. A check of vertical-hold range is also a good preventive measure. Perhaps the vertical oscillator is on the verge of drifting off frequency, and the customer won't be able to distinguish this trouble from the sync trouble you just finished repairing. Whenever a vertical oscillator circuit seems overly critical to adjust, replacing the oscillator tube could save you from making a free callback.

Sound IF and Detector

Tubes used in these stages may vary enough in internal capacitance to cause mild detuning. A slight touch-up of alignment may be the difference between clean sound and an irritating trace of buzz. Gated-beam (6BN6) and locked-oscillator (6DT6) detectors, along with their associated sound IF's, can often be repeaked in the home by using regular station signals as an indicator. For accurate results, the signal strength must be held down to an extremely low level (except in the quadrature-coil circuit of the 6DT6, where a strong signal is needed for proper adjustment). Each slug is tuned for maximum audio with minimum hiss and buzz. In the 6BN6 circuit, don't forget the rear-panel *buzz control,* which adjusts the DC bias on the detector tube for optimum limiting and clearest sound.

Ratio-detector and discriminator circuits can also be slightly re-adjusted in the field, but be very careful to turn only the *secondary* slug of the detector transformer. Rotate it no more than one-half turn in either direction to determine the point of clearest audio. If any more adjustment than this is required, it will be necessary to shop-align the circuit with a signal generator and scope.

Video and AGC Tubes

The sync take-off point is usually on the output side of the video amplifier, so replacement of the video tube is likely to increase the amplitude of the signal applied to the first sync stage. This may create a need for readjustment of the noise-inverter control.

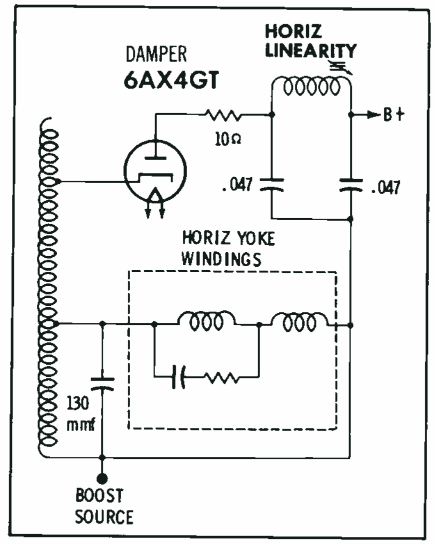


Fig. 4. Typical location of horizontal linearity coil at plate of damper.

The video amplifier also furnishes an input signal to the grid of the keying tube in sets having keyed AGC systems. Therefore, if an AGC level control has been advanced to compensate for a weak video amplifier, inserting a new video tube may cause excessive AGC voltage to be developed. Likewise, replacement of a weak keying tube will probably increase the AGC bias level. Once again, the remedy is to reduce the setting of any AGC control that may be present.

Misadjustment of this control can cause troubles varying from complete "white-out" of the picture to strong overloading. In every case, the AGC control should be adjusted while the set is receiving the strongest available signal. The contrast control should be adjusted to maximum, the fine-tuning control set for best reception, and the AGC control adjusted for as dark a picture as can be obtained without sync buzz in the sound or bends in the image. To provide a margin of safety, back off the control about ⅛ turn from the "best" setting. If turning down the contrast control provides a picture of proper contrast ratio, the AGC adjustment has been correctly set.

When a simple FRINGE-LOCAL switch is employed instead of an AGC potentiometer, customers in some areas will have to be taught how to set the switch for best performance on all channels.

RF and IF Amplifiers

Since the over-all gain of a TV

set is largely dependent on the amplification factor of the IF strip, replacing just one tube in this section can cause a marked rise in gain. If either the AGC or sync adjustments had been reset when bad IF tubes were present, you might end up with overloading or sync instability on strong signals after tube replacement. For your own benefit as well as the customer's, check operating conditions on all channels *in the home* after making any RF, IF, video, AGC, or sync repairs.

The RF amplifier is a primary factor in determining the signal-to-noise ratio of the receiver. Under certain conditions, this tube could furnish plenty of gain but suffer from a very poor noise characteristic. If the sync-stability control had been adjusted with the old tube in use, installing a new RF tube would make it necessary to touch up the sync adjustment.

Oscillator-Mixer Tube

Internal capacitances of different individual tubes vary to such a degree (even in good, new stock) that oscillator tuning is bound to be changed when the oscillator-mixer tube is replaced. This change is more noticeable on high- than on low-band channels. Checking the oscillator slug adjustments (often accessible from front of cabinet) is usually a sufficient corrective measure. On incremental-inductance (switch-type) tuners, don't forget to start with the highest active channel and proceed to lower channels in descending order. In most turret tuners, the order of adjustment doesn't matter.

It is always a good idea to make a mechanical check of tuner condition if you suspect that the set owner, or others of dubious technical background, have been tinkering with the oscillator adjustments. Switch wafers, pivoting contact strips, wafer-type fine-tuning assemblies, and paper coil forms are too delicate to take much punishment, and the average "screwdriver jockey" can completely ruin a tuner before he even knows something is wrong.

A Final Word

A thorough "follow-up" on every

tube replacement takes a little extra time, but it pays off because it can only help you forge your chain of customer good will.

Handy Gadget

Did you ever wish you had some convenient means of checking phono speed in a customer's home? Here's a "natural" to have in your tube caddy if you're wanting to build your business in the hi-fi and phono fields. It's the *Strobolamp* by Switchcraft. The kit contains a 4¼″ disc with dot pattern for checking all four record speeds; also supplied is a 6′ cord with a neon lamp to provide the required light for a stroboscopic test of turntable rpm.

When you use this device on a home call to check your customer's platter-spinner, the "visual-aid" clarity of the demonstration implants in his mind that you're the one to call the next time service is required—even if everything is fine when you make the check.

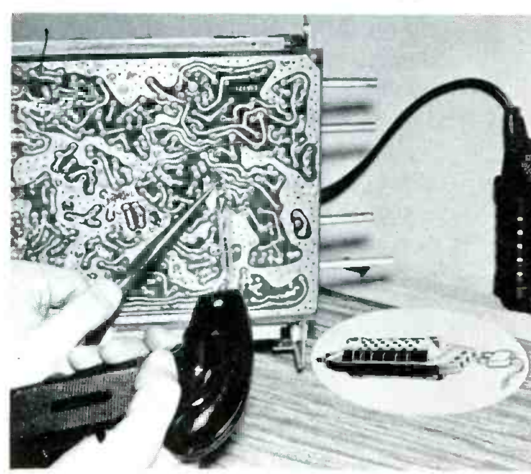
Packaged in a clear plastic bag, the $1.95 kit contains operating instructions for the "do-it-yourselfer" — so you can include it in your record-accessory display.

Control Soldering Temperature

If you're the kind of serviceman who prefers to use a soldering gun instead of an iron, but you find the wattage of your present gun unsuitable for printed-board work, you should know about *Gunchoke*. Recently introduced to the market by Electric Soldering Iron Co., Inc. (ESICO) of Deep River, Conn., *Gunchoke* limits gun-tip temperature to a specified maximum.

As shown in the photo, the unit is inserted between the gun's AC plug and the 117-volt outlet. Note the three-prong receptacle, which permits inserting the plug either of two ways to provide a choice of 500° or 600° tip temperature.

Six different *Gunchoke* models are available. W4 is for use with Weller S400 and D440 models and the Wen 288; W5 is designed for Weller's S500 and D550, as well as Wen's 250; the Weller 8100 takes W8; WE1 is for the Wen 199; and Esico's Model "C" *Luger* gun uses the L1 with all AB tips, or L2 for C tips. ▲



Testing Hi-Fi Amplifiers

(Continued from page 33)

It would seem that the response of an amplifier would be adequate if it extended down to just beneath the lowest frequency, or fundamental, of the square wave. But this is not the case. Poor response to lower frequencies causes a shift in the *phase* of the fundamental-frequency component — even though the *amplitude* may remain unchanged. At the same time, the higher harmonics do not undergo this phase shift. The phase relationship between different components of the square wave is thus destroyed, and the waveform is distorted.

As a rule of thumb, adequate response of an amplifier to a square wave generally means the frequency response of that amplifier is linear throughout a range extending from about one-tenth to ten times the fundamental frequency. For example, adequate reproduction of a 400-cps square wave would indicate "flat-topped" amplifier response from about 40 to 4000 cps.

Following this rule, a good idea of an audio amplifier's over-all response can be obtained by applying only two square-wave frequencies to the unit. To be more exact, tests at 200 and 2000 cps serve to check the amplifier over a total frequency range of about 20 to 20,000 cps.

Fig. 2 shows several different types of square-wave distortion which can result from nonlinear frequency characteristics of amplifiers. Fig. 2A shows a practically perfect square-wave output, indicating excellent over-all response. B, C, and D show progressively worse attenuation of low frequencies only. E shows a slight, but not serious, loss of high-frequency response, while F illustrates a serious deficiency in gain at higher audio frequencies. Don't look for absolute perfection during square-wave tests, because any amplifier — even the best — will show some drop-off in gain at both extremes of the audio spectrum.

One restriction on the use of a square-wave test is its unsuitability for checking equalized preamp stages. Misleading indications are produced because the equalization network is purposely designed to alter the frequency response of a signal applied to it.

Tone-Control Action

The same tests used for measuring frequency response can also be used to examine tone-control action. The basic setup in Fig. 1 is again employed for these tests, but instead of setting the tone controls at "flat" and checking for level response, the technician seeks to measure the variation in amplifier response as the tone controls are rotated through their full range. Published specifications on the unit under test provide the most reliable indications of what to expect. In most data sheets, the range of tone controls is stated in terms of the maximum boost and attenuation obtainable for two frequencies (one

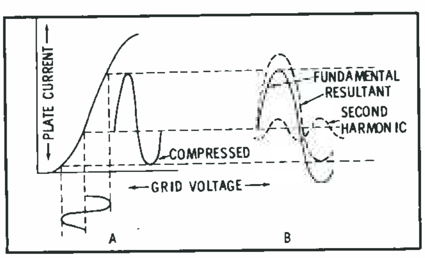


Fig. 5. Output-waveform compression is a symptom of harmonic distortion.

low, one high). For example, the output-signal level of a certain amplifier at 15,000 cps can be boosted by as much as 15 db or attenuated by 20 db from the "flat" level, for a total range of 35 db. The bass response of the same unit (at 50 cps) can be varied over a 30-db range—from 18 db of boost to 12 db of attenuation. These variations are shown graphically in Fig. 3. Although the actual maximum and minimum db values will vary from one amplifier design to another, the general shape of these curves remains the same. The values given here are fairly typical of most hi-fi tone control circuits.

To check separate bass and treble controls, 50- and 15,000-cps sine waves are applied in sequence to the input of the amplifier. With the 50-cps signal applied, the audio output is measured at both extremes of the bass-control setting. The treble control is checked using a 15,000-cps input, again measuring the output-signal level at maximum and minimum control settings.

To compare these readings to the published specifications, the voltage

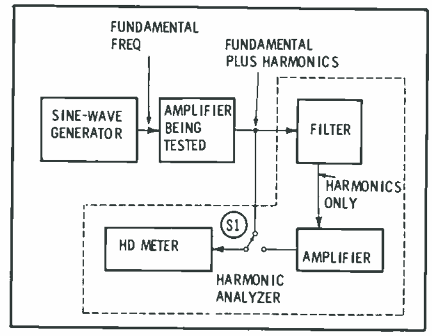


Fig. 6. Test setup for measuring harmonic distortion in an amplifier.

or wattage readings must be converted to decibels (db). If output voltage is being read, the following equation may be used:

$$db = 20 \log \frac{E1}{E2},$$

where E1 is the voltage output at the maximum boost setting (either for bass or treble), and E2 is the voltage at the maximum attenuation setting. If a wattmeter is being used for direct measurement of power output, the equation becomes

$$db = 10 \log \frac{P1}{P2}.$$

Output meters employed in hi-fi service work are often equipped with db scales, thus eliminating the need for calculations. While the test results need not correspond exactly to figures in published data, they should be reasonably similar.

Square waves can also be used in checking tone controls, unless an equalization network is associated with the tone-control circuit. This test is performed by injecting a square wave (at about 1000 cps) and adjusting the controls so that a good square wave is visible on the scope. As a rule, the treble control chiefly affects the leading and

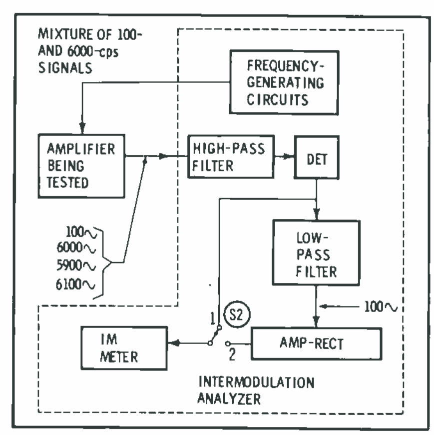


Fig. 7. Intermodulation-distortion analyzer supplies its own test signals.

trailing edges of the waveform, while the bass control determines the degree of slant across the top and bottom. Waveforms like those in Fig. 4 are developed by most amplifiers at extreme settings of tone controls. Assuming a good square-wave output is achieved when both controls are at their "flat" settings, the waveforms of Figs. 4A and 4B will result from maximum and minimum bass boost, while Figs. 4C and 4D correspond to maximum and minimum treble settings. Although this method does not reveal the exact amount of boost and attenuation available, it does serve as a fast over-all check of tone-control action.

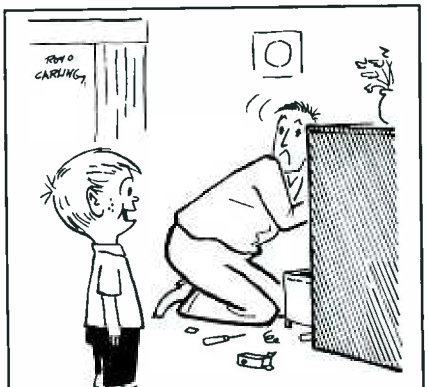
Harmonic and IM Distortion

Uneven response to various frequency components of the input signal plays a definite part in causing distorted output from hi-fi amplifiers. However, more severe effects (and more difficult service problems) are created when frequencies *in addition to those contained in the input signal* are generated within the amplifier itself. This type of spurious-signal distortion originates in two ways, both caused by nonlinear operation of some portion of the amplifier circuitry. In harmonic distortion, applying a certain frequency component of the input signal to a stage causes one or more harmonics of that frequency to be added to the signal. Intermodulation distortion occurs when various signal components are heterodyned to form new frequencies *not* harmonically related to the original signal.

Incorrect circuit characteristics often lead to distortion. For example, if an amplifier stage is biased too close to cutoff, the resultant plate-current waveform will be as shown in Fig. 5A. The distorted plate waveform can be shown to contain both fundamental and second-harmonic components (Fig. 5B); this will serve to illustrate how a harmonic which was not a part of the original signal can be added in the amplifying process.

Although harmonic and IM distortion often occur together in the same amplifier, they are measured individually with highly specialized instruments — or by two separate sections of a multipurpose instrument.

A typical arrangement for analyzing harmonic distortion is shown in block-diagram form in Fig. 6. An external audio generator supplies a sine-wave signal to the amplifier at some frequency such as 1000 cps. The output of the amplifier is fed to the harmonic-distortion analyzer, where a filter removes the fundamental frequency and leaves only the harmonics generated in the amplifier. Switch S1 is set to position 1, and the amplitude of the



"Our regular repairman wouldn't come because Pop owes him a lot of money."

total output signal from the amplifier is measured in order to set a reference level on the harmonic-distortion meter. Then the switch is thrown to position 2, and the amplitude of the harmonics alone is compared to that of the entire signal. The reading is obtained in terms of "percentage of harmonic distortion." In many high-quality amplifiers, this reading is below 1%.

The intermodulation analyzer (Fig. 7) differs from the harmonic-distortion analyzer in that it supplies its own amplifier-input signal for the test. This signal consists of a mixture of two different frequencies — say, 100 and 6000 cps. If intermodulation occurs in the amplifier, the output of this unit contains sum and difference frequencies (5900 and 6100 cps) in addition to the original signals. The composite signal is fed through a high-pass filter to remove the 100-cps component, and the remaining frequencies are passed through a detector. In the latter stage, a 100-cps component is returned to the signal as a result of heterodyning between the other signals — and the strength of this new 100-cps signal is proportional to the amount of IM distortion which occurred.

The actual reading is taken in almost the same way as for harmonic distortion. First, the composite signal amplitude is measured (with S2 in position 1), and then the 100-cps component of the detector-output signal is measured alone (with S2 in position 2). The ratio between the two readings determines the "percentage of intermodulation distortion" — which should be less than 3 to 5% for quality reproduction, and even less in top-grade hi-fi instruments.

Trouble Isolation

Of course, the test equipment used in making the aforementioned over-all checks can be used just as well in isolating trouble to a specific stage. Either a signal-tracing or signal-injection procedure can be employed; the setup would still be similar to Fig. 1, except that the indicating instrument or the signal generator (or both) would be connected to some intermediate point in the amplifier circuit. Once localized to a specific stage, a defect can often be found by usual trouble-shooting procedures, including visual, voltage, resistance, and component-value checks.

Miracles shouldn't be expected from distortion-analyzing test equipment. It isn't designed to do all the work in pinpointing a trouble — just to supply a signal or measure some characteristic of operation. The rest is up to the serviceman. ▲

"What a day! I wrecked my car, lost my wallet, received a summons, broke my best soldering gun—imagine . . . my *best* soldering gun!

Batteries Today

(Continued from page 24)

This extremely long life compensates for their price, which is several times the cost of nonrechargeable types.

In addition to their use in transistor radio and TV sets, sealed nickel-cadmium units have also become available in various small cell sizes for operating flashlights and other low-current electrical devices. (See photos above.) Some have a built-in recharging circuit which is activated by merely plugging the cartridge into an AC wall socket; others require an external DC charging source, usually a rectifier circuit of the type shown in Fig. 1. The battery manufacturer can furnish specific information about the correct value of supply current, which varies according to the storage capacity of the cell; typical values range from 10 to 90 ma. In general, a proper charging rate is one which will restore a fully depleted battery to full charge in 14-16 hours. Considerable overcharging can be tolerated *if* current is not applied at an excessively high rate.

Care of Zinc-Carbon Batteries

In spite of all the new developments of the past several years, the low-cost, nonrechargeable zinc-carbon battery is still the bread-and-butter of the radio-battery replacement business. To help you get the best possible service out of these staple items, here is a review of some basic facts about their storage and testing requirements.

Voltage Tests

Checking the actual voltage of a radio battery by the "open-circuit" method—i.e., measuring the potential across the terminals after removal from the radio—is generally not recommended, because this check doesn't tell you whether or not the battery will hold up satisfactorily under a load. However, such a test is of some worth in a negative sense; if the open-circuit voltage is definitely lower than normal, the battery should be discarded. The normal potential of a new battery of the conventional zinc-carbon type is about 1.6 volts per cell. This voltage gradually tapers off during use or with age, and the battery is usually ready to be junked by the time the potential under load declines to about 1.0 volt per cell. Of course, the main criterion for judging the condition of a battery is whether or not it still satisfactorily operates the equipment. However, if it shows signs of going bad, it should be promptly removed from service. Even a modern, sealed-type cell, when worn out, can leak or swell enough to damage the equipment in which it is used.

The mercury batteries used in some transistor radios have a nominal open-circuit voltage of 1.345 volts per cell when new. Here's a fact about these units that may surprise you: Only a slight decrease in output voltage is sufficient to indicate that the battery is getting close to the end of its life. This small change is highly significant because the output potential of a mercury cell is extremely stable throughout practically all of its useful life span.

Why do some batteries check OK in an open-circuit test and then turn out to be pitifully weak when connected to a load? The answer lies in the internal resistance that tends to build up in a dry cell with age. This does not affect the cell's output voltage until a heavy current drain is imposed, and then it causes a considerable voltage drop within the battery. Result: Low operating voltage.

Thus, the most dependable way of checking the condition of a battery is to leave it in the radio, turn the switch on, and measure the voltage across the terminal connections. You can expect the normal output voltage of any battery under load to be somewhat less than in the open-circuit test. Unfortunately, it's impossible to set an arbitrary minimum value below which a battery should be considered weak. The measured operating-voltage value will depend on whether the current drain of the load is relatively high or low in comparison with the capacity of the battery. If in doubt, compare the performance of the battery being tested with that of a new unit installed in the same receiver. It helps to be familiar with typical supply voltages in properly operating receivers of various makes.

No presently-known test gives a reliable prediction of a battery's future life expectancy. The checks just described merely let you know what shape the battery is in at the time you test it.

Storage and Shelf Life

When stored at ordinary room temperature under conditions of moderate humidity, zinc-carbon batteries have a shelf life of one to two years. (When planning your stock, don't forget to include the time on the distributor's shelves in this figure!) A battery gradually deteriorates in storage, but it should retain as much as 70% of its original capacity even after a couple of years on the shelf. Mercury batteries have even greater longevity.

To insure keeping your stock as fresh as possible, don't forget to "rotate it" — just as food markets do with their produce, meats and other perishables. This procedure is as simple as can be: Just put the newest stock at the back of the shelf and use up the oldest units first.

Special storage arrangements are not essential for keeping a battery stock. However, the familiar admonition, "Store in a cool dry place," emphasizes the fact that extremes of temperature and humidity must be avoided. Just about the worst place for batteries is near a steam radiator, where their life is shortened because the increased heat speeds up chemical action within the cells, and the extremely low humidity tends to dry them out. True, modern batteries are generally sealed for protection against drying and leakage; nevertheless, a certain amount of water vapor can escape through the seal, which is never absolutely 100% tight.

Very high humidity, such as is found in many basements and other storage areas, can damage batteries. The effect is usually external rather than being the result of any chemical action within the cell. In other words, moist air simply promotes corrosion of the outer shell of the battery.

If the humidity becomes so high that moisture condenses on the battery, a conductive leakage path may form between the terminals and permit the unit to discharge as it sits on the shelf. This action is especially likely to occur in "B" batteries, whose high potential can force current more easily through the relatively high resistance of the leakage path.

You increase the risk of accidental discharge if you leave batteries in close-fitting cardboard cartons that touch both positive and negative terminals, or if you jumble them in a heap.

Freezing is one type of extreme condition that does not seem to hurt batteries permanently. Some units have been frozen solid at temperatures far below zero, and then have worked normally after being completely thawed out again. Of course, a battery's operating efficiency would not be up to par if it were put into service at abnormally low temperatures.

As for deliberately giving batteries the "deep-freeze" treatment to prolong their life—why not? Slow-moving stock items could be stored at about 0°F, if wrapped in polyethylene film to prevent condensation of moisture on the battery surface. The covering should be left on while the battery is being warmed up for use.

Corrosion

It was mentioned that humid air will often cause a battery case to corrode. This effect is often mistaken by laymen for a different condition — internally-caused corrosion of the zinc case—which has been known to occur near the end of the battery's service life. The case is the negative terminal of the cell, and zinc is eaten away from it during the normal process of discharging. Holes will appear in the case if this chemical action goes too far. Perforation of the case seldom occurs nowadays because modern batteries are made with extra zinc to give ample thickness to the case. As an added protection, some batteries are sealed in a steel jacket; therefore, most corrosion in today's batteries is not a sign of disintegration of the cell, but is due either to a surface condition or to a slight leakage of the electrolyte. The latter in particular is an uncommon occurrence.

Rejuvenation?

Many readers have undoubtedly had an experience similar to the following: A customer brings in a portable radio for new batteries, saying that the sound became extremely weak (or faded out entirely) after the radio had been played for several hours. You turn it on, and find that the output has come back up to normal. Did the battery rejuvenate itself? Your suspicions are aroused—is the recovery permanent, or just a dying gasp?

In order to explain how a battery can recover after being apparently exhausted by an overload, we need to take into account an action called "polarization." In a dry cell, the materials in the electrolyte break up into positively- and negatively-charged ions which are attracted to the electrodes of the cell during operation. Hydrogen ions go to the carbon electrode; if discharge is rapid, they form hydrogen gas bubbles which cluster around the electrode and reduce cell activity.

To hold gassing to a minimum, a material rich in oxygen is included in the cell as a "depolarizer." (A chemical generally used for this purpose is manganese dioxide.) This compound gives up some of its oxygen, which combines with the hydrogen to form water. An alkali is employed as an electrolyte in some recently-developed batteries (e.g., the alkaline cell and the mercury battery) partly for the purpose of making depolarization more efficient.

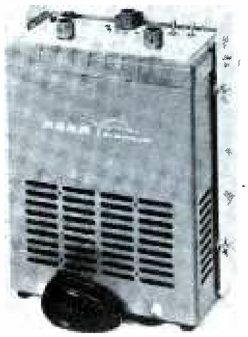
During prolonged, continuous use of the battery, polarization produces an unbalanced condition in the cell and provides a barrier to current flow between the electrodes. When the battery is disconnected from its load and allowed to rest, it is gradually restored to its original condition by diffusion and depolarization. After "recovery," the battery usually has lost only a small portion of its total energy capacity and should continue to provide normal service for a moderately long period. (Of course, repeated overloads will shorten its life.)

If a battery is going to recover at all, it will begin to do so immediately after the load is removed —so it's worth waiting awhile to see if recovery will take place. Zinc-carbon cells will "spring back" to a great degree after several hours' rest, and mercury cells (which have much less tendency toward gassing in the first place) will show improvement within a few minutes. ▲

PRODUCT report

For further information on any of the following items, circle the associated number on the Catalog & Literature Card.

Marine Radio (420)



All circuits in the Kaar *Marlin* marine radiotelephone are transistorized, except the oscillator and power amplifier in the transmitter. Power input to the latter circuit is 65 watts. The unit operates from a 12-volt DC source only. Standard models have a frequency range of 2 to 3 mc, but an optional 2- to 4-mc version is also available. The receiver includes a series-impulse type of noise limiter. Price is $399.00.

AGC For Master Amplifier (430)

Automatic gain control for amplifiers in master antenna systems is provided by the Blonder-Tongue Model MAC. When connected to an amplifier having at least 16 db gain and an output of 0.6 to 2.5 volts, the control device functions over a range of input-signal levels from 1900 to 100,000 microvolts. The unit is available to master-antenna contractors at $121.50.

High-Fidelity Cartridges (440)

A *Collectors' Series* of cartridge-stylus combinations, based on the Model 380 *Stanton Stereo Fluxvalve* magnetic pickup, has been announced by Pickering. The Model 380E Collectors' Ensemble ($60), for use with transcription tone arms, includes three easily-interchanged *V-Guard* styli with 0.7-, 1-, and 3-mil tips. Models 380A (for transcription arms; $34.50) and 380C (for changer arms; $29.85) are each equipped with a single 0.7-mil stereo stylus.

Short-Range Transceiver (450)

The transistorized Model 4303 transceiver (RME div. of Electro-Voice, Inc.) is designed for limited-range communications according to Part 15 of FCC rules; as such, it requires no license for the prescribed type of operation. Maximum RF output is less than 100 mw. The low-power channels largely overlap with Class D Citizens band frequencies; therefore, the 4303 can also be used to communicate with regular Class D stations if a license is obtained for this purpose.

Stereo-Playback Tape Recorder (460)

Either two- or four-track stereo tapes can be played on the Recordio Model 692 with no need for switching or adjusting tape heads. Retail price of the recorder, including microphone, is $239.50. Accessories obtainable are a radio tuner (for installation in the recorder's storage compartment) and a separate, matching record changer; both play through the amplifier of the recorder.

Connecting Cable (470)

Connections between a stereo tone arm and a dual-channel preamp can be made quickly and neatly with the Rek-O-Kut *Stereo Konnector Kit* No. KK-1. Four color-coded wires, enclosed in an outer sleeve for most of their length, are terminated in twin phono plugs at one end, and in four separate spade lugs at the other. A counter display offered to dealers holds 18 cables. Net price is $2.49 each.

Dual "L" Pads (480)

Ganged pairs of constant-impedance "L" pads, for varying the output of stereo speaker systems from a remote location, are available from Audiotex in brass housings designed for surface mounting. Power rating of each pad is 10 watts (continuous) or 20 watts (peak). Controls are available for either 8- or 16-ohm systems at a list price of $10.50. Also obtainable are single "L" pads for in-cabinet mounting, priced at $3.50 each.

Anti-Slip Chemical (490)

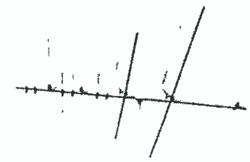
Slip Stop, a liquid dressing developed by Colman Electronic Products for use on phono-drive components and dial-cord pulleys, increases friction and prevents slippage. As it dries, it forms a hard-surfaced coating with no tendency to become either sticky or slippery. An applicator is attached to the lid of the 2-oz. bottle.

Plug In and Talk (500)

Signal connections between Vocaline Model CC-60 *Vocatron* intercom stations are completed through the AC power wiring, thus eliminating the need for additional wires. The "press to talk" switch includes a *talk-lock* position for the user's convenience when delivering long messages. Bursts of noise between transmissions are silenced by a squelch circuit. Units are priced at $109 per pair.

Preassembled TV Antennas (510)

JFD *Quik-Rig Banshee* broadband antennas are similar in design to the standard *Banshee* series, but are fully preassembled and have other new features such as a heavy-walled, 1"-diameter boom with a square cross section. 9-, 11-, 15-, and 18-element models are available in a price range of $22.00 to $39.30 (with gold anodized finish) or $19.30 to $31.50 (in aluminum finish).



Capacitor Substitution Box (520)

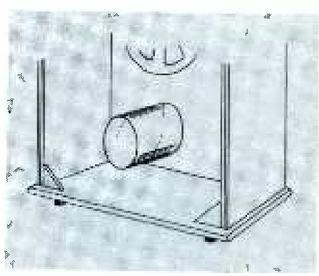
The Cornell-Dubilier Model CDE *Electrolytic Capacitor Substitution Box* has four front panel toggle switches that can be arranged in various combinations to provide 15 values of capacitance, ranging from 10 to 150 mfd in 10-mfd steps. Maximum voltage rating for any combination is 450 WVDC. Net price of the unit is $12.50.

Miniature Signal Injector (530)

The transistorized *Mosquito* signal generator, manufactured by Don Bosco Electronics, is useful for signal-substitution tests. The output of this pen-sized unit consists of a basic audio-frequency tone (approximately 1.5 kc) and many harmonics extending well up into the RF range.

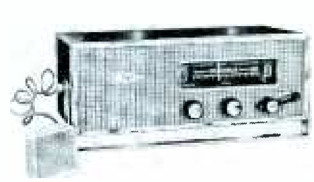
Speaker-Matching Device (540)

Argos high-fidelity speaker enclosures are equipped with a *Tuning Tube* so that the resonant frequency of the enclosure can be adjusted to match that of any desired bass speaker. Besides increasing system efficiency at low frequencies, matching eliminates "bass boom." When installing the speaker, the tube is trimmed to the recommended length.



Class "D" Transceiver (550)

The Shell Model CB-12 Citizens band transceiver incorporates a continuously-tunable superregenerative receiver plus a transmitter that can be operated on any of the 22 Class "D" channels (using proper crystal). Power requirement is 1.9 amp at 12 VDC or 37 watts at 105-125 VAC. The unit costs $79.95 wired and is also supplied in kit form.



Replacement Tubes for TV (560)

Sylvania has added the following tube types to its renewal line; 2- and 6FH5 *Guided Grid* RF amplifiers for operation at a plate potential of 135 volts; 6AX4GTB, 6DE4, and 17DE4 damper diodes with higher electrical ratings than type 6AX4GTA; 6- and 8GN8 miniature triode-pentodes for video-amplifier and sync-separator service; 4EW6 high-Gm, sharp-cutoff pentode for video IF amplifiers not controlled by AGC; 12BZ6 semiremote-cutoff pentode; 10DR7 dissimilar double triode, a series-string version of 6DR7; and 10EG7 octal-based dissimilar double triode for use as vertical oscillator and output tube.

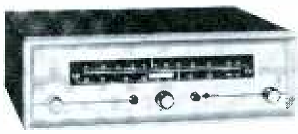
Professional Tape Recorder (570)

The Crown Model 714C *Stereo X* tape recorder, manufactured by International Radio & Electronics Corp., records and plays four-track stereo, or two-track monophonic tapes. It is also capable of playing back two-track stereo tapes recorded on other machines. The standard model has three tape speeds (15, 7½ and 3¾ ips), accepts 10" or smaller reels, and can mix stereo inputs from two pairs of microphones. Price is $730.

Ceramic Mikes in Pairs (580)

Acoustically - matched pairs of Sonotone *Ceramikes* are available for making stereo tape recordings. Set No. CM-T10 consists of two wide-range microphones with a frequency response of 50-13,000 cps and sensitivity of -62 db; Set CM-T11 offers more sensitive units (rated at -55 db), with a narrower frequency response (50-8000 cps). Each pair has a list price of $36.75; table stands are $5 each.

Prealigned Tuner Kit (590)



All tuned circuits of the PACO Model ST-45PA AM-FM tuner kit are preassembled on printed-wiring boards and prealigned; therefore, no touch-up adjustments are needed after completion. AM and FM circuits are entirely separate to permit reception of stereo simulcasts. In addition to this "semi-kit" at $99.95, identical tuners are obtainable in regular kit form ($84.95) or wired and tested ($134.95).

Replacement Needle Line (600)

More than 250 types of replacement phono needles are now available from Electro-Voice. All are individually packaged in plastic cases with a protective padding of plastic foam. A black and gold package is used for diamond needles; blue and silver for sapphire types. A currently-available catalog gives needle-replacement information for practically all types of cartridges and specific stereo-phono models.

Soldering Irons (610)

The *Trig-R-Heat* soldering gun, made by P. Wall Mfg. Co., operates on either AC or DC. Squeezing the trigger for a few seconds causes the copper tip to heat up to normal soldering temperature. The trigger is then released, and the tip remains hot enough to melt solder for a minute or two. The work is illuminated by a recessed 7-watt lamp, which has its own "push-push" switch. A 40-watt pencil-type iron is also available.

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Latest Jackson Tube Test Data

TUBE TYPE	MODEL 648 FIL.	CIRCUIT D.	CIRCUIT E.	PLATE TEST
6FH8	6.3	A12	A689	30XZ
	6.3	A12	A789	40XZ
	6.3	A12	A489	40XZ
	6.3	12	A35	16XZ
7360	6.3	1234	AB578	60XY
	6.3	1234	AB569	60XY
7551	12.6	1249	AB358	25W
7558	6.3	1249	AB358	25W

TUBE TYPE	MODEL 598 A.	B.	C.	FIL. CONT.	D.	E.	F.	G.
6FH8	6.3	5	–	4Y	9	6	7	60
	6.3	5	–	4Y	8	6	7	95
	6.3	5	–	4Y	1	6	7	95
	6.3	5	–	4YZ	3	2	–	70
7360	6.3	48	–	5	6	3Z	2Y	75
	6.3	49	–	5	7	3Z	2Y	75
7551	12.6	4	18	5	6	2	3	20
7558	6.3	4	18	5	6	2	3	20

TUBE TYPE	SEC.	HEATER	MODEL 658 CIRCUIT H-K	P-G	PLATE	GRID TEST	HEATER CURRENT
6FH8	P	13.6D	A1247	a689	32Q	15WY.	
	P	13.6D	A1246	a789	55Q	15WY	
	P	13.6D	A1267	a489	55Q	15WY	
	T	13.6D	A12	a35	50R	15WY.	
7360	B	6.4J	12467	b359	48Q	35WY.	
	B	6.4J	12467	b358	48Q	35WY.	
7551	P	13.6K	1249	ab358	20Q	60VY.	
7558	P	6.4L	1249	ab358	20Q	60VY.	

Latest Chart Form 648-22, 598-1, 658-2

CATALOG AND LITERATURE SERVICE

ANTENNAS & ACCESSORIES

1O. *CLEAR BEAM* — Flyer on three-way Miracle Mount do-it-yourself kit.

2O. *JFD* — 20-page Exact Replacement Antenna Guide for portable and toteable TV sets, compiled and edited by Howard W. Sams & Co., Inc. Gives TV receiver model number, manufacturer's antenna part number, and model number of corresponding JFD Exact Replacement Antenna. *See ad page 27.*

3O. *JERROLD*—Data sheet on TX series of antenna mixing networks for combining signals from several antennas, mixing or splitting VHF-UHF or TV-FM signals, and related applications. *See ad page 73.*

4O. *WINEGARD* — Information on precise-match, coil-type TV-FM antenna coupler that provides positive signal isolation and minimum insertion loss. *See ad page 47.*

AUDIO & HI-FI

5O. *CBS* — Pocket-sized retail price list and cross-reference chart for CBS-Ronette and Columbia *CD* cartridges. *See ads pages 19, 72.*

6O. *DUOTONE* — Leaflets describing the "how" of needle replacement; wall chart with reference data on replacement needles; catalog of phono needles and accessories. *See ad page 66.*

7O. *EICO* — 20-page catalog of kits and wired equipment for stereo and monophonic hi-fi, test instruments, "ham" gear, Citizens band transceivers, and transistor radios. Also, "stereo Hi-Fi Guide" and "Short Course for Novice License." *See ads page 83.*

8O. *JENSEN INDUSTRIES* — Information on latest innovation in stereo cartridges. *See ad page 64.*

9O. *PARKWAY SPECIALTIES* — Catalog of *Aud-O-Gril* speaker systems and audio accessories, including enclosures, grille panels, stereo adapters and controls, crossover networks, etc.

10O. *SWITCHCRAFT* — Illustrated folder describing lines of "Mini-Mix" audio mixers. Also Catalogs S590 and C501 on connectors, including adapters, connectors, and plugs. *See ad page 87.*

COMPONENTS

11O. *AUDIO DEVELOPMENT* — Catalog TF, featuring audio and power transformers; also catalog supplement describing line of communications-type plugs, jacks and patch cords.

12O. *BUSSMANN* — Three-color bulletin on *Stak-Pak* fuse assortment, showing how new packing idea can help TV servicemen on home calls. *See ad page 55.*

13O. *CORNELL-DUBILIER* — 56-page *TV Capacitor Replacement Guide* gives TV-set manufacturers' original part numbers, rating information, and replacement recommendations for electrolytic capacitors in over 3500 applications. *See ads pages 53, 63.*

14O. *IRC*—Revised numerical listing of CTS-IRC exact duplicate controls, showing *Concentrikit* equivalent as well as original "trade-name" part number for each type of control. *See ad page 82.*

15O. *MERIT* — *Exact Replacement Guide*, covering 6,000 exact replacement parts for TV sets. *See ad page 25.*

16O. *SAMPSON* — 12-page catalog, "Important Electronic Components Economize Through Import," with complete listings on tubes, transistors, resistors, capacitors, tone arms, cartridges, etc., imported from Japan.

17O. *SPRAGUE* — 6-page bulletin describing *Difilm* molded and dipped tubular capacitors with combination plastic-film and paper dielectric. *See ad page 10.*

SERVICE AIDS

18O. *CASTLE TUNER* — Leaflet describing service for all makes and models of TV tuners. *See ad page 82.*

19O. *GENERAL ELECTRIC* — Cross-reference of General Electric and Hotpoint TV model numbers, listing chassis designations and applicable service manuals. *See ads pages 39, 59.*

20O. *KESTER* — Technical literature on *Resin-Five* flux-core solder; booklet, "Soldering Simplified"; 78-page advanced training manual for service-supervisory and production personnel, "Solder—Its Fundamentals and Usage." *See ad page 56.*

21O. *3M ELECTRICAL PRODUCTS*—Technical data on *Scotch* Brand No. 33 stretchable plastic insulating tape in 3/8" width for radio, TV, and hi-fi applications.

22O. *WALDOM*—Informative bulletin on the economics and advantages of speaker reconing; referral to a local reconing station on request. *See ad page 82.*

SPECIAL EQUIPMENT

23O. *LAMPKIN LABS* — Literature on new *PPM Package* (incorporating frequency meter and crystal calibrator) for accurately adjusting transmitter frequency of VHF-UHF mobile radio equipment to comply with FCC split-channel regulations.

24O. *PERMA-POWER* — New flyer illustrating and describing latest model radio-controlled garage-door opener with transistorized transmitter. *See ad page 71.*

TECHNICAL PUBLICATIONS

25O. *HOWARD W. SAMS* — Literature describing all current publications on radio, TV, and hi-fi servicing. *See ads pages 36, 60, 61, 86.*

TEST EQUIPMENT

26O. *ANCHOR* — Catalog sheet on Model UT450 *Test-Adapt* for equipping any CRT tester to handle 110° tubes, non-standard filament voltages (2.34, 2.68, and 8.4 volts), and color picture tubes. *See ad page 62.*

27O. *B & K*—Bulletin ST24-R, digest of information on Model 1075 *Television Analyst*, Models 1070 and A107 *Dyna-Sweep* circuit analyzers, Models 550, 650 and automatic 675 *Dyna-Quik* dynamic mutual conductance tube and transistor testers, and Model 440 CRT rejuvenator-tester. *See ads pages 17, 54.*

28O. *CENTRAL ELECTRONICS* — Descriptive folder on Model RE-2 *Rejuva-Tube* CRT rejuvenator, with instructions for use.

29O. *ELECTRO PRODUCTS* — Bulletin D612T describing DC power supply for transistor circuits, hybrid auto radios, and marine radio equipment. *See ad page 42.*

30O. *JACKSON* — Two-color flyer describing complete line of *Service-Engineered* test equipment. *See ads pages 67, 88.*

31O. *RCA ELECTRON TUBE DIV.*—Flyer on line of electronic test instruments. *See ads pages 58, 3rd cover.*

32O. *SECO*—Article reprint of "Take a Tube Tester Home" plan; two-color folder describing full line of test equipment and servicing aids; also information on dynamic tube checking and troubleshooting TV deflection circuits. *See ad page 65.*

33O. *SENCORE* — 4-page brochure on complete line of time-saver instruments. *See ads pages 76, 77, 78, 79, 80, 81.*

34O. *SIMPSON*—Brochure describing VOM's, DC VTVM, color-bar generator, and many other types of radio and TV test equipment. *See ad pages 22-23.*

35O. *TRIPLETT* — Technical data on new Model 2590 transistor tester. *See ad page 49.*

TOOLS

36O. *BERNS* — Data on 3-in-1 picture-tube repair tool, *Audio Pin-Plug Crimper*, and *Ion* adjustable beam bender. *See ads pages 56, 66.*

37O. *ESICO* — Information on the *GUN-CHOKE*, a simple and inexpensive device that controls tip temperature for soldering on printed-circuit or laminated boards. *See ad page 64.*

38O. *VACO*—New catalog sheets on *Compact* tools for the electronic serviceman, including glow-type voltage testers, hex key wrench sets, pocket-sized Phillips screwdrivers, thin-jawed adjustable wrenches, and reversible screwdrivers. *See ad page 87.*

39O. *XCELITE*—Bulletin 360 on new four-way pocket tool with 1/4" and 7/16" nut-driver, No. 1 Phillips, and conventional slot-type bits, designed for removing back covers of TV sets and installing antennas. *See ad page 48.*

TRANSISTORS

40O. *TUNG-SOL* — *Similar-Type Transistor Reference Guide*, available as wall chart or booklet; *Transistor Replacement Guide*; data booklet on recommended circuits for transistorized radios. *See ad page 37.*

TUBES

41O. *RAYTHEON* — *Reliable Tube Replacement Guide*, printed on heavy 8½ x 11 stock, lists Raytheon Reliable replacements for standard tubes in communications equipment. *See ad page 9.*

FACTS

to help you sell more

RCA Silverama Picture Tubes

... the All-New replacement picture tubes that command premium price and profits.

Here are the facts—proof that RCA Silverama is your customers' best picture tube buy.

1. FREE OF GLASS DEFECTS. Glass cord lines, scratches, chips, or buffed faceplates are common defects found in many brands of tubes made with used glass. Surest way to avoid these defects and also obtain the latest optical advances in faceplate engineering: an All-New RCA Silverama!

2. ALL-NEW. Of the three largest-selling brands of replacement TV picture tubes, only RCA Silverama is guaranteed 100% all-new—new glass, new gun, new phosphor, new everything! You'll get written proof—right on the warranty card.

3. FINEST SCREEN QUALITY. Advanced screen coating and bonding processes combined with RCA's giant vibration-free screen settling machines assure the maximum in picture screen quality and uniformity.

4. RCA "KNOW-HOW". RCA's continuous product research and advanced design engineering have resulted in RCA Silverama picture tubes being steps ahead of all other brands.

5. WORLD'S FINEST. RCA Silverama is manufactured in the world's most modern manufacturing plant using all-new premium-quality materials. Result? RCA Silverama is the world's finest picture tube.

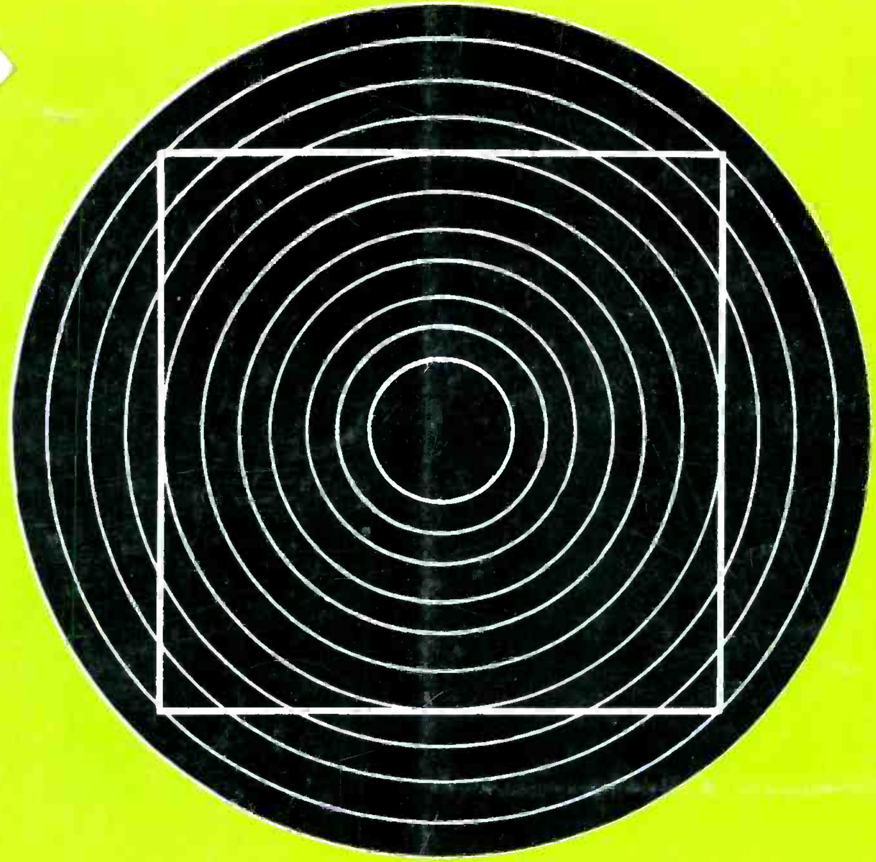
® Silverama

RCA®

RADIO CORPORATION OF AMERICA

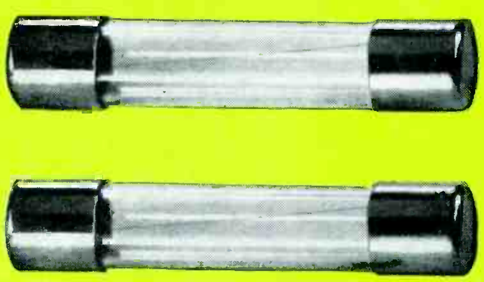
Electron Tube Division **Harrison, N. J.**

Visit RCA at the Electronic Parts Distributor Show.
Our Booth is North Exhibit Hall #874; and our display rooms, 659-661.

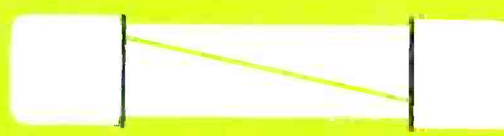


things are NOT *as they seem . . .*

This is a perfect square within the circle
—it is an optical illusion that the sides bend.



Things are not as they seem . . .
These two fuses look alike . . .
But they are not.



This fuse may burn out anywhere along the length of the filament even in the cap—this blown fuse is impossible to detect visually.

This Littelfuse has a controlled blowing point—the filament is plated throughout its length except in the very center—the fuse will always blow here. A blown Littelfuse can be detected immediately—a Littelfuse feature.

Littelfuse holds more design patents on fuses than all other manufacturers combined.

LITTELFUSE

DES PLAINES, ILLINOIS